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IASDR 2019

DESIGN REVOLUTIONS

IASDR 2019 CONFERENCE PROCEEDINGS | **VOLUME 3**

PEOPLE

EDITORS Professor Martyn Evans, Dr Annie Shaw, Dr Jea Hoo Na

iasdr2019.org

Manchester Metropolitan University

MANCHESTER SCHOOL OF ART

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About IASDR

The International Association of Societies of Design Research (IASDR) is an international, nongovernmental, non-profit-making, charitable organisation, and is comprised of member societies of design research from around the world. Established on 01 November 2005, its purpose is to promote research or study into or about the activity of design in all its many fields of application, through encouraging collaboration on an international level between independent societies of design research. IASDR members include the Chinese Institute of Design (CID), the Design Research Society (DRS), the Design Society (DS), the Japanese Society for the Science of Design (JSSD) and the Korean Society for Design Science (KSDS).

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Manchester School of Art believes an art school is more than just a place.

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DESIGN REVOLUTIONS

As the cradle of the industrial revolution, Manchester is known for its radical thinking. Through heritage, culture and innovations, it is a city that embraces revolution. As Tony Wilson famously claimed, "This is Manchester, we do things differently here"…

Design Revolutions explored how design drives and responds to revolutionary thinking through questioning the norm, probing the now and embracing the new. For the first time IASDR conference was held in the UK and fostered new thinking towards a compelling, meaningful and radical dialogue regarding the role that design plays in addressing societal and organisational issues.

The biannual conference enables academics, practitioners and students join together to explore contemporary agendas, emerging directions and future challenges that are at the forefront of design research. IASDR 2019 will provide opportunities for the presentation and publication of a collection of high-quality peer reviewed research papers alongside the space to discuss and debate the evolution and revolution of design.

Editorial

In September 2019 Manchester School of Art at Manchester Metropolitan University was honoured to host the bi-annual conference of the International Association of Societies of Design Research (IASDR) under the unifying theme of DESIGN REVOLUTIONS. This was the first time the conference had been held in the UK. Through key research themes across nine conference tracks – Change, Learning, Living, Making, People, Technology, Thinking, Value and Voices – the conference opened up compelling, meaningful and radical dialogue of the role of design in addressing societal and organisational challenges. The conference was a truly international gathering of the key thinkers in design research from 28 countries. 215 papers were presented and 13 workshops delivered alongside two exhibitions. RADICAL RESPONSES was a peer-reviewed exhibition of the research-informed design practice from academic design staffs from Manchester School of Art. This was complemented by an engaging display of design artefacts from the MATERIAL AND PROCESS INNOVATION COLLECTION curated by University's Special Collections. Such diversity enriched the exchange of ideas at presentations, workshops and social events for the duration of the innovative and dynamic event.

Support and contributions from the design research community have made this conference possible. Our thanks go to each one of our 488 authors for the papers and workshops that provided a rich source of inspiration, all 162 reviewers for ensuring quality and rigour and the 44 session chairs for ensuring the effective flow of ideas and discussion throughout the sessions. We also extend our sincere gratitude to all delegates of the conference who questioned the norm, probed the now and embraced the new. We hope you enjoyed your experience of Manchester and look forward to welcoming you to our city once again.

IASDR 2019 was a part of the design revolution in progress. We are excited to see how these proceedings fuel on-going discourse and debate at IASDR 2021 and beyond.

Martyn Evans, Annie Shaw and Jea Hoo Na

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Table of Contents

Paper titles	Authors	Page
PEOPLE		1
A critical examination of theThe interaction between the co-branding strategies within fashion retailing and the associated consumer behaviour of millennials	Yueyi Wang, David Hands	2
A Cross-modal Study on Scent and Music for Hospital Environment Design	Chen Zhou, Fumihiro Shutoh, Hiroshi Komada, Toshimasa Yamanaka	7
A framework to understanding factors that influence designing for older people	Raghavendra Reddy Gudur	15
A Study of Basic Needs Pictogram Structure of Nonverbal Communication for Aphasia Patient	Fang-Suey Lin, Hong-Chun Shi	30
A Study on Smart Phone Icons: Styles and Recognition	Qing Guo, Sunghyun Kang	41
Affordance, a concept for a measurable Design - Fitness furniture, a case study	Ana Isabel Sousa, Teresa Sarmento, Afonso Borges, Rui Mendonça	50
An Art Program to Maintain and Improve Swallowing Function Focusing on Respiratory Rehabilitation - Practice and Evaluation of Physical and Mental Functions of a Program to Encourage Continuous Efforts	Kiyomi Yoshioka	59
An Image-making Collaboration: Drawing in the design of Stagewear	Pam Schenk, Theresa Coburn	70
Application of Peak-end rule in research of product use	Meng-xun Ho, Hsi-Jen Chen	85
Assessing User Needs of Senior Women during Yoga Exercises to Optimize the Design Criteria of Sports Bras	Jun Zhang, Shichen Zhang, Newman Lau, Joanne Yip, Kit-lun Yick, Jie Zhou, Winnie Yu	92
Audience Matters: Participatory Exploration of Speculative Design and Chinese Wedding Culture Interaction	Fangzhou Dong, Sara Sterling	108
Co-Design Framework for New Product Development: Case Study on a Smart-Textronics Product	Sooyeon Leem, Sang Won Lee	118
Co-living for Ageing in Place: Mapping Privacy and Movement in a Long-Term Care Setting	Aria Chien-Hui Yang, Newman Lau, Henry Ma	126
Could Participatory Design Offer a Revolution To Architecture? Field Notes From A Situated Action In Hasselt, Belgium	Emily Crompton	138
Cross-cultural design teamwork: researching at the edge between design and cross-cultural management	Francesca Mattioli	150
Cultural Blindness: Eye-tracking trial of visual attention towards Assistive Technology (AT) product, by students from the UK and Pakistan	Salman Asghar, George Torrens, Hassan Iftikhar, Robert G Harland	156
Design considerations for play experience in children's hospital: from perspectives of child inpatients, parents, nurses and hospital service experts	Kwangmin Cho, Chajoong Kim, Sanghyun Ma, Jungkyoon Yoon	169
Design for civil society. The model project "Citizens connect neighborhoods – community development harnesses digital transformation"	Bianca Herlo, Gesche Joost	185
Design for empowerment: A case study of using information visualization to support and promote college students' subjective well-being	Yvette Shen, Shasha Yu	196

Paper titles	Authors	Page
Design for human connectivity: A framework and research agenda	Peter Mandeno, Weston Baxter	207
Design Interventions against Trolling in Social Media: A Classification of Current Strategies Based on Behaviour Change Theories	Kate Sangwon Lee, Huaxin Wei	222
Designing Design for Safety: How emergent methods indicate new safer future design practices	Ashley Hall, Laura Ferrarello, Paul Anderson, Rachel Cooper, Chris Ross	237
Designing the User Experience for New Modes of Electric Vehicle Charging: A Shared Vision, Potential User Issues and User Attitudes	Lanyun Zhang, Rebecca Cain, Tracy Ross	252
Developing a questionnaire to explore people's attitudes towards emotional-driven prostheses: a pilot study	Anna Vlachaki, Abby M. J. Paterson, C. Samantha Porter, Richard J. Bibb	265
Does Roleplaying Facilitate a Holistic Perception of the User? An Exploratory Study on Simulating the Elderly Experience	"María Laura Ramírez Galleguillos, Terry Eskenazi, Aykut Coşkun"	278
Eight practice issues in design knowledge transfer: a case study	Daniele Busciantella Ricci, Michela Ventin	288
Encoding from Visual Content Analysis in Cultural Design Research	Amic G. Ho	304
Establishing Trust through Storytelling: A Model for Co-Design	David Parkinson, Laura Warwick	315
Evaluating Crowdsourced Designs: How Community Shapes New Product Design	Wei Liu, Tao Wang	326
Exploring Intensity Factors and Patterns of Experience	Eric Chen-F Hsieh, Min-yuan Ma	332
From Copenhagen to Gorton: Wellbeing, Democracy and the Role of Urban Design	Aissa Sabbagh Gomez	351
Ignite, Share and Reflect: Design Tactics to Foster Social Interactions Between Migrants and Locals in Istanbul	"María Laura Ramírez Galleguillos, Ece Şekerli, Aykut Coşkun"	360
Improving User's Well-being Through Leveraging Attachment to Interactive Products	Heimin Kang, Chajoong Kim	374
In-Progress Reporting: Development of China's Creative Economy Through Participatory Design Research in Post-Industrial Regeneration	Emma Roberts, Jon Spruce	382
Invisible Minorities': Exploring Improvement Strategies for Social Care Services aimed at Elderly Immigrants in the UK using Co- Design Methods	Nevena Balezdrova, Youngok Choi, Busayawan Lam	394
Layout Preference for Movie Posters of Koreans: Contextual background or Character dominance	Juhee Kim, Juyeon Kim, Hyeon- Jeong Suk	408
Methods for researching and building capacity in co-design among non-experts	Katerina Alexiou, Theodore Zamenopoulos	423
Narrative dimensions for the design of contemporary visual identities	Catarina Lelis, Elizete de Azevedo Kreutz	437
Opportunities to design for the wellbeing of children undergoing cancer treatment at a Brazilian Hospital	Francielle Daudt, Leandro Miletto Tonetto, Valentina Marques da Rosa, Priscila Brust-Renck, Claudia de Souza Libânio, Luiza Leal Fontanella	455
Parents Experience at Children Hospital: The Desire and Difficulty of Caregiving	Soyoung Kim, Kyoung Wook Min, Jungkyoon Yoon, Chajoong Kim	465

Paper titles	Authors	Page
Pottery Workshop Design for Medical Settings "Pressed into a pot": Investigation of Mood and Expression in Pottery Workshop in Specific Pottery Tasks	Pornpan Sutas, Koichi Nishio	476
Presence of Motion Lines in Human Pictograms: Analyses and Evaluations	Mikihiro Ishii, Kazunari Ito	496
Product user testing: the void between Laboratory testing and Field testing	Bethan Gordon, Gareth Loudon, Steve Gill, Jo Baldwin	509
Re-Designing Design - Design Principles Based on Historical Analyses of Human Emotions and Values	Yoshiro Miyata, Yasushi Harada, Ken Yokomizo, Tamaki Motoki, Tomohiro Ueshiba	521
Redevelopment or Gentrification? Community-led perspectives in the co-designing of urban housing	Tom Morton	530
Rehabilitation Design Intervention for Older Adult Women through Community-based Co-Design Activities	Muhammad Tufail, YangGyu Moon, KwanMyung Kim	545
Seeking Emotions in Mobility Experience Elicitation: A Singapore- France Comparison	Penny Kong, Flore Vallet, Ouail Al Maghraoui, Henriette Cornet, Fritz Frenkler	558
Stigma Probe: A Design Toolkit for Managing Older Adults' Stigmatization Perception on HMWs	Chen Li, Chang-Franw Lee, Song Xu	568
The effect of visual complexity and task difficulty on human cognitive load of small screen devices	Jinghua Huang, Zhen Chen, Ming An	580
The Evaluation about a Sense of Speed, Danger, and Being Disturbed for Road Marking on Expressway	Yutaka Nagami, Hideki Takahashi, Masahito Takizawa	594
The Furniture of Science Fiction: Studying Audience Cognitive Mechanisms to Understand How Designed Objects Convey Social Ideas through the Semantic Differential Method	Tong Han, Matthew Wizinsky	608
The influence of facial photo processing on interpersonal impressions.	Agu Naoto, Kubo Masayoshi	621
The Relative Impact of User- and Marketer-generated Content on Consumer Purchase Intentions: A Case of the Social Media Marketing Platform, 0.8L	Yu-Jin Kim	630
Using the Technology Acceptance Model to Evaluate Behavioural Intention to Use Mobile Games—A Case of Pokémon GO	Ya-Fen Fan, Pei-Jung Cheng	643
Why designing may help treat psychosis	Erika Renedo Illarregi, Katerina Alexiou, Theodore Zamenopoulos	654
Author Index		669

UNDERSTANDING HUMAN BEHAVIOUR, AND JUST AS IMPORTANTLY MISBEHAVIOUR, PROVIDES OPPORTUNITIES TO DESIGN COLLABORATIVELY FOR, AND WITH, PEOPLE. BY ENABLING SOCIAL AND CULTURAL DIMENSIONS TO BE CONSIDERED, DESIGN CAN CONNECT TO THE NEEDS OF CITIZENS TODAY AND IN THE FUTURE. WHY ARE PEOPLE IMPORTANT TO DESIGN? HOW WILL CO-DESIGN AND CO-PRODUCTION MODELS EVOLVE IN THE NEXT DECADE? WHAT SOCIAL DIMENSIONS IN SOCIETY CAN DESIGN EMBRACE AND WHY?

PEOPLE

A critical examination of the interaction between co-branding strategies within fashion retailing and the associated consumer behaviour of millennials.

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This short paper offers a critical understanding of the primary drivers that foster co-branding strategies within the fashion industry. It interrogates theoretical literature on this emergent phenomenon, concluding with key insights that will be subsequently taken forward within the next stages of current research undertaken by the authors.

Keywords: ***Millennials; co-branding strategies; marketing, fashion retailing.***

1 Introduction

According to the Pew Research Center (2019), they announced in March 2018, “Anyone born between 1981 and 1996 (ages 23 to 38 in 2019) is considered a Millennial, and anyone born from 1997 onward is part of a new generation.” Millennial are also called Generation Y. Amongst Generation Y, internet is the most popular media type (B. Valentine and L. Powers, 2013), they were born and grown in the development of computer technology and the advent of the Internet era, and catch up with the specific historical background and social environment, they have gradually formed their distinctive consumption concepts. Millennial consumption is inextricably linked to retailing, where they have become the main consumer group, which is large and valuable.

When viewed from a marketing orientation, we are witnessing the rapidly changing consumptions patterns and structures. With fashion consumption increasing at an exponential rate, leading fashion retailers are revisiting their design and marketing strategies in order to remain competitive. In addition to this, the emergence of co-branding strategies are transforming established business models and the relationship between fashion retailers and their customers.

Millennials’ purposes of consumption are not simple, choosing a brand is related to the definition and value of themselves (Ordun, 2015). Since the forming of fashion brands, collaboration until it gradually popular, young consumers have increasingly been noticed in the marketplace, being the main area of attention for high street fashion retailers. Both in a co-branding product sale in physical store, and online platforms or social media platform, these millennial consumers are highly interested in co-branded products.

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Findings from the literature under review will inform the second stage of research activities (empirical data collection) shortly to be undertaken by the researcher. This paper will critically explore and discuss how co-branding strategies build connections to millennial consumers and influence their consumption behaviours. However, for the purpose of this paper, it will offer a comprehensive overview of current literature on millennial consumption and co-branding strategies.

2 Millennium consumer behaviour

Millennial consumers have very strong brand awareness, they will choose branded products according to their preferences (Lazarevic, 2012). Different Brand identities have different brand characteristics, which often reflects the brand's product quality, brand attitude, consumption concept and so forth., They will resonate with millennial consumers, it influences them to build self-image, and lifestyle and consumption patterns (Martin & Bush, 2000). Besides, Millennials are growing up in an environment where the Internet is highly developed offering a better material life. They browse information at a more rapid pace every day. According to the Pew Research Center report (2010), most teens and young adults have a game console, mp3 player and laptop. Music, sports, games and other entertainment information fill their daily life, which means entertainment-related products will arouse their consumption desire. (Bolton et al., 2013)

Millennials are no longer drawn to traditional type of advertising campaigns from brands, moreover, they prefer real reviews from people who purchased the products, the word-of-mouth from peer network (Gentina & Bonsu, 2013), or consult a blog or are influenced by peer review prior to making a purchase. Millennials prefer to share experience; they also care about the impact and the feedback from their social network. (Martin & Bush, 2000). Millennials display strong personality and attitude, they prefer customized, unique, diversified and personalized products which having a strong distinguishing element that reflects the character of a person. These exclusive, limited edition, unique products can attract more attention from millennial consumers (Shen et al., 2014). More than that, the “hyped and drop business” are prevalent among millennials (Elven, 2019). This sale pattern makes people feel a sense of urgency and more desirable by releasing a drop list with a limited-edition product in advance.. This type of marketing strategy also drives hyped business, which can increase the resale price up to several times more than the original price. For instance, the supreme x the north face collaboration jacket sold out in 15 seconds, and the original price was £318, on their website but the resale price was between £700-£800.

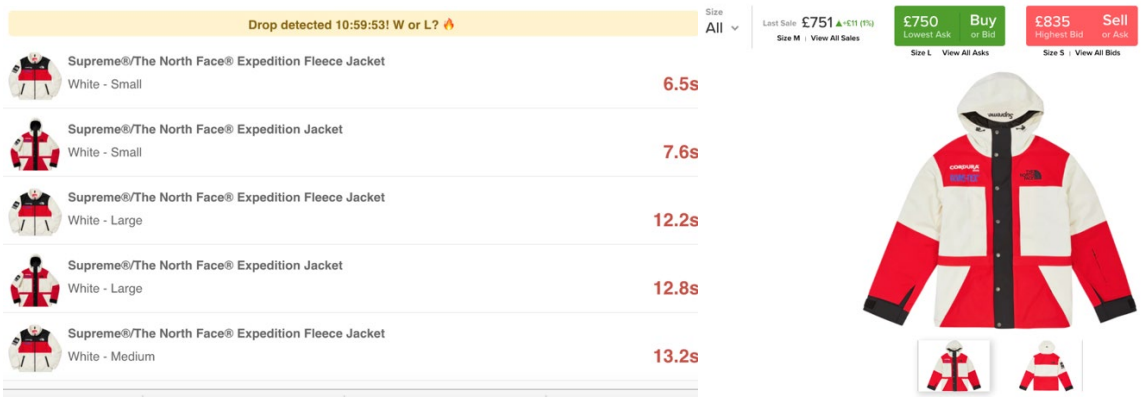


Figure 1. Supreme x The North Face collaboration original price and resale price on stock X.

3 The fashion industry and the rise of co-branding

The fashion retail industry is becoming much more competitive in particular to new market entrants on a regular basis. The vast majority of established fashion brands are formed by their own particular culture(s). The demands of their customers have changed, for satisfying more demands of customers, innovation is necessary, and co-branding strategies in the fashion industry are continually transformed by the development of changing consumer needs; non moreso than the millennial market segment. The cooperative brand strategy makes the old fashion house popular again and opens up new elements for the fashion industry. Co-branding strategy can bring young consumers' confidence, style and personality (Poulsen, 2019). The phenomenon of fashion collaboration can be turned into a variety of branding strategies (Ahn et al., 2010), more connections between two cooperative brands in the joint marketing, brand extension, ingredient branding, composite branding and so on (Oeppen et al., 2014; Ahn et al., 2010). Cooperation with a brand with the same usage situation, user identity, and brand perceived value is a necessary condition for allying with a fashion brand with variable relationships and various symbolic meanings (Ahn et al., ibid).

There has been a rise in academic debate regarding the emergence of co-branding partnerships; firstly, it is a positive way to expand the existing market scope (Oeppen et al., 2014). In addition, co-branding offers the fashion industry a steady stream of new opportunities and sustainable competitive advantage. From the perspective of design, it provides a good chance to elicit new ideas, and consumers enjoy new experiences (Shen et al., 2014). Furthermore, co-branding in fashion industries bring benefits for both partner brands. The use of co-branding to attract future brand partners through increasing brand awareness with other potential brands (Oeppen et al., 2014). Cooperative brands can obtain a higher media exposure rate, and joint brand products are fast becoming the most popular commodities. Cooperation between fashion brands takes many forms, even with other non-fashion brands, alongside this, many of the leading international fashion brands are planning to launch joint brands collections. For example:

1) Multi partnerships co-branding such as Uniqlo x Kaws x Sesame street (2018), Chanel x Pharrell x Adidas (2017). The collaborative partnership of triple brands means that the customers' group are extended and diversified. Meanwhile, the difficulty of cooperation between parties will increase so the potential risk for participation also increases. For example, maintaining the individual brand features while harmoniously integrating the design elements of the three brands is a challenging element. Co-branding strategy does not always strengthen the brand image, on the contrary, after the failure of cooperation it may in fact, cause brand image damage (Geylani et al., 2008).

2) Collaboration with celebrities, bloggers or designer, such as the footwear brand, Puma and music artist - Rihanna (2015). Celebrities who cooperate with the brand generally have similar values with the brand. Celebrities have their own distinct image and popularity in the minds of consumers accompanied with a large fan base. Therefore, celebrities can leverage the relevant elements of a brand and are feasible brand partners (Seno, 2007). However, co-branding partnerships between celebrities and brands are not same as endorsement (Poulsen, 2019).

3) Fashion brands cooperating with non-fashion companies. This is termed inter-industry collaborations (Varley et al., 2019).Fashion brands collaborate with technology-led companies, such as Nike and Apple (2006), Samsung and Armani (2007). The partnership between fashion brands and different cultures can lead to forming a widened product portfolio and customer division. Another example could be the fashion brand Paul Smith collaborating with Anglepoise to offer Lighting products for the home.

4) Brand cooperation sharing similar attributes, such as two luxury brands co-creating one bespoke collection (for example, Burberry and Vivien Westwood). Fashion cooperation strategies can be drawn upon as an effective means to promote high-end cooperation between luxury and well-known brands; as such, this could lead to memorable branding experiences (Oeppen et al., 2014).

5) Collaboration with an e-commerce platform, fashion brands have the relationship of interdependence, and these e-commerce retailers have a clear positioning and understanding of their customers (Reichheld et al., 2000). In addition, e-commerce retailers offer multi-ranges of fashion brands, exclusive collections that can satisfy the customers' need for uniqueness (Shen et al., 2014) (Hippel, 2005), improve customer loyalty (Reichheld et al., 2000) for the platform so to enhance the competitiveness of online retailers.

4 Conclusions

By exploring the phenomenon of millennial consumption behaviour, it can be seen that is closely related to co-branding strategy, and that it influences one other. There is no reference to verify which strategy is established first, but it can be confirmed that they are the certain results by societal development. There are some drawbacks due to the development of co-branding strategies over fast. A novel tactic is not enough to influence the consumption behaviour of millennials for a long period. The theoretical aim of this paper provides a critical and informed background for understanding co-branding strategy development and Millennials consumption behaviour. This succinct discussion is based on an extensive examination of literatures, which will form the basis for the next stage of the research project – the collection of empirical data via in-depth case studies. As such, it aims to develop a deeper understanding of co-branding partnerships between leading fashion retailers; in particular investigating revitalised consumer experiences through these emergent partnerships. Although the future of co-branding strategies within the fashion industry is unpredictable, it is also changing brand business models. In addition, from the perspective of current cooperative brand development, the rise of co-branding strategies has not yet reached its full maturity and wider adoption.

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A Cross-modal Study on Scent and Music for Hospital Environment Design

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Scent and music are prevalently applied on various occasions to create an affirmative environment, lowering people's anxiety level, or enhancing buying behaviors. However, hardly has the simultaneous implementation of scent and music in hospital environment been determined. Towards a better understanding about the olfactory and auditory environment in hospital condition, therefore, we investigated the effects of scent and music on people's mood and stress in wards. We conducted an experiment with 3 groups of scent (peppermint, rose geranium, and control) and 2 pieces of healing music. As a result, our study revealed that compared to scent, music had much weaker effects on people's stress evaluation, but significantly affected mood. On the other hand, scent noticeably affected both mood and stress evaluation. These implications definitely enhanced our comprehension of the use of scent and music, and we also obtained further inspiration for the design of scent and music environment in wards.

Keywords: scent; music; hospitalization; mood; stress

1 Introduction

Ambient environmental stimuli are believed to affect people's mood, cognition, and behaviour (Fenko and Loock, 2014). In addition, the common belief that though people perceive discrete stimulus, their emotional response is determined based on the whole configuration of stimuli is widely convinced (e.g., Holahan,1982). That means, mental images are usually created by combining olfactory, auditory, and other sensory inputs. The congruent combination of scent and music in terms of arousal is reported to significantly raise consumers' satisfaction of the retail store, and bring about impulse buying (Mattilaa and Wirtz, 2001).

On medical occasion, where physical medical treatment is definitely required, psychological medication is also indispensable. Research showed both music and scent could reduce patient's anxiety in a waiting room of a plastic surgeon, while the combination of scent and music was not effective (Fenko and Loock, 2014). Similar studies like Cepeda et al. verified that music diminished pain intensity levels and opioid requirements (2006), and music therapy is reported to be an attractive and successful method for palliative care (Ichie, 2006). The role of props and music were explored in dementia care to engage participants and inform design (Morrissey et al., 2016).

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On the other hand, the scent of orange sweet is clarified to have positive effect on a sound sleep, and refreshes wakeup of aged females (Matsunaga et al., 2013). However, little observation is found about using of scent and music simultaneously.

According to a review article summarizing the present state of aromatherapy research in nursing (Suzuki and Okubo, 2008), although the number of papers has increased, few of them are evident. Furthermore, blood pressure and pulse rate are also suggested not effective to examine the effect of aromatherapy, while the measurement of autonomic nervous activity is recommended to investigate subtle physical changes by aromatherapy. Therefore, we are notably inspired to employ other methods, such as Kansei subjective evaluation to observe the effect of scent. Also, we cannot ignore the intriguing issue that although relaxing music is usually involved during aromatherapy in practical condition, the effect of aromatherapy was examined without music in experimental environment.

In hospital room, patients tend to feel more stress due to the unfamiliar, too well-organized living environment which would interfere health recovery (Kawaguchi et al., 1994). Daemen clarified that the hospital room could be seen as the epicenter of patient experience design, because they spend most of their time there. Prior research on healing environment design has identified essential design characteristics (Schreuder, Lebesque, and Bottenheft, 2016). A broad range of mood-regulating activities is convinced to best influence mood (Desmet, 2015). Thus, to refine ward environment, and lead to patients' well-being, in this research, we investigated the relationship between scent and music, by exploring how scent and music in different arousal affect people's mood and stress in wards. The fundamental knowledge generated from this research will contribute to novel hospital environment design and improve the hospitalization experience for affected patients. Such understanding is particularly essential as the problem of aging society is becoming inevitably severer progressively (Ejiri et al., 2018).

2 Preliminary Experiment

The purpose of preliminary experiment is to decide proper scent and music stimuli. As clarified in previous research (Zhou and Yamanaka, 2018), peppermint and rose geranium were perceived pleasant, but high arousal and low arousal respectively. Therefore, we used these 2 kinds of scent in this study as well. For music, we chose a healing music album called <Aroma> by Makiko Hirohashi, which is relatively relaxing, soothing, and is recommended to be applied during aromatherapy, and massage by aroma therapists. We selected 2 pieces of music as high arousal music stimuli *(<Orange - Refresh>* and *<Rosemary - Concentration>*), and 2 pieces of music as low arousal stimuli *(<Sandalwood - Meditation> and <Lavender - Fall asleep>*). We expected to determine a high arousal music, and a low arousal music by this experiment. Because all music in this album is comparatively relaxing, to let participants get used to the music atmosphere, we applied another piece of music (*<Frankincense - Balance>*) to play at the beginning as baseline.

2.1 Procedure

During the experiment, firstly, the participant was asked to listen to the baseline music (*<Frankincense - Balance>*) for 1 minute, and answer the questionnaire to rate how pleasant and how arousing it was. Then, we randomly played another music for 1 minute, and let the participant fill the same questionnaire. The same procedure was repeated until all 5 music were tested.

10 participants (2 males, 8 females; age: 26.6± 4.34) took part in this experiment. The content of the questionnaire is a two-dimension mood scale to measure psychological arousal level and hedonic tone (Sakairi et al., 2003), including 8 adjectives (energetic, motivated, frustrated, on edge, relaxed, calm, inactive, and sluggish). We also added a question at the beginning to verify whether the music stimulus is long. Participants rated each item with a 9-point Likert scale, from “not at all” to “very much”. Friedman test was performed on 4 music stimuli, as well as Wilcoxon pair-wise comparison as Post hoc tests.

2.2 Result

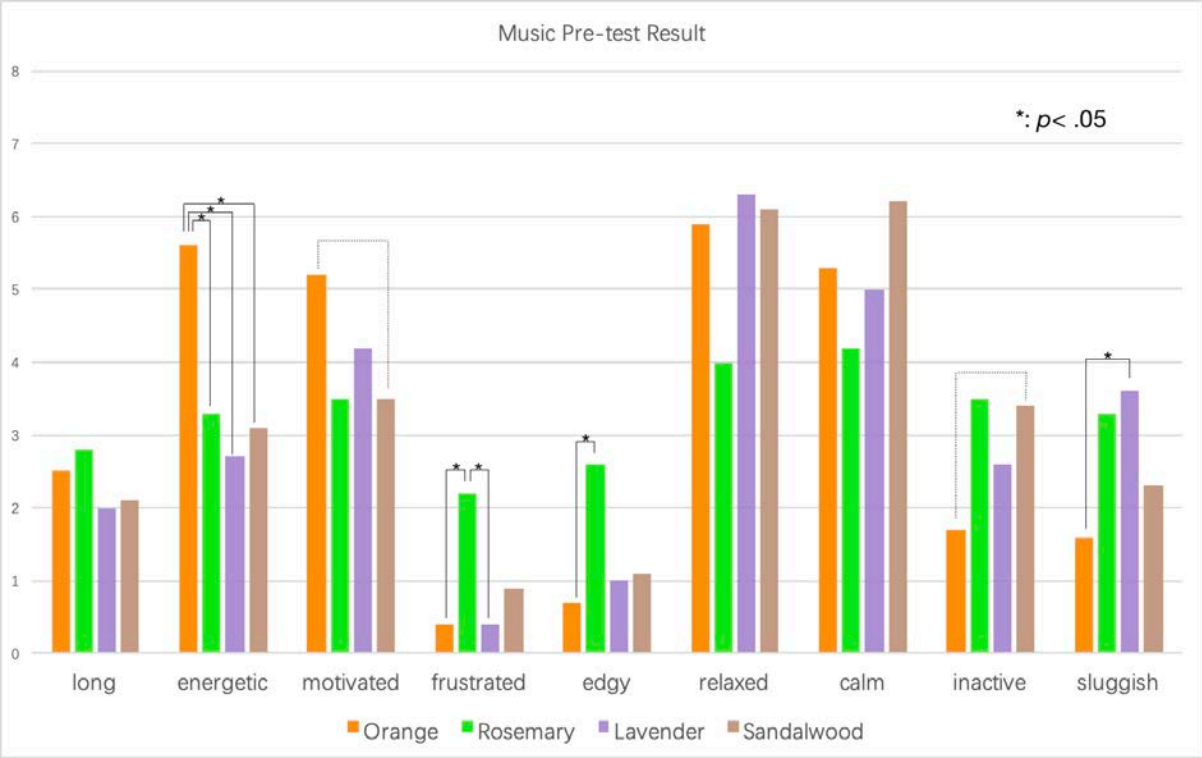


Figure 1. Result of Music Preliminary Experiment

From Figure 1, we can know that <*Rosemary - Concentration*> was evaluated significantly higher than <*Orange - Refresh*> (p= .047) and <*Lavender - Fall asleep*> (p= .047) on “frustrated”, and it was also considered significantly “edgier” than <*Orange - Refresh*> (p= .041). In addition, <*Orange - Refresh*> was shown to be more “energetic” than the other 4 music (p< .05), we chose <*Orange - Refresh*> as the high arousal music stimulus consequently. The results also showed that <*Sandalwood - Meditation*> was evaluated both higher than <*Orange - Refresh*> on “relaxed” and “calm”, which was different from <*Lavender - Fall asleep*>. Moreover, the substantial difference between <*Sandalwood - Meditation*> and <*Orange - Refresh*> on “motivated” and “inactive” was seen. Accordingly, <*Sandalwood - Meditation*> was selected as the low arousal music stimulus.

2.3 Summary

As yielded by the results, we considered to apply <*Orange - Refresh*> as the high arousal music stimulus, and <*Sandalwood - Meditation*> as the low arousal music stimulus in further experiment. Because some participants reported that listening to the music for only 1 minute

destroyed the sense of unity, as we also confirmed that participants did not reckon the music stimuli long, we played the entire music (around 8.5 minutes) in the main experiment.

3 Main Experiment

In this experiment, we manipulated 2 music stimuli, and 3 scent groups (peppermint, rose geranium, and control). In the control group, we employed alcohol instead of water to avoid drastic change of humidity of the experiment environment. Each scent was presented by essential oil, and the essential oil bottle was installed in an aroma diffuser, which periodically spreads out scent for 10 seconds, and rests for 50 seconds. Music stimuli was demonstrated by a MacBook (at around 77dB) in the same way as preliminary experiment.

3.1 Procedure

This experiment was conducted in a room which was arranged like a ward, shown in Figure 2. Each participant was presented with 1 combination randomly chosen from the total 6 combinations of scent and music.

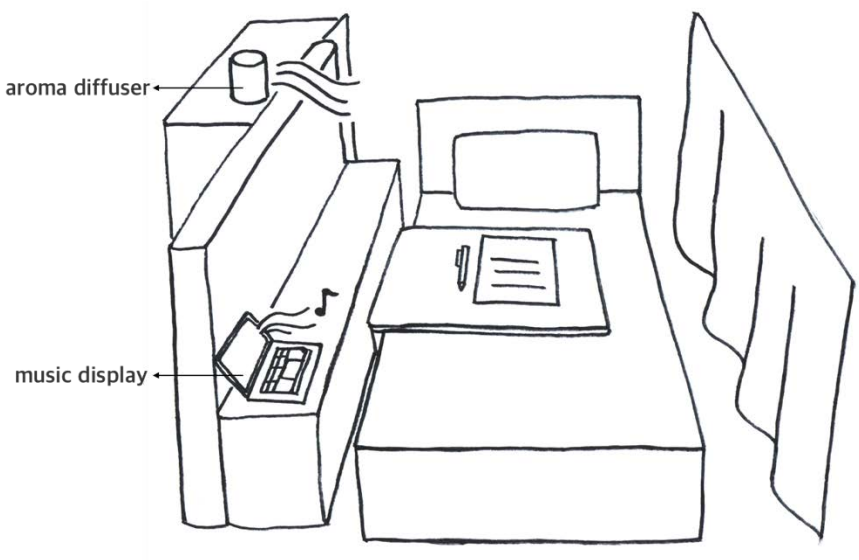


Figure 2. The Environment of Main Experiment

After informing the instructions about the experiment, participants were indicated to sit and relax on the bed as staying in hospital. Subsequently, the curtain was closed, a music stimulus was played and the aroma diffuser was turned on at the same time. As soon as the music ended, the diffuser was turned off. After that, the participant was asked to answer a questionnaire to report his/her mood and stress level. After each experiment, we ventilated the room until it was scentless.

5 participants took part in each combination of scent and music, except 3 people in the group of rose geranium with low arousal music. In total, there were 28 participants (11 males, 17 females; age: 25.2± 4.14), and all of them are healthy students from the university. After the experiment, we asked people in control group whether they felt any scent, and none of them recognized the smell of alcohol.

The questionnaire included the assessment on mood and stress level. The mood scale is developed to examine patients' as well as common adults' mood condition on clinical occasion (Sakano et al., 1994). There are 40 items divided into 5 factors to describe mood

state: tension and excitement, refreshing mood, fatigue, depressive mood, and anxious mood. Participants assessed their mood by a 4-point Likert scale, from “1: not at all” to “4: very much”. Besides mood evaluation, participants also rated their stress level under 38 situations during hospitalization. This scale was revised by Kawaguchi et al. (1994) based on another prior research (Volicer and Bohannon, 1975) to observe the stress degree of inpatients. Participants reported their stress level in the same way as mood assessment, from “1: not at all” to “4: very much”.

3.2 Result

We performed MANOVA on mood assessment, and stress evaluation individually after transforming the original nonparametric data to rank (Conover and Iman, 1981). According to the result of Multivariate tests, there was a statistically significant difference in mood assessment based on scent (F (42, 4) =12.03, p = .013; Wilk's Λ = .00). To state specifically, rose geranium significantly raised up the feeling of “too filled with emotions to stand still” than peppermint and control group (both p= .033). Moreover, rose geranium also had significant difference on “painful” (F (2, 22) =6.81, p = .005), with peppermint (p= .026). In the aspect of music, it was indicated that low arousal music evoked stronger mood on “troublesome” (F (1, 22) =5.02, p = .036), “painful” (F (1, 22) =8.85, p = .007), and “lots of (negative) memories come across my mind” (F (1, 22) =9.81, p = .005) than high arousal music. However, high arousal music was verified to trigger the mood of “lonely” more easily than low arousal music (F (1, 22) =5.08, p = .034). Furthermore, the significant effect of the interaction of music and scent was also demonstrated by Multivariate tests (F (42, 4) =8.42, p = .025; Wilk's Λ = .00). In addition to the mood which was generally influenced by scent or music, such as “troublesome” (F (5, 22) =2.76, p = .044), “painful” (F (5, 22) =6.38, p = .001), and “lonely” (F (5, 22) =3.14, p = .028), the specific combination of scent and music also had significant effects on the mood of “apathetic” (F (2, 22) =13.06, p = .000), “depressed” (F (2, 22) =6.54, p = .006), and “vain” (F (2, 22) =12.18, p = .000). As claimed by Post hoc tests, the combination of LR (Low arousal music and Rose geranium) received significantly higher score than HC (High arousal music and Control, p = .029), HR (High arousal music and Rose geranium, p = .029), and LP (Low arousal music and Peppermint, p = .006) on “apathetic”. Similarly, it was revealed that the combination of LR definitely generated the feeling of “depressed” compared with LP (p = .019), and was also higher scored on “vain” than HR (p = .007), LC (Low arousal music and Control, p = .036), and LP (p = .007).

On the other hand, music did not show significant effect on stress according to the result of Multivariate tests, while the significant difference by scent was confirmed (F (42, 4) =9.87, p = .019; Wilk's Λ = .00). With the scent of peppermint, participants significantly felt less stress when they “not knowing when to expect things will be done to you” than rose geranium (p= .020), and control group (p= .023). Under the situation of “having to be assisted with bathing”, peppermint also appeared significantly positive influence than control group (p= .045). We also observed that compared with control group, rose geranium considerably lessened the stress of “having to be assisted with a bedpan” (p= .016). Further, Multivariate tests yielded a notable result in stress evaluation based on the combination of scent and music. Therefore, we realized that LP significantly reduced the stress level in the situation of “having nurses or doctors talk too fast or use words you can’t understand” (F (5, 22) =3.40, p = .020). Specifically, the combination of LP was enormously rated less stressful than HP (High arousal music and Peppermint, p = .034), and LR (p = .028).

4 Discussion

As well as other interior design elements such as colors, music and scent are also pretty effective in providing an improved user experience in ward. Our findings emphasized that both music and scent could affect the mood of people in a ward, but stress seemed to be more affected by scent. This suggests that although we discuss using music or scent as design aspects to reduce negative moods and stress in the same situation, designers should notice that negative moods and stress are different things and could be dealt with different treatments. Scents could be applied to particularly reduce the stress level, and music could be used focusing on the mood improvement in a ward or rehab room.

In education program for patients, pleasant aromatherapy and relaxing music are regarded as relaxation techniques to calm down, alleviating the stress caused by pain and side effects of medicine (Yamada et al., 2003). Unexpectedly, our results implied that low arousal stimuli intensified despondent and worried mood. As substantiated in a prior study, scent modifies people's perception of music, and low arousal scent has the potential impact on lowering the arousal level of music (Zhou and Yamanaka, 2018). Therefore, a conceivable hypothesis might be that low arousal scent (rose geranium) considerably diminished the arousal level of music, so that the low arousal combination might lead to an overly low arousal state, such as melancholic and gloomy moods, far beyond relaxing and calm moods.

An intriguing finding is that despite high arousal music reduced most of the negative moods, "loneliness" was only allayed by low arousal music. The difference between "loneliness" and other negative moods such as depression should be further discussed in the subsequet study. Nevertheless, designers should be aware of this exception that when targeting on "loneliness", low arousal music seemed to be a better choice than high arousal one. Still, the reason for high arousal music boosts "lonely" feeling is undetermined on the authority of existing studies, further observations are needed to explore the effect of high arousal music.

When it comes to the stress of bathing and excreting in ward, it is manifested that different types of scent should be considered. Peppermint lowered participant's stress level of having to take bath inconveniently, and rose geranium reduced the stress of having to be assisted with a bedpan. It is believed that floral scent might be better for covering unpleasant smell since it is widely used and popular for toilet, and mint is preferable for giving users the feeling of refreshing and clean.

5 Conclusion

In summary, our work revealed that music and scent could influence people's experience in different ways, with music relatively tends to affect mood more than stress, and scent tends to affect both. Moreover, we are enlightened that when applying together, low arousal music and low arousal scent might not provide a relaxing, peaceful experience as expectation. Other combinations such as low arousal music and high arousal scent might be further beneficial to inpatients, because the upsurge of tension brings about cheer and confidence to them, which will be absolutely advantageous to their health recovery. It is indubitable that the new knowledge and perspectives gained through this work will provide designers with the critical information to execute needed design techniques, ultimately upgrading the welfare for patients. Our findings of this exploratory study will also serve to the thorough and supplementary research in the future.

Although we tried to re-create a ward environment for the experiment, the participants in our study were not real-life patients. Therefore, we look forward to improving our theory and method and conduct experiments in a real hospital in the near future.

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A framework to understanding factors that influence designing for older people

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There is a considerable amount of research literature that is focused on the importance of inclusive design. There is a steady increase in research that is also focused on understanding how to design for older people. However, most of the research available focuses on ageing as a variable in understanding patterns of technology usage, preferences and difficulties. What is more necessary is research that explains why the age differences occur. For this reason, it is essential to investigate mediating factors such as cognitive abilities and experience. In this paper, we did an extensive literature review to understand various factors that explain why age differences occur and how these factors are interrelated. Based on which we propose a framework that will help other researchers and designers to provide a quick map to investigate inclusive design problems.

Keywords: older people; cognitive ageing; inclusive design;

1 Introduction

Research suggests that many older adults have difficulty using contemporary consumer products due to their complexity both in terms of functionality and interface design. Moreover, studies have found a strong correlation between age and the time taken to use modern electronic devices (Lewis, Langdon, and Clarkson 2007, Reddy, Blackler, and Popovic 2018).

Use of technological products in older users is a complex issue mediated by technology prior knowledge, cognitive capabilities, sensorimotor function, technology anxiety, perceived technology self-efficacy and socio-demographic factors (Czaja et al. 2006). This paper discusses several of these important factors of ageing that influence use of technological products in older adults and to understand interdepended nature of these issues. The objective of this study is to provide a framework for both researchers and designers to help address problems related to design for ageing population.

2 Sensorimotor function and ageing

Ageing progressively impairs various cognitive skills and sensory-motor abilities. Some abilities decline more markedly than others, and some may remain intact till the late 70s (Mynatt, Essa, and Rogers 2000, Salthouse 2010). This decline is not constant and varies widely between individuals (Gregor, Newell, and Zajicek 2000, Czaja and Lee 2007). Baltes and Lindenberger (1997) found a strong correlation between visual acuity, auditory pure tone

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threshold and different measures of intellectual functioning. In other words, degraded sensory impairment implies degraded intellectual functioning (Li and Lindenberger 2002). However, it is not clear which is the cause, and which is the effect.

2.1 Vision

Problems with vision start in the early forties and it deteriorates progressively as people grow older (Fisk 2004, Fisk et al. 2009). One of the most noticeable declines in vision is the loss of ability to focus on close objects (presbyopia), which is mostly caused by reduced reactivity of the lens. Among many others, some common ageing-related vision problems include: decline in visual acuity (the ability to see fine detail), contrast sensitivity, colour discrimination and detection, and glare sensitivity. Most of these problems are results of clouding of the lens. Reduced reactivity of the pupil over time degrades vision in dim light. Degradation in visual information processing reduces the ability to detect flicker, and creates difficulty in estimating depth and visual searching (Hawthorn 2006, 2000, Fozard and Gordon-Salant 2001). While older people seem to cope with age-related vision decline quite well, the middle-aged are more concerned about their vision-related problems (Kosnik et al. 1988).

2.2 Hearing

Decline in hearing is one of the most frequently noted problems of the ageing process. Older people with mild to moderate hearing problems have reported difficulties with speech comprehension especially under stressful conditions (Corso 1977). Hearing declines with age, and around 20% of those aged between 45 and 54 have some hearing impairment. This rises to 75% for those between 75 and 79 years of age (Hawthorn 2000). The most noticeable decline in hearing with age is an inability to detect tones over 2500 Hz (Schleber 1992). Age-related cognitive decline further contributes to deterioration in speech understanding, particularly in difficult listening conditions. However, older people compensate for most of these declines by using their knowledge of language and available contextual cues (Fozard and Gordon-Salant 2001).

2.3 Motor control

Response time on complex motor tasks lengthens with ageing. Proprioception, the ability to perceive (without visual monitoring) the position of body segments in space, also declines. There is a lack of substantial research data on the learning of new motor skills in older adults, but the available information suggests that they do not learn as well as the young (Ketcham and Stelmach 2001). Overall, fundamental neural events become slower for all cognitive and motor functions. Slowing of movement is evident, ability to reach and grasp diminishes, and older adults have difficulty in coping with the demands of repetitive speed, such as double clicking a mouse (Kroemer 2006).

However, ageing does not diminish performance on all types of tasks. There is little effect of ageing on older adults' ability to perform single, discrete actions that are planned in advance of the stimulus. On the other hand, negative effects of ageing become apparent when the task is complex, unfamiliar and uninteresting (Vercruyssen 1997). Many researchers have found that older people are more concerned with accuracy than speed. They tend to slow down their movements to attain accuracy in tasks related to movement. This also explains why older people are slower than younger people (Goggin and Meeuwsen 1992, Goggin and Stelmach 1990, Larish and Stelmach 1982).

3 Ageing and cognitive processing

It is generally agreed that old age causes a decline in cognitive skills which, in turn, affects the learning of new information. Some research points out that this decline is not global, as not all skills are affected by ageing (Bäckman, Small, and Wahlin 2001). For example, crystallised memory (such as vocabulary) remains constant or improves with age. Fluid intelligence (such as problem-solving, learning, and pattern recognition abilities), on the other hand, declines markedly. Other researchers have shown that age-related memory impairment is a result of damage to some parts of the brain, such as the hippocampus (Marighetto et al. 1999) or the frontal lobe (Rabbitt 1997). These changes take place at a sub-clinical level and are part of the normal processes of ageing.

However, the brain compensates for this diffuse neuron loss by recruiting other unaffected parts of the brain. This recruitment is not universal, as it is only evident in high performing older people; lower performing adult brains do not show this flexibility (Cabeza et al. 2002). This adaptability of the brain gives credence to the maxim ‘use it or lose it’ for successful ageing (Hawthorn 2006).

To summarise, Salthouse (2004) suggests that cognitive processing speed affects almost all measures of performance in the aged. However, some research challenges the idea that cognitive slowing is global and suggests that it depends more on the task being performed (Ratcliff, Thapar, and McKoon 2003).

3.1 Memory and ageing

Memory is more than just a simple storage facility: it lies at the core of thinking and learning (Howard and Howard 1997). It is also a very complex phenomenon, which is not yet completely understood. In general, literature suggests an overall decline in memory performance with ageing (Old and Naveh-Benjamin 2008, Howard and Howard 1997). However, this decline is not linear and there is ample evidence that age-related memory impairment varies greatly between individuals.

Memory is broadly categorised into five major systems. Of these, four are particularly important for research that involves older people and interaction design: 1) working memory, 2) episodic memory, 3) semantic memory, and 4) procedural memory (Fisk and Rogers 1997). Episodic, semantic and procedural memory systems all deal with long term storage of information and are hence clubbed under long-term memory. Working memory, on the other hand involves holding a limited amount of information for a limited time for processing. Of these four memory systems, working and episodic memory are most affected by age-related degradation, while semantic and procedural memory are relatively un-affected (Howard and Howard 1997).

Episodic memory deals with the ability to retain and consciously recollect information that is acquired at a particular place and time. Extensive literature on ageing shows that episodic memory performance declines with age (Fisk and Rogers 1997). Episodic memory deficits lead to older adults’ difficulty in recalling events and faces. Source memory, another important aspect of episodic remembering, is also affected by ageing (Bäckman, Small, and Wahlin 2001). Source memory refers to the specific conditions and context that was present when the memory was acquired. Its deficit leads to difficulty in recollecting where knowledge was acquired and can also lead to false memories resulting from a confusion of imagined and real experiences (Howard and Howard 1997).

Semantic memory deals with facts about the world and knowledge of language, including the meanings of words, concepts and symbols and their associations. This system of memory, in general, is not affected by age. However, age-related deficit in information access makes the retrieval process slower (Bäckman, Small, and Wahlin 2001). Both episodic and sematic memories are termed as 'explicit' or 'declarative' knowledge as they are involved with information, such as knowing that or remembering something.

Procedural memory is non-declarative, or implicit, knowledge. Procedural knowledge is not directly accessible to consciousness and its presence can only be demonstrated in action (e.g. driving or walking). Ageing only affects the speed of acquiring this knowledge. However, once the knowledge is acquired, there is no significant difference between the old and the young (Fisk and Rogers 1997). Priming, like procedural memory, is referred to as 'implicit' and refers to the facilitation of the processing of a stimulus as a result of a recent encounter with the same or related stimulus (Schacter 1987). In general, ageing-related deficits in implicit memory are relatively small.

Working memory operation can be broadly placed into two functional categories: one that deals with holding information in consciousness, and the other that is involved in processing this information while keeping task-relevant goals and strategies at a conscious level. In general, ageing has little impact on the amount of information held in consciousness. However, the information processing function deteriorates with ageing. Moreover, age-related working memory deficiencies become more prominent as the complexity of cognitive tasks increases, such as when a task requires the simultaneous storage and processing of information (Bäckman, Small, and Wahlin 2001). However, manifestation of working memory deficiencies in ageing can be mediated by coping mechanisms adopted by older individuals (Brébion, Smith, and Ehrlich 1997), especially when the task is simple.

One of the dominant theories of working memory was proposed by Baddeley and Hitch (1974). According to this theory working memory is not a unitary system; rather, it is a multiple component system that emphasises functional importance rather than just storage. This system has three components (later expanded to four): the central executive (a limited capacity attentional controller or processing component); aided by subsystems, the phonological loop; the visuospatial sketchpad; and the most recent addition the episodic buffer (Baddeley 2002).

The central executive is engaged in reasoning, decision-making and co-ordinating the activities of other subsidiary systems. It also plays a critical role in storing, coordinating and updating information in the long-term memory. Age related decline in working memory is mostly due to slowing down of the central executive component (Salthouse and Babcock 1991). Phonological loop is a temporary store for phonological information. Similarly, visuospatial sketchpad is a temporary store for visual and spatial information. The function of episodic buffer is to combine information from phonological loop, visuospatial sketchpad and long-term memory.

These four important memory systems give a clearer understanding of prior experience in the context of this study. Use of product interfaces involves both procedural (implicit, non-declarative) knowledge for knowing how to do something, and semantic (explicit, declarative) knowledge for understanding and interpreting a product's interface features and functions. Recent research on interaction design (Reddy et al. 2010, Blackler, Mahar, and Popovic 2010) also shows that, more than chronological age, domain-specific prior experience and

central executive function is important for fast, intuitive and error-free use of product interfaces.

4 Attention and ageing

A variety of behavioural inefficiencies are attributed to age-related changes in attention. In general, attentional capacity is conceptualised as a limited supply of energy that supports cognitive processing. The central executive is thought to play a key role in directing and controlling attention (Baddeley 2002, Norman and Shallice 2000). 'Attention' is a term used to describe a variety of cognitive functions, and is usually defined in literature by its various functions. For example, 'selective-attention' is processing of one source of information at the expense of another; 'divided-attention' is simultaneous processing of two or more sources of information; 'switching-attention' is alternately processing one source then another; and 'sustained-attention' is maintaining a consistent focus on one source (McDowd and Shaw 2000). However, these descriptions of different functions of attention are used to organise and present information in research literature. In reality, there are no clear boundaries between various functions of attention, a complex cognitive task, at a time, may employs more than one attentional function for its processing.

Age-related decline is most noticeable in selective-attention and divided-attention functions. Selective-attention, the ability to attend selectively to relevant information and ignore irrelevant information, is considered a prerequisite for extracting relevant information from distracting or irrelevant detail (McDowd and Shaw 2000, Kramer and Madden 2008). Some researchers argue that age-related decline in selective-attention is due to the inability of older people to inhibit task irrelevant information (Hasher and Zacks 1988, Morrison 2005). This inability to suppress irrelevant information is also known to affect divided-attention in older adults.

Ageing shows one of the clearest declines in the ability of older people to divide their attention between two sources of information, to attend to one source of information while holding onto another, and to hold and respond to both the sources (Craik 1977, McDowd and Craik 1988). For example, when driving a car, divided-attention ability involves scanning the road for other vehicles and pedestrians and, at the same time, performing other unrelated tasks such as taking directions from a global position satellite navigation system or talking on a mobile phone. However, age-related decline in divided-attention is only apparent when the task is complex, and it is not evident when performing automatic tasks (Kramer and Madden 2008). For example, performing a familiar divided-attention task such as driving a car and keeping it in the centre of the road while maintaining a set distance from other vehicles on the road, is not affected by ageing. However, when this familiar task is changed – as in a study conducted by Korteling (1994) where the polarity of the accelerator pedal was reversed so that faster became up - the divided-attention deficit is more prominent in older people. Interestingly, Korteling found that when the accelerator pedal polarity was reversed, the older people had difficulty with steering the car rather than the accelerator pedal. It was concluded that the complex task had overwhelmed cognitive resources, leaving little capacity to deal with the second, less complex task. Some researchers argue that this deficit in older people is a result of overall task complexity, rather than of divided attention per se (McDowd and Craik 1988).

5 Ageing and technology adoption

A common belief is that older people are unwilling or reluctant to use contemporary technologies. Contrary to this assumption, available data suggests that older people are, in general, open to the use of technology (Czaja and Lee 2007). However, they exhibit more anxiety about their ability and confidence in using these systems successfully; this in turn, hampers their adoption of new technologies (Marquié, Jourdan-Boddaert, and Huet 2002).

The usage of new technologies by the present generation of older people is low, especially by those who are less educated and come from a lower income bracket (Tacken et al. 2005). Tacken et al. (2005) also suggest that age-related cognitive decline is a major contributing factor to the low use of technology by the older people. However, some researchers view new technology adoption by older people from a different perspective, suggesting that the low adoption and use of technology could be viewed more as the reaction of older people to generational changes in technology rather than to age-related declines. Furthermore, the way people handle current technology could be based on the kind of technology they were exposed to during their formative years from age 10-25 years (Docampo Rama, Ridder, and Bouma 2001). People who have experienced certain technology of consumer products in their formative years show similar technology usage behaviour in their later life (Sackmann and Weymann 1994). This group of people can be identified as belonging to a certain 'technological generation' (Docampo Rama, Ridder, and Bouma 2001, Lim 2009).

It is also observed that a digital divide exists for certain segments of the population, such as those belonging to minorities, those who are older and those who are less educated (Czaja et al. 2006). However, adoption of technology is a complex issue that cannot be explained by just socio-economic factors, attitudinal approach, age and education alone. There are other psychological factors, such as self-efficacy and technology anxiety that could influence the attitude of an individual towards technology (Czaja et al. 2006).

6 Prior experience and ageing

Prior experience with technology is a strong predictor of performance for a variety of computer-based tasks (Czaja et al. 2001); the more experience a user has with related technology the faster they will learn to use new technology (Lewis, Langdon, and Clarkson 2008). Prior experience or familiarity is also the backbone of intuitive interaction (Blackler 2008, Hurtienne, Weber, and Blessing 2008, Blackler, Popovic, and Mahar 2010). Moreover, literature on interaction design and usability stresses the need to design products based on users' experience, familiarity, and prior knowledge (Preece, Rogers, and Sharp 2002). Also, interactions that exploit a user's prior knowledge are significantly faster and are less prone to errors (Langdon, Lewis, and Clarkson 2007, Lewis, Langdon, and Clarkson 2008, O'Brien 2010).

There are two facets to prior experience – exposure to technology and competence with technology (Hurtienne, Horn, and Langdon 2010). Exposure to technology is a measure for duration, intensity and diversity of technology use, and competence with technology is a measure for skill and knowledge required to interacting with the product. The outcome of this study suggests that a measure of competence with technology, compared to exposure, might be more predictive of usability of a product in older adults.

A much more comprehensive study by O'Brien (2010) also supports Hurtienne et al. 's (2010) finding. O'Brien (2010) investigated the role of prior experience in the use of

technology in users of different ages and experience levels. Results show that prior experience was often cited as the reason for successful use of technology. The most common approach for resolving problems in technology use was to use a combination of prior experience and the *knowledge in the world* (affordances). Older people also reported more problems than younger people due to insufficient knowledge. Further, participants who had reported higher relevant experience generally performed better. Interestingly, younger participants performed better on all technologies compared with the high-tech older age group. Although the younger group and the high-tech older group shared similar technology experience, the age differences were still significant. Older group were also more variable in their performance. In other words, older participants with higher technology prior exposure performed much more slowly than younger participants with the same level of technology prior exposure. Similarly, other studies found that, although prior experience with related technology improved the performance of older adults, age-related differences in processing speed and memory are still important factors that influence the usability of a product (Blackler, Mahar, and Popovic 2010, Reddy et al. 2010, Czaja et al. 2001, Czaja and Sharit 1993).

All the literature reviewed here agrees that both domain-specific prior knowledge and cognitive abilities are important for successful use of complex technological product interfaces. However, depending on the sample size, age groups and measures used in a particular study, there appears to be some variation in identifying the most influential factor among prior knowledge, age or cognitive abilities. One of the reasons for these variations could be that all three factors are interrelated.

Prior experience is acquired knowledge, and efficiency in acquiring new experiences is based on existing knowledge. In other words, the greater the knowledge base of a person, the easier it is for them to understand and integrate new knowledge. However, due to generational effect, older people tend to have a low knowledge base for contemporary technologies (Docampo Rama, Ridder, and Bouma 2001). Moreover, the knowledge thus acquired, both explicit and implicit, is stored in the long-term memory. Use of prior experiences involves procedural memory (implicit) to recollect the process needed to accomplish a task, and semantic memory (explicit) to understand how a task needs to be performed (Lim 2009). However, working memory facilitates both acquiring and using of knowledge. Both procedural memory and working memory are affected by the process of ageing. This could be one of the reasons why older people, although they are exposed to relevant technologies, find it difficult to use new technological products intuitively.

In summary, age, cognitive abilities and generational (or cohort) effect are some of the important factors that influence prior knowledge of older people. This prior knowledge, in turn, affects the process of acquiring new knowledge. In other words, all of these factors - prior knowledge, age, and cognitive ability - are interdependent.

7 Anxiety and cognitive performance

Many studies have shown that anxiety impairs cognitive functioning by reducing the amount of resources available for task accomplishment (Eysenck and Calvo 1992, Eysenck et al. 2007, Eysenck and Derakshan 2011, Wetherell 2002). People in an anxious state worry about threats to their current goal and try to develop effective strategies to reduce anxiety to achieve the goal. These worrisome thoughts interfere with their attention to task-relevant information, thus competing with cognitive resources available for task-related information

processing activities (Eysenck et al. 2007, Eysenck and Calvo 1992). While this interference of worrisome thoughts with the cognitive process results in the individual taking longer to accomplish a task, it does not necessarily result in more errors (Darke 1988). A brief look at basic theories of anxiety gives a better understanding of its impact on performance.

Conditions of anxiety and danger produce stressful circumstances that increase physiological arousal. Razmjou (1996) defines arousal as 'a hypothetical construct that represents the level of central nervous system activity along a behavioural continuum ranging from sleep to alertness' (p. 530). An optimal level of arousal is needed to perform any goal-oriented tasks successfully. Researchers have found that there is a strong relationship between the arousal state and a person's performance. The cornerstone of this anxiety-performance research for many decades has been the inverted-U hypothesis. It originated from a study by Yerkes and Dodson (1908), cited in Hardy and Parfitt (1991). The study, of habit strength formation in mice under different conditions of punishment stimuli, states that for any given task, optimal performance is achieved at some intermediate level of arousal. In other words, performance is predicted to be poor at low levels of arousal, good at moderate levels, and progressively worse as arousal increases beyond this optimal level.

However, the inverted-U hypothesis has been criticised by many for its lack of rigour in terms of empirical support. Fazey and Hardy (1988) suggest that the inverted-U should not have a symmetrical shape as it is usually presented. They suggest a 'catastrophe model' which states that, when performers 'go over the top', performance appears to drop dramatically rather than gradually. Once this happens, it is very difficult to achieve even a mediocre level of performance (Hardy and Parfitt 1991).

Stress impacts both physiological and cognitive functioning of a person. People under stress seem to be less capable of using working memory effectively (Wickens et al. 2004, Eysenck et al. 2007). Almost all functions of working memory - processing, storing and rehearsing - are affected by stressful conditions. However, long-term memory is relatively unaffected by these conditions (Wickens et al. 2004). This causes a person under extreme stress to access most available thoughts/actions and to linger on them due to the unavailability of the information processing function of working memory. This could impact effective accomplishment of tasks that involve the central executive, processing component of working memory.

One of the dominant theories from recent research on effects of anxiety on cognitive functions is Attentional Control Theory proposed by Eysenck, et al. (2007). Eysenck, et al. (2007) suggests that anxiety interferes with the cognitive processing centre of the central executive component (Baddeley 2007), more specifically, attentional control resources of the working memory system (Eysenck and Derakshan 2011). According to Attentional Control Theory, anxiety adversely effects the functioning efficiency of the goal-directed attentional system and increases the influence of the stimulus-directed attentional system. The goal-directed (top-down processing) attentional system is driven by expectation, prior experience, knowledge and current goal, while the stimulus-driven (bottom-up processing) attentional system is more influenced by unexpected, conspicuous stimuli (Corbetta and Shulman 2002). In other words, anxiety increases the allocation of attentional resources to threat-related stimuli at the expense of reduced focus on the current goal.

The core assumption of Atttentional Control Theory is that anxiety impairs processing efficiency more than performance effectiveness (Eysenck et al. 2007). For example, in a

typical usability study, response accuracy is a measure of performance effectiveness and response time is a measure of processing efficiency. In effect, what this theory suggests is that high-anxiety individuals, when compared with low-anxiety individuals, will likely take more time to complete a task; however, they may not necessarily make more errors. In other words, high anxious individuals, under stressful conditions, trade time for accuracy in achieving their goal. They also use increased effort and working memory resources.

Overall, Attentional Control Theory makes various predictions of the effects of anxiety on the goal-directed attentional system. Some of these effects are: a) reduced ability to inhibit incorrect prepotent responses, b) increased susceptibility to distraction, c) impaired performance of secondary tasks in dual-task situations, and d) impaired task-switching performance. (Eysenck et al. 2007, 348). On the other hand, some have found that high trait anxious individuals' performance was comparable to, or even superior to that of low anxious individuals (Hayes, MacLeod, and Hammond 2009). Eysenck, et al. (2007) suggests that high anxious individuals perform by increasing effort and by using processing resources in a manner that can overcome functional restrictions resulting from worrisome thoughts. Moreover, Attentional Control Theory also contends that when the task is demanding and task goals are clear, high anxious individuals exhibit a high level of motivation.

7.1 Older adults and anxiety

Older people can experience more anxiety when it comes to interacting with new technologies (Czaja et al. 2006, Eisma et al. 2004). This may stem from an assumption that it requires considerable effort to learn to use them (Eisma et al. 2003). Ageing also diminishes attention capacity (Craik 1986), in particular, the ability to inhibit irrelevant information (Hasher and Zacks 1988) and dual-task performance (Stawski, Sliwinski, and Smyth 2006). An anxious state interferes with attentional resources available for task-relevant processing activity (Eysenck et al. 2007). With age-related decline in attentional resources, the compensatory mechanisms of using more effort and resources in highly anxious individuals could result in substantial impairment in the performance of older adults. Compounding this, research also suggests that higher anxiety in older adults results in poorer performance on tasks that require divided attentional resources (Hogan 2003).

On the brighter side, greater anxiety in older adults does not seem to have a significant effect on performance when it is measured as rate of errors in accomplishing a cognitive task. However, older adults did take more time to complete the task compared with younger ones (Delgoulet and Marquié 2002). On the other hand, this study involved participants from only younger and middle age group of ages, 25 to 49 years.

8 Perceived self-efficacy

Self-efficacy can be defined as a judgement of 'how well one can execute courses of action required to deal with prospective situations' (Bandura 1982, 122). In general, individuals with high perceived self-efficacy are determined and show more effort across a broader range of tasks than people with a lower level of self-efficacy. Bandura (1986) also suggests that decreased levels of self-efficacy, resulting from low levels of exposure to related stimulus, is also associated with higher levels of anxiety. In other words, self-efficacy beliefs can be influenced and manipulated by many factors. People who are younger and better educated or who have higher levels of crystallised and fluid intelligence have higher computer self-efficacy and lower levels of computer anxiety. These people also tend to use more types of technologies (Czaja et al. 2006).

Computer self-efficacy is an important predictor of the general use of technology. People with lower computer self-efficacy may be less likely to engage with technology in general (Bandura, Freeman, and Lightsey 1999). The effects of computer self-efficacy are mediated by computer anxiety, which, in turn, is linked to the breadth of computer experience.

However, some researchers found no significant relationship between experience and computer anxiety (Mahar, Henderson, and Deane 1997, Bozionelos 2001, Wilfong 2006). Mahar et al. feel that the relationship between computer anxiety and computer experience is much more complex than there simply being a general reduction in anxiety with experience. Furthermore, the research of Bozionelos (2001) and Wilfong (2006) suggests that more than computer experience, low perceived self-efficacy has a significant relationship to computer anxiety.

9 Discussion

Age-related declines in cognitive and sensory-motor function occur slowly and at varying intensities from individual to individual. In other words, compared to the younger population, variability in older adults is significantly larger (Fisk 2004, Zajicek 2001). Central executive function, a component of working memory, is most affected by the process of ageing (Bäckman, Small, and Wahlin 2001). Central executive also facilities the acquisition and use of new knowledge; age-related decline in this function not only slows down the acquisition of new knowledge, but also slows the use of existing knowledge on demand (Czaja et al. 2006). This could be one of the reasons why some older adults, even with high domain-specific prior knowledge, find it difficult to use contemporary technological products intuitively.

People with low technology self-efficacy exhibit higher levels of technology anxiety and may be less likely to engage with technology in general. This, in turn, may result in low domain-specific technology prior experience. Thus, technology self-efficacy is mediated by technology anxiety; which in turn, is linked to prior experience (Bandura, Freeman, and Lightsey 1999, Czaja et al. 2006).

In short, the literature identified complex interrelationships between the use of technological products in older people and domain-specific prior experience, age, cognitive aspects of ageing, and technology self-efficacy.

Figure 1 illustrates this relationship: Domain-specific prior knowledge is the key to intuitive interaction; age-related cognitive decline slows down the acquisitions of new experiences, resulting in older people having low prior experience with contemporary technologies; low prior experience with contemporary technologies, in turn, could result in low perceived technology self-efficacy; low technology self-efficacy could result in technology anxiety; and anxiety could interfere with intuitive use.

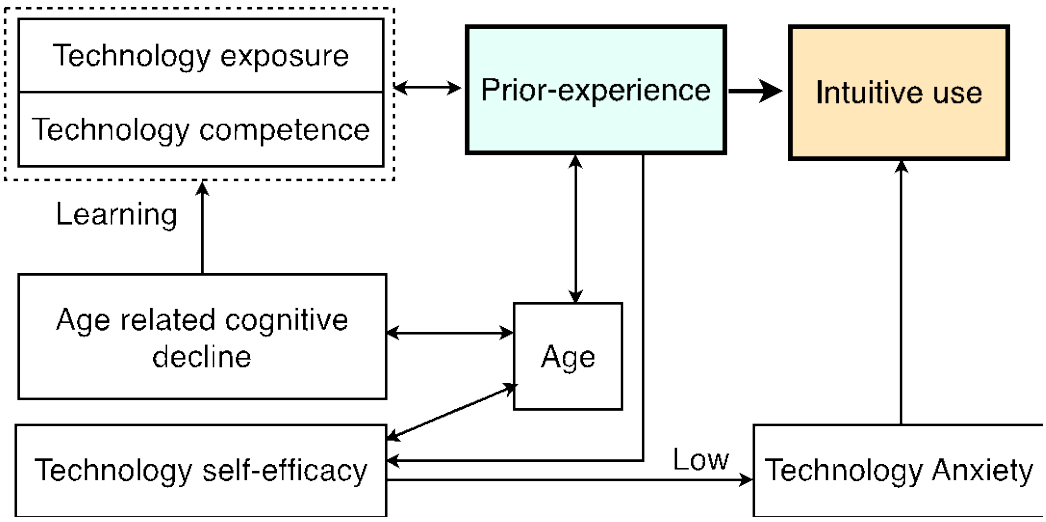


Figure 1: Interrelationships from the literature review

The above framework explains different issues one encounters when researching or designing for older people. Such as:

How to design an intuitive to use product: Design for intuitive use basically involves two steps: 1) to understand domain-specific prior experience and competence of the user; and 2) to design interfaces that reflect this prior experience. (other influencer- cognitive capability)

Ageing and diversity: Normal process of ageing slows down acquiring new knowledge. A significant factor for diversity associated with ageing. (other influencer- technology self-efficacy)

Bad design and how it contributes to the problem: Inability to use a product due to bad design in a critical situation can contribute to technology anxiety. Which can result in low technology self-efficacy and reluctance to use and learn new technology. Thus, low technology prior-experience, more diversity, etc.

In conclusion, we hope this framework will help other researchers and designers to address ageing issues in a comprehensive fashion. Most importantly, provide a foundation for people who are just stepping into this area. Finally, this is still in development we hope to develop it further to increase its granularity to capture more mediator factors.

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A Study of Basic Needs Pictogram Structure of Nonverbal Communication for Aphasia Patient

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APHASIA PATIENTS are difficult to correctly express general physiological or psychological needs in spoken language, and non-verbal communication method can be more assist when communicating with aphasia patients. Using pictograms to communicate can improve the effectiveness of communication. This study uses five basic needs vocabulary words in the process of medical care: hunger, sleepless, too cold / too hot, thirst and defecation / urination. 30 designers understood the vocabulary and mapped the corresponding images, a total of 150 images were obtained, and then 150 images were discussed by the focus group method to obtain the most suitable image as a reference for further communication pictogram design. The research results are as follows: 1. The five needs include the physical responses caused by physiological changes, including the facial expressions and behavioural expressions. Therefore, the subjects showed the correlation between physiological needs and body and behaviours according to their own experience. 2. In the process of constructing pictorial communication system, pictograms are highly related to the living environment and connectable objects, and the concrete objects associated with the basic needs can be used to express the corresponding needs. 3. Two of the needs are not single demand, and the subjects would choose to express only one of them. 4. The constitution forms of language and graphics share similar properties. The process of constructing basic needs pictograms coding for needs is the embodiment of the common experience of the graphic designers, it is the concentrated reflection of the designer's psychological reflection and the direct expression of empathy for the person or objects in reality, using metaphor and simile. The results showed that the images of some needs were easily confused with symptoms. The framework of pictogram coding for basic needs is mainly decomposed into the human body, body parts, environmental objects, and need state, these parts can produce a more accurate understanding of the pictograms.

Keywords: aphasia patient; non-verbal communication; doctor-patient communication; basic needs; pictogram communication

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1 Introduction

Compared with normal people, aphasia patients need more time for basic communication and family activities. Because patients cannot communicate with others successfully and effectively, therefore, their interpersonal relationships and social life are obviously hindered, which also affects the patients' self-esteem and leads to anxiety, depression, anger, frustration and autism. In the aspect of communication in caring process, patients often fail to express their basic needs correctly. Relevant studies have shown that non-verbal communication methods, such as gestures, expressions, actions, pictures and photos, can be used to assist patients with abnormal oral communication ability (Gathay General Hospital Rehabilitation Section Language Therapy Group, Ramsberger, 1994). In the field of special education, the symbol-based auxiliary communication alternative system (AAC) is better than text-based and can communicate effectively (Ruppar, 2017). As a basic element of auxiliary communication, graphics present diversified forms in the process of language therapy (Stewart & Riedel, 2016), well-designed graphic images have better learning effect (Große, Jungmann, & Drechsler, 2015). In addition, pictogram can provide effective information for communication when patients have limited knowledge or cannot speak normally under special conditions. Pictogram can improve the understanding ability in communication process, but corresponding communication standard and systematic evaluation system for ensuring the effect of different groups using pictogram are absent (Kim, Nakamura, & Zeng-Treitler, 2009). Although pictograms can provide information in the communication process effectively, there is no effective solution in the establishment and verification process(Kim et al., 2012). In the process of medical communication, the form of information transmission is highly correlated with the model (Kessels, 2003); visual expressive behaviour is a direct simulation of real-life behaviour (Feng & O' Halloran, 2012). The combination of pictograms and language can effectively facilitate the communication between doctors and patients; pictograms are especially useful for patients with low literacy. Cultural relevance plays a very important role in the process of understanding. Even small differences in pictograms will affect the degree of understanding of the pictograms of the viewers (Houts, Doak, Doak, & Loscalzo, 2006).

The construction of basic need pictograms is mainly applied to patients who have normal cognitive ability but cannot perform normal language communication. These patients include: (1)The pharynx and larynx cannot be used for vocalization due to an emergency. (2)Some patients with limited literacy. (3)Pictograms are needed in special education communication training. This study combines medical communication, visual communication design and other fields, converts the words that convey basic needs of non-verbal communication patients into pictograms, in order to construct the visual symbol system through semantic analysis of visual symbols.

This study is a preliminary survey and will be jointly studied with the National Cheng Kung University Hospital Douliu Branch in the future. In the pre-study research, it was found that currently limited to PinYin Board during clinical application in the communication between doctors and patients. This is inconvenient for the application of low-level literacy, no sign language basis or limbs can't move, The researchers also observed some language treatments for autism children，the picture system is basically used from language therapist. Of course, this study is exploratory, in order to solve the problem of using symbols to communicate in special medical environment through the designer's thinking.

2 Literature review

2.1 Definition and application of non-verbal communication

Nearly two-thirds of social interpersonal communication is non-verbal communication (Brook. & Servátka., 2016); in clinical communication, a large amount of information is transmitted through non-verbal behaviours (Blanch-Hartigan, Ruben, Hall, & Schmid Mast, 2018). Non-verbal communication is conducted through facial expressions, body language and gestures. These non-verbal communications can enhance and enrich the content of oral language (Brook & Servátka, 2016). Pictograms play an important role in non-verbal communication, but the use and understanding of pictograms is the most difficult part of the study; so far, there is no validated standard for construction and readability of visual symbols, therefore, errors and obstacles are easy to occur in the process of non-verbal communication using pictograms(Hwang et al., 2005). The construction of auxiliary communication tools needs to meet personal needs and relevant preferences, which can enhance non-verbal speakers' dependence on auxiliary communication tools, and play a role in long-term use（Tsai，2013）. Communication tools developed when patients are unable to express themselves normally are an important part of the communication process to facilitate the exchange of information.

2.2 Communication of basic needs and presentation methods

When patients cannot express their basic physiological needs correctly, they need to use other communication methods instead of oral communication. Patients show different states of basic needs in different ages and environments (Wu, 2012); Maslow believes that when certain needs are threatened, they will again become incentive conditions, and the process of constantly meeting the needs will present the best condition for patients (Noltemeyer, Bush, Patton, & Bergen, 2012). In the research process of doctor-patient communication, the principle of nursing or medicine is patient-centered, but in fact, patients are in a passive role in the communication process; information interaction should be achieved in patient-centered communication (Ishikawa, Hashimoto, & Kiuchi, 2013). Although this point of view is consistent with the human-centered design (HCD) concept in design, however, the information exchange is usually unequal between doctors and patients. Patients cannot express personal needs, doctors rely on experience to judge patients, may produce communication bias, equal communication under special circumstances is difficult to achieve. The study on the needs of patients undergoing pneumonectomy includes the physiological needs and psychological needs (Orduña Beuzón, Vicente Bardón, Martínez Gago, & Plaza Mayor, 2009). Basic needs are different in the medical environment; according to Maslow's early need-hierarchy theory, in order to promote patients in special medical environment, patients' stakeholders play an important role at each stage (Karnatovskaia, Gajic, Bienvenu, Stevenson, & Needham, 2015). Maslow's basic needs theory presents an inverted triangle state in special medical environment, in which patients' physiological needs are in the most important stage (Figure 1).

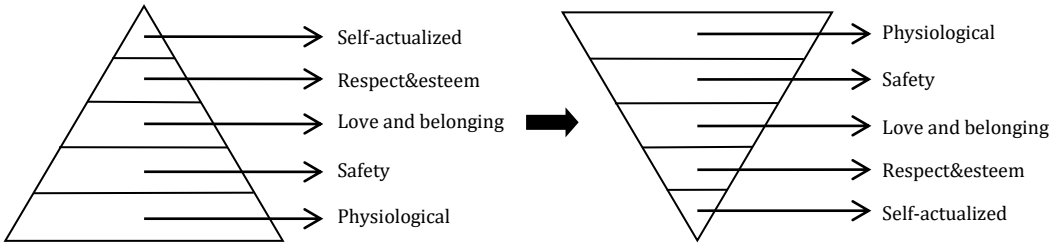


Figure 1. Maslow's early need - hierarchy theory structural changes between doctors and patients' relationship

Assistive communication tools can increase the interaction time and skills in communication process, but there is room for improvement for assistive communication tools(Sun, Hsueh, & Wu, 2013). Pictogram is the most important element in visual communication; about pictogram, what we need to pay most attention to is its constituent signs; each element of the pictogram directly constitutes the final interpretation of the symbolic meaning. The process of symbol construction includes many kinds of pictures, such as line drawing, photo and other cartoon pictures. Saussure's semiotics theory not only had an influence in the field of linguistics, but was also involved other fields. He believed that "symbols are part of social life". Language is a sequence and symbols are carriers of ideology (Cobley, 2006b). Roland Barthes believed that symbols were a system and its formation was determined by motivation (Cobley, 2006a). In the process of using vision as a hint, there should be a clear goal: to be able to get the corresponding information by looking at the picture, and the visual presentation should be presented in a way as clear as possible (Peregrin, 2010). As the connection between items and mental images in communication, the process of symbol construction plays an important role in denotative meaning. At the same time, we should also analyse the context of symbol use.

2.3 Theory of symbolic construction

Assistive communication tools can increase the interaction time and skills in communication process, but there is room for improvement for assistive communication tools (Mei-Ling Sun, Ming-Li Hsueh, & Wu, 2013). Pictogram is the most important element in visual communication; about pictogram, what we need to pay most attention to is its constituent signs; each element of the pictogram directly constitutes the final interpretation of the symbolic meaning. The process of symbol construction includes many kinds of pictures, such as line drawing, photo and other cartoon pictures. In Aristotle's view, in the linguistic scene the order is item→ psychological experience→ language→ written words. However, Derrida believed that the relationship between things and psychological images gave rise to the classical concepts of "signifier" and "signified" in semiotics (Daylight, 2012). Saussure's semiotics theory not only had an influence in the field of linguistics, but was also involved other fields. He believed that "symbols are part of social life". Language is a sequence and symbols are carriers of ideology (Cobley, 2006b). Roland Barthes believed that symbols were a system and its formation was determined by motivation(Cobley, 2006a). In the process of using vision as a hint, there should be a clear goal: to be able to get the corresponding information by looking at the picture, and the visual presentation should be presented in a way as clear as possible (Peregrin, 2010). As the connection between items and mental images in communication, the process of symbol construction plays an important role in denotative meaning. At the same time, we should also analyze the context of symbol use.

3 Research methods

Understanding of pictograms decreases over time as they are tested; complex meaning is susceptible to the process of long-term memory. Pictograms are better at conveying information than complex text messages, but require simple and clear instructions (Houts., Witmer., Egeth., Loscalzo., & Zabora., 2001). In the process of pictogram construction, there should be a clear method to evaluate whether the pictogram is compatible with the corresponding words.

During the investigation process of this study, we screened five basic needs in the demand study of patients with tracheotomy (Huang et al., 2008). The five basic needs of non-verbal communication patients in the process of seeking medical treatment were hunger, sleepless, too cold / too hot, thirst, defecation/urination. Based on their own experience or relevant reference materials, 30 college students with visual communication design background were asked to hand-drew these five basic needs into pictograms that could express these needs. Each need corresponded to one pictogram. There was no limit on drawing time and tools, but the students were not allowed to discuss with each other. At the end of the survey, the researchers collected all 150 pictograms, scanned them, saved them into JPG files and numbered them. 30 pictograms of each need were arranged on the same A4 page.

We then invited six designers with communication design background to participate in focus-group-method, and told them about anonymous recordings before participation. Thirty pictograms of each need were printed on A4 size papers and distributed to the participants. Participants were given 20 minutes to select the most suitable pictogram for conveying the need, and to describe the reasons for their choice. At the same time, the researchers gave them guidance and obtained the designer's ideas and process of symbol construction by listening to the speeches of six participants. Finally, the participants chose the image that best fits the need among all the images and propose suggestions for modification. After the study, the researchers then sorted through the transcripts word by word and analyzed the conversations.

Symbol structure analysis is adapted in the analysis and disassembly of symbol elements. The following steps are used for image analysis: symbolic meaning→ signifier (symbol plotting)→ pictographic symbol composition→ symbol understanding. After the symbols drawing, 150 symbols are analyzed and the number of the components of the pictogram symbols is counted. Analyze why designers use this element, discuss the position of this element on each symbol, summarize common elements, analyze the constitution rules of the basic structure of pictogram, classify different symbols and analyze the results of difference and commonness.

4 Results and discussions

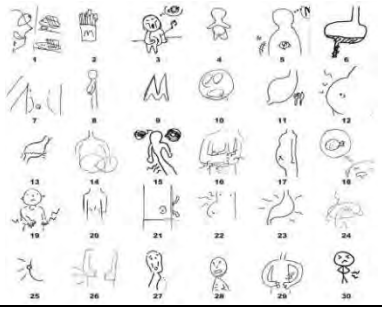
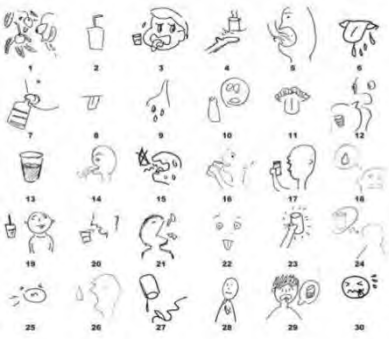
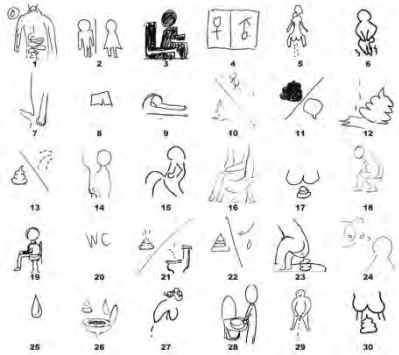
Doctor-patient communication is a verification process circulating among the required words, symbols, pictograms and symbolic meanings, so as to determine whether symbols can meet the users' psychological needs and understanding level in the construction process.

4.1 Results and analysis of graphical symbols of needs

A total of 150 images are obtained based on the five needs, and the analysis results based on the commonality and difference of image codes are as follows (Table 1):

1. The five needs include the physical responses caused by physiological changes, as well as the facial expressions and behavioural expressions. Therefore, the experimental subjects would show the correlation between physiological needs and body and behaviours according to their own experience. The images emphasize on “body” parts, most of which are head, limbs and trunk, followed by the body parts based on different needs. For instance, the subjects would lay emphasis on the belly, stomach and other parts for “Hunger”; the head, dark circles and wide-eyed facial expressions for “sleepless”; opening mouth and protruding tongue for “thirst”.

Table 1 Graphical symbols of needs and the statistic of numbers

Basic needs	Hand draw pictograms	The number of symbols
Hunger		Head, limbs and trunk（23） Belly part（20） Hungry symbols（16） Facial expressions（8） Gastric organ（4） Food（2）
Sleepless		Head, limbs and trunk（27） Facial expressions（24） Sleep Symbols（9） Pillow（6） Moon（5） Quilt（3） Clock（3） Animal（1）
Too cold / too hot		Head, limbs and trunk（17） hot and cold Symbols（14） Facial expressions（14） Partition comparison (13) Water droplets (8) Snowflakes (4) Sun (4) Thermometer (2) Snowman (1)
Thirst		Head, limbs and trunk（18） Facial expressions（18） Water bottle (15) Tongue (12) Water droplets (7) Thirsty symbols (4) Plant (1)
Defecation / urination		Head, limbs and trunk（15） Excreta shape (15) On the toilet (14) Partition comparison（7） Physiological organ（7） Closestool & squatting closet（6） Water droplets（4） Toilet sign（2）

2. In the process of construction, communication symbols are highly related to the living environment and connectable objects, and the concrete objects associated with the needs can be used to express the corresponding needs. For example, “Hunger” can be expressed by food, and “sleepless” can be expressed by the symbols highly related to the objects around the sleeping environment (such as pillow, bed, alarm clock) and night environment, such as the moon and etc. The concrete objects of cold (snowflake, water drop) and heat (sun, flame) can be used to express “too cold / too hot”, the water drop, drinks and water cups, etc. for “thirst”, and the shape of urine and feces, etc. for “defecation / urination”.

3. Two of the needs are not single demand, and the experimental subjects would choose to express only one of them. For example, when the experimental subjects drew “too cold / too hot” and “defecation / urination”, the motion of only one of them would be expressed.

4. The constitution forms of language and graphics share similar properties. For example, “too cold / too hot” and “defecation / urination” are two similar concepts divided by slanting lines. Based on the morphology of words, the experimental subjects would determine the expression forms of graphic symbols according to the text forms given.

4.2 Graphical symbols in line with the needs and the suggestions for modifications

Six professional designers made understanding and discussion according to the 30 images of each need, and the results showed that the images of some needs were easily confused with symptoms, for instance, hungry and stomach-ache were two different concepts, but if the subjects just pointed to the parts of body, it would be difficult to distinguish the both due to the same position, so it was necessary to use other clues to link this meaning. The situation of demand, the expression of surrounding objects, and the use of similes and metaphors could reflect the meaning of words about needs. The appearance and structural rationality of images, as well as the accuracy of meaning expression is also the focus among experts.

The results of discussion by focus groups are shown in Table 2:

Table 2 The results of discussion by focus groups and the suggestions for modifications

Basic needs	The results of discussion by focus groups		Final symbols
Hunger	Selected symbols	16、18、18、19、23、27	18 
	Symbolic interpretation	Hungry can be reflected through facial expressions, but the concept of hungry and pain is not clear, and some of the graphic expressions are like stomach pain. In addition, the structure of the graph affects the degree of comprehension, and the elements of the onomatopoeia should be placed during the drawing process.	
	The suggestions for modifications	Elements should be added to the details of the characters, and the face should be added with depressions.	
Sleepless	Selected symbols	1、27、16、15、15、26	15 
	Symbolic interpretation	The facial expression can reflect the state of being unable to sleep well, but it is easy to be confused with the word "have a late night." Part of the eye drew	

		eye bags，that is easy to be choosen. Adding the sun or moon should be added to the surrounding environment can express time .	
	The suggestions for modifications	The shape of the characters should look good. The facial expressions of other symbols should have time and eye bags, dark circles and other elements.	
Too cold / too hot	Selected symbols	6、19、19、19、19、27	19 
	Symbolic interpretation	The draw of body symbols cannot reflect the vocabulary of temperature for the first time. It is convenient to draw the thermometer symbols to express the meanings. It is not desirable to use too exaggerated symbols in the choice of graphics. Generally, snowflake is used to indicate cold, and flame is used to indicate hot.	
	The suggestions for modifications	Cold should add a snowflake symbol, the facial expressions should be express cold, the expression of body symbols should be accurate, the painting is too scribbled, and the hot part should be sweating.	
Thirst	Selected symbols	1、3、12、15、19、29	29 
	Symbolic interpretation	Symbols should have facial expressions, thirst without water's symbols felt stronger, tongues sticking out like want drinking water, some symbols do not feel thirsty, and designers think of the concept of console oneself with false hopes. the facial expression of symbols is easy to be Choice, the professioner curious about the environment in which symbols are needed.	
	The suggestions for modifications	Tongue drawing needs to be exaggerated.	
Defecation / urination	Selected symbols	2、3、3、21、21、21	21 
	Symbolic interpretation	It is not appropriate to use the excrement as a symbol directly. The privacy behaviour is not fit for using in pictograms performance too clear . It is considered that the toilet symbol in the hospital represents want to go to the toilet, but the situation of using the pictograms are not well understood. In addition, gender factors should be considered in the process of using this pictogram.	
	The suggestions for modifications	There is no need to make the excrement too obvious.	

5 Conclusion

In this study, the basic needs of aphasia patients were illustrated to show the feasibility and effectiveness of assisted communication. Pictograms combined with language can effectively assist communication between doctors and patients (Barros et al., 2014). Graphic representation was more illustrative than text in the medical process, and the use of graphic representation could assist the communication among doctors, carers and patients. The users could not only understand the text but also help recall (Zeng-Treitler et al., 2008), and the communication with others could be achieved through non-verbal communication.

The process of graphic coding for needs is the embodiment of the common experience of the graphic designers, and the direct expression of real people or things, using metaphor and simile. In the process of cognition, metaphor as the mapping of real objects is the connection between two objects，which is the core of thinking (Neuman & Nave, 2009). In the whole construction process of need coding, the designers emphasized on the concept of demander, especially that most graphics were reflected in demander's body and expression state. The process of pictorial code construction was similar to that of language construction (Feng & O'Halloran, 2012), Although the subjects presented different styles in the process of sketching, the emotional behavior of visual performance was a direct simulation of the behavior in real life when the words about needs were converted into pictorial expressions (Feng & O'Halloran, 2012).

The framework of graphic coding of needs is mainly decomposed into the human body, body parts, environmental objects, and need state, in which the first three belong to concrete symbols, which have direct reference objects in life (Figure 2). When interpreting the body or emotions, humans will naturally use metaphors in the context of the environment. Metaphor is a direct mapping of living environment, cultural patterns, behaviours and values(Pritzker, 2003). The abstract symbols can also be used to express the need state, for instance, a radial line is used to represent the gurgling sound of hunger.

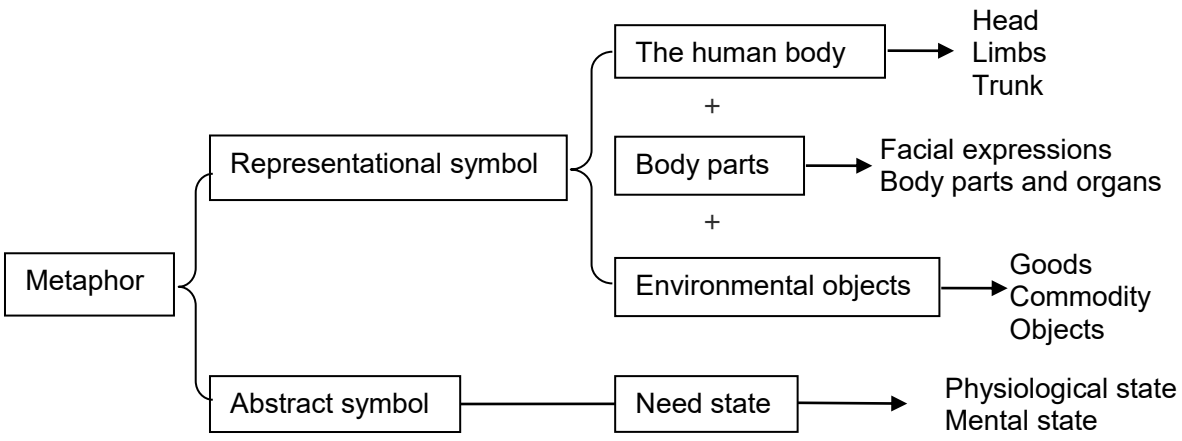


Figure 2 The pictograms' framework of the basic needs

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A Study on Smart Phone Icons: Styles and Recognition

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Current smartphone manufacturers share similar icon styles, which is a materialized drawing with filtered details. A well-designed and well-formatted icon can make the interaction quicker and easier. However, complex information can become confusing and may appear muddy at smaller sizes. With regards to different simplicity levels and styles, this study examines at what point viewers have trouble recognizing smartphone icons. Twenty-five icons focusing on five primary functions of the smartphone were generated for this study. This experiment was divided into two phases: 1) a study to identify the most recognizable icons, and 2) a study to test recognizability with simplified icons that were designed based on the findings from the phase 1 study. Data was collected from a total of 1,305 online survey participants. This study found that simplified icons with minimal elements did not decrease their recognizability when the form included visual cues for meaning recognition. When the visual cues did not represent the meaning, viewers misinterpreted the meaning of the icons

Keywords: Icon Recognition, Visual Cue, Icon Style, Smartphone

1 Introduction

Icons are not a product of modern society, instead, they are one of the oldest communication forms that can be traced back to ancient ages. Before having languages to communicate, ancient people began to express themselves through facial expressions, postures, and gestures (Horton, 1994). As shown by cave paintings that were found by modern archaeologists, ancient people used simple pictorial images to represent objects from nature to record, mark, and communicate. For example, they drew abstract cows to record how many cows they owned or to mark ownership. In the modern written Chinese language, we can still see the original objects in some characters. Also, drawing on the ancestry of the icon is Semantography. Semantography, also known as Blissymbolics, as designed by Charles Bliss, is defined as an ideographic writing system including “several hundred basic symbols, each representing a concept, which can be composed together to generate new symbols that represent new and more complex concepts” (http://www.blissymbolics.org/).

Current icons represent modern society, globalization, or even a high technology world. Understanding an icon is based on viewer interpretation. Icons can be seen everywhere, no matter if they are offline or online, or physical or digital interfaces. Icons are commonly seen where visual information is needed to be provided in order for viewers to grasp the main content easily and quickly. Common examples of this are road signs, computer screens, and

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machine control panels. Summing up information visually and graphically, icons provide relatively higher readability than text and even make text unnecessary in some situations (Mertz, 2012) . This is especially true for those people who are illiterate in certain languages (Horton, 1994) . Apart from higher readability compared to text; icons save space. What's more, the fewer details an icon carries, the less space is needed to display this icon clearly (Torralba, 2009) . With complex icons, it is difficult to see and recognize small details when the icons are at a reduced size compared to a larger size. What's more, complex details can become confusing and may appear muddy at a smaller scale (iOS human interface design guidelines, 2015) .

In the rapidly growing smartphone industry, some mobile phone brands gradually grew to occupy most of the market—Samsung, Apple and Lenovo share around half of the market worldwide. Even though these smart phones were produced by these three different manufacturers, the existing icons on their interfaces look similar in terms of design style and icon appearance. Every smartphone brand's icons seem alike. The current icon situation is that they share a similar style—a materialized drawing with filtered features. Apple tends to use flat, solid colored geometrics; Samsung and Lenovo are more likely have 3-dimentional elements in order to be relatively more realistic.

Seeing means grasping the essentials. By only one glance, people can tell the rectangularity of a building, the roundness of a ball, the curve of hair, et cetera. One of the most outstanding features of visual stimuli is their shapes. We can see two kinds of shapes: one is a physical shape and the other one is a conceptual shape (Arnheim, 1974) . Physical shape is picked out by the physical boundary—edges, sides, and outline; perceptual shape comes from the interaction among objects—shadow, gestalt, etc. Decoding is technically a process of connecting the icon with existing knowledge of the physical boundary in order to determine what it is. When a viewer encounters an icon, he or she will try to determine the known concepts that are associated with this visual perception. If there are no matched pairs, this icon will be decomposed into simpler graphics for matching familiar simpler concepts until the viewer can determine the meaning of this icon by combining all of the separated subparts' meanings together. Therefore, we can regard decoding as assigning a verbal concept to a visual perception. When we look at an icon, what we see comes from our memories instead of only from our eyes (Horton, 1994) . What we have already seen affects the way we see now and, in the future, because we tend to 'see' what we have already known.

According to the Oxford Dictionary, simplicity is defined as "the quality of being easy to understand or do." But simple never means minimal (Colborne, 2011) . Simplicity in this paper is defined as the minimal elements that enable the icon to be recognized with the given meaning. If an icon is a simple shape, viewers can focus only on the most essential characters. Therefore, the process of getting information will be quick and direct.

This study had three goals: to investigate at what level of simplicity icons can maintain their ability as a visual cue; to seek whether different guidelines can be formed for designers to design more abstract and simplified but still recognizable icons; determine recognition in different icon styles. Two research questions were generated to seek the answers: at what point can viewers recognize icons on smartphone interfaces, regarding different levels of simplicity and design style; and how do viewers' recognition abilities vary due to demographic information such as age, gender, and educational background?

2 Research Methods and Procedures

Because we see the world in a common way, pictorially representing existing natural objects is a shortcut to showing an object shared by senders and receivers. One study run by Rungtai Lin (Lin, 1994) shows that the highly recognized icons always have strong ties with an existing object. “Skeuomorphism” as a design principle also indicates that: design cues should be taken from the physical world. The design aiming to recall the existing world makes visual elements more familiar to viewers (Cho, et al, 2015). Another study found that participants tended to associate physical objects with the meaning of the icon (Sengupta, et al, 2015 CHI). According to Horton (1994), icons can be classified into five levels of realism: photograph, drawing, caricature, outline, and silhouette. A photograph is the most detailed and realistic level while the silhouette is the most simplistic and abstracted. Twenty-five icons were developed based on Horton's classification with objects and graphical elements. Figure 1 shows each icon design with five different levels of simplification and styles designed for the Phase 1 study. Instead of photographic icons, form reduction icons were added to investigate the simplified form with visual cues base on Horton’s icon classification. Five most frequently used icons of the smartphone such as Phone Call, Message, Email, Camera, and Browser were selected to examine recognition. In the icon development process, icons from Apple, Samsung, and Lenovo were studied as a reference.

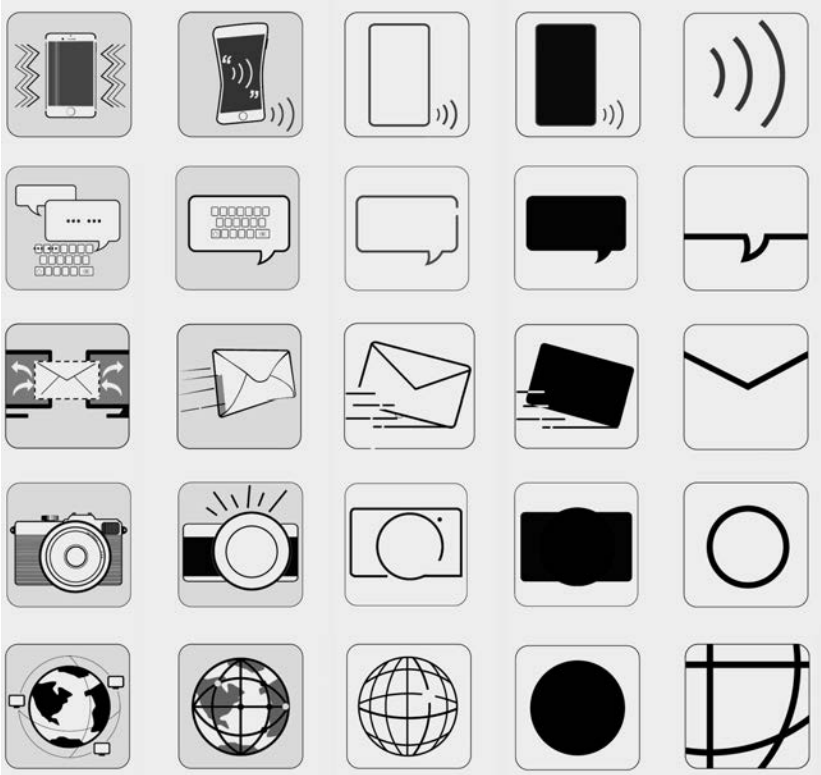


Figure 1. Twenty-five Icons with five different styles and simplicity levels for the Phase 1 study. In the row shows drawing, caricature, outline, silhouette, and form reduction style respectively and in the column shows a phone call, message, email, camera, browser respectively.

Apple’s iPhone Human Interface Guidelines claim that a target size of 44 x 44 pixels is the minimum. (https://developer.apple.com) . The icons’ actual size appearing in the surveys was 88 x 88 pixels (twice as big as the standard icon size) because a study run by Ankrum, D.R. (1999) showed that the comfortable eye-to-computer distance is at least 25 inches, which is twice as far as the eye-to-phone distance (12 inches) .

After receiving Institutional Review Board approval, the online surveys were conducted to better comprehend icon recognition at a large university in the USA. The study was divided into two phases and participants' information was collected from all surveys. In the Phase 1 survey, each of the icon's five styles were shown, and participants were asked to choose all of the icons they could recognize with the given meaning. For example, "Select icon(s) that indicate(s) 'Phone call'. Please check all that apply (Multiple Answer)." The purpose of this survey is to find out participants' recognition of given icons and meaning. From the results of the Phase 1 survey, two sets of the five most recognizable icons and the simplest recognizable icons were selected for Phase 2. After the Phase 1 study, form-reduction-style icons were created as shown in Figure 2 to increase the recognition for the second phase study.



Figure 2. Modified form-reduction-style icons for the Phase 2 study shown as a phone call, message, email, camera, browser respectively.

In the Phase 2 survey, each set of the five icons were presented to the separate participant groups. Each participant was asked to identify the function of the icon and to scale their confidence level in the six-level Likert scale from minus 3 to plus 3. The scale was labeled with "strongly not confident," "not confident," "somewhat not confident," "somewhat confident," "confident," and "strongly confident." Each participant took only one survey and there was no overlap with participants across the surveys. Also, the order of the simplicity level was randomly arranged in all of the studies. The purpose of this survey was to identify the participant's understanding of each icon's function and their confidence level in their choice.

The data was downloaded from Qualtrics into IBM Statistical Package for the Social Sciences (SPSS) . All data were analyzed in SPSS. One-way analysis of variance (ANOVA) tests were conducted to examine significant effects. A significance level of $p \leq .05$ was used for all ANOVA analyses.

3 Results and Findings

3.1 Phase 1

In Phase 1, 528 students completed the survey. Among all participants, 510 of the participants' data were analyzed with valid answers. Group 1 was composed of 54.7% female and 45.3% male students. The age distribution of the participants ranged from 18 to 64 years old. About 75% of participants were from 18 to 24 years old, 22% were 25 to 34 years old, and 4% were older than 35 years old. Regarding backgrounds, 35.3% of participants were graduate students, 62% were undergraduate students, and 2.5% had high school or lower educational backgrounds. Of the 510 participants, 88.4 % were native speakers of English, and 11.6% were non-native English speakers. About 31% of participants used Samsung phones, 49% of participants used Apple phones, and 20% of participants used other phone brands.

Table 1 shows the results of the Phase 1 survey. In four out of the five questions in Phase 1, the outline-style icons were relatively more recognizable for participants than other icon styles. The recognition rate for the Message, Email, and Browser style icons was especially strong at over 80% for the outline-style. Even though the most recognizable style for the Camera icon was drawing, the recognition rate of the outline-style icon was still more than 50%. Therefore, it can be inferred that the outline-style icons were the most recognizable of the five icon styles. Even though the form-reduction-style icons were extremely simplified icons, they were still recognizable according to the results. The “Phone Call” icon was recognizable for 22% of participants, the “Message” icon’s recognition rate was 29%, the “Email” icon was recognizable for 37% of participants, and the recognition rates for the “Camera” and “Browser” icons were 13% and 8% respectively. Additionally, it is worth mentioning that silhouette-style icons likely had lower recognition rates than that of other style icons except the Phone Call and Message icons.

Table 1. Twenty-five Icons Recognition Study

	Drawing	Caricature	Outline	Silhouette	Form Reduction
Phone Call	46%	36%	53%	49%	22%
Message	50%	34%	86%	72%	29%
Email	32%	66%	88%	7%	37%
Camera	89%	69%	51%	9%	13%
Browser	60%	66%	80%	1%	8%

3.2 Phase 2

Because the purpose of the study is to find the breaking point of simplicity at which viewers begin to feel lost or lose the ability to recognize icons, five outline-style and form reduction style icons were selected for the Phase 2 study. As mentioned in the methods and procedures, form reduction style icons (Figure 2) were revised for better recognition. Each set of icons was used in an online survey.

For the outline style icon survey, a total of 415 students participated and 409 participants’ data were valid for analysis. Of the students participating, 56 percent were female and 44% were male and the age distribution of the subjects ranged from 18 to 54 years: Ninety-one percent of them were from 18 to 24 years old, 7 % of participants were from 25 to 34 years old, and the percentages of both 35 to 44 years old and 45 to 54 years old were one percent. Eighty-six percent of participants were undergraduate students, nine percent of them were graduate students, and five percent of participants had high school or lower educational backgrounds. Ninety-five percent of participants were native speakers of English and five percent were not native speakers. Twenty-eight percent of participants used Samsung phones, 57% of participants used Apple phones, and 15% of participants used other phone brands.

Table 2 shows the icon recognition rate and confidence level of the outline style icons. Among the outline style icons, the “Phone Call” icon recognition is the lowest with 15.4% correct answers. The mean value of participants’ confidence level was minus 0.1057, which means that participants tended to be “somewhat not confident” with their answers when they guessed the function of the “Phone Call” icon. Most participants recognized the “Phone Call” icon as speaker, voice, volume, and so on. The wave image beside the phone affected the recognition even though it is a small and secondary element. This result also shows that participants did not recognize the association of the smartphone shape with a phone call.

The “Browser” icon’s correct recognition rate was about 87%, and the mean value of participants’ confidence level was at around 1.5. This indicates that when participants guessed the meaning of the “Browser” icon, participants’ confidence level was between “somewhat confident” and “confident.” The recognition rate for three icons, “Message,” “Email,” and “Camera,” was higher than 90%, and participants’ confidence level mean values were all around 2, which stands for feeling “confident.” What’s more, the “Camera” icon enjoyed the highest correct recognition rate (98%), and the mean value of participants’ confidence level (2.1275) was between “confident” and “strongly confident.”

Table 2. Recognition of the Outline Style Icon and Confidence Level

	Phone Call	Message	Email	Camera	Browser
Recognition	15.4%	97.1%	91.2%	98%	86.8%
Confidence Level	-.1057	1.6201	1.8382	2.1275	1.4755

For the form reduction survey (Figure 2), 394 students participated in the study and 386 participants’ data were valid for the analysis. Participants were composed of 52.6% female and 47.4% male students. The age distribution of the participants ranged from 18 to 74 years old: 90.7% of participants were from 18 to 24 years old, 7.5% were 25 to 34 years old, and less than 2% were older than 35 years old. About 12% reported themselves as graduate students and 87% of participants reported themselves as undergraduate students. Of the 386 participants, 93% were native speakers of English and seven percent of participants were non-English native speakers. Also 26.4% participants used Samsung phones, 57.5% used Apple phones, and 16% used other phone brands.

Table 3 shows the icon recognition rate and confidence level of the form reduction style icons. The “Phone Call” icon in this study was still not recognizable enough: only six percent of participants identified it correctly. Thirty-two percent of participants recognized it as “Wi-Fi” and 26.7% of participants identified it as “Voice” because of the sound waves. About 60% of participants recognized the “Phone Call” icon as “Wi-Fi” or “Voice,” and their confidence level was between “Somewhat Confident” and “Confident.” The “Message” icon was recognizable for most of the participants (96.6%), followed by the “Browser” icon with a correct recognition rate of 88.9%. Both the “Email” and “Camera” icons had correct recognition rates of around 81%.

Table 3. Recognition of the Form Reduction Style Icon and Confidence Level

	Phone Call	Message	Email	Camera	Browser
Recognition	6.2%	96.6%	80.8%	81.1%	88.9%
Confidence Level	1.3187	2.0440	1.2617	1.3010	1.3005

3.3 Demographic Information and Icon Recognition

The one-way ANOVA test was used for examining whether there were any significant differences between the means of two or more independent groups (Howell, 2002) . To examine the study question: how demographic backgrounds influenced icon recognition, one-way between-group ANOVA tests were conducted using data from the Phase 2 study in SPSS. One-Way between-group ANOVA tests were conducted with the correctness of icon recognition as a dependent variable with age, gender, educational background, language, and use of phone brand as independent variables. Results were interpreted using a significance level of $p \leq .05$ to test the effects.

Educational background matched with age groups; the group of ages 18 to 24 matched with undergraduate students and the group of ages 25 to 34 matched with graduate students. Ages between 18 to 24 recognized the outline style “Browser” icons better than ages between 25 to 34. Data indicates that age group significantly affected the results with significant p value: .001 for the “Browser” icon. However, in general, age was not a factor in recognizing the two sets of icons.

The statistical results calculated by SPSS showed there was a significant relationship ($p=0.001 \leq .05$) between icon recognition correctness and age, in terms of “Browser” icon recognition. More specifically, when seeing this icon, younger participants had a higher mean icon recognition correctness (0: wrong, 1: correct) at around 0.9, while older participants had a mean icon recognition correctness of less than 0.7, which indicates that this outline-style “Browser” icon assisted younger participants recognition better than for older participants. Also, different age ranges significantly affected icon recognition of the form reduction “Camera” icon with a $p = 0.000 \leq 0.05$. Again, younger participants also maintained a higher ability ($mean \approx 0.9$) to recognize this icon correctly than older participants ($mean \approx 0.7$) .

Gender was an interesting factor in the two sets of icons. Females recognized the outlined style Email icons better than males with a significant p value of 0.038, while males recognized the form reduction style Message icon better than females with a significant p value of 0.029.

Language could be an important factor in the recognition of icons with somewhat abstracted forms. The majority of English speakers’ icon recognition was higher than non-native English speakers, mainly in the form reduction style Camera and Browser icons with a significant p value of .053 and .011 respectively.

There was a notable phenomenon surrounding icon recognition correctness of both “Email” icons in the outline and form reduction styles with regards to the participants currently-used phone brand. The ANOVA results indicated that Samsung users were significantly less likely to guess the meaning of the “Email” and “Message” icons correctly than users of other phone brands in outline style icons and the “Camera” icon in the form reduction style with a significant p-value of .061, 000, and .020 respectively.

In addition, the icon recognition correctness had a significant relationship with how confident participants felt with their answers. Participants were more confident recognizing the icon correctly or incorrectly, especially with the “Email” icon ($p=0.31$) , “Camera” icon ($p=0.000$) , and “Browser” icon ($p=0.000$) . In the form reduction icon study, with the exception of the “Phone Call” icon, the other four icons’ recognition correctness had significant relationships with participants’ confidence levels: all the p values of these four icons were 0.000.

4 Discussion and Conclusion

Materialized drawing with filtered features works as an icon style when shared by different phone manufacturers. Complex details can become confusing at smaller sizes (iOS Human Interface Design Guidelines, 2015) , and icons with uncombined or simple visual elements are easily recognized without unnecessary visual elements that could distract viewers (Colborne, 2011) . This study examined at what point of simplicity viewers stop recognizing or feel lost in recognizing smartphone interface icons.

From the results of survey Phase 1, outline-style icons were identified as the most recognizable for a majority of the participants among five different style icons. The silhouette-style icons generally had the lowest recognition rate among participants because the objects shown in those icons did not have distinct shapes that would help participants interpret their function correctly. The form-reduction-style icons were still recognizable for participants, even though the visual elements in those icons were extremely simplified by removing the profile and showing only one feature of each object.

From the results of Phase 2, recognition of the form-reduction-style icons was similar to that of its corresponding outline-style icon. According to Peirce's semiotics model, the object shown in an icon signified the meaning and guided the viewers' interpretation (Peirce,1931) .

This study found that a simplified form with the necessary visual cues for the objects in the icons did not decrease recognition dramatically. However, when the object does not signify the meaning such as the "Phone Call" icon in this study, viewers will misinterpret the meaning of the icons. When icons and symbols became conventional, it would be difficult to change the meaning even though the element is secondary. When we look at an icon or object, what we see comes from our existing knowledge instead of only from our eyes (Horton, 1994,) . Some icons' recognition was influenced by age, gender, language, or use of phone brand as seen from the results of the Phase 2 study. It seems that familiarity, as part of existing knowledge, played a role in icon recognition.

The recognition of the "Phone Call" icons in both the outlined and form reduction styles was low. The low recognition could be explained by Rungtai Lin: Icon recognition confusion falls into three types: (1) "Visual similarity (shape feature) ", (2) "Conceptual similarity (image feature) ", and (3) "Visual and conceptual similarity (function feature) ". For the outline-style "Phone Call" icon, the low recognition could be caused by visual and conceptual similarity, since "Voice" and "Speaker" versus "Phone Call" yielded the same image at first glance, and they all shared similar functions. For the form-reduction-style "Phone Call" icon, its shape feature had visual similarity with "Wi-Fi" or "Volume" icons (Lin, 1994) .

The results of this study suggest several practical applications for interface icon design: Use silhouette as the style of an icon only if the object shown in this icon has a distinguishable profile shape. The results of this survey were consistent and supported the literature review that icons with the silhouette-style need to have a distinguishable profile (Horton, 1994) . If the object shown in an icon is not familiar to viewers, even though the object is shown with enough details, the icon could be recognized with a different meaning.

To create widely acceptable icons, icon recognition tests with diverse user groups will be necessary because when viewers see an icon, the decoding process includes connecting to their existing knowledge and experiences. The absence of participants with more diverse backgrounds was a limitation of this study. This study was completed with students from a Midwest university in the US. Since students in one university cannot represent the students at other universities, and students cannot represent people at different age ranges, the results cannot be used for a broader population. Also, color was not included in this study and color could be an element for icon recognition. The results and limitations of this study suggested several directions for future research. Most immediately, future research should take participants' emotional reactions into consideration. For example, future research could examine people with different personal backgrounds and how their preferences differ,

especially regarding icon styles including color, simplicity, and other design elements. Also, in a future study, the participants could be recruited from a broader population.

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Affordance, a concept for a measurable Design - Fitness furniture, a case study

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Bearing in mind the population growth, Design follows economy's pace by choosing multifunctional solutions. However, this reality challenges the usefulness of products, making us question the extent to what all functions are perceptible and feasible in a positive manner. Moreover, by a functional design, one expects an intuitive use advocated by the concept of *affordance*, which in practice translates unconscious actions into well-designed aspects. When referring to a multifunctional design, where different contexts coexist, many items must be clearly communicated. Throughout this paper we try to establish a relationship between the concept of affordance and multifunctional design, having as an argument the development of furniture that enhances sports practice, and so fulfils a twofold functionality. The conceptual definition of affordance is exposed first, by using examples of design that validate its relevance, and then tackles the hybrid design in an analytical setting. The discussion stands for affordance as a concept able to measure the hybridity of a product through its latent functions, which established by the user's unconscious interaction, contribute to the multifunctionality of the objects. It is also understood that affordance serves as a generative element in product design, by translating it into more concrete purposes.

Keywords: Design, Affordance, Multifunctionality, Fitness furniture

1 Introduction

"Good design always explains itself naturally, without the need of an instruction manual, without provoking the phrase 'What's that for?'" (Moggridge, 2014).

According to a United Nations report, by 2050, cities will have an increase of population of 66% leading housing space to reduce (Thøgersen, 2017), making sure design will save space and the selection of multifunctional solutions where one appliance serves several purposes. Conscious of this need, and making it coexist in two different contexts, it was proposed in academic context, by a furniture company, the development of home furniture that simultaneously enhances the practice of sports. Nevertheless if, in one hand, the multifunctional design proves advantageous in the face of current needs, on the other hand, the hybridity creates doubt in the perception of its practical utilities. It is thus questioned, whether a multifunctional object positively fulfils all the functions, and communicates them in a clear way. One way to accomplish that would be by making the design as simple and

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intuitive as possible, so that the user won't think about the diverse functions and can enjoy it in the most natural way (Thøgersen, 2017).

The concept of *Affordance* is deeply rooted with the instinctiveness of an interaction in the Design field. By being focused on the user, it describes how products communicate with people through its shape and usefulness (Norman, 1988). This idea is present in our daily life from user's interaction with products in a dynamic and almost unconscious way. The individual doesn't need to recognize the product's presence or being aware of its utility in detail but rather that he/she intuitively enjoys its possibilities (Gibson, 1986). Design must provide noticeable *Affordances*, so that the user can easily understand the functionality of objects, following physical, cognitive and sensorial principles (Hartson, 2000). Furniture design focused on multifunctionality might find, in the concept of *affordance,* a tool to identify new purposes (Broch, 2010). This way, the concept might change a multifunctional product by suggesting other interaction possibilities and simultaneously be used as an ideation concept in design (Broch, 2010).

This paper endorses the relevance of a hybrid design through functional issues by suggesting *Affordance* as a qualitative measure for multifunctionality. This approach is enlightened through several perspectives of different authors about the concept that are subsequently challenged with multifunctional design. The ultimate point of this report is focused on the viability of fitness furniture as a concept.

2 The *Affordance* Concept

Initially introduced by the psychologist James Gibson (1986), and later recovered by Donald Norman (1988) the concept of *Affordance* "explains the connection between users' tasks and products' physical characteristics" (You, 2007), being essentially an intuitive interaction. This said, the functionality of objects by revealing the possibilities of use through their formal characteristics. However, *affordances* don't promote the action, they only make it possible and endorse its readiness (Reed, 1996 You & Chen, 2017). The potential uses for an object are massive and belong to it, the user only subconsciously perceives the actions the object "affords". Conversely the *Affordance* concept is still not clear, there are - real *affordances* - those that exist in the object in their physical form - and the perceived *affordances* (or signifiers) the clues or hints that transmit a possible action (Norman, 1988).

"The development of the concept of affordance in design practice has not yet matured, and the differentiation between affordance and signifier seems unclear" (Hsiao-chen You). It is understood: For Gibson (1977), affordances need not be perceived or even known. They exist independently of the user's perception or the existence of signals (Rizzo, 2006). In contrast, Norman (2008) argues for perceived affordances, stating that "the perceivable part of an affordance is a signifier" (Donald Norman, 2008). These, when intentionally designed in a product, provide clues and indications for the different possibilities of use (Donald Norman, 2008). In this way, "the difference is in the user's consciousness, clearly present in the Significant, and desirably not present in Affordance" (Borges, 2015); "In Affordance, action is transmitted from unconscious knowledge, and the result may be unexpected; contrary to the clarity of conscious communication implied in Norman's discourse "(Borges, 2015). In short, the Signifiers exhibit no control over the interpretation of the user, whereas in Affordance perception is achieved by manipulating the physical properties of the artifacts (Hsiao-chen You).

In practice, the concept arises "for designers to guide behaviours indirectly" (Sasaki, 2007), for which it is necessary for the designer to know the reality of using the product and to verify the different actions imposed by the user. Naoto Fukasawa believes that the user shouldn't think when is operating a certain product, and so he proposes the Without Thought concept from which he stresses the transformation of "unintended actions into visible things" (Ding, Cheng, Li, Xiong & Zhang, 2019). Fukasawa adopts the behavioural dimension to explore functional aspects of the objects "with the goal of designing what we can use without thinking" (Parsons, 2009 apud Author, 2015). The designer considers spontaneous behavioural human actions and transports these ideas into new products describing the method as "designing the unconscious". Products' never say 'to be used like that', at most, they offer subtle guidance to the fact that 'This use is also possible" (Sasaki, 2007). In The Umbrella (Figure 01) - the user acts intuitively by placing the bags in the concavity like a suitable space is provided to complete the action (Xu, 2013). "The idea seems to lie between the universes of invitation and permission, inviting to act in a certain way and allowing action" (Author, 2015).



Figure 01 - The Umbrella, Naoto Fukasawa (Fukasawa, 2014)

The "fallen tree in the forest allows you to seat" (Fukasawa,2007) is also an invite to do so. The image was translated by Jurgen Bey (figure 02) and Naoto Fukasawa (2007) (fig.03). This way, ironically the context involves comfort so the action might happen. The "Treetrunk Bench", the added back chair makes the trunk an improved piece of furniture, but in the "Swedese Log" cleanness contributes to an immediate recognition of purpose. Both, inviting for an unconscious interaction with the user.



Figure 02 - Treetrunk Bench, Jurgen Bey (Bey, 1999)



Figure 03 - Swedese Log, Naoto Fukasawa (Fukasawa, 2006)

3 *Affordance* and Multifunctional Design

The concept of Affordance refers to the perceived and real properties of objects (Norman, 1988). So, what happens when we manage products with multifunctionalities? How do we perceive the different goals of interaction? Can a product be considered multifunctional

beyond its apparent *affordance*? A multifunctional object must communicate effectively its potentiality. However, in the face of a possible conflict of functions, and against what Dieter Rams defines as honesty, design should not "manipulate the consumer with promises that cannot be fulfilled" (Lovell, Ive, & Kemp, 2011), it shouldn't indicate functions that aren't achievable.

Multifunctional design is only relevant when the user perceives the many different uses and can take advantages from them (Broch, 2010). A product can be considered multifunctional if it meets the demands that the user places on it and is only justified when all of them are necessary for the normal execution of the task for which the product is intended (Hashemian, 2005 apud Broch, 2010). The first approach would be, therefore, to make all the attributes relevant in the interaction. However, multifunctional design should be defined as well by the ability to respond to the objects several meanings. So, the concept of *affordance* acts over all the objects potentialities, its amplified purposes without a change of its physical shape.

We can assume there are latent *affordances* that the user unconsciously evidence. Other functions might be presented in the object involving the interaction with the user (Broch, 2010). Likewise, Jane Fulton Suri (2005), explores the product potentials when facing the real use – a railing with a square section, for example, invites you to land a packet of milk, as well as a pencil offers the possibility of attaching your hair (fig.04). The concept of "Thoughtless acts?" claims that a product might be different from the goal it was designed for – and there is no control for all the variables (Author, 2015).



Figure 04 - Thoughtless Acts? Jane Fulton Suri (Suri, 2005)

"Stacking books on a chair is a way to use this chair" (Hara, 2007) and use this same chair as a step or to land clothes are equal possibilities of use. "Gestures might be the accurate *affordance*, truthfully working for and revealing a multitude of functions of an object beyond its main goal" (Borges, 2008). Given these possibilities, Morelato Design (2018) conceived two multifunctional pieces based on a chair (figure 05-06): the first can be used as a ladder and the second as a hanger, thus providing means for actions to be possible. However, this is still metamorphosis, where it demands a change in the configuration and so it doesn't reveal an immediate purpose.



Figure 05 - Scala Zero Chair, Morelato (Morelato Design, 1998)



Figure 06 - Metamorfosi Chair, Pietro Barcaccia (Morelato Design, 2014)

4 Fitness Furniture, a case study

Fitness and household might overlap in the same object if in an adequate manner. The effectiveness of objects' communication stands in the understanding of what and how their morphological features really communicate their functions. "(…) understanding how and what they communicate their functions for which they were designed for" (Volli, 2007 apud Laburú, 2017).

Affordances, are conveyed by physical attributes and their distinctiveness on shape and materials as well as their different purposes (Broch, 2010). Albert Au and Glory Tam (2018), in "The Habit", clearly show through a "V" shape and material, enunciating the fitness goal. In addition, it is still possible to use the user memory, taking ownership of objects with which, they are familiar and / or serving the same functions, encouraging their recognition. This approach to the concept of affordance, conveys meaning using metaphors, for example another form of relating the product to that field (Hsiao-chen You).



Figure 07 - The Habit, Albert Au e Glory Tam (Au and Tam, 2018)

Departing from the proposed briefing by a Portuguese furniture company - the aim was to reach new concepts towards different publics and lifestyles. Challenged by this method and its practical application, an analysis of the projects under development was made. In order to gather information, a questionnaire was prepared to the respective designers as well as to the coordinator of the project, in a total of 14 interviewees. From the recorded data, literally transcribed and qualitatively analysed (Ritchie, J. and J. Lewis 2003). - It was readily noticeable the existence of different perspectives before the assumption defended throughout this paper - Will the designer have a conscious concern with *affordances* when considering the different purposes while is creating and developing the product? Although projects make use of the concept of *affordance* to their supplementary function, they don't assume it exclusively in its main shape, they do so by distinguishing parts and materials.



Figure 08 - Multifunctional stool, focused on the practice of attentiveness activities such as Yoga, Pilates and Meditation (Author et al, 2017)



Figure 09 - Stool/coffee table with a movable bar that allows the practice of several exercises (Author et al, 2017)



Figure 10 - Bench or table with a interior lining that works like a rug to do some exercises, such as sit-ups (Author et al, 2017)

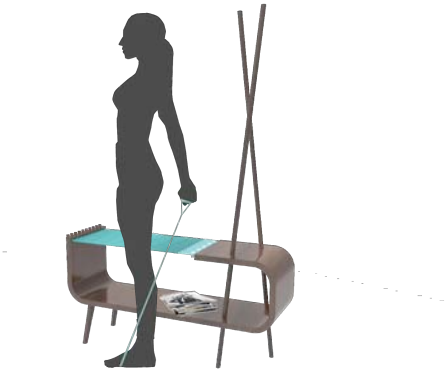


Figure 11 - Sideboard with hanger and elastic bands for practicing low intensity exercises (Author et al, 2017)

During the process of designing the products, the majority were not concerned with the concept of *affordance*. However, they revealed adjacent concerns, that is, although they haven't done it consciously, by instilling concerns regarding dimensions, ergonomics and distinction of the parties they tried to enable an easiest perception of the functions a consequent and immediate interaction. However, while 57% of respondents said there was concern about these issues, only one respondent mentioned that were "made full-scale prototypes" and tested with sports practitioners for hands-on validation. Moreover, as stated, in all the examples the function *home furniture* is the most evident, whereas the *fitness character* demands previous explanation. Sometime after the project, it was asked whether the products communicate their purposes in a clear way and only 35% of the answers was affirmative, while the all the others mentioned the main function as being home furniture. One mentioned (figure 08-11) "It is a simple shape that could be used as a side table. It doesn't induce you to do other activities"

This way, the fitness character offered by several elements demands explanation in advance. Necessary actions are required to enjoy the fitness features of each product, which doesn't contribute to a direct interaction with both purposes. In contrast, the elements from the mat to the rubbers "deconstruct and differentiate the link between home furniture and fitness".

In short, as stated by the coordinator of the project, "Any of the products contains elements with standardized shapes that can subliminally convey their function. (...) It is easily understandable that we have parts that allow us to sit and others just to store contents and they quickly express the information of what they serve for. However, as far as fitness is concerned, that's not so obvious". Since the interaction between user-object occurs unconsciously and that many of the functions attributed by the user weren't previously designed by the designer - the products under study may offer other possibilities of use in addition to their main purposes; however, as stated by one of the interviewees, - "several hypothesis may "only be possible through user-interaction tests".

5 Conclusion

The appropriate *Affordance* denotes the possibilities of action of a product. It can be translated into the intrinsically behavioural relationship between user and object, and the expectable interaction only happens when its purposes are immediately perceptible. Thus, when referring to a multifunctional context, where a conflict played by the different means is possible, *affordances* must be communicated in a clear way so the user can intuitively enjoy all functions without significant changes in the product.

Based on this assumption and reflecting on the contribution of the concept of *affordance* to the development of fitness furniture, it is determined that the morphological characteristics of an object, when representing its functional meaning, must translate in a perceptible way all the possibilities of action, either through shape or materials. Thus, its application is aimed to increase the possibilities of using the furniture in a fitness aim, hoping that it responds primarily to its function as furniture and when exposed to a sport context allows the actions imposed by the user. However, given the natural use of objects a range of action options are not controllable by the design, a multifunctional object must communicate the purposes for which it has been designed in an inviting way, that is, should invite the user to the several tasks that it makes possible. Moreover, *affordance* may work as an impetus for interaction and not as a use instruction.

Considering the cases under study, the coexistence of different contexts in a single object, creates a barrier related to spontaneous interaction, since it requires a careful perception of all their possibilities. The results highlight one of the functions, as opposed to the need for previous explanation of the other options - as mentioned by the interviewees; In this case, the furniture purpose prevails over fitness for an easier perception. Furthermore, while in practice *affordances* are ideally generated during project development through observation and knowledge of potential users, it is in a final phase that these are effectively tested and validated through prototyping and usability testing, revealing other options of use in particular for designers who after a distance can identify numerous possibilities.

In short, this paper discusses how roles can be determined by an unconscious interaction. As such, it is determined that multifunctionality may not be defined by the number of tangible purposes, but rather by the actions that an object enables independently of the main role for which it was designed. Affordability, if properly designed, can show the multiple uses of a piece of furniture and promote multifunctional use. In this way, this hybridity is instituted by *affordance* and not by the inherent role of the object. Lastly, this paper seeks as well for a

concordant approach to fitness furniture and following the same it is expected a practical application of the concepts here advocated.

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An Art Program to Maintain and Improve Swallowing Function Focusing on Respiratory Rehabilitation

- Practice and Evaluation of Physical and Mental Functions of a Program to Encourage Continuous Efforts -

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Focusing on respiratory rehabilitation for maintaining and improving swallowing function, we have developed a program that involves production of an artwork with smiling face icons into which breath is blown. As a result, a significant difference in the average scores on a face rating scale before and after the art program indicated a mood improvement effect. This shows that the program using smiling face icons has beneficial psychological effects on seniors requiring primary nursing care. Sustaining patients' motivation to perform simple and repetitive exercises is an issue to be addressed in conducting rehabilitation aimed at the recovery of physical functions. The rehabilitation session consisted of strongly blowing into a doll 10 times in a row, and the subjects went through one such session per day for 30 days. The results of the MWST, RSST, and MPT tests conducted after completion of the rehabilitation sequence showed that their swallowing function remained in as good condition as before the sequence. As the participants completed the full 30-day sequence of respiratory rehabilitation sessions it indicates the program using artworks created by participants is effective for sustaining rehabilitation on a long-term basis.

Keywords: Art Program; Swallowing Function; Respiratory Rehabilitation

1 Introduction

Japan’s population is aging rapidly, with people aged 65 or over exceeding 27% of the total population in 2016. Among these, the number of those who have been certified as requiring nursing care or support under Japan's nursing care insurance system exceeded 6,292,000 individuals as of the end of January 2017, which corresponds to roughly 18% of the elderly population, and represents a roughly 1.43-fold increase from 4,410,000 at the end of April 2007 [The Cabinet Office, 2017]. Against this backdrop, the number of nursing homes for seniors requiring primary nursing care was 9,726, and the number of service recipients was 577,000, as of 2017 [The Ministry of Health, Labour and Welfare, 2017], with still greater demand expected in the future.

While origami, painting, and handicrafts are being implemented as part of recreational activities at nursing homes, the quantitative effects of these creative activities on cognitive and physical functions have not been elucidated. Previous studies have investigated the mood of inpatients in palliative care wards and pediatric medical facilities, and have

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confirmed there is a beneficial psychological effect on participants' moods when art programs called ‘Active Art’ involving tactile motion are implemented [Yoshioka, K., 2013, Yoshioka, K. et al., 2015, and Yoshioka, K., 2015]. The workshop program with ‘Active Art’ in palliative care , intended to encourage art creation movement through the use of colors that draw the eye, and textures with an appealing feel to the hand, was developed. Evaluations of patient’s mood were made before and after the program, and patients behavior were observed. Patient mood after the program was confirmed to have improved significantly in comparison with before the program. Patient interviews conducted after the program indicated that program was evaluated highly in the categories of ‘fun’, ‘satisfaction’ and ‘refreshing’ (Fig. 1).



Figure 1. ‘Active Art’ program in palliative care

On the other hand, in the ‘Active Art’ program in pediatric medical facilities, the participants created a nurse call button of clay and use their completed works to simulated communication with the nurse. Since the participants’ works had eyes and a mouth similar to creatures, they were encouraged to maintain eye contact and converse with their works. In this workshop, we analysed ratings of the participants’ psychological and physiological measurement, and behavior observation. The participants’ mood improved after the program in comparison with that before the program. The blood pressure of participants showing no mood change before and after the program declined, and these participants were suggested to relax (Fig. 2).



Figure 2. ‘Active Art’ program in pediatric medical facilities

Among the main causes of death in Japan, the mortality rate of pneumonia is increasing, with pneumonia replacing cerebrovascular disease in third place from 2011. Roughly 70% of patients with pneumonia are elderly people aged 75 or over, and more than 70% of these

have aspiration pneumonia [The Ministry of Health, Labour and Welfare, Sept. 2016]. While the main approaches to preventing aspiration pneumonia are oral care and diet, one study has reported that training using sport blowguns is an effective rehabilitation method for maintaining and improving the swallowing function [Kawashima, T. et al., 2010]; and another study suggests that the oral and respiratory muscle functions are improved by continuing expiratory muscle strength training for eight weeks [Ito, N. and Watanabe, S., 2017].

Focusing on respiratory rehabilitation for maintaining and improving the swallowing function, we have developed a program that involves production of an artwork into which breath is blown (patent pending). The present study evaluates the results of implementing the program with elderly people who need long-term care at one nursing home. We investigated the practicability of art creation by elderly people whose cognitive capability has declined, and evaluated the psychological effect of implementing the program. Further, we investigated the possibility of sustained respiratory rehabilitation using the artworks they produced, and the resultant effects on their swallowing function.

2 Implementation and psychological effects of the developed art program

2.1 Description of the program

An art program involving the creation of a matryoshka-style doll into which breath is blown, was implemented with elderly requiring long-term care, as described below.

The materials for the artwork included a matryoshka-shaped base model made of corrugated cardboard packed with newspaper (Fig. 3), handmade Japanese paper in various colors, and face parts. To enable the participants to create their artwork according to their capability, the author prepared different options corresponding to different levels of ability (such as choosing desired Japanese paper pieces, tearing them into smaller pieces, and pasting these onto the model; or choosing desired pre-torn Japanese paper pieces and pasting these onto the model), to encourage their active participation in the artwork creation (Fig. 4). Previous studies on "smiling face icons" noted a psychological effect of mood improvement through the arrangement and drawing of a smiling face icon composed of simple eye and mouth shapes [Yoshioka, K., 2017]. On the basis of such studies, the author allowed participants in this study select their favorite face parts (hair, eyes, and cheeks), paste the selected parts onto the model, and draw a mouth to create a smiling face. Each participant was also asked to give a name to their doll, so that he or she could feel an attachment to the completed artwork.

The completed artworks were then used for respiratory rehabilitation to maintain and improve the participant’s swallowing function. To encourage a continued relationship between the participants and their artworks, a sensor that responds to exhalation (sound and pressure) and a module that generates an electronic beep in conjunction with the sensor were installed in the center of each model (Fig. 5). The sensor responds when a person puffs into the doll through a straw inserted in a tube hole on the front side of the doll.



Figure 3. A base model used in the art program



Figure 4. Material options prepared for different levels of ability

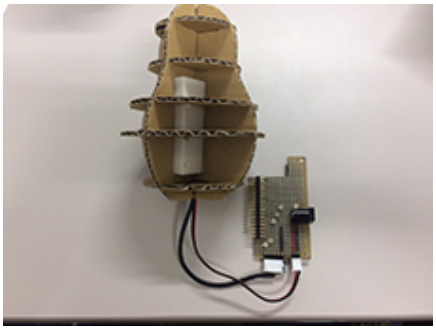


Figure 5. Sensors installed inside the models (patent pending)

2.2 Implementation of the program

The art program (Fig. 6) was implemented with 12 nursing home residents (two males and ten females) with levels of Japanese nursing care requirements from Level 2 to 4, and psychological assessments were carried out before and after the program, using a face rating scale (Wong-Baker FACES Pain Rating Scale, Fig. 7). Face rating scales are used to assess pain in childhood cancer treatment. For the assessments, the participants were

asked to look at the face scale and point to the face which best represented their mood at that time. As they provide a simple scale for evaluating moods through the selection of specific facial expressions, in this study they were utilized for the psychological assessment of elderly people whose cognitive capability has declined.

To develop a respiratory rehabilitation program for maintaining and improving the swallowing function, a preliminary experiment was conducted after completion of the art program, for ten days (performed on alternate days for each participant). In the experiment, the participants placed their own artworks in front of them during tea breaks, and blew into them, while their relational behavior with the artwork was observed by care staff.



Figure 6. Artworks created in the art program

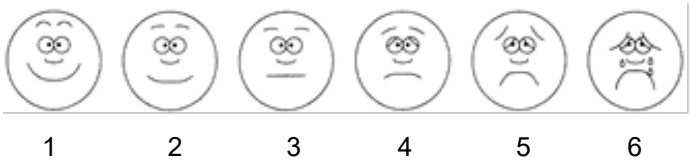


Figure 7. Wong-Baker FACES Pain Rating Scale [Wong DL, Baker CM., 1988]

2.3 Results

Of the twelve participants (hereafter labelled A to L) assessed, using the face rating scale, before and after completion of the art program which took approximately one hour, eight showed an improved mood after the program, four showed no change in mood, and none showed a worsened mood (Fig. 8). Two of the four participants whose mood did not change registered the top-scoring mood both before and after the program. In comparing average scores on the face rating scale, statistical processing was conducted on the assumption that the distances between the facial expressions are all equal. A variance analysis involving one factor and two levels showed a significant difference ($p < .005$) between before and after the program (Fig. 9), confirming the observed mood improvement. This indicates that psychological assessment using the face rating scale is also applicable to elderly people with reduced cognitive capability.

With regard to the continued relationship with the completed artworks, ten of the participants were observed blowing into their completed artworks, while the other two participants were not subject to observation because of overnight absence or other reasons. More than half of the ten observed participants remembered creating their artwork, looked at the artwork affectionately, called its name, studied its expression, and/or willingly went to the location where the artwork was placed. A follow-up survey conducted six months after completion of the art program showed that among the ten participants above, three were displaying their artworks at home, and six were displaying them in their nursing facility rooms. One was observed cherishing her artwork by displaying it in her room, next to a picture of a deceased family member (Fig. 10).

Among other things, members of the care staff who observed the participants said in an interview: "They treated the dolls like their own children as the level of cognition improved, and this was all the more effective," and "They showed a stronger attachment to the dolls because they had themselves created them."

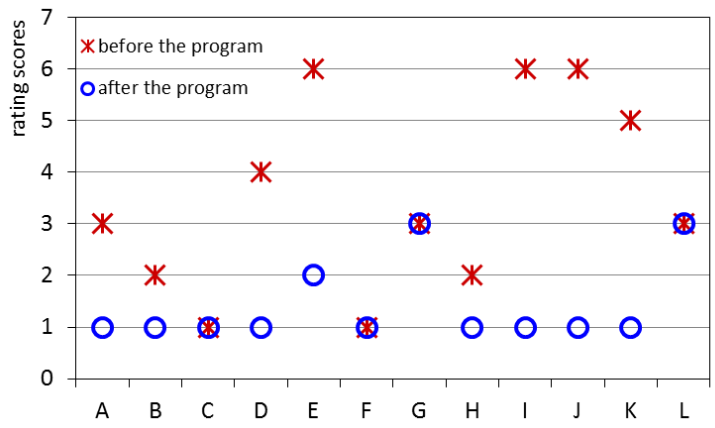


Figure 8. Comparison of scores on the face rating scale before and after the art program

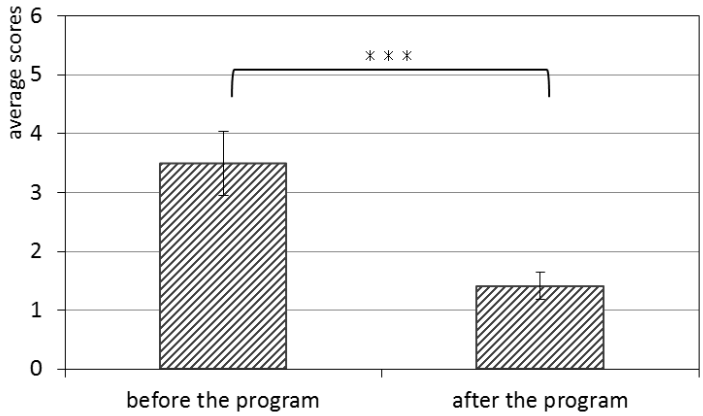


Figure 9. Comparison of average scores on the face rating scale before and after the art program



(a) (b)

Figure 10. Examples of treatment of artworks six months after completion of the art program, suggesting affection and respect; the artwork is displayed (a) next to the picture of a deceased family member, (b) as part of a Buddhist altar

2.4 Discussion

The significant difference in the average scores on the face rating scale before and after the art program indicates a mood improvement effect from the program. This shows that the program using smiling face icons has beneficial psychological effects on elderly requiring primary nursing care.

In the present study's program, participants were offered different options for their choice of materials, enabling them to create artworks according to their capability. The program also incorporated design-based elements to encourage active participation in their artwork's production, such as selecting facial parts (hair, eyes, and cheeks), drawing a mouth, and giving names to their artwork. The fact that all the participants were able to complete their artworks within about an hour indicates that the program was successful in encouraging creative activity in elderly people with reduced cognitive capability.

A continued relationship between the participants and their artworks was confirmed by the fact that all ten observed participants blew into their artworks. Further, they remembered creating the artwork, looked at it with affection, called its name, studied its expression, and/or willingly went to the location where the artwork was placed, all of which indicate attachment to their own artwork. These results suggest that creating a continued relationship between the program participants and their artwork can enhance their motivation for respiratory rehabilitation, which is beneficial in maintaining or improving their swallowing function.

3 Implementation of rehabilitation using artwork

Sustaining patients' motivation to perform simple and repetitive exercises is an issue to be addressed in conducting rehabilitation aimed at the recovery of physical functions. The results of the investigation described in Section 2 show that it may be possible to encourage elderly people with reduced cognitive capability to perform respiratory rehabilitation in a sustained manner, using artworks they have created. Below, the study investigates the possibility of such sustained exercise and the resultant effect on the swallowing function.

3.1 Structure of the respiratory rehabilitation

Two of the participants in the art program were selected for further study, given their physical condition and cognitive capability. They were both female, and corresponded to I and L in Fig. 6, with a level of nursing care requirement of 2 or 3, and with non-reduced swallowing function. Each rehabilitation session consisted of strongly blowing into their doll 10 times in a row, and the two subjects went through one such session per day for 30 days. Immediately before the first session, and after the last session, the subjects' swallowing function was investigated using the modified water swallow test (MWST), the repetitive saliva swallowing test (RSST), and the maximum phonation time (MPT) test. The details of these tests are as follows.

- Modified water swallow test (MWST)

  Each subject takes 3 ml of water into his or her mouth and swallows it for investigation of swallowing provocation, coughing, or respiratory change. The test result is determined by selecting from the following five items.

  (1) Not swallowed (coughing and/or respiratory distress)

  (2) Swallowed (respiratory distress)

  (3) Swallowed (sound respiration; coughing and/or wet hoarseness [characterized by a phlegmy gurgling sound])

  (4) Swallowed (sound respiration, no coughing)

  (5) In addition to (4), two or more swallows are achieved in 30 sec.

- Repetitive saliva swallowing test (RSST)

  This test records the number of repetitive saliva swallows achieved in 30 sec. The test result is normal if the number is three or more, and abnormal if the number is two or less.

- Maximum phonation time (MPT) test

  Here the subject is requested to say "Aaah" as long as possible with one breath, and the longest time among three trials is recorded.

A running record of the rehabilitation exercises conducted over the 30 days was maintained by pasting a sticker on a sheet after the completion of each session, resulting in a series of bouquet images when the 30-day sequence was completed (Fig. 11).



Before the rehabilitation exercises　　After the rehabilitation exercises for 30 days

Figure 11. Sheet for continuous recording of respiratory rehabilitation exercises

(A sticker is pasted on the sheet after completing each session, and a bouquet image is completed after each 10 sessions.)

3.2 Results

The results of investigating the swallowing function are shown in Table 1. The modified water swallow test (MWST) on participants I and L resulted in a score of 5, both before and after the rehabilitation sequence, indicating that a good condition was maintained, with sound respiration, no coughing, and two or more repetitive swallows in 30 sec. In the repetitive saliva swallowing test (RSST), the subjects were able to swallow saliva three times in 30 sec both before and after the rehabilitation sequence, indicating that they remained in good condition with no decline in the swallowing function. The results of the maximum phonation time (MPT) test exhibited slight variation before and after the rehabilitation sequence, with participants I and L showing a decrease of 2.21 sec and an increase of 0.03 sec, respectively. Both subjects completed the full 30-day rehabilitation sequence.

Table 1 Results of testing the swallowing function

participant	MWST		RSST		MPT	
	before	after	before	after	before	after
I	5	5	3	3	22.13	19.91
L	5	5	3	3	2.85	2.88

3.3 Discussion

The results of the MWST, RSST, and MPT tests conducted after completion of the rehabilitation sequence showed that the swallowing function remained in as good condition as before the sequence. Since no changes were observed in the other two evaluation items, it is not likely that the slight variation in the MPT results was due to the implementation of the rehabilitation sequence. Since the two subjects showed no reduction in the swallowing function at the beginning of the sequence, no improvement was found in the swallowing function after the sequence. However, the fact that both completed the full 30-day sequence of respiratory rehabilitation sessions indicates that the program using artworks created by participants is effective for sustaining rehabilitation on a long-term basis. It would appear that

the continued relationship between the participants and their artworks was effective for maintaining motivation for long-term rehabilitation. In addition, maintaining a record of the rehabilitation exercises by pasting a sticker on a sheet after completing each session, and eventually completing a series of bouquet images to visualize the daily achievements, may also have contributed to the continuation of rehabilitation exercise by the participants.

4 Conclusion

Focusing on respiratory rehabilitation for maintaining and improving the swallowing function, the study developed an art program that generates sustained participant involvement by asking them to blow into artworks they have created (patent pending). The art program was implemented with elderly requiring primary nursing care in a nursing home, to investigate the psychological effect of its implementation, the possibility of continued respiratory rehabilitation exercise using the artworks, and the effect of the exercise on the swallowing function.

It has been shown that the mood of participants improved after implementing the art program, compared with before implementation. The results indicate that a program using smiling face icons has beneficial psychological effects on elderly requiring primary nursing care. By incorporating design-based factors of different options for the choice of materials and facial parts in the program to enable the creation of artworks according to the abilities of individual participants, it was possible to encourage active participation. The participants showed attachment to their own artworks after going through the art program, and their motivation for respiratory rehabilitation exercise was heightened by the creation of a continued relationship with the artwork.

The subjects participating in respiratory rehabilitation sessions for 30 days, using artworks created by themselves, completed the sessions without missing a single day, indicating the possibility of conducting long-term rehabilitation. The participants showed no decline in the swallowing function before starting the sessions and were found to still be in good condition after completing the rehabilitation sequence. Though the duration of the rehabilitation sequence was 30 days in the present study, a study on expiratory muscle strength training has suggested that functional improvement is achieved by continuing rehabilitation exercise for eight weeks [Note 7]. A further related study is therefore needed, with greater sequence duration and evaluation of functional improvements.

In the present study, elderly people with reduced cognitive capability were able to sustain respiratory rehabilitation exercise on a long-term basis using artworks created by themselves. It is probable that the use of artworks created by participants in long-term rehabilitation exercise is effective not only for the supporting the swallowing function but also for various other mental and physical functions, and thus the author plans to extend the present approach in the future.

This research was conducted with the approval of the Research Ethics Committee of Meisei University and the Research Ethics Committee of Sapporo City University.

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An Image-making Collaboration: Drawing in the Design of Stagewear

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The paper describes an investigation of a collaborative commission involving two people, a client who is a singer and a fashion designer who has extensive experience of designing stagewear. The commission was for a garment that was to be an important part of a promotional video, tour and press campaign, and the client wanted it to be based on a theme involving the style of iconic female singers whom she admired and project an image of a strong, confident performer. Face to face meetings between client and designer were impossible for much of the period of the design process, but the designer was able to use her command of various drawing techniques to support informative and appropriate communication with the client at each step of the process, and it was evident that traditional, paper-based drawing was an ideal medium for achieving close, careful collaboration. The decision was taken to base the garment on a classic trench coat design, an emblematic garment with both utilitarian and high fashion connotations. During the investigation five sequential steps were identified as being significant in the collaborative process and indicative in terms of distinctive uses of drawing. These steps have been termed briefing; collection of visual reference; concept exploration; concept development; and specification for making. Moreover, five distinct types of collaborative communication were also identified in the use of the drawings included in the analysis namely, to suggest; to inform; to persuade; to demonstrate; and to instruct.

Keywords ***designer client collaboration, bespoke stagewear design; drawing for design; cultural resonance***

1 Introduction to the investigation and methods of research

The topic of this paper is an investigation of a collaboration between two people, a client and a fashion designer. This type of collaboration can be seen to represent an important aspect of contemporary design practice, where close cooperation between a designer and client forms the basis for the initial brief, after which the client continues to participate in the ongoing decision-making process. In this case, an articulate client with very specific and exacting requirements is working with a fashion designer with many years' experience of working with similar clients.

The commission that formed the subject of their dialogue was for a garment that was to be an important part of a promotional video, tour and press campaign, the type of garment that

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is generally known in the fashion industry as ‘stagewear’. The client and designer were geographically separate for much of the progress of the design process and, because of this, email messages and attachments of drawings became a very important part of their collaboration. Drawing not only played a significant role in the conception of the design, it also informed that process by facilitating feedback and interaction between the protagonists. The very limited opportunity for meeting seemed at the time to cause additional problems, so good visual communication became an essential aspect of their dialogue, and considerable effort was put into gauging the expressive and informative value of the drawings used. Subsequently, because of this, the drawn record and the emailed commentary relating to it were both detailed and thoughtful, thereby forming a readily verifiable testimony to the collaborative exchange.

The research on which this investigation is based involves a different kind of collaboration, one between the designer in the above partnership, namely Theresa Coburn, and a design researcher, Pam Schenk, whose aim was to support the designer in an examination and analysis of the details of the collaborative exchange between designer and client. In this way, the authors were able to explore the synergy which could result by a detailed exploration of the drawn record of practice from different points of view, one in which the fashion designer re-evaluated her erstwhile tacit understanding of her own drawing-based practice and the experienced researcher extended her own knowledge of the role of drawing in design. Cohen, Manion and Morrison (2018 443) have described this sort of critical collaborative enquiry by reflective practitioners, self-evaluating their practice and thus contributing to their continuing professional development. Earlier investigations conducted by the authors had already led to a review of the effective utilisation of drawing in the design of stagewear, (Coburn & Schenk, 2017), and to a study of the capacity of drawings to depict the materiality of cloth and garments, (Schenk & Coburn, 2018). In preparation for this present paper, attention was focussed on the functionality of the drawings in the collaborative process, with the aim of achieving a greater understanding of the singular efficacy of drawing in facilitating a responsive and reflexive reaction from the designer to the client’s wishes.

Early stages of the investigation had begun in a relatively informal manner, with regular discussion to identify key aspects of designerly drawing as the authors jointly examined Coburn’s portfolios of recent work and selected commissions for further scrutiny, with that discussed below chosen for particular focus because of the completeness of the retained record of collaborative communication. More formal discussions and email queries then led to a structured evaluation of the range of drawings observed, with identification made of key types of drawings and of the tasks they performed, where necessary with reference to the literature (see, for example, Schenk, 2016 174-179). At this stage, having made herself aware of the key issues in the design process, investigation continued with Schenk, interviewing Coburn and putting questions to her about her recollections of the experiences of collaboration. Next, following ‘the path laid out by the interviewee’, as Moore and Williams (2014 58) describe it, drawings from each stage of the design process were matched up to this commentary, and selection made for in-depth analysis on the basis of demonstrating different forms of designer/client collaboration, the particular characteristic of drawing activity that the authors intended to examine (Silverman, 2013 146). Where applicable, Coburn’s comments from the email record and interview transcript, and the client’s from the email record and transcribed phone calls, are given verbatim in the discussion below.

The early theoretical models of the design process emphasizing formal phases of 'analysis', 'synthesis' and 'evaluation' (Lawson, 1983 17) have been more recently replaced by operational models with their identification of sequential steps or procedures (Newman & Landay, 2000 264; Staples, 2001 8; Aspelund, 2006 xiv; Amy, 2011). Here, the work of the fashion designer constitutes an example of such an operational model and the drawings generated during the design process can be considered in terms of such sequential steps and procedures. During the investigation five such sequential steps were identified as being significant in the collaborative process and indicative in terms of distinctive uses of drawing. These have been termed, respectively, as the briefing; collection of visual reference; concept exploration; concept development; and specification for making.

As with many design professionals, in addition to drawings produced for the client, a fashion designer also generates many drawings purely for their own use, drawings depicting a kind of private conversation with themselves and, as these form an important part of the successful realisation of an effective design, they cannot be ignored here. Therefore, the types of drawings discussed below display a kind of 'evolution' from private early scribbles into the presentation drawings of a professional designer (Rosenberg, 2008). Five distinct types of collaborative communication were identified in the drawings analysed, namely communication to suggest; to inform; to persuade; to demonstrate; and to instruct, and are respectively discussed below.

2 The client, the commission, and the designer

The client, an up-and-coming singer, who had adopted the stage name 'LAW' had very clear ideas as to how she wanted to develop the LAW persona. As she explained to the designer:

> 'I like to exude a powerful image - a clear image on stage sticks with people. Your image should be a recognizable statement...I like androgynous clothes. I like different genders wearing the same clothes…being able to express themselves, blurring boundaries and combating stereotypes. Its empowering to challenge peoples' perception.'

She wanted to feel like a performer on stage, 'stepping up and being dressed up for performance' and she also wanted her clothes to be unique and memorable and engender curiosity in the audience. 'The clothes [have to be] special and make you feel more confident' she claimed. 'Your own unique statement; your songs, your voice, your image.' To achieve these goals, it was important to set up an image-making collaboration with a skilled and sympathetic designer. As mentioned, the actual commission described below was for a bespoke stagewear garment for use in a promotional video, tour and press campaign and, at the client's request, various twentieth century historical influences had to be considered in establishing the 'theme' for this garment, including the influences of various subcultures of fashion design and the style of iconic female singers LAW admired.

The designer herself is a fashion designer whose area of specialization is stagewear for musicians, an area in which she has worked for many years. In her experience, many pop stars and musicians regard their 'image' as almost as important as their music, a phenomenon evident in the work of an artist like David Bowie. Therefore, design of stagewear is about the image that the performer wants to achieve to represent themselves to their audience. Coburn's designs have been popular with avant-garde performers in the music industry since the 1980s and have played a significant part in counter-cultural and

underground movements, for which reason they have been featured in a major international exhibition on street style in the 1980s (V&A exhibition, 2013).

When working with an individual client the garment is technically 'couture', that is made to a client's specific requirements and measurements, so collaboration is inevitable. 'There has to be a dialogue with the client – that is the reason they employ a designer in the first place'. It is also important that the client participates in the design process and that the final garment is an authentic interpretation of their wishes. The designer is not styling the client but working with them to achieve an image collaboration, so 'the stage is a catwalk and…the performer a muse'. By exploring notions of gender and nonconformity, she is working with the client 'in a symbiotic relationship which facilitates exploration of their own psyche and their own relationship with their body and clothes'.

It is of the utmost importance that the garment design underpins the image that the client wishes to project to the world. However, although her clients want the creation of a stage presence, that is to say an image wrought with exaggerated features and cultural allusions, they still need to understand the function and wearability of the garment, and how it will support and not detract from their performance. The image-making activity starts with a discussion with the client about how they think the bespoke garment will help project the image they are trying to portray. Firstly, the designer makes herself fully aware of the personal and practical aspects of the client's work, identifying personal constraints which can take many forms, from body-image to politics, and fabric types to colour. There will also always be practical restraints, like freedom of movement, the heat of venues, use of musical instruments, etc. Then, she will try to ascertain what the client is particularly interested in, what their own inspirations and influences are, and thereby establish common cultural reference points from which to start to develop ideas.

3 Collaboration in the design of stagewear

Turning now to the aforementioned five sequential steps in the collaborative design process and the associated drawn record of the mutual collaboration between client and designer, the designer (Coburn) had been working collaboratively with musicians since 1983 and was strongly of the view that the design process within that genre had to be collaborative, otherwise, as she said, 'they may as well buy clothes off the peg'. The initial stage when discussing key characteristics in a participatory design exercise is iterative, with both knowledge and understanding emerging as a consequence of the exchange of ideas (Luck, 2003 524), and so there needed to be a dialogue with the client to achieve both understanding of the purpose and form of the garment, and to underpin the brief and set the parameters for the design. Thus, drawing activity began during the initial conversation with the client, when the designer started to rapidly scribble down her own responses to the client's key fashion themes.

3.1 Briefing

The client had spoken of her admiration for the style of the singers Nina Simone and Billie Holiday, and of the activist Angela Davis, before the commission was initiated, and the designer had prepared mood boards and collages to inspire fashion design ideas for their first and, indeed, as it turned out, only meeting during the design phase. Figure 1 shows one of the mood boards, with photographic material brought together to capture the visual aesthetic of women the client admired. Figure 2 depicts a type of adaptation and transformation created in collage combining disparate visual sources to represent the type of

powerful, yet glamorous, image the client seemed to be aspiring to, a collage created using the designer's visual 'repertoire' developed through experience and exposure to many sources (Petre, Sharp & Johnson, 2006 189). The designer continued to use these types of boards for her own reference when designing, consulting them mainly for styling ideas for hair, make up, accessories, etc., to underpin the image-making process.



Figure 1. Mood board showing stylistic references. Theresa Coburn, photographic collage, 2016.



Figure 2. Photographic collage. Theresa Coburn, 2016.

It is vital for a specialist stagewear designer to have the skill and experience to use drawing as a means of providing cues for creative thinking (Bilda, Gero & Purcell, 2006), and from the initial briefing at the beginning of the design process the designer was able to access at will her own established range of drawing techniques. The ability to represent design intent through sketching is important in providing support for reasoning between problem definition and generative resolution ideation (Self, 2017 317), and her initial sketched ideas were deployed to explore the client's theme and play with the silhouette, proportion and balance of the proposed garment. Whilst speaking with the client, rough notes and drawings were produced in a sketchbook in the manner Pigrum (2010 4) defines as 'provisional' modes of drawing. Figure 3 shows a double page spread from the sketch book. The notes of course were mostly meant for herself, as the beginnings of concepts formed whilst talking with the client. The designer recalls the initial discussion at the time, when exploring her theme by referencing androgyny and male/female crossover, and contrasting youth culture with the endurance of classic garments

During this first conversation the decision was taken to focus on just one garment and base this on a trench coat design, an emblematic garment with both utilitarian and high fashion connotations (Rodriguez McRobbie, 2015). The choice of the trench coat, with its martial heritage as the main reference point for the commission, is indicative of the importance of the 'materiality' of garments in fashion design. These material qualities externalize certain kinds of cultural categories (Woodward & Fisher, 2014), with the distinctive shape of military garments contributing to the association of masculinity and power (Peoples, 2014). Pass

(2014 31) describes the rationales of fashion designers like Jean Paul Gaultier, Alexander McQueen and Olivier Theyskens who design women's clothes with a militant, masculine quality as a way of 'arming' their wearers.

3.2 Collection of visual references

According to Garner (1999 110), observational drawing heightens a designer's abilities for exploring, understanding, remembering and critically judging visual information. Much of the designer's work here had its roots in 'classic' garments, with the analysis of details conducted through drawing from observation, and she describes drawing parts of a classic Burberry trench coat 'from life' (from an actual trench coat), for example the epaulettes, cuffs, fastenings, seams, topstitching, buttons etc. Drawing from observation in this way enabled the designer to further understand the construction of the garment and engender ideas for the repurposing of garment detailing, for example through exaggeration and changes in juxtaposition. Figure 4 shows examples of such drawings.



Figure 3 Early concept drawings in a sketchbook. Theresa Coburn, 2016.

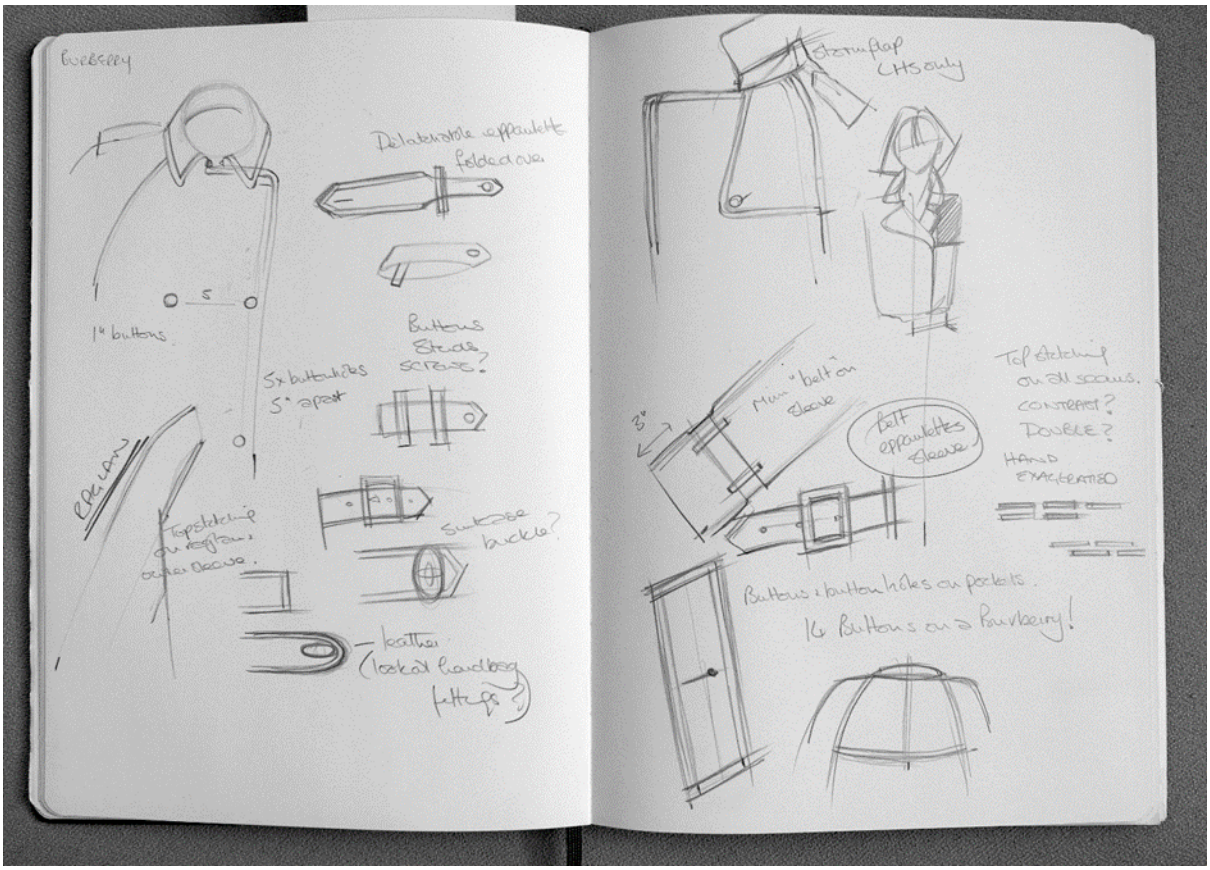


Figure 4 Details of a classic garment drawn from observation. Theresa Coburn, 2016.

3.3 Concept exploration

The designer explained how, when initiating concepts, drawing was very quick and spontaneous and, essentially private, for her own use only. She was exploring ideas with, apparently, simple sketches that were still capable of expressing form, detail, scale and other information quite readily (Garner, 1992). However, although she could herself visualize finished products from these drawings, they were not types of drawing she could show to a client unused to 'reading' drawings, unless she was herself also present to verbally support and explain them. Working freely to establish the silhouette, proportion and balance of the main features within the garment, the act of drawing at this stage was very much concerned with establishing the overall 'look'. Moreover, because of their ambiguity, the 'unfinished' nature of the drawings produced could also facilitate further interpretation and the emergence of new ideas (Oxman, 2002). However, in the designer's own words, this kind of drawing remained a 'suggestion' of a garment. Van der Lugt (2005 2) describes the distinction between the role of designers drawing for their individual thinking process and drawing in a collaborative activity, and this distinction between conceptualization on the one hand, and visual representation on the other, is important, in that a drawing may be both part of a private process of designing in an ideational sense and a public image to be shared in an interpersonal sense (Cikis & Ipek Ek, 2010 333). Early concept drawings allow the designer speed and spontaneity, but the client requires more self-explanatory drawings and it is important that they can imagine themselves in the outfit. The drawing could, for example, communicate fashion, fun and excitement, but it must also present a realistic potential outcome.

3.4 Concept development

It was, of course, important to both designer and client that effective collaboration was maintained, and, as soon as the designer had developed several promising ideas, she shared them with the client through drawings intended both to inform and persuade, first sent by email and then picked up on in conversation via Skype. Figure 5 shows one such set of drawings annotated to record the commentary of their on-line discussion. This kind of annotation was particularly pertinent when numerous initial ideas were being explored, with comments being added by the designer to copies of drawings already sent to the client, thereby creating an 'aide-memoire' for agreed changes.

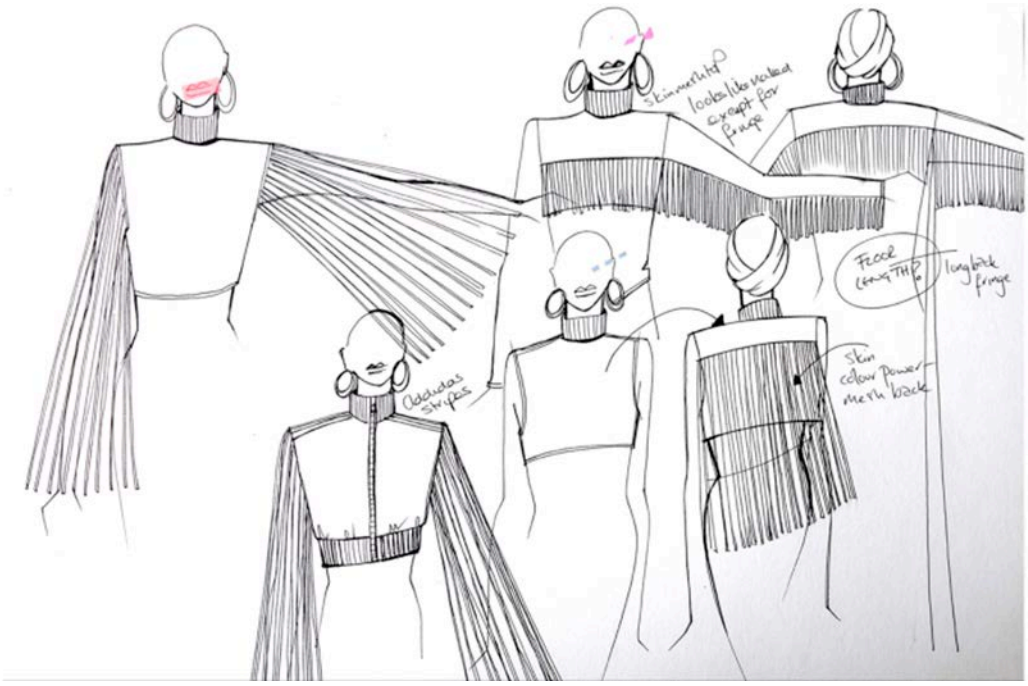


Figure 5. Annotated early presentation drawings. Theresa Coburn, 2016.

As both the design process and the collaboration process progressed, proposals for the garment became increasingly resolved, and it was necessary for the drawings that represented these proposals to be similarly resolved. They had to become precise, detailed and informative, easy for the client to visualize, and thus persuasive. They became an essential form of expression in creating the overall stage personality of the client. A drawing featuring a garment could also include the type of footwear to be worn with, for example, 'Dr Martens' confirming a hard-edged androgynous aesthetic and evening sandals implying a more feminine aesthetic. By citing the trench coat and its military heritage, the designer's drawings here eloquently depicted garments that, while evidently for a woman, still evoked a feeling of strength and power. The designer has recorded the client's actual reaction from a telephone call made on her first receiving the drawings featured in Figure 6.

> 'I loved that the drawings looked like me. It was like seeing myself in a comic book and added an extra layer to the dialogue. I could see that the outfits were going to suit me. The drawings helped me think about the styling and how it would work on me, and the drawings that I thought I would love to look like were the designs I chose. I realized I became persuaded by the drawings.'

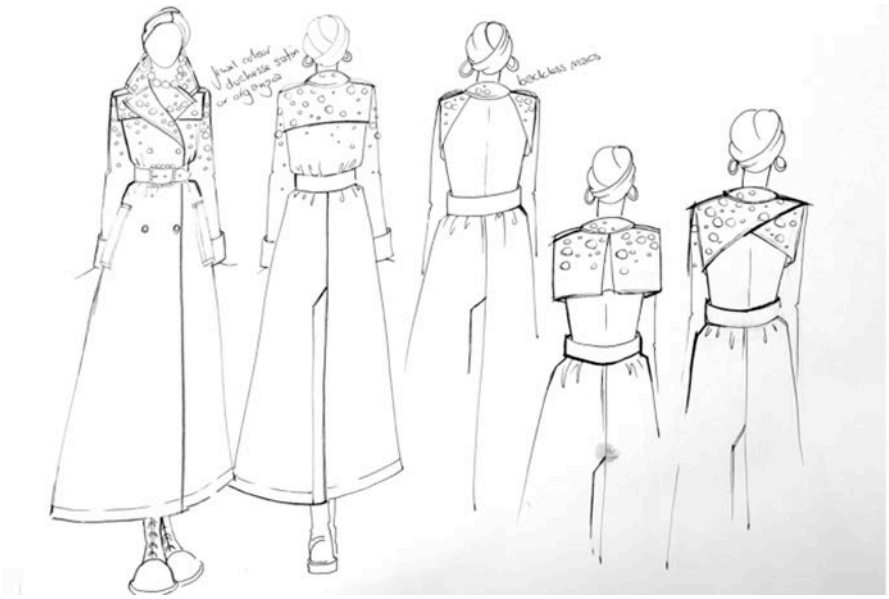


Figure 6 Client-readable drawings with explicit design detailing. Theresa Coburn, 2016.

With further development and the synthesis of several design concepts prompted by the requests of the client, a definitive set of drawings were then sent to her from which to make a final selection. (While colour is never depicted in the drawings, swatches of the proposed cloth were also sent to the client.) As shown in Figure 7, the drawings depict individual garments drawn with clarity and precision and demonstrating the development of a particular design concept, with attention also given to design and construction details so that they also include suggestions for topstitching lines around the collar, as well as pockets, pleats and the depth of hem. They detail both front and back views and are drawn in a way that realistically depicts how the final garment will look, showing a variety of ideas around a 'total look' which takes into consideration styling and accessorizing. The designer confirmed that through this type of drawing she aimed to capture an image that the client could identify with based on their ongoing dialogue. The drawings had to be a clear representation of what the client could expect to receive, that is to say 'they had to be able to envisage themselves wearing this garment on stage'. It is important in presentation drawings for stagewear to capture the visual style of the stage persona'.

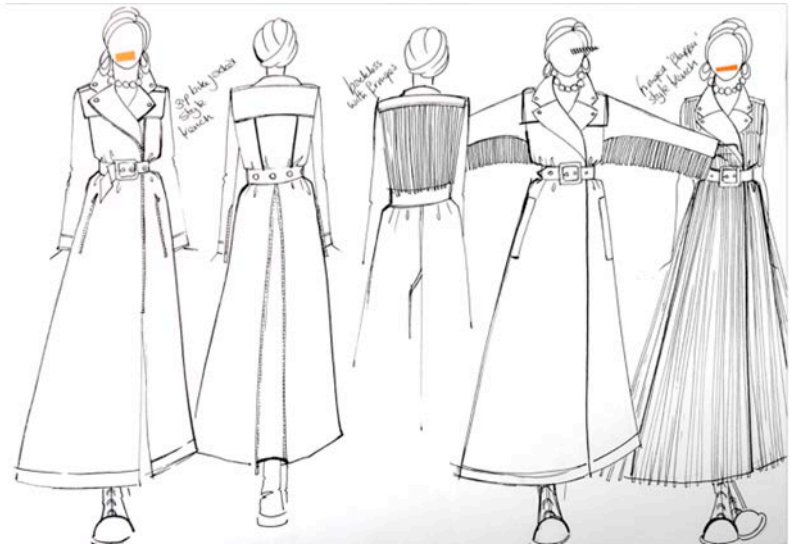


Figure 7. Client-readable drawing capturing client's overall 'image'. Theresa Coburn, 2016.

3.5 Specification for making

Once the main creative stages of the design process were complete and the client had made her final selection, the drawing activity became 'private' once more, underpinning the thought processes that the designer embarked upon in considering the production of the garment. Drawing was employed as a form of shorthand instruction or specification to work out how details and features within the garment might be constructed. Thus, in Figure 8, the process of overdrawing and annotating a photocopy of the final design can be seen. The designer explained how, when working out a production technique, she always had to draw it, this being the only way that she could problem-solve when planning the making of the actual garment. Even when used solely for the benefit of the designer herself to envisage the process of making, drawing remained the best and, sometimes, the only way to proceed, as it linked directly to the visual manifestation of the product being assembled. Hence, the detailed and accurate presentation drawing of the garment (shown in Figure 7 above) was repurposed in Figure 8 to help inform the construction of the garment through the production of relatively informal but nonetheless accurate specification drawings.

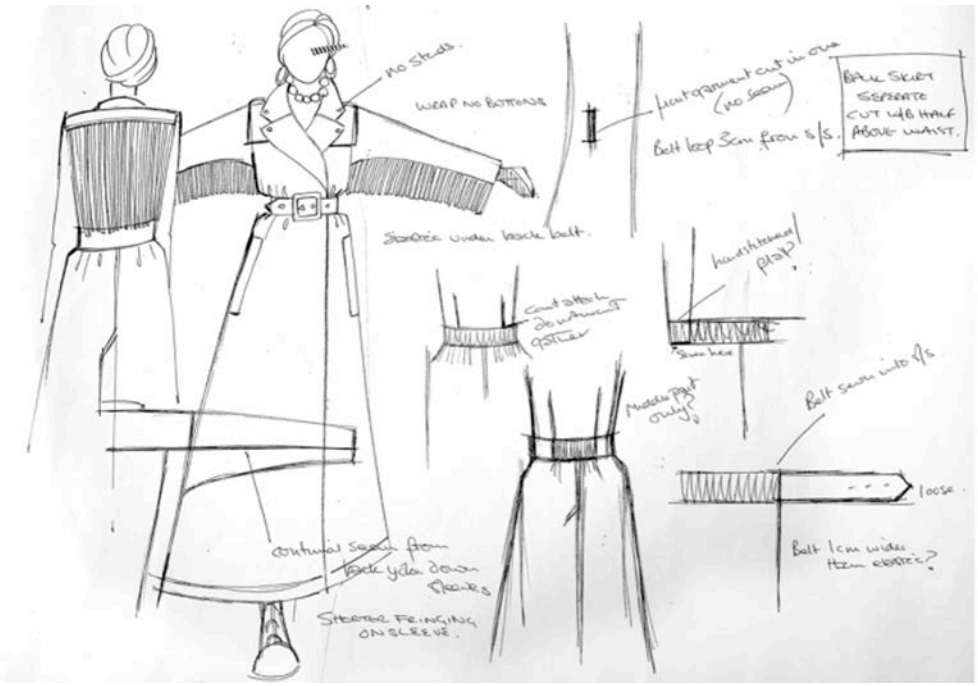


Figure 8. Drawing used as a template to work out production specifications. Theresa Coburn, 2016.

The designer and client concluded that the limited opportunity for them to meet did not seem to have had a detrimental effect on either the progress or the success of the design process. Indeed, the distance might actually have helped as it had pushed the designer to develop more ideas, and to present them through more explicit types of drawing, than was usual.

4. Conclusions

It is evident that traditional, paper-based drawing is *an* ideal, perhaps even *the* ideal, medium for collaboration between client and designer in areas of bespoke fashion design, given that in this digital age long-distance communications are facilitated by electronic means. As has been demonstrated, there are many reasons for this. Having firstly gauged the client's capacity to 'read' drawings, the designer was able to ensure that only appropriately resolved concept exploration or development drawings were shared with the client to demonstrate a potential design. Paper-based drawing techniques were readily adaptable for this purpose and, as the design process progressed, the process of adjustment and development could be communicated to the client electronically using different drawing styles. Finally, highly finished presentation drawings could both be shared with the client to demonstrate the appearance of the chosen solution and also be readily repurposed to instruct accurate specification for garment-making. During the design process, other types of drawings were created by the designer herself, without necessarily being shared with the client. Observational drawing facilitated and recorded visual enquiry in the concept initiation and concept development steps, and helped to inform design details. Gestural drawing could help demonstrate the behaviour of fabric in drape, or the nuance of silhouette in a proposed design. However, more than any of these applications, the capacity of hand-made drawings to evoke the complexity and individuality of a stage persona and persuade a client of the effectiveness of that persona was unparalleled. Thus, the drawings that formed part of the collaborative stagewear design process could be either private or shared, they could be quickly scribbled or carefully rendered, but in the repertoire of an experienced fashion designer they were essential in the creation of a bespoke solution.

The client's concluding reaction was very revealing:

> 'I found this a very personal and emotional process. The fact that [the designer] drew things opened my mind to possibilities. I wouldn't have liked [verbal] descriptions but I loved the drawings and each discussion around a drawing became a decision.'

At the end of the analysis of her own drawn record, the designer concluded that 'this process has made me reflect on much that I have previously taken for granted in my design work'. While in many respects, her approach to the commission corresponded to that observed for other designers with well-established specialist and professional drawing skills (Pipes, 1990 6; Ferguson, 1992; Van der Lugt, 2005 2), some specific characteristics could be identified. In particular, the intention to work collaboratively with the client, albeit from a distance, made her produce more clearly defined and more individualized presentation drawings than might otherwise be typical. However, the limited opportunity for face to face meetings was not, of course, the only distinct feature in a commission that was concerned not just with the design of a simple garment but one that would also play a significant part in the projection of a stage persona. Evidently, the client's intense interest demonstrated her own professional determination to witness the melding of cultural influences in a fashion garment that would not only enhance but also help to define her stage presence. Although the persuasive effects of drawings are invariably put to good effect by designers, the client's own comments here described the distinct impact that the drawings had on her, i.e. 'I loved that the drawings looked like me', and 'I realized I became persuaded by the drawings'. Evidently, not only did the drawings help to sell the design ideas to the client but they also engaged her in the design drawing process. The use of hand-made drawings in this way made the client more of a participant in the design process than if the designer had simply described concepts to her, or employed soulless computer-generated drawings, and so created a bond of visual language between them both.

Drawings became a physical record of the designer's analysis of an actual classic garment, a trench coat, and thereby informed the chosen solution. Drawings informed the client about the visual impression that several concepts would create and persuaded her to select the concept most appropriate to her needs. Drawings demonstrated how she would look and finally became instructions for the designer to achieve that 'look' in reality.

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Application of Peak-end rule in research of product use

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Nowadays, products are supposed to meet the users' needs, including their emotions and experience. Evoking positive emotions will be an important design goal. This study is based on the Jordan's experiment (1998) which arranged that participants recalled the pleasures with product in the interviews. However, the more we want to know is all the emotional changes in using a product and why users recall it pleasantly. This research applies the peak-end rule to assess the user's emotions in a product use process. This study is expected to (1) explore the feasibility of the peak-end rule applied to the product use process;(2) establish a theoretical framework that can effectively finding the peak and end points of emotions that following researchers can apply it to product design. It's a good start to apply peak-end rule to directly and efficiently gain insights and emotions from participants.

Keywords: peak-end rule, user experience, pleasure with products

1 Introduction

The trend in product design has undergone several changes. It started from production-oriented, marketing-oriented in the past to user-centred nowadays. Based on user-centred design, products are supposed to meet the user's needs, and change the design targets from the aims on usability to the users' emotion and experience. From the three levels (visceral level, behavioural level and reflective level) of the book *emotional design* authored by Donald A. Norman, the product can arouse users' positive feelings in the three aspects of intuitive attraction, ease of use and meaning of products. All of them can cause users to feel the appeal of the products and create pleasure, which will prompt users to feel better when using products (Norman, 2004). Furthermore, hedonic consumerism refers users' emotions and experience to the multi-sensory image, fantasy and emotional arousal experience that users pay attention to when using products (Hirschman & Holbrook, 1982).

Human beings seek happiness in the lifetime, and we are also constantly seeking pleasure in the daily life. Meanwhile, people unavoidably interact with miscellaneous products every day. Therefore, if the product can provide pleasant emotions for users, pleasure can meet people's need and desire. Jordan (1997) proposes the four pleasures in product use, quoting the anthropologist Lionel Tiger's four kinds of pleasures. According to Jordan's definition of pleasurable products, it should be based on ease of use, and provide functional advantages and the benefits of pleasure and enjoyment(Jordan, 1997).

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This study is based on the Jordan's experiment (1998), which arranged participants recalled of the product's pleasure. We arrange every participant use a product and assess the using process. This study is conducted with thinking aloud protocols that can efficiently gain insights into participants' thought in the experiment. In addition, we apply the peak-end rule to assess collected thoughts and emotions after the experiment. The peak-end rule suggests that people's feelings in recalling events will be affected by the peak and end of the emotion. (Kahneman, Fredrickson, Schreiber, & Redelmeier,1993).

This study intends to uncover the user's emotions in the product use and applies the peak-end rule to conduct qualitative interviews and evaluations. To discuss the user's pleasure, the assessment after the experiments will verify that the user's emotions are related to the peak-end rule. Results are expected to be applied to the future design of the products and establish the framework of the product design or usability testing. It provides a model that researchers can effectively apply to the product development in the future. In summary, there are two research goals as below:

(1) Exploring the feasibility of the peak-end rule applied to assess a user's emotions in product use process, effectively distinguishing the emotional points of a user in each step of product use and evaluating the extreme peak-end points of the emotion.

(2) Providing a theoretical framework for assessing the user's emotions in product use process and a model for effectively finding the extremes of emotions that allows follow-up researchers to apply this framework for product design and development.

2 Review of the Literature

2.1 Pleasures in the product use

The four pleasures mentioned by the anthropologist Lionel Tiger in the book *The Pursuit of Pleasure* include: physical, social, psychological and ideological(Tiger, 1992). Then, Jordan define the four pleasures in the product use(Jordan, 2003).

- Physio-pleasure: The physiological pleasure comes from human's senses, which can be connected to touch, taste, smell, etc.
- Socio-pleasure: The social pleasure comes from interacting with others, and products can promote interpersonal interaction in different ways.
- Psycho-pleasure: The psychological pleasure is related to human cognition and emotional response. In terms of products, people may have cognitive demands and emotional reactions to products.
- Ideo-pleasure: The ideo-pleasure is connected to human values. In the context of products, it refers to the aesthetics of products and the value embodied in products.

2.2 Peak-end Rule

The peak-end rule is a popular practice when talking about user experience. The theory of peak-end rule suggests that a person's feeling in recalling an event will be affected by the peak and end of emotion (Fig.1).

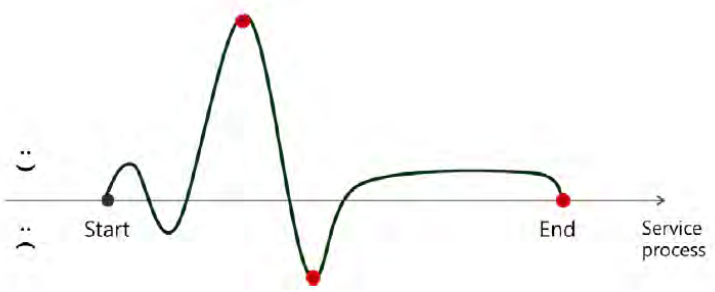


Figure 1. The peak-End Rule (Chen, 2016)

Kahneman et al. (1993) conduct experiments that patients undergoing diagnostic colonoscopy. Two groups of participants suffer from colonoscopy and reach to same level of pain. However, there is a big difference between the two groups' ending experience. The patients of group A suffer a process of pain and stop in the extreme pain. Group B suffer from a longer process but feel less painful in the end (Fig.2). Finally, the research points out that the participants' retrospective evaluations are affected by the peak and end ratings. The group of patient A recognize the colonoscopy as worse experience. This result shows people's memory is influenced by the end moments of experience(Kahneman, 2011). Although the group of patient B undergo longer process and reach to the same level of pain as well. The reaction of emotions is contrary to objective facts(Do, Rupert, & Wolford, 2008). In the same way, the study also points out that people think the life which ends in the perfection is better than the life with additional few years which are not so happy as before(Diener, Wirtz, & Oishi, 2001).

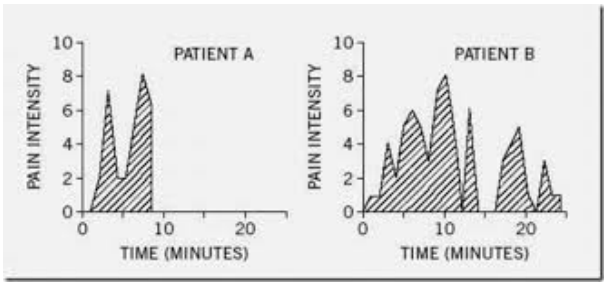


Figure 2. Colonoscopy experiment (Kahneman et al., 1993)

2.3 Thinking aloud protocol

Thinking aloud protocol is a method that requires participants to speak aloud while solving a problem or working in a task. This protocol is widely used in usability testing, which acquire the context of building computer systems (Jaspers, Steen, van den Bos, & Geenen, 2004). The think aloud protocol is a method to efficiently gain insight in the human's thoughts when solving problems. It produces qualitative data and insights in user's thoughts and emotions that can provide a wide knowledge for researchers to get deep understanding of users (Mack, Lewis, & Carroll, 1983).

Usually, participants are asked to verbalize their thoughts when they worked in the task and describe what questions come into their mind. They are encouraged to speak aloud the plans, inferences, knowledge or what they are aware of currently(Mack, Lewis, & Carroll, 1983). The comments from participants are tape-recorded or video-recorded and prepared for later analysis.

3 Methods

We select participants who have low involvement in the coffee machine through the pre-test interviews (Fig.3). In the experiment, the participants are asked to use coffee machine step by step. After, the participants recall their memory and convert their emotions to scores from 1 to 10 in a diagram. The scores are turned into an emotional curve in the end. This study analyses the emotional curve and understand whether the experimental results are related to the peak-end rule. This study chooses Nescafe® dolce Gusto® Mini Me as an experimental product. This product which won the red dot award in 2014, includes the four pleasures of the product defined by Jordon (2003). In addition, it also includes a series of operation steps. And we choose unsweetened latte macchiato to do experiments because it can cover all the steps and its flavour is neutral which avoid affecting participants' emotions.

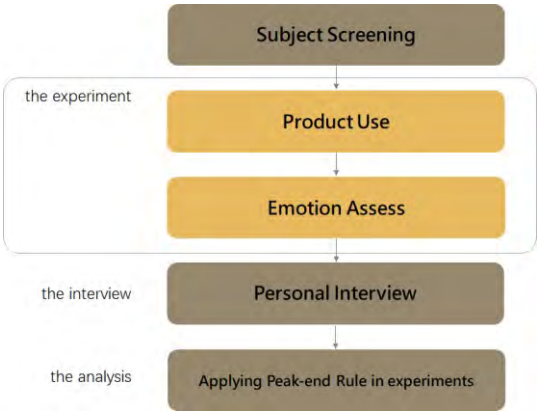


Figure 3. The research process of this study

3.1 Participants

There were 6 participants in the experiment, aged from 22 to 26. In the subject selecting step, each participant was interviewed one to one. We chose participants who drinks 1-3 times a week which are classified as light users(Bhumiratana, Adhikari, & Chambers, 2014) that we can focus on the using experience. All of them have experience using two kinds of coffee machines, but they are not familiar with the capsule coffee machine. Thus, they have more objective feelings in the product use process. The participants were asked questions about the habits, frequencies and reasons of using coffee machine (see as Table 1).

Table 1 Participant's personal data

Subject	Age	Gender	Frequency	Reasons of using coffee machine
1	25	Female	1-3 times a week	Efficient Easy to use
2	25	Male	1-3 times a week	Efficient
3	26	Male	1-3 times a week	Good taste Cheap
4	25	Male	1-3 times a week	Good taste Easy to use
5	23	Male	1-3 times a week	Efficient Good taste
6	22	Female	1-3 times a week	Efficient Cheap

3.2 Experiment Design

In the beginning of the experiment, the participants were asked to see a video which shows how to use capsule coffee machine, and they should follow the process step by step. During the experiment, participants are encouraged to say the thoughts or feelings in the brewing process and all their using processes are recorded. After using the coffee machine, participants are asked to recall and evaluate the emotions in using steps. They have to give scores from 1 to 10 in every step which are defined in this experiment. In the end, the participants' emotions are converted to the emotional curves.

4 Results

As the table shows, the participants' emotions were collected in every step (Table 2). Overall, most participants started with lower emotion and felt better until the put-in-capsule step. The feelings from the first put-in-capsule step to the second take-out-capsule are relatively higher, and all the participants reached the highest emotions in this section apart from the finished step. On the other hand, the turn-on and turn-off steps are two lowest points. In average, the lowest point is turn-on step which gets 4.33 points in average, and the second lowest is turn-off which gets 5.33 points. In addition, the relative lower points are throw-away steps, and the first gets 6 points and the second 5.5 points. The two highest points are happened in the filling hot water which gets 7.67 and 7.5 points.

The last part in the table 2 we discussed the peak-end value and the feeling of satisfaction. The peak-end value is an average of the peak value and end value. Take sample 1 for example, the peak value (except end value) is 9 and the end value is 10, so the average is 9.5. There are little connections between peak-end values and retrospective evaluations except participant 2and 6.

Table 2 The emotional values in every step

No.	Turn on	Place cup	Put in Capsule1	Fill Water1	Take out Capsule1	Throw Away1	Put in Capsule2	Fill Water2	Take out Capsule2	Throw Away2	Turn off	Finished	Peak-end value	Retro.
1	4	5	6	8	9	8	8	9	5	5	4	10	9.5	9
2	5	2	8	9	9	7	7	8	7	6	3	5	7	8
3	5	5	6	9	3	5	5	9	5	5	5	7	8	8
4	6	7	8	5	7	1	6	7	7	4	7	7	7.5	8
5	3	6	6	8	9	9	9	9	8	7	6	5	7	7
6	3	8	9	6	7	6	8	4	6	6	7	10	9.5	7
AVG	4.33	5.50	7.17	7.50	7.33	6.00	7.17	7.67	6.33	5.50	5.33	7.33	8.08	7.83

The chart of the emotional curves describes how the participants feel and why the emotions changed through the whole process (Fig 4). All the thoughts next to the curve lines were collected from each participant. The number on the top of a thought which represents participant's number as the table shows. The seven thoughts above the chart are positive comments, and six below are negative. In the upper part, five out of seven positive comments are connected to the interaction and design in the process. They can be classified to unique operation, visual and audio factors. On the other hand, participants expressed more kinds of thoughts in the lower part. Two users thought that turn-on step is long time to wait (from red light to green light) until the machine prepared. Two users were depressed

about the design of upper cover. In addition, one thought that it is not eco-friendly in throw-away capsule step, one forgot to turn off and the other one felt sad in the end of using process.

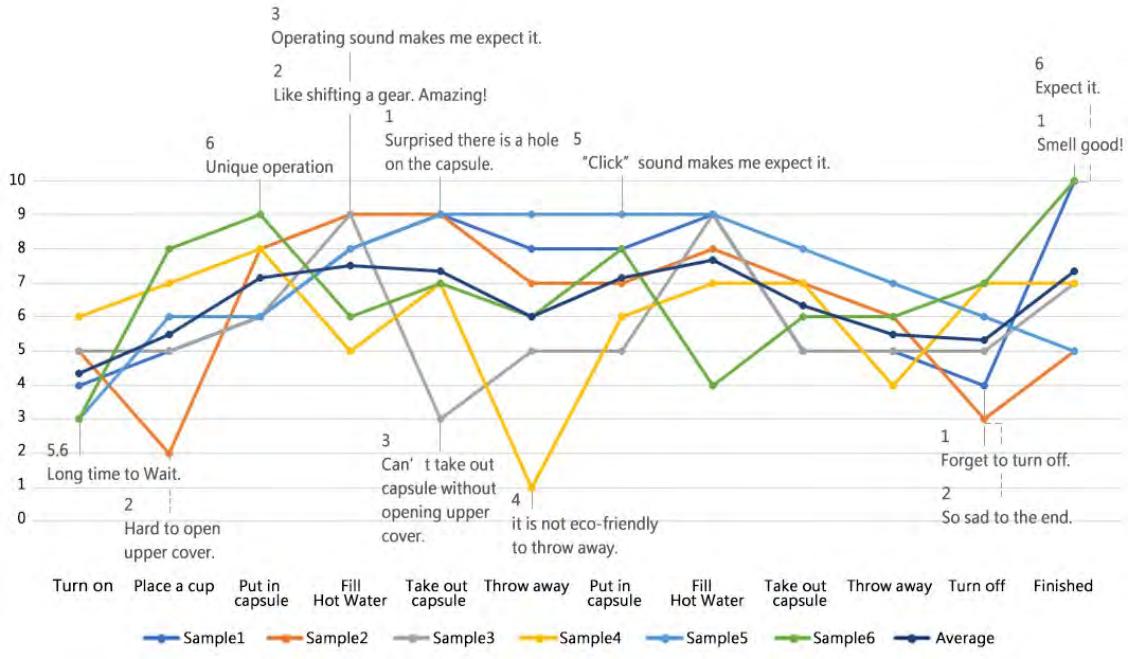


Figure 4. The feelings and emotional curves of six participants

5 Discussion

5.1 Limitations

In this research, only light coffee users were discussed, and the scale of research was small so far. Second, we limited the process of using capsule coffee machine and set every using step in the experiment in order. However, users do not use coffee machines in the same steps in the daily lives. Thus, the results uncovering the participants' emotions in the using process only can represent part of users in real life.

5.2 Discussion

We intended to find a way to measure the emotions and thoughts in the product use process. Although emotional scores were explained and clarified in the beginning of the experiments, tt still showed individual differences in measuring their emotions which influenced the results of the experiments. However, it uncovered some insights that are difficult to recognize by other design methods, such as: user journey map. We build a framework for users to assess their experience and emotions by themselves instead of creating a journey map by designers.

6 Conclusions

This study expected to know if the peak-end rule is feasible in product use process and gained the evidences that the higher the peak-end value of the positive mood in the product use, the higher the pleasure users feel.

The results pointed out some difficulties when applying the peak-end rule to assess users' emotions in product use. Although the correlation between the peak-end values and

retrospective evaluations cannot be verified so far, we still build a theoretical structure to extended research. It provided some insights that were rarely discovered by other design methods. In this research, we built a framework to assess users' experience and emotions based on users' real emotions instead of creating a journey map by designers.

In addition, we also found some insights in using capsule coffee machine. Participants got positive feeling because of unique operation, visual and audio factors. On the other hand, participants expressed more kinds of thoughts when having negative feeling.

In the future, there are few things that need to adjust, including defines of the emotional values and scales of the researches. However, it's a good start to apply thinking aloud protocol and peak-end rule to these experiments. This is a method that directly and efficiently gain insights and emotions from participants. After, more participants will take part in the study to make further study robust and we also discuss more users' sensory experience in the research.

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Assessing User Needs of Senior Women during Yoga Exercises to Optimize the Design Criteria of Sports Bras

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Given the arising burdens in social, economic and healthcare aspects due to the ageing population, senior women are encouraged to do more exercises in order to stay active. However, they are unwilling to do so due to various physical and psychological barriers. During the ageing process, the overall body shape has significant changes and breast becomes sagging. The design of sportswear could be one of the major factors recovering their motivation and confidence during social activities. In this study, questionnaire and field experiments were conducted to investigate the influence of sportswear on senior women. By analyzing the results, the needs on sports bra were primarily determined. Coupled with the results of biomechanical analysis from motion tests, the breast deformation during yoga poses was analyzed. The questionnaire shows that senior women mainly focused on the support and comfort of sports bras no matter how long their yoga practice history. Following are the "easy to wear on and take off" and "more coverage such as long shirt design and higher neckline design". From motion analysis, the breast deformation was changing in a large range when doing Warrior I and Warrior II yoga poses. To address the needs, sports bra design in terms of fabric, elastics, and over 10 features of construction were determined. As a result, the main purpose of this study suggests the design criteria on the optimization of sports bra which can fulfill the needs of physical and psychological for senior women.

Keywords: senior women; exercise behaviour; sports bra; design criteria

1 Introduction

The ageing population is one of the most common phenomena worldwide, which brings some formidable challenges on social, economic and healthcare (Cheng, Lum, Lam, & Fung, 2013). Response to those challenges arising from the ageing population, senior individuals are encouraged to be more physically active. Among those low-intensity physical activities, yoga is a very popular and age-friendly choose for senior women because yoga lacks the age restraints. It is well-known that yoga has versatile poses and different available levels for practitioners with a different level of physical conditions. Regular yoga practice can not only improve physical functions such as muscle strength, body balance and metabolic system but also benefits for psychological health to alleviate stress, late-life depression and nervous. (Banks, 2011; Chen et al., 2009; Roland, Jakobi, & Jones, 2011)

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It is well documented that physical activity is essential for older adults which can be worked as a mechanism to improve the quality of late-life for achieving successful ageing. (Berlin, Kruger, & Klenosky, 2018) However, despite the senior individuals possess more leisure time after retirement, the amounts and rates of engagement in physical activities have a trend of declining as age increases. (Zuzanek, Robinson, & Iwasaki, 1998)

2 Literature review

The reason for senior adults having sedentary behaviour may be concluded into two determinants: one is the elderly is lack of confidence to perform the exercise (Chogahara, 1999; O'Brien Cousins, 1998) and the other is the declining health condition. The senior individuals view themselves as a group who are vulnerable to injury during exercise, besides, they usually magnify the risks arising from physical activity. Those are usually deemed as the barriers to engage the older adults in exercise. (Calnan & Johnson; Chou, Hwang, & Wu, 2012) Some researchers in the exercise psychology field have developed a lot of psychological theories and concepts to explain the exercise-related behaviours of the older adults, such as what motivates them to initiate physical activity and how to maintain that activity. Fisher had used the Information-Behavioural Skills (IMB) models to analyze the arena of health-related behaviours influenced by social factor and psychological factors. In his model, it is asserted that information, motivation, and behavioural skills are the fundamental determinants of initiating behaviours. (Fisher, Fisher, & Harman, 2003) Baudura's social cognitive theory (SCT) as the most convincing theory is often used to understand and predict the exercise behaviour of the elderly. It consists of four cognitive constructs: self-efficacy, motivations, goals, environments or social influents and outcome expectations. (Bandura, 1986) Then, O'Brien Cousin conducted experiments and the precaution of risk was demonstrated highly correlated with self-efficacy ratings ($r= -.657$, $p<.0001$) during six same physical activities in the study of 327 women conducted by (O'Brien Cousins, 1998) She built a composite model of adult physical activity (as shown in figure 1), the model illustrated with 16 variables. After validation of the model, the determinants in the composite model have best explained why senior adults were physically active. Confidence and personal feeling of efficacious for physical activities are the most important determinants of motivating exercise behaviour of the elderly.

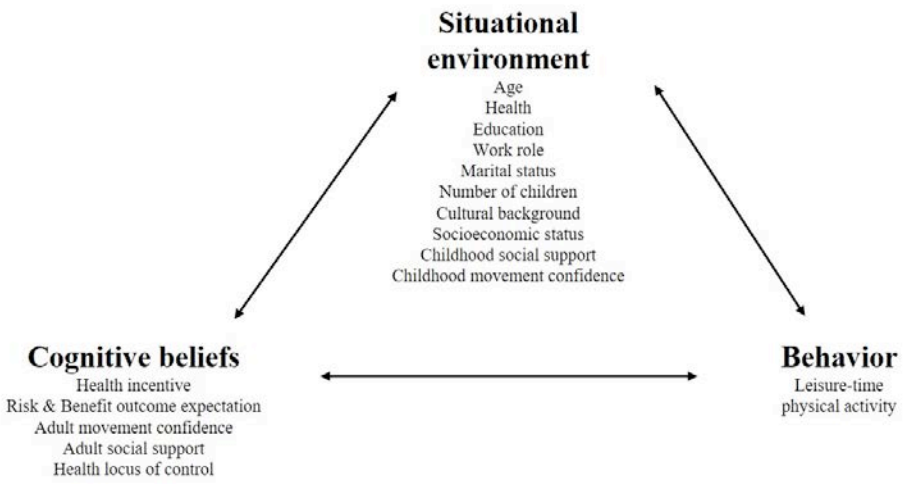


Figure 1. O'brien Cousin's composite model of adult physical activity.

In other words, it can be understood that people might be motivated to initiate and maintain exercise behaviours if they think they are capable of performing the activity, it strengthens the motivation to improve their perceived efficacy for maintaining adherent behaviour. From the described of self-determination theory (SDT) developed by Deci and Ryan, the exercise motivation originates from physiological or psychological needs that generate a behaviour aiming to achieve a goal. Differently perceived locus of causality scale decided the level of motivation. By the prevalence of SDT on sports and exercise behaviours field, Markland developed Exercise Motivation Inventory determined many motivations of initiating to exercise. (Markland, 1999) These motivations are stress management, revitalization, enjoyment, challenge, social recognition, affiliations, competition, health pressures, ill health, avoidance, positive health, weight management, appearance, strength and nimbleness. (Gefen and Dilmoney, 2007) Based on these theories, for promoting people to wear a sports bra during yoga exercising, the foremost thing is to investigate what kinds of motivations influence them most and how to utilize external motivations internalize. Improving their motivation is helpful for initiating and persisting this behaviour.

Sports bra as a kind of worn equipment may help to fulfil the psychological and physical needs of exercisers. It also has been regarded as major sports equipment plays an important role in improving the performance of exercise directly, prevention of exercise-induced breast injuries and improving their confidence psychologically. (McGhee & Steele, 2010; McGinnis) Despite the existence of a large amount of commercial sports bra, there is still a lack of ergonomic design of sports bra to satisfy the demands of aesthetic, comfort and support (Brown, White, Brasher, & Scurr, 2014; Yu, 2011) What is more, limited researches focused on the study of sports bra design for senior women aged above 55 years old. Women in this aged area have a lot of breast perceptions that accordingly changed their psychological and physical demands on a sports bra. There is an amount of evidence to support the idea that the ageing process has a profound influence on the mechanical properties of their breast. To be specific, as the age increases, the proportion of glandular tissues are decreasing and the proportion of fat tissues are increasing, the skin becomes laxity, less stretched Cooer's ligaments caused an inferior lateral migration of the breast tissues. (Risius) Despite the fact of large differences between senior women breast and younger women breast, current intimate garment market emphasis on the development of bras designed for younger women that do not fulfil the physical and psychological demands

for the older women. Previous literature found that large breast size of women and ill-fitting of a sports bra would exert much more loadings on the thoracic and surrounding musculature resulted in thoracic pain. The breast size and BMI index of the postmenopausal women proved to have a positive relationship with the thoracic pain. This may be due to post-menopause has an effect on the spectrum of anthropometrical changes, which potentially results in altered biomechanics and affect pain states. (Spencer & Briffa, 2013)

Researches in the domain of human breast kinetic and kinematic analysis typically focused on the displacement measurement between the breast and human torso. The motion capture system was the most widely used method to track the makers' movements placed on the breast and the human body during the running or walking. Researches regarding the measurement of the bra and breast during individuals doing activities are limited. One finding on the kinetic measurement of the breast shows that the breast acceleration had been moderated by the supporting level of a sports bra, as well as changing the exercise intensive (yoga, walking versus running, rope skipping). (Greenbaum, 2003) When a woman upright standing statically, there is an anterior torque on the thorax caused by net bare breast forces. (Scurr, White, and Hedger, 2011) In order to test this torque force, Chris developed the buoyant forces provided by water and soybean oil to estimate the non-loaded neutral nipple position. (Chris, 2016) It concluded that gravity plays an important role in effecting the static nipple position, particularly the directions of inferior and posterior. Scurr et al. quantified multi-dimensional breast displacement during walking and running on a treadmill under bra and braless conditions. It is concluded that there is a significant effect of reducing the amplitude of breast displacement under sports bra during treadmill activities, but the motion direction of the breast during walking and running was unaffected. (Scurr, White, & Hedger, 2011; White, Scurr, & Smith, 2009) With regard to the kinematic measurements, McGhee et al. had quantified the motion of breast relative to trunk and foot by infrared emitting diodes on participants' several selected points under the bra condition. (McGhee 2003)

However, the biomechanical analysis of senior women during yoga poses was neglected which it is difficult to investigate the tiny differences among activities, which is crucial to study the physical performances during doing activities. Women who wore the sports bra not only anticipant to alleviate the breast sagging problem but also to mask the sign of ageing. Specific design for senior women has become an essential target for this study. The purpose of this study is to assess the need of senior women on the sports bra based on the health exercise behaviour theories and models and further to provide an instruction of sports bra design for senior women to fulfil their psychological and physical needs.

3 Research methodology

The yoga bra is a kind of intimate which next to human skin, the comfort of handle feel and the comfort feeling from external bra are an instant and direct transfer to the wears' perception (Yu 2011). The handle feeling of fabrics usually tested from the aspects including softness, stiffness, smoothness, itchy, prick, roughness, crispness, tightness etc. (Klatzky and Lederman 2010). Mostly evaluated by subjective methods such as questionnaire because people's perceptions is difficult to be quantified by testing mechanical approaches. Coupled with the motion analysis to evaluate the breast movement with and without sports bra, it is reasonable and systematic to evaluate the key performance of sports bra.

The roadmap of the methodology was shown in figure 2. In order to propose the design criteria of the age-friendly sports bra, the key performance variables should be identified at first. This part can be obtained by the questionnaire survey to get an understanding of the subjective needs from the psychological dimension, coupled with the conduction of the motion capture experiments to collect the biomechanical behaviour of the senior women breast from the physical dimension.

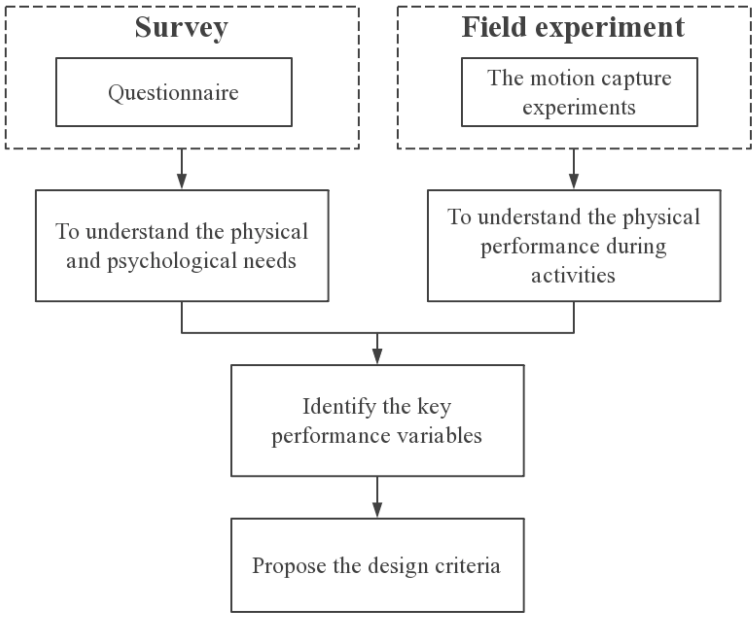


Figure 2. The roadmap of methodology.

Identifying the reasons for senior women to engage in the yoga exercise was thus necessary to improve their motivation in yoga exercise by properly designing the psychological satisfied sports bras. According to the previous literature, senior individuals weighted the estimated benefits against its costs and risks from doing physical activities (Conn, 1998) At the same time senior women are strongly driven by health-related goals aiming to keep them healthy. (Giles, 2004) As a result, it is necessary to study the perception of senior women on yoga exercise benefits. Thus, the reason for participating in yoga exercise was included in the questionnaire items. Following was to investigate if the sports bra motivate the senior women engagement into the yoga exercises, what kinds of sports bra components influence their attitude and needs on the sports bra. Therefore, this item was involved in the questionnaire. Different exercise history of yoga was assumed to have different influences on senior women's preferences and perceptions on the sports bra, so the yoga exercise history was included, and the considered factors of wearing a sports bra during doing exercise was also included into the questionnaire and designed in multiple-choice questions, which can be also used to propose the sports bra design criteria specialized for the senior women.

Besides the questionnaire, it is equally essential to analyze the biomechanical behaviour of senior women breasts, so the field experiment was conducted to collect the breast deformation during the participants doing yoga poses. In this study, motion capture method was adopted to collect three-dimensional trajectories of selected points on the breast. From

the data captured on the senior women during 2 selected yoga poses, the skin extension and approximate whole breast deformation can be analyzed. Combined the questionnaire results and the breast motion characteristics, the needs, features of senior women on the sports bra were understood. Accordingly, the age-friendly sports bra design criteria were proposed.

3.1 Questionnaire data collection

Regarding the current study focused on analyzing the influence of age and consequent exercise behavioural reaction, purposive sampling was introduced to improve the generalizability of the results as an accurate representation of the population to a large extent. Therefore, we began to collect survey responses from online sampling. In total, 229 unique responses. 170 participants were equal below 39 while 59 participants were equal or above 40.

The Self-Determination Theory (SDT) has a wide range of applications in a different field of exercise psychology research. (Duda, 2006) By using SDT aimed to examine the relationship between motivation and exercise behaviour. The individuals with different level of motivations (intrinsic motivation, extrinsic motivation, and motivation) (Miller, Deci, & Ryan, 1988) results in different possibilities to persist or dropout behaviour. Intrinsic motivation is expected, people have intrinsic motivation can perform behaviour autonomous and feel enjoyment which is expected to have a higher level of participation. Extrinsic motivation refers to the situation in which people perform one behaviour for competition, environmental factors, the rewards. For example, the senior women participant in the yoga exercise because they wanted to present their ability to others or because they followed their peers. Amotivation is the situation in which a lack of intentionality.

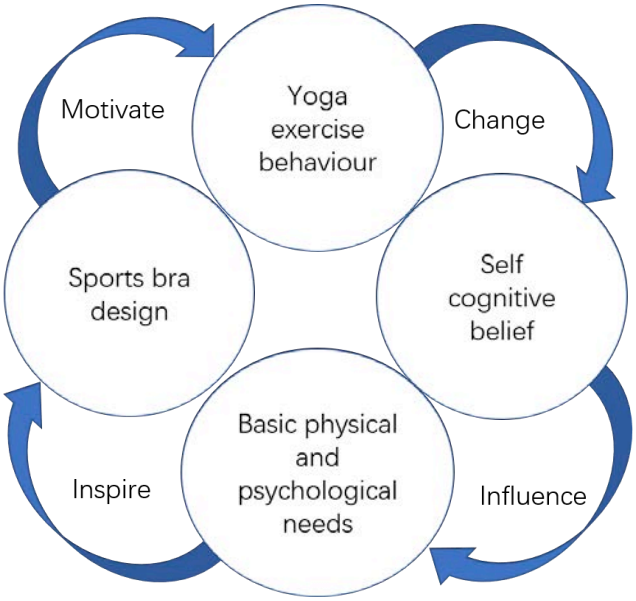


Figure 3. Conceptual model of sports bra and yoga exercise for senior women.

Figure 3 shows the conceptual model of the sports bra and yoga exercise. It is assumed that self-cognitive belief influences their basic physical and psychological needs. Their needs accordingly inspire to design the sports bra more age-friendly and the optimized age-friendly sports bra works as an incentive to motivate the senior women to be involved and persistent in yoga exercise.

The reason for participation in yoga exercise was included in the questionnaire. The aim was to identify the motivation differences between senior women. Following was to explore the

motivational determinants of sports bra on a different period of yoga exercise history. The physical and psychological needs of senior women on the sports bra were included. The self-cognitive belief is predicted to occur exercises behaviour for senior women. If they do yoga exercise because the health-related factors (incentive to act, benefits), or they are enjoyable to do yoga exercise (self-efficacy) Questions regarding the purposes of wearing sports bra included items “feel confident”, “show out the body”, “avoid accidental exposure”, “provide stable support” are related to the self-efficacy which are the indicators for better activity performed under the help of sports bra. So maybe can motivate by extrinsic motivation. Besides, some items namely “peers have bought”, “famous brands of sports bra”, “recommendation of friends”, “recommendation of social media” are assumed belong to one of the four cognitive constructs - social/environmental influences. According to the previous studies, (Zhou, Yu, & Ng, 2013), effective sports bras shared common features or functions such as comfort, support and aesthetic. As a result, “wear comfortable and not tight”, “breathable perspiration”, “provide stable support”, “good looking” are included in the questionnaire. Considering the special for declining functions of the senior women body, for example, senior women cannot lift hand over the shoulder, reduced muscle strength. The performance of sports bra regarding the “easy to wear, easy to take off” is involved.

3.2 Motion capture data collection

Motion capture system is a set of equipment which is used to measure motions and record the motion of objects in three-dimensional space as shown in figure 4. It has been widely used to measure kinematics and kinetics data of participants. In the past, the subjects were asked to evaluate the systems and respond to questionnaires. While nowadays some more advanced and rigorous approach is developed to obtain human’s kinematic evaluation and analysis. In the beginning, the infrared reflective markers are attached to the specific positions of the targeted objects. Followed by tracking and recording the three-dimensional trajectories of those markers by using 12 high-resolution digital cameras. After the reflected signals were captured, the motion data will be transferred to the computer system for further biomechanical analysis. Usually, the raw data directly recorded by the motion capture system has some missing points. The acquired data was not qualified for analysis. Data cleaning and filtering are imperative for the accuracy of further data analysis, which can be finished on the motion capture system.

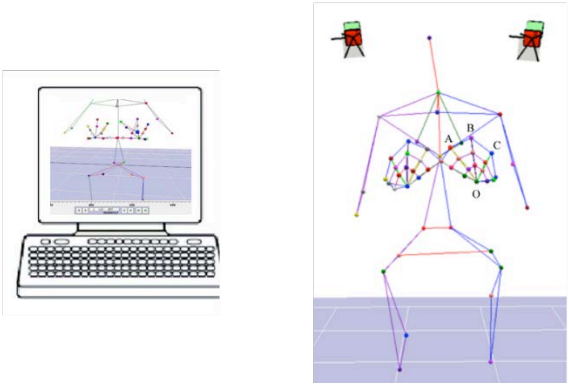


Figure 4. The retro-reflective markers captured by the motion capture system preview on screen.

In this study, the motion capture system (Eagle, Motion Analysis Corporation, US) is adopted because of its advanced sensitive and reliable data capture ability. This type of system directly measures markers and followed by analysis algorithms to get attitude. The arrangement of those markers should be careful. Markers on selected locations on the human body should not change relative distances. Each marker should be posited as far

away from each other for reducing computational errors in the attitude and increasing sensitivity. The placement of the infrared reflective markers is shown in figure 4, herein, 31 markers are selected in total (with a diameter of 9.5 mm) for the breast. The markers are attached on the nude breast. It is well-known that the female breast covers from the anterior axillary in the horizontal direction to the costal cartilage and sits from the second rib in the vertical direction to sixth/seventh rib. The outer upper quadrant of the breast tissue extends towards the axilla. Before starts the record, the motion capture system should be calibrated. Then the participant was asked to stand at the centre of a camera focused, following she will do the arm abduction position from 30° into 90° in the horizontal direction on both sides. The real-time 3D coordinates in x, y, z directions of marked points A, B and C were measured and recorded during the participant doing abduction.

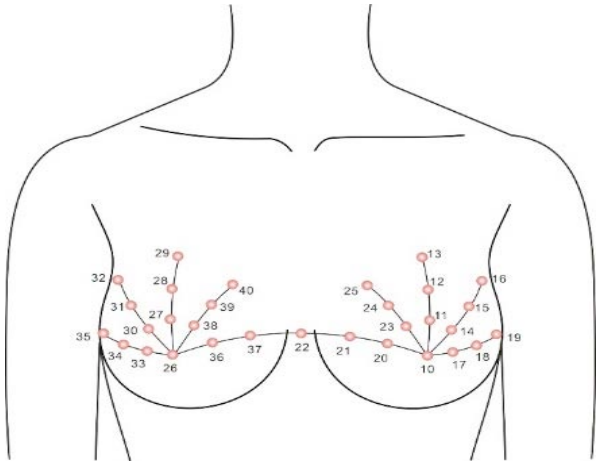


Figure 5. Placement of motion capture markers on the breast.

The researchers received the approval of conducting the motion capture experiments from the School of Design of The Hong Kong Polytechnic University. Prior to the experiments, the participants have informed the content and purpose of this research. All of the participants were signed the informed consent form. Their personal information remained confidential and all the experimental data will not be disclosed. Participants are selected the female at the age from 60 or above without any breast surgery history which was selected strictly based on selected criteria.

One participant volunteered for this study, whose age is 65 and meets the subject recruitment criteria that is no breast surgery history and muscle of body functional problems, The motion including 2 yoga poses from bare skin, motion capture was conducted using EVaRT5 to collect the marker data and data clean-up after measurement. The 2 yoga poses are Warrior I, Warrior II as shown in figure 5. Those two kinds of yoga poses will lift arms in different directions, they are upward and lateral, respectively. The reason for choosing these 2 yoga poses is to investigate the differences in the skin extension of the senior women breast when the breast was stretched in different directions.

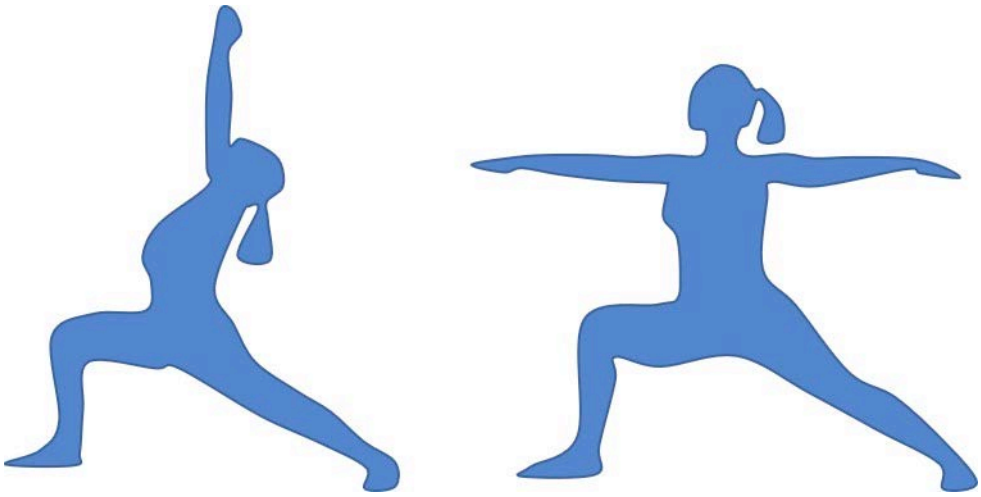


Figure 6. The selected 2 yoga poses for the motion capture experiments, Warrior I (left), Warrior II (right).

4 Results and discussion

4.1 Analysis and results of the questionnaire

The reasons for participating in Yoga exercise was shown in figure 6. It can be found that “lose weight and stress reduction” and “relax mind” are the two major reasons why senior adults take part in the yoga exercises. Followed closed by physical fitness exercise and improvement of temperament or gesture. The result expresses a combination of mental and physical reasons from the perspective both the self-efficacy and the perceived benefits. Other emerging themes like “feels good” (15%), “enjoyment” (4%), and those “who feel it has become a part of their lifestyle” (4%) indicates that participants to do yoga practice is somewhat due to the precaution of benefits overweighed its costs/risks which persistent them to adhere the exercise practice, they think they can perform well although exercise is a complex, time-consuming. The relax and stress relief of the yoga exercise outcome promote their self-confidence, encourage them as motivation. It goes obvious that participants who had longer yoga practice history reported being motivated more which can also be explained by integrated regulation and intrinsic motivation. In other words, those who have practised yoga report more autonomous forms of motivation.

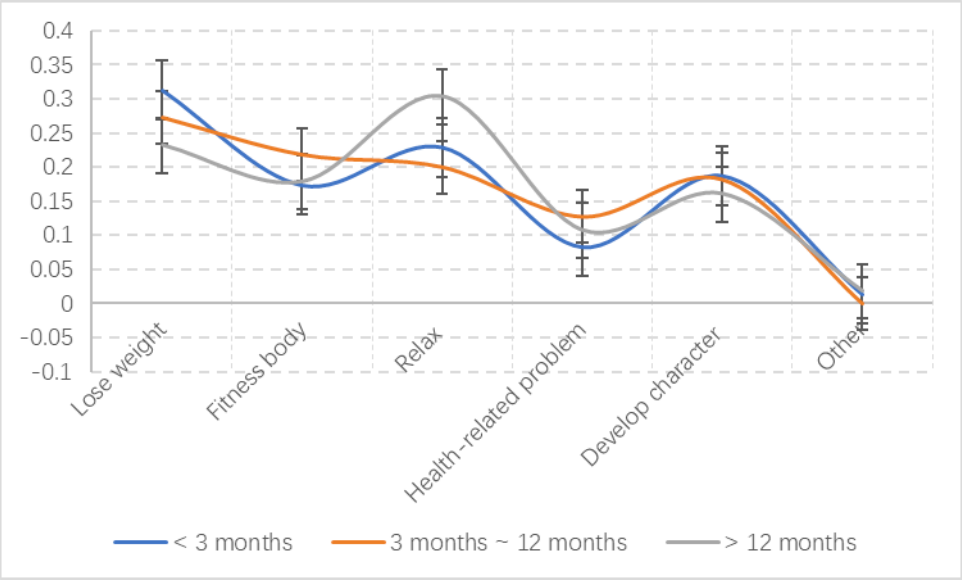


Figure 7. The reasons for participating in Yoga exercise.

As shown in figure 8, “wear comfortable”, “breathable perspiration”, and “easy to wear and take off” are three main demands for participants’ selection no matter how long of the participant's yoga practice engagement time. So, the senior women may pay more attention to the comfort and support of sports bra. It also should be noticed that “the demand of sensor of ritual” in three months’ yoga practice history has a larger proportion than who has half a year and more yoga exercise history. This is a result of that “the sense of ritual” motivates yoga beginners to start yoga exercise. SDT theory indicated that behaviours are fully integrated with the self-concept, values, goals. (Sanli, Patterson, Bray, & Lee, 2013) “The sense of ritual” satisfies the psychological needs to motivate exercise behaviour which is totally incorporated into the behavioural repertoire. “Feel confident” it seems more important for participants with more than one-year yoga practice history. These results also indicate that integrated regulation may play a role in individuals’ abilities to reach the transformed stage of change for practising yoga. In other words, sports bra may help participants internalize to do yoga practice over time.

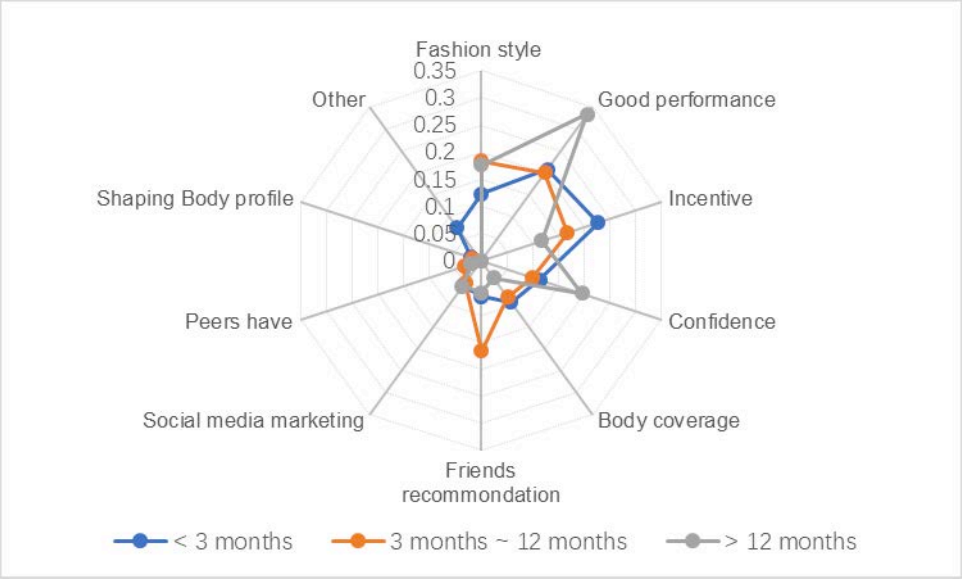


Figure 8. The considered factors of wearing a sports bra for senior women with different yoga exercise history.

4.2 Biomechanical analysis of motion capture

To describe the movement of the senior women breast, the skin extension of the breast and how the breast deforms during the two selected yoga poses should be analyzed. The linear displacement of the selected points on the breast surface was calculated. All kinematic displacements of the points were assumed as a two-dimensional basis in one plane. The linear displacements of the selected points are calculated by the equation:

$$\lambda = \left(\frac{\Delta L - \Delta L_0}{\Delta L_0} \right) \times 100\%$$

Herein, the ΔL presents the original displacement while the ΔL_0 presents the deformed displacement, the λ presents the strain.

Because the differences in the strain λ are too small to obviously observe. The strain λ takes the form of the logarithm. The skin extensions from bare skin are calculated by using the software OriginPro (OriginLab Corporation, USA). The results of the skin extension under the different status of 2 poses are shown below. The down position in figure 9 means the arms at the lowest position 45° angle of the gradient with the trunk on two sides. The up-position means the arms lift over the head.

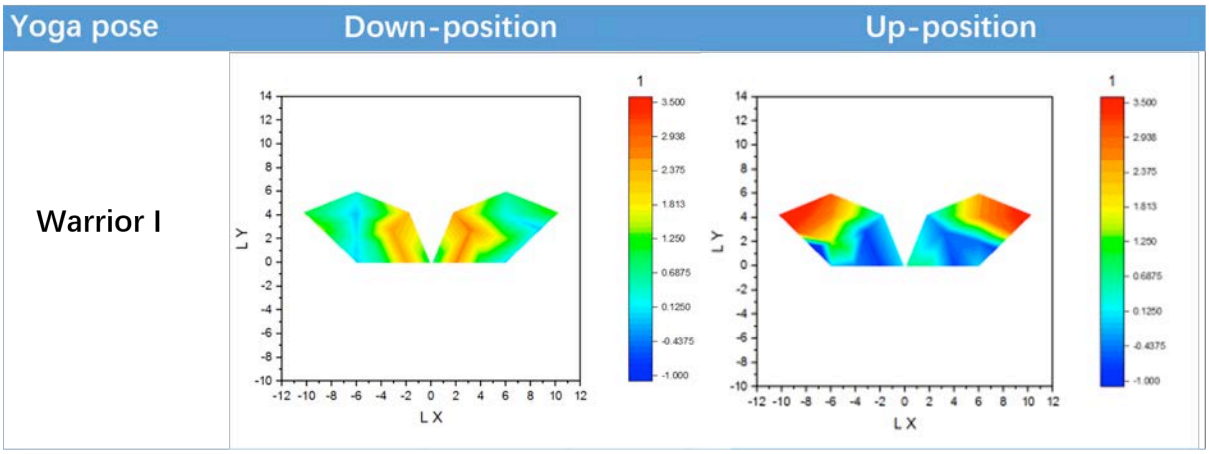


Figure 9. The visualization of motion results of yoga pose: Warrior I.

While the medium-position is the start of the Warrior II. The arms put together at the medium height in the centre director and the T-position is the end pose of the Warrior II as shown in Figure 10. The magnitude of the displacement as shown in the right hand of the graph. The value varies from the lowest to highest is a small value to big. In the down position of Warrior I, the displacement of each part on the breast seems closed. Only slightly orange colour in the centre of two breasts which mean there is stretched, while the green colour can be seen in the upper outer part on the breast means that this part is contracted.

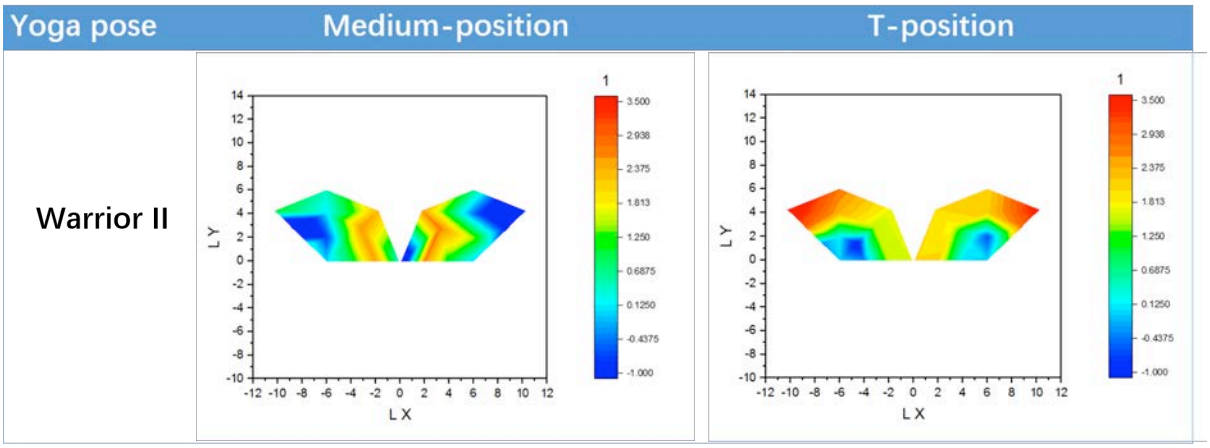


Figure 10. The visualization of motion results of yoga pose: Warrior II.

Figure 10 shows the motion results of Warrior II the arms rotated from down-position to up-position, the area of red colour in the upper outer part is the most extended part at that moment, on the other hand, the blue colour representing the tightened part in the centre of two breasts. It shows the upper outer part of the breast has the largest positive value which indicates this part skin is stretched largest, while the centre of two breasts has the negative value means that the place is contracted. It is demonstrated that the displacement is increasing as the arm uplift, especially when the hands are raised up, the extra support is needed on the upper cup for senior women when doing exercise. When it comes to talking about the skin extension during Warrior II, the deformation of the linear displacement is similar to that of down-position. However, the level of the linear displacement change of medium-position is larger than that of down-position. This may be due to the push force of arm on the breast when arms put together. When medium-position pose changes to T-position, all boundary part both of the inner and outer part are stretched. Conversely, boundary part to left nipple and then the right nipple is stretched in a lower level compared with the boundary part, it means nearly the nipple point maintaining the lower level movement during the change of the arm position. At the t-position, nearly the whole breasts are stretched at a large extent. This also indicates that the senior women breast has a large deformation during doing yoga. The large deformation may further influence the stability of the breast, and repetitive deformed breast may result in lack of the support structural system inside the breast and serious breast sagging. In order to avoid this situation, the sports bra designed for senior women should pay more attention on the support.

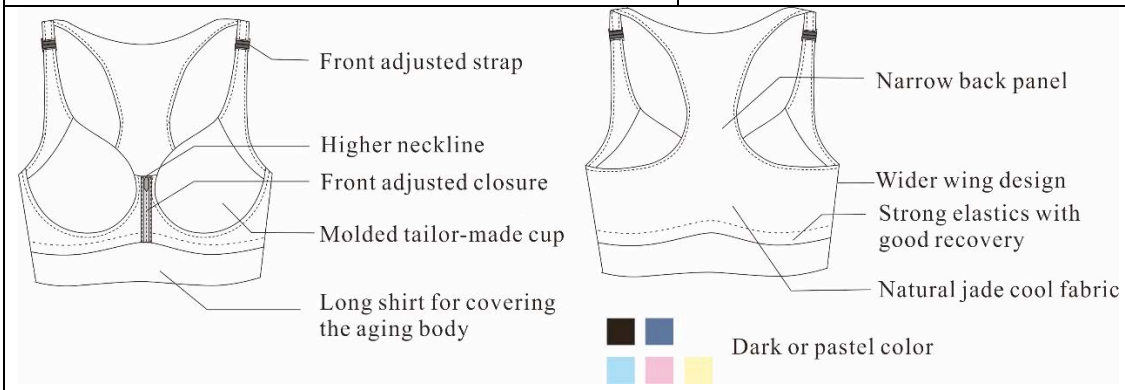
4.3 Propose of the sports bra design criteria

Some researchers concluded the features of the most effective sports bra that are short vest style, high neckline, slings, cross back, bound necklines, no center gore, no wire, no cradle, no pad and a non-adjustable wide strap (Zhou jie, 2013, Zhangshichen, 2018). The breast displacement can be reduced by the improvement of the gore height, shoulder strap width, neckline height and side seam depth. The design criteria were established based on the needs of older women in over 10 design features of construction based on the previous questionnaire results and motion capture results. To address every need and aims to provide effective support, comfort and stability, the specific design features were made based on the result of content analysis, in terms of fabric, elastics, and over 10 features of construction. For each need, design features were concluded from bra samples by

frequency analysis in wear trial comments. Therefore, the design criteria can be summarized based on the good design features and bad design features under each theme.

Table 1 Design criteria of aged-friendly sports bras

Needs		Design criteria
Fabric	Breathable	Natural jade cool fabric
	Thermal comfort	Odor resistance polyester knitted fabric
		Breathable and thin materials
Elastic strap	No spreading	Adjustable straps and closure
	Easy to adjust	Front adjusted strap
	Easy to wear	wide enough
	Easy to move	Strong elastics with good recovery
Neckline	No exposure	Higher neckline
Back	Large movement space Hidden back fat	Not cross-back and pull-over bra
		Back design: Narrow panel
Armhole	Large movement space	Concave panel
Cup	Round breast shape	Molded tailor-made cup for older women
	No sagging	
Side panel	Lift up the breast	Special cutting to lift up and firm the breast
Aesthetic	Fashionable	Dark color or pastel color
	Look younger	Long shirt for covering the aging body
		Color matching
Closure	Easy to wear	Front adjusted closure
	Easy to move	
Wing	Better coverage	Wider wing design



5 Conclusion

The needs of the older women on the sports bra are explored by conducting the questionnaire survey, combined with results of the motion capture results on the nude breast of older female participant, the design criteria of the sports bra for the older female users is proposed. Design specification of age-friendly bras in biomechanical fitting terms for various bra components and construction will be helpful for the development of sports bra. The development of age-friendly sports bra can not only satisfy the physical needs but also can fulfill participants' psychological needs, then motivate then to wear sports bra and to initiate and maintain the yoga practice because the extrinsic motivations are more effective than intrinsic motivation at the beginning period. Those who have practiced yoga for longer periods of time would be more autonomous forms to do yoga exercises.

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Dr. Zhou Jie mainly focuses on sketches of the bra and active wears design, ergonomic design of functional intimate products. Recently, computing science such as neural networks, mathematic models has been carried out.

Prof. Yu Winnie is internationally reputable in the field of clothing technology and biomechanics. She published over 125 papers and 17 book chapters. She was the director of Ace Style Institute of Intimate Apparel in the Hong Kong Polytechnic University.

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Audience Matters: Participatory Exploration of Speculative Design and Chinese Wedding Culture Interaction

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Users play an essential role in the process of designing new products and services. At the same time, culture also acts as a resource for design practice through user research and co-creation. Meanwhile, the behavior of designed products via their use and users result in culture becoming an outcome of design. With this in mind, speculative design promises to comment upon culture mainly through building futuristic scenarios via design exhibitions and similar provocative public space interactions. Without products acting as a central focus of novelty which eventually become part of users' everyday lives, as is the case in product design or other more tangible design fields, this paper examines instead the interaction between speculative design and culture. This paper explores the impact of participatory activities on the interaction of speculative design and culture using a Research through Design approach, in which a set of speculative design concepts are formulated within the context of Chinese wedding culture. By conducting several participatory activities and analyzing collected data, this paper proposes that speculative design which reshapes material culture could attract public attention towards immateriality.

Keywords: participatory activities; design and culture; speculative design; Chinese wedding culture

1 Introduction

Design is to nudge and change the current situation to a preferred one through new products, systems and services (Simon, 1996). In order to ensure more predictable success with new product launches, designers conduct a series of user research using anthropological methodologies, or as Clarke suggests, "design anthropology", to identify real user needs (Clarke, 2010). Participatory design is one of the more well-known research methods which invites users to participate in the product/design development process to better interpret their demands into design language and product functions. There have been many studies on the value of co-design and co-creation in multiple design disciplines (e.g. Trischler, Pervan, Kelly & Scott, 2017, Mitchell, Ross, May, Sims & Parker, 2015). Design and culture are innately linked through user research and the co-design process. When products are mass produced and used in people's daily lives, culture is reproduced by changing user behavior with through design. In this way, culture is both a resource and an outcome of design practice (Balsamo, 2010).

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Proposed by Dunne and Raby (2013), speculative design is conceptualized to reveal social problems and comment upon culture. It focuses on possible political and cultural issues in the future. Instead of conducting research and getting users involved in the production process, the impact of designed products draws more attention. Since there are usually no products available in real life which can represent the design concepts, speculative designers mainly use provocative images and multimedia scenarios to express their cultural perspectives. Users are engaged as an audience by reading and imaging the designers' expressions. However, DiSalvo (2012) argues that although speculative design exhibition "can spark a curiosity that might be pursued, it failed to rouse to action" (p.119). Elsden et al. (2017) proposes the term Speculative Enactment, an experience-centered approach to speculative practice, where people can interact with and experience speculation. It works by making speculation matter to the participants, making their actions and non-actions meaningful in the designed future scenarios. Lyckvi, Roto, Buie and Wu (2018) also work on the overview of the combined participatory design / design fiction process. These studies shed a light on the intersection of both participatory design method and speculative design practice.

This paper aims at exploring the impact of participatory activities in speculative design and cultural interaction in terms of designer-audience communication. A set of speculative design concepts related to Chinese wedding culture was formed, followed by three participatory activities including group discussions and a co-design workshop. It is proposed that participatory activities, as communication methods, provide the audience with an opportunity to deeply reflect on the current issues and co-create the future.

2 Speculative design in practice

2.1 Cultural context

The ritual of marriage is recognized as one of the most significant family events throughout in nearly all cultures across the globe, and China is no exception. The wedding ceremony in particular is the most important part of the ritual, with members of both couples' families and friends all playing some role, be it formal or informal. The couples, especially the brides spend a huge amount of money on their dresses on the wedding day to show their tastes and social status. Tiger Hill Bridal City in Suzhou is one of the largest wedding market in China, attracting both domestic and international customers to buy their wedding dresses there. The price of one dress can range from 40 RMB to 400,000 RMB with varying levels of quality of materials and details.

Despite geographical differences and climates, the Chinese wedding ritual generally involves three parts: pick up, ceremony and banquet. Pick up is when the groom escorts the bride from her family to his. It often takes place in the morning. The bride sits on the bed while the bridesmaids challenge the groom with some games at the door. Only when the groom and his team pass all the game tests can they enter the room and meet the bride. The wedding ceremony is held before the banquet when the couple stands on a stage in front of all the guests and shares their love stories. There is usually a professional master of ceremonies who hosts this session (similar to priest in the western wedding but without the same legal linguistic powers). Then the couple and their parents toast to each table during the banquet.

It is common for a Chinese bride to wear three, four or even five dresses on her wedding day. Brides wear different dresses to fit different ritual events. For instance, the bride often wears a floor-length dress during the pick up session. The bride sits and spreads her dress on the

bed, and may sprinkle some red ‘shuang xi’ (means double happiness in Chinese) on the white dress to create a beautiful scene (see figure 1). At the ceremony, Chinese bride prefers a western-style dress with long train to suit their wedding stage, demonstrating their social status (see figure 2). At the banquet toast, the bride changes into a dress that is more convenient for walking, which may be Chinese traditional clothing or knee-length dress, generally in red (see figure 3). The bride only wears each dress for one to two hours. No matter rented or bought, after the wedding day those dresses will not be worn again (see table 1). It thus is reasonable to argue that the relationship of the bride and her wedding dresses is weak by the time factor alone. This relationship without or with little (true) relation is claimed as alienation (Jaeggi, 2014, Rosa & Henning, 2017). Originally identified by Karl Marx (1988), alienation theory has attracted interest from research coming from multiple different angles. After the 1950s, alienation was interpreted as the outcome of consumption and scholarly work focused on the alienated behavior of consumers (Xue, Manuel-Navarrete & Buzinde, 2014). Alienated consumers continuously and easily consume products they do not really need and thus hold a weak relationship with after purchase.



Figure 1, the bride was sitting on the bed waiting for her husband



Figure 2, the couple was walking on the stage of their wedding ceremony



Figure 3, picture of the bride (fourth from left) and some guests after the banquet

Table 1 The prices, wearing scenarios and durations of the three dresses on the wedding day

	Price	Wearing Scenario	Wearing Time	Wearing Duration
Dress 1	1300RMB in total, rented	Pick up	10am-12pm	2 hours
Dress 2		Ceremony	5:30-7pm	1.5 hours
Dress 3	400RMB, bought	Banquet toast	7-10pm	3 hours

2.2 Design concepts

The background of the speculative design concept acts as a response to the relationship between the bride and her dresses. With the assumption that the relationship will become weaker in the future, the speculative design concept is formed as a water resolvable wedding dress which will totally disappear when washing after the wedding day. On the contrary, another design concept is a wedding dress that is tailored from a daily dress of the bride using water resolvable material. The wedding dress is able to change back to the original one after washing. Under this circumstance, the relationship is strengthened since the bride shares more stories with the dress both before and after the wedding day.

3 Participatory activities and results

3.1 Activity 1&2: Online and offline group discussions

The two design concepts were discussed with unmarried and married females through an offline and an online discussion respectively (see figure 4 and 5). Their discussions followed

the same structure with deeper and deeper descriptions of the concepts step by step. The discussion was divided into the following four parts. Participants freely exchanged their opinions in each step.

1. The design concept was described as a magic dress which totally disappears after wearing once. The unmarried participants were curious about why and how the dress disappears and they discussed several possibilities. The married group did not mind as long as they were not the only one whose wedding dress disappears. They discussed more about their own wedding experience. “My wedding dresses were rent so I do not care if they disappeared or not. I would feel ominous if only my dress disappeared bizarrely. But it would be fine if others’ dress also disappeared”, said one participant.
2. The water soluble fabric was introduced to the participants. The unmarried participants worried about the functions of the new dress such as what if the wedding day is a rainy day, while the married group did not treat it as a problem - they all had their weddings indoors. One unmarried participant mentioned the possible user behavior change with this concept. “Maybe when I buy the dress I want it to disappear after wearing. But after my wedding I change my mind and want to keep it. In this case I will need to store it in a special way”, said her. The married group all agreed that if the price is acceptable they would like this dress.
3. The tailored partly water dissolvable dress was described for them to compare. The unmarried group all preferred this concept. One participant described it as “special story for me and my husband”. The remained part of the dress fitted their imagination that brides like keeping the wedding dress as a memento. They also mentioned there might be special rituals on the wedding ceremony because of the new dress. Surprisingly, almost all participants in the married group said they would not choose the partly resolvable dress since they thought they did not own a suitable dress to tailor. Only one participant thought the idea is creative and might be attractive to those who loves to try newest fashion.
4. The design theory behind the practice was explained. The unmarried group thought it as a great design concept but could not share more opinions. The married group also did not care about the design theory. They only cared about the shape and price of the dress.



Figure 4, offline group discussion with unmarried females



Figure 5, online group discussion with married females

The participants of both online and offline discussions tend to judge the new design concept under the current cultural context. They focused more on the functions and value for money of the dress. Their perspectives were mainly considering whether they would buy the dress for their wedding.

3.2 Activity 3: co-design workshop and interviews

A design workshop was held with nine participants from both design and other backgrounds. Participants were divided into three mix-background groups (see figure 6). They were encouraged to imagine what the Chinese wedding ceremony would be like in the future based on the two wedding dress design concepts. Each group made a wedding dress collage and a ceremony scenario paper prototype to explain their imagination and design. All the participants were interviewed after the workshop.



Figure 6, co-design workshop with nine participants in three groups

The design of group A was inspired by baptism from the western Christian religious concept. In their future wedding ceremony, the bride would wear a white dress with super long water soluble train. She would be baptized by passing through a river from the entrance to the main stage of the wedding hall, where the dress train would resolve and her dress would become a floor-length train (see figure 7). Group B designed a ceremony in martial arts style and created new rituals for the couple in response to the water resolvable clothing. Similar to the wedding dress by group A, their bride would wear a dress with super long train. The guests attending the wedding would pour their wine and drinks onto the long dress train to express their best wishes. Afterwards the bride would take off her long train and put it into a huge wine glass with wine, to make it resolve together with the groom's cloak made of the same material (see figure 8). The imagined wedding ceremony of group C would take place in the space. In their scenario, the couple would first meet and fall in love with each other at a barren planet where looks like desert. The bride would wear in tights at this moment. Then the couple would go through a waterfall door and arrive at a lively planet, representing their new life after marriage. When walking through the waterfall, the tights would disappear and a tutu inside would show up (see figure 9).

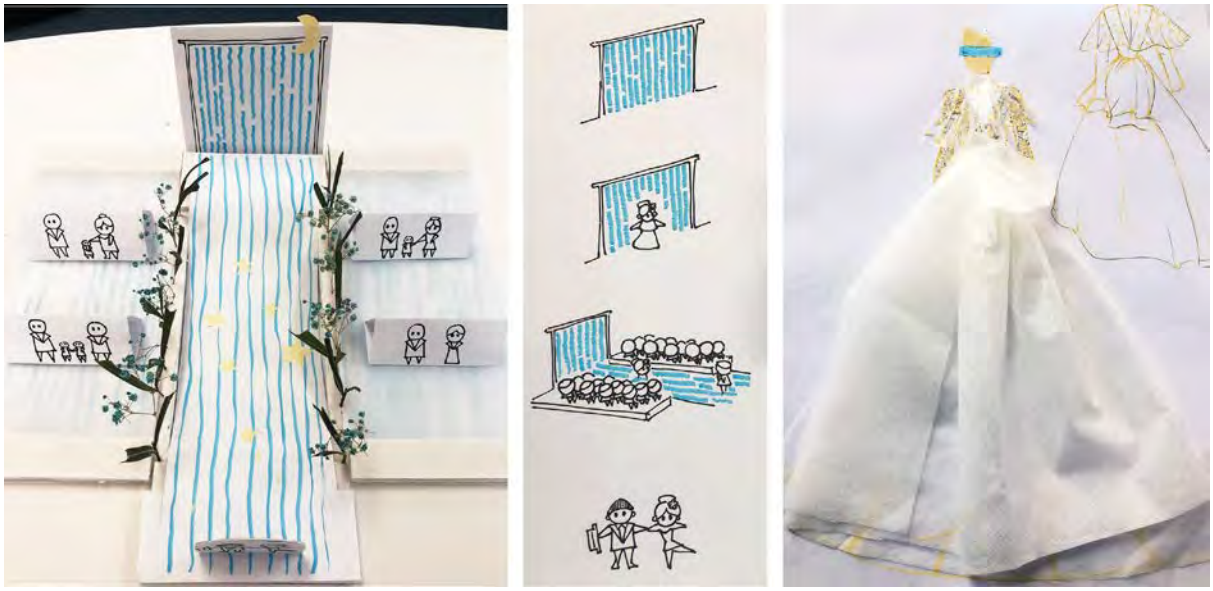


Figure 7, wedding ceremony prototype, storyboard and dress collage of Group A



Figure 8, wedding ceremony prototype, storyboard and dress collage of Group B

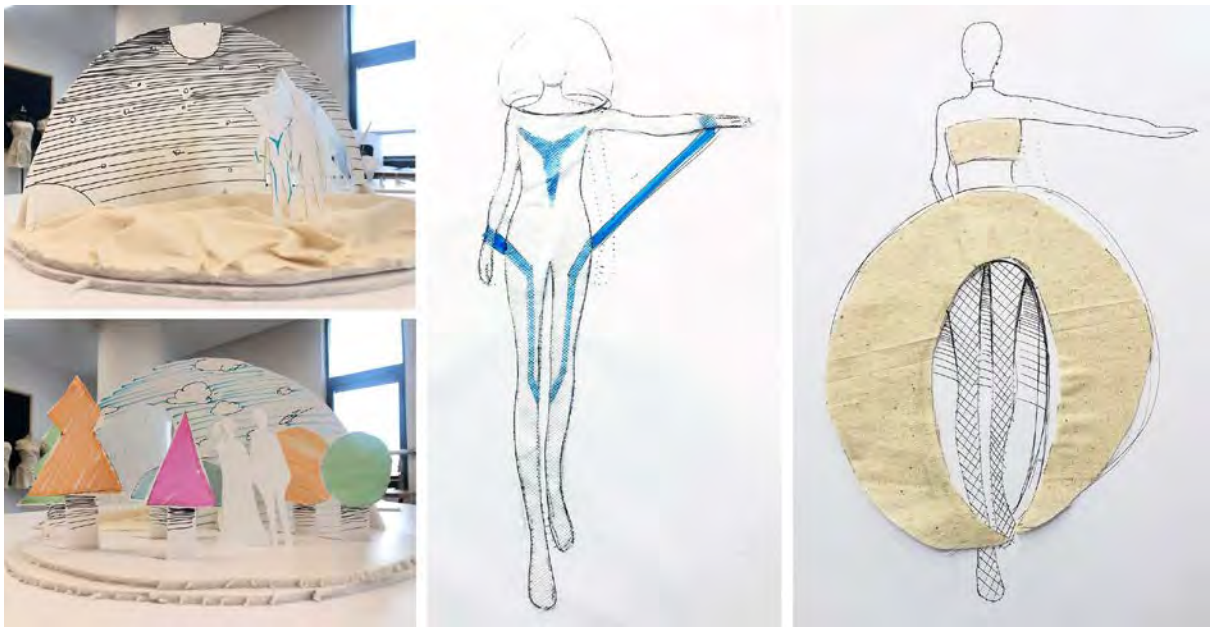


Figure 9, wedding ceremony prototype, and dress collage of Group C

All the participants imagined more possibilities about Chinese wedding culture during the workshop no matter they were conscious or not. Their thoughts during the workshop were critical and reflective, while most of them did not pay attention to wedding culture before. All the participants have attended some wedding ceremonies of their friends and relatives, and two of the participants (they are a couple) had their wedding in 2016. They all recalled their wedding experiences during the workshop. When talking about what did they gain from the workshop, one girl said “maybe it will change my decisions on my own wedding”. It is reasonable to argue that they will also recall their workshop experiences in wedding related scenarios in the future. Only one participant had some considerations about wedding culture before the workshop, such as the differences of Chinese and western wedding and the future wedding forms. The workshop provided her with an opportunity to communicate her former thinking with other participants. “It enriched my former imagination of future wedding. I am very happy to express my ideas using design language”, said her. The design task in the workshop pushed the participants to pay more attention to the cultural ritual in the future instead of the functions of the dress compared to the group discussions. The wedding ceremonies they designed are towards a preferred future. They all endued the wedding stories positive endings, while in the group discussions participants imagined more accidents during the wedding.

4 Conclusion

There is no doubt that involving a public audience is essential to speculative design and culture interaction. The provocative images and scenarios that speculative design produced make it possible to arise public attention. The material culture (in this case, the wedding dress) has been reshaped to new concepts in the speculative designing process. However, when exposed to new concepts only or as a central focus, users tend to judge the functions, costs and prices, usability and practicality at first glance, ignoring deeper potential experiences and impact on personal practice. Nevertheless, group discussion activities encouraged more opinion exchanges when compared to visiting an exhibition, or other more passive forms of interaction with prospective new concepts or ideas related to weddings. Co-design activities after speculative designing process provided participants with a platform to

reflect more on cultural practices. The hands-on, participatory nature of the activities allowed the participants to enact a sense of tangibility to the abstract ideas of “culture” and “weddings”, and at the same time, enabled a sense of reflection through both activities and their respective discussions. Participants were allowed to create future scenarios, which enables them to take immateriality (wedding culture) into consideration based on the change of material culture (new design concept of wedding dresses). The co-design activities act as catalysts in speculative design and culture interaction. Although the activities are short-term and participants’ reflection is limited during the activities, the experience has the potential to have continuous influence on participants in the future. Engaging with speculative design through the use of participatory design activities provides a significant platform for creativity and reflection via materiality, which will in turn act in a kind of reciprocal manner with regards to the creation and acceptance of new cultural ideas and norms.

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Co-Design Framework for New Product Development: Case Study on a Smart-Textronics Product

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Recently, human-centred design methods have been actively considered for developing new products and services. Therefore, a new human-centred design framework for developing the smart-textronics products is proposed in this paper. The 'smart-textronics' technology has recently been popular for making people's daily life better by combining electronic components into clothes. The proposed co-design framework is composed of two phases – problem finding and problem analysis. In the phase of 'problem finding', activities of the self-immersion and co-creation are conducted through the usability test of existing similar products and the workbook in which users describe their usage activities, emotions, associated values and solution ideas. In the 'problem analysis' phase, the result analysis and online survey are carried out to frame a final design problem. Finally, the proposed framework is validated with the case study on designing the LED light jacket for bicycle users.

Keywords: Human-centred design; Co-design; Problem finding; Problem analysis; Smart-textronics products

1 Introduction

A human-centred product development approach has attracted more attention since the launch of various smart devices, because they have been successful by providing a customized experience for users. In this context, smart wearable products had been introduced about a decade ago, and smart textile, which is referred to as a combination of soft textile and smart devices, was also been of significant attention for making people's every life convenient and pleased. More recently, a concept of smart-textronics has been introduced as the new interdisciplinary paradigm comprising textiles, electronics and informatics (Gniotek & Krucinska, 2003). Products embedded with the smart-textronics technology can be applied in various situations. For example, it can provide an immediate help in a life-threatening situation for the elderly or patients with the sensor integrated in the textile that can monitor the health condition (Axisa et al., 2005). In addition, they can be used for the smart fire suit with a wireless communication and the art works with a lightening function such as the designer Moritz Waldemeyer's work (Vallozzi et al., 2010).

The smart-textronics products usually have complex characteristics because they are composed of various components to support multiple functions (Chan et al., 2012; Lymberis & Paradiso, 2008). Besides, they are supposed to be used by people for many hours of the

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day, and therefore, user satisfaction should be successfully ensured to provide an appropriate user experience. In this context, researches of integrated sustainable service designs for the smart-textronics products have been considered by cooperating and ideating with experts in different disciplines (Ten Bhömer et al., 2012; Briggs-Goode et al., 2016). In addition, a future user's needs and desires for the smart-textronics products should be predicted in the framework by properly handling ambiguity. For such framework, potential users should participate in the early design stage.

To effectively involve users in the design process, various approaches have been studied such as human/user-centred design, participatory design, co-design, and so on. The participatory design approach has been popularly applied in the new product development these days. In the participatory design, key stakeholders should be involved into design process (Sanders & Stappers, 2008). Vácha et al. and Vácha and Kandusová emphasized that it was essential to actively listen and analyse users' needs and preferences by involving them and having feedbacks for the proposed solution (Vácha et al., 2016; Vácha & Kandusová, 2018) in the participatory design. The concept of co-design which emphasizes the collective creativity of designers and stakeholders who are not trained in design has been growing (Sanders & Stappers, 2008). In their co-design framework, they discussed that users should be regarded as 'experts' of the design project, not passive stakeholders, by making them actively participate in the design process. The co-design process can also be more efficiently carried out by using proper toolkits, especially in the case that participants are not experienced in the design project (Sanders & Stappers, 2008; Sanders & Westerlund, 2011). Tassi (2009) collected the comprehensive tools such as role play, group sketching, issue cards, storytelling, and so on. Sanders and Westerlund (2011) suggested the concept of co-design space where creative design toolkits or workshops can improve the creativity of stakeholders in the process of design. In addition, the concept of value and the journey map were exploited for the co-design space (Yoo et al., 2013; Reay et al., 2017).

Although significant efforts have been made to develop design methods making users actively participate in the design process, a detailed methodological framework for effectively discovering potential needs and wants of users have not been sufficiently explored. This framework is of much significance to define design problems for products and services considering a great deal of user experiences and associate contexts such as smart-textronics products, which are of major concern in this paper. Therefore, we develop the novel systematic co-design framework where users can actively participate for an effective development of new smart-textronics products. The proposed framework consists of two main phases – 'problem finding' and 'problem analysis'. The problem finding phase has two sub-steps such as 'self-immersion' and 'co-creation'. In this phase, the workbook is prepared as a toolkit for users to be immersed into certain usage situations and to ideate fragmentary, yet very insightful, solutions. The workbook guides participants to describe their usage activities, emotions, pain points, values, functions and possible solutions. In the phase of problem analysis, the user analysis and problem framing are conducted in the step of 'results analysis', and the 'online survey' for possible users is conducted after developing the questionnaire on the proposed product ideas. Finally, the proposed co-design framework is applied to designing the LED light jacket for bicycle users as a case study.

2 Co-design Framework

The schematic view of the proposed co-design framework is given in Figure 1. As can be seen in Figure 1, the framework is composed of four steps such as self-immersion, co-creation, results analysis and online survey. The steps of self-immersion and co-creation are carried out in the phase of 'problem finding', and the results analysis and online survey are conducted in the phase of 'problem analysis'.

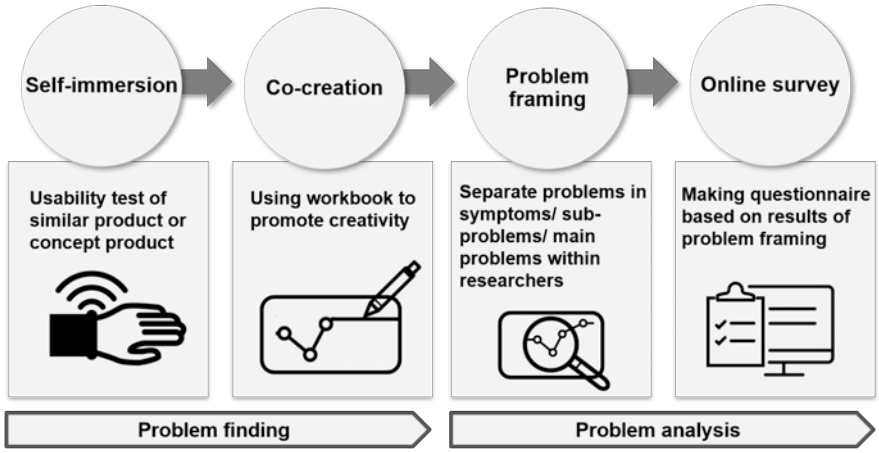


Figure 1. Schematic view of the proposed co-design framework

In the self-immersion step, 1:1 in-depth interview is mainly carried out for participating users. In particular, the usability test on existing similar products is considered to immerse users in usage situations. In the co-creation step, the workbook is developed, and participants are asked to fill out the workbook. The workbook includes two parts: (1) journey map, activity and emotion and (2) value and ideation. In the first part, users are asked to describe activities in a sequential manner when using the products. Then, they denote their emotional status for each activity node with possible reasons. Besides, users' pain points should be described with their significance levels. In the part of value and ideation, users can play a role of product developer by relating value words with their activities and pain points and coming up with desired functions and possible solution ideas. The value words can be selected from the E3 value framework which had been proposed by Cho et al (Choe et al., 2010). In Figure 2 and Figure 3, the snapshots of the parts 1 and 2 of the workbook are given.

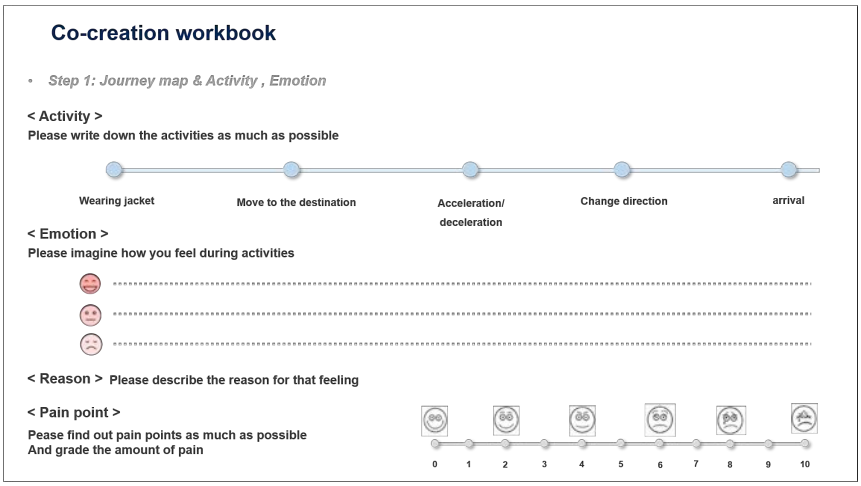


Figure 2. Snapshots of the workbook – part 1

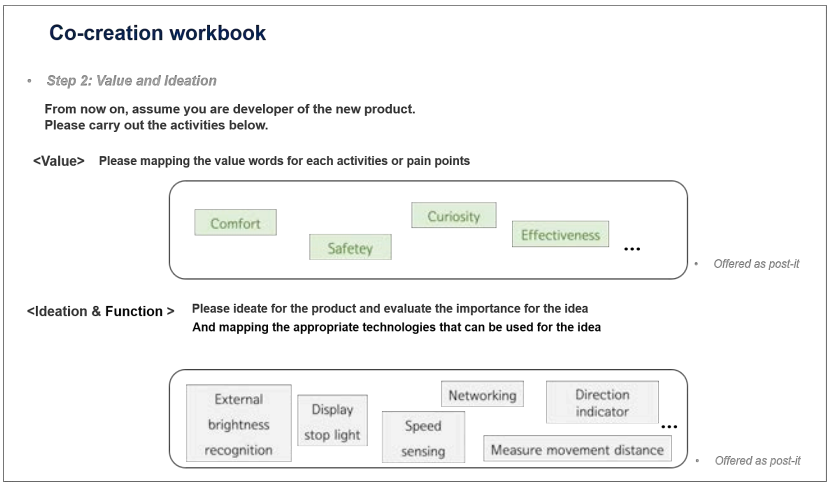


Figure 3. Snapshots of the workbook –part 2

After the above-mentioned steps, two steps – the results analysis and online survey – in the phase of problem analysis are carried out. The data obtained during the problem finding phase are processed and analysed in the step of results analysis. In this step, the user analysis and problem framing are carried out. In the user analysis, several user groups are identified based on characteristics of the participating users, and in addition, their product creativity scores are compared and analysed. The product creativity score is composed of three dimensions including the centrality (attraction), desire and importance which are associated with customer satisfaction and purchasability (Horn and Salvendy, 2006). Afterwards, the problem framing is proceeded via the classification scheme of symptom, sub-problem and main-problem by multiple researchers having heterogeneous knowledge and experience (Frishammar Johan et al., 2016). Then, their individual work is aggregated and further discussed, and the integrated problem is framed and defined. Lastly, the questionnaire is developed by addressing important issues raised in the problem framing step, and the online survey is conducted for many unspecified users to get suggestions of the final conceptual product idea.

3 Case Study: LED Highlight Jacket for Bicyclers

In order to validate the proposed co-design framework for the smart-textronics product development, the case study on the LED highlight jacket for bicyclers was conducted. The LED highlight jacket has been mainly used for bicycle users to enhance their convenience and safety. In the meantime, the company tries to improve its design and function by actively integrating smart-textronics technology to further enhance user satisfaction.

3.1 Problem finding: Self-immersion and Co-creation

We recruited 6 bicycle users having diverse experiences in terms of the frequency and duration of cycling and number of people riding a bicycle together, and so on. The 1:1 in-depth interview was conducted for each user. During the interview, the usability test on the existing LED jacket and the co-creation activity with the workbook were conducted. Figure 4 shows the photo of the step-by-step sequence of the usability test and one of users wearing the LED jacket during the test.

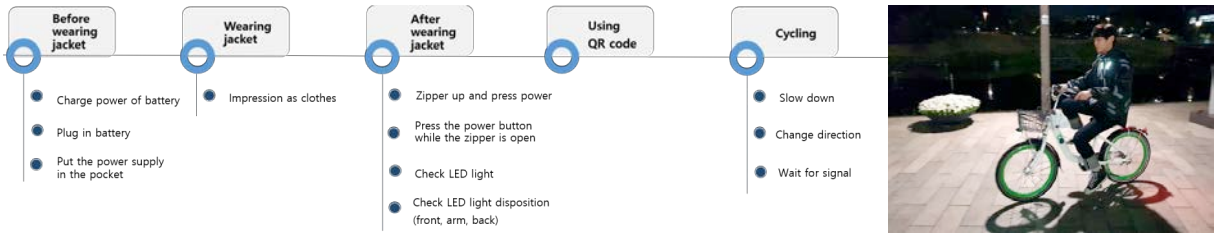


Figure 4. Photos of the sequence of the usability test (left) and the users wearing the LED jacket (right)

After the usability test, the users were asked to make scenarios by conceiving additional activities during usage of the LED jacket and to denote their emotional status at each activity node with needs and wants during the co-creation part 1 – journey map, activity and emotion. In the part 2 – value and ideation, the users were asked to map value words to each activity and pain point. In addition, they ideated additional functions and associated possible solutions. They also expressed significance levels of the pain points and the value-function-idea sets. Figure 5 shows the snapshot of the results of one user during the co-creation step. In Figure 5, the red-coloured activities are added ones, and the emotional status for each activity node is given. As can be seen in Figure 5, the user addressed several key needs such as the impossibility of a simultaneous operation of the bicycle gears and LED controller, the complicatedness for installing and recharging the jacket before, the difficulty in washing the jacket, and so forth. In order to resolve such needs, the user emphasized the values of convenience and comfort, and he addressed the functions of motion detection and ventilation. Then, the ideas of a goretex textile for effective ventilation, a provision of left/right direction signals with automatic detection of a bicycle rider, and a connection between a bicycle and an LED controller have been come up with.

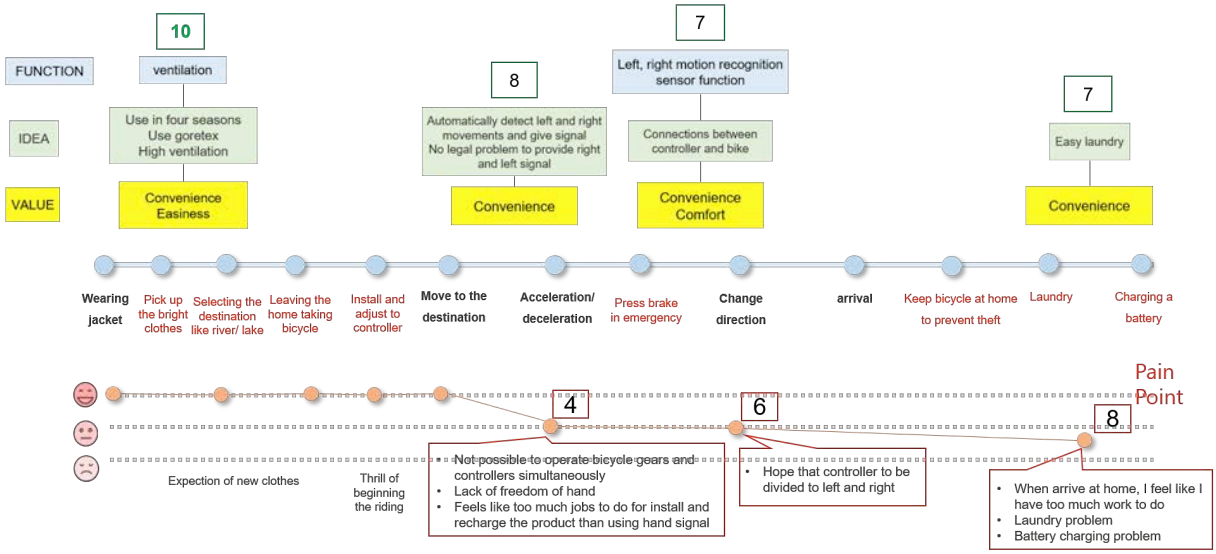


Figure 5. Snapshot of the results of one user during the co-creation step

3.2 Problem analysis: Results analysis and Online survey

In the results analysis, the user groups were identified based on characteristics of the participating users. Table 1 shows the identified user groups and their summarized characteristics. As can be seen in Table 1, three user groups were categorized.

Table 1 Three user groups identified from the user analysis

Group	Users	Characteristics
People who participate in the bicycle club	C, E	• Ride a bicycle once or twice a week, and ride it for more than 3 hours at a time • Socialize with the people of the club • Sensitive of design when buying bicycle clothes • Have various bicycle accessories
People who ride a bicycle alone everyday	D, F	• Ride 1~3 hours on weekdays evening or on weekends • They use it when commuting • They need clothes to protect themselves at night while riding alone
People who ride a bicycle often	A, B	• Often ride for 20 min to 2 hours on the weekdays or weekends • They usually cycle at late night

In the problem framing step, three researchers analysed the data obtained from the users, and the final main problem was defined by using the symptom-sub problem-main problem structure. Figure 6 shows how the final main problem was identified in this step.

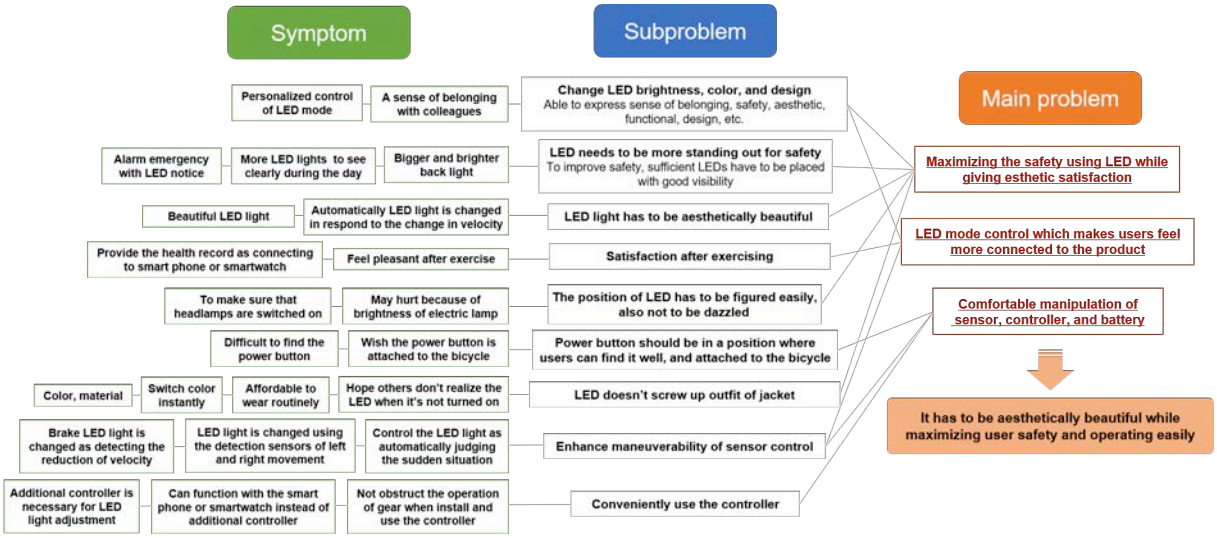


Figure 6. Schematic view of the final main problem definition in the problem framing step

The questionnaire for an online survey was created by considering the main problems that were defined in the previous step. The questionnaire was composed of total 28 items altogether. Among them, 16 items were extracted from the results from symptom-sub problem-main problem analysis. In addition, 9 items were obtained from the analysis on usage patterns of the users and 3 items were evaluation questions on the overall concept. The online survey was conducted for 23 respondents, and the results for 16 items that were extracted from the problem framing are given in Figure 7. As can be known from Figure 7, three insights having more than 4 points were obtained such as “affordable design to wear routinely”, “Not interfere with gear operation when using the LED controller”, and “alarm emergency with the LED notice”. Others having scores between 3.5 and 4 were also seriously considered for the product refinement and development. Finally, they were transferred to the company for the development of an advanced LED highlight jacket with the smart-textronics technology.

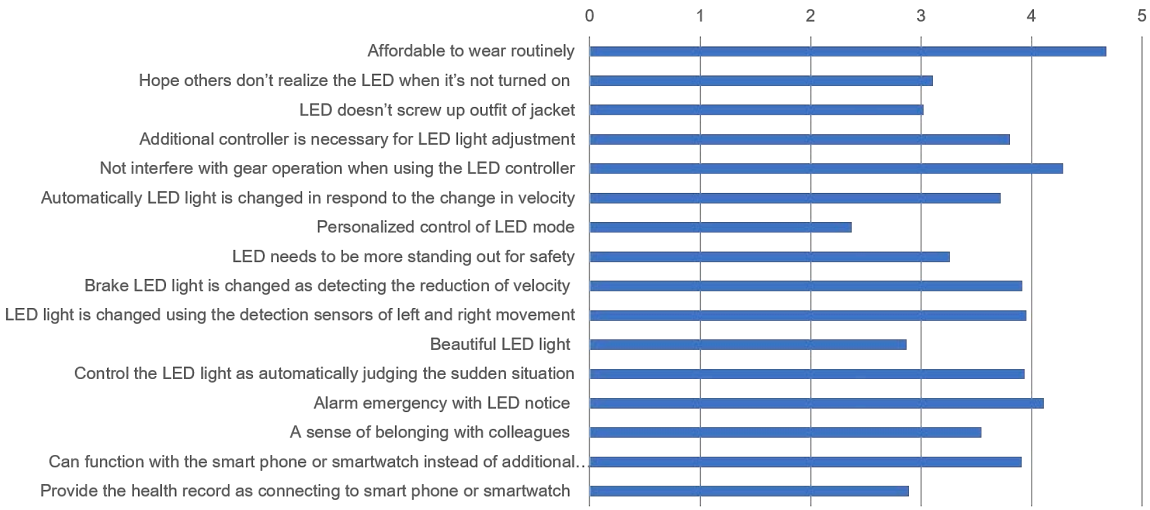


Figure 7. On-line survey results in the problem framing step

4 Concluding Remarks

In this paper, the new human-centred design framework for a new product development was proposed by considering co-creation between designers and users. Two main phases – problem finding and problem analysis – are included in the framework. In the phase of the problem finding, the self-immersion and co-creation steps are considered to make the users deeply involved in the usage situation and ponder pain points, values, functions and possible solutions with the 1:1 interview and the developed workbook. In the phase of the problem analysis, the critical main problems are identified based on the user analysis and problem framing. Then, the questionnaire is developed based on the results from the problem framing, and the online survey is conducted. In order to investigate applicability of the proposed framework, the case study on the LED highlight jacket for bicycle users was conducted. The results were transferred to the company for advancing the current LED jacket by adding insightful issues that were extracted from the users. Therefore, the case study showed usefulness and applicability of the proposed framework for an early development stage of the smart-textronics products. As a future work, the company will produce the new LED jacket based on the results from the case study and the usability test will be carried out to validate the proposed co-design framework.

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Co-living for Ageing in Place: Mapping Privacy and Movement in a Long-Term Care Setting

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With a rapidly ageing population, Hong Kong is facing a multitude of challenges in providing suitable housing models for ageing in place. This leads to a high level of institutionalisation and many elders eventually have no choice but move into long-term care facilities long before they need to. The rise of co-living is increasingly seen as an alternative ageing in place model. The study proposes that co-living could also be conceptualised in a long-term care setting in order to transform care environments from institutional to domestic. Privacy, as a key design factor in various living conditions, has been investigated in relation to the movement of older residents in a long-term care setting in Hong Kong. Data were collected through an indoor location-tracking system. The results show three movement patterns — (1) residents regularly withdrew to their bedrooms; (2) residents mostly moved within in short-range distances and (3) residents travelled farthest from their bedroom in late afternoon or early morning – that carry implications for future co-living layout designs.

Keywords: co-living, long-term care facility, privacy, movement

1 TRACK THEME: DESIGN AND PEOPLE

While we are ageing at an historic rate, research has shown that the ageing processes are modifiable and that people are living longer without severe disability (Christensen, K. et al., 2009). The emerging life stage, the third age, is now considered by many to be the “golden years” of adulthood (Barnes, 2011). With increased life experiences, our aspirations for this life stage are undergoing deep transformations. We need a new approach to reflect upon the reality of the traditional 3-stage (education – work – retirement) life cycle. How do we keep healthy? How will we afford to live without income? How will we sustain relationships? (Gratton & Scott, 2016). How then can we use design to help people live better lives? A study by Langdon and Thimbleby (2010) pointed out that inclusive design, an approach that enables designers to relate to the realities of ageing users, has a key role in addressing these changes. In addition, Orpwood et al. (2008) suggested that in order to create a useful design that will support the needs of older adults with dementia, inter-disciplinary knowledge combining the fields of social science, architecture, mechanical engineering, and care and social services is indispensable.

Participatory design researchers have suggested that community engagement is the key to creating designs that bring meaningful experiences. For instance, a study conducted in Portugal indicated that by building relationships with the users, designers could inject

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meanings into design (Branco et al., 2016). Dindler and Iversen (2014) suggested that nurturing relationships with the target groups has a critical impact on the design process and should be an object of design also. However, studies suggested that designers need to acquire skills to build relationships with the people they are designing for. Dankl (2017) pointed out that designers are mostly not trained, in comparison to, for example, healthcare professionals, in using a relational approach in the design process. Another study by Hendriks et al. (2018), stated that by learning about the person-cantered care adopted by care professionals, designers too could acquire the relational expertise when designing for and with people who have dementia. That said, Stevens et al. (2016) specified that when working with a single client, architects are familiar with ways to gather information and empathize with the client. Yet, when working with a group of different clients, it becomes more challenging for the designers to empathize with an abstract and undefined client. The study suggested that by engaging the users as a narrator, architects could overcome this obstacle.

This study proposes that, in the context of spatial design, indoor location-tracking technology offers a subtle and embedded method to engage the users. Although not a relational approach, ubiquitous data also has the potential to reveal how the elderly residents move and live. The system recorded the movement data of 50 residents in a field study for 31 days for analyses. The research sees digital technology as an alternative component in the co-design process in enabling designers to gather deeper insights and engage the participants in a more profound way.

2 RESEARCH FOCUS

Co-living is envisioned as an emerging housing model that could bridge the gap between domestic and institutional settings and support older adults to age in place. To facilitate the development of co-living spaces in Asia, the study aspires to understand the social behaviours of older adults in a shared living environment through a field study using indoor location-tracking technology. The focus of this research is to explain the residents' movement patterns through the spaces in a care facility in relation to their needs for privacy and social interaction.

2.1 Ageing in place

As the older population continues to grow, it is critically important to consider where and how older adults will live (Bookman, 2008). Many older adults want to 'stay put' in their homes as they age. These experiences have been found to have significant effects on older adults' physical, cognitive, and social wellbeing (Burton et al., 2011), as well as supporting feelings of inclusion, security, dignity, identity, and choice (Chui, 2008; Wiles et al., 2012).

However, to support ageing adults to age in place, Hong Kong still has a number of hurdles to overcome. There are currently over 150,000 older people who live alone in domestic settings (13% of total ageing population) and over 94,000 elders (8.1%) live in long-term care facilities or non-domestic environments (Hong Kong Population Census, 2016). The wide gap in housing quality between the domestic and institutional settings, referred as "the slippery slope" by Sullivan (1998) is still valid in the situation in Hong Kong today. Figure 1 illustrates the current that there are limited options of housing units provided for the seniors in Hong Kong. What is a cause for concern is that institutionalized environments, especially those that are privately run, vary greatly in standards and quality of services (Chui, 2011).

Private facilities are commonly regarded as “dire”, even with the government’s recent proposal to tighten the regulations (Chiu, 2019a). However, with the long waiting list to a subsidised care home, many elders have no choice but turn to private facilities which are not subsidised (Chiu, 2019a). As reported by Social Welfare Department (2019), there are currently around 42,000 elders living in private nursing homes. A study on infection control in residential care homes indicated that the service in private homes are variable because they are only required to meet the minimum statutory standards (Wong et. al, 2019). Another news article reported that some rooms in private facilities are as small as 32 square feet in size, failing to meet the existing already-low requirement of 70 square feet (Chiu, 2019b).



Figure 1. The “slippery slope” is a gap where a diverse range of housing prototypes is needed (“star” represents shared units that are being phased out by government agencies).

Therefore, there is an urgent need for more attractive and inclusive housing options for a diverse group of third age adults who are single, widowed, empty nesters, downsizers, etc. (Battersby and Nicholson, 2014). In between the domestic and institutional settings, authorities in Hong Kong had resorted to some forms of communal living units. However, these initiatives did not deliver satisfactory results. These units are being phased out due to the low occupancy and high level of conflicts. Non-profit organizations have also introduced a number of housing schemes in hope to support the vision of ageing in place but were reported to face challenges of financial viability (Sing Tao Daily, 2014). With the gradual elimination of these specialized housing, elderly people will more likely end up living in a long-term care setting, even when they may not need to. Figure 2 indicates the different degrees of ownership older adults have in the available senior housing.

	Independent Living				The "slippery slope"	Institutionalized Setting		
	1 Public / Private Housing	2 ★ Shared / Subdivided Housing	3 Senior Housing 1	4 Senior Housing 2	5 ★ Elderly Hostel	6 Home for the Aged	7 Care and Attention Home	8 Nursing Home
Bedroom	Private	Private	Private	Private	Shared	Shared	Shared	Shared
Kitchen	Private	Shared	Private	Private	Shared	None	None	None
Bathroom	Private	Shared	Private	Private	Shared	Shared	Shared	Shared
Dining	Private	None	Private	Private	Shared	Shared	Shared	Shared
Living	Private	None	Private	Private	None	None	None	None
Communal	None	None	Shared	Shared	None	None	None	None

Figure 2. The degree of ownership that older adults have in the existing housing units ("star" represents shared units that are being phased out by government agencies).

2.2 Co-living as a new housing model

According to recent studies, a number of concepts towards elderly living have pointed to the importance of community living or co-living. As Rioux (2010) observed, some older adults choose to move into a residential care home at their own will, even without major health issues. The well-known architect, Matthias Hollwich advocated co-living as a key product for ageing in place (Frearson, 2017). The re-emergence of co-housing in Europe and the United States is seen to contribute to a sense of community (Cooper Markus, 2000) and encourages social interaction (Williams, 2005). In Asia, co-living is also embraced by Japan, who has abandoned the approach of building more long-term care facilities (Lee, 2018) and redirected its focus to "housing with services". These developments often adopt the model of intergenerational co-living, from households in Nagoya (Zhan, 2017) to the health- and work-integrated senior housing complex in Kashiwa (Urban Renaissance Agency, 2014). However, shared housing remains a major setback in Hong Kong. Reports on violent conflicts were common in the public housing units for seniors where bathroom and kitchen were shared. The recent promotion of "co-living" developments has also been hotly debated as repackaging the illegal subdivided units as "luxury apartments" (LinePost.hk, 2018). It would require a new housing model for ageing in place to happen in the form of co-living in Hong Kong.

It is therefore important to fully understand the behavioural patterns of older adults in a shared living environment. By getting a better understanding on the behavioural patterns of the older adults in a shared living environment, we can further identify the reasons behind these behavioural patterns and develop motivation methods to alter the behaviours of the older adults to a more advantageous situation. Intrinsic and extrinsic motivations are the two important factors that drive the attitudes of older adults whether they are willing to accept, to adopt, to be active, and to put into action in daily living (Dacey et al, 2008). The self-determination theory is the research theory that puts design into factors that motivate intrinsically the mind of old adults into the first step of experience. Competence, autonomy and relatedness are the major design research parameters that could bring the concept of motivation into older adults, extract meaningful experience in co-living, and, essentially, the adoption of the living patterns and behaviours. The satisfaction comes from physical level of

safety and belonging, and then seek progressively higher in esteem and self-actualization (Thielke et al, 2011). It is also important to understand and consistently maintain the expectation of needs, which accumulate and becomes the personal living pattern of each individual older adult. By providing suitable “opportunity”, “encouragement” and “reward”, the living behaviours of the older adults in the scenario of co-living can be further shaped and designed.

The research chose a long-term care home in Hong Kong as a form of a co-living environment to investigate the residents’ movement patterns. Using indoor location-tracking technology, the study collected the location and time duration data on the study site for a period of 31 days. Altman’s privacy typology was adopted to explain how the design of the privacy affected the residents’ movements, which in turn shaped the territories for activities.

3 CONCEPTUAL FRAMEWORK

The aim of the study was to establish the connection between the design of privacy and residents’ movement patterns in a care facility setting. To achieve the goal, the research asked the following questions: (1) What privacy settings can be identified in a long-term care facility? (2) How does privacy affect the movement of the residents in relation to personal territories?

The research focuses on the investigation of privacy in relation to movement patterns. Privacy, often overlooked in many institutions for the ageing, is the subject of study. According to literature, by allowing adequate privacy, people are more likely to have control over space, i.e., territory and hence participate in activities (Proshansky et al., 1970). Altman’s privacy model (1975) suggested that privacy as a boundary regulation process where, just like a cell membrane, it can be closed or permeable depending on circumstances.

Along these lines, the field study examined the movement patterns of residents within a care home study site within different territories of privacy. This research categorized the spaces in a selected long-term care facility into territories where spaces were grouped based on the states of privacy as delineated by Westin (1967): seclusion, intimacy, anonymity and reserve. Applying these principles, four territory zones can be found on the study site to describe the different privacy conditions: secluded, intimate, anonymous and optional territory. Figure 3 illustrates these zonings on a typical floor plan. The four territory zones are defined as follows:

- Secluded territory is a single or cluster of rooms where residents can be most separated from fellow residents, i.e., bedroom and washroom.
- Intimate territory is a single or cluster of rooms where residents can participate in social activities with a small group of peers, i.e., peer’s bedroom.
- Anonymous territory is a single or cluster of rooms where residents can find “public privacy” and avoid intrusions, i.e., pantry and common room 1 (being monitored by care givers from staff room).
- Optional territory, as opposed to being in reserve, is defined as a single or cluster of rooms where residents are open to social interaction, i.e., common room 2, washroom 2, and peer’s bedroom in the adjacent unit, and the lift and reception area on ground floor.

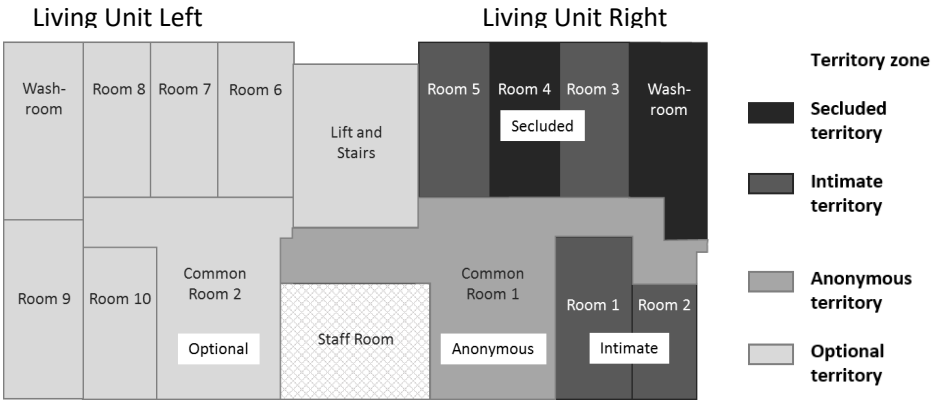


Figure 3. The four territory zones on a typical floor plan of the study site

4 METHODS

4.1 Design of Field study: Using Sensor Technologies

An indoor location-tracking system using Bluetooth Low Energy (BLE) technology was set up on the study site. The system was set up as permanent installations in the facility for the purposes of monitoring in case of falls. Each participating resident is assigned a smartwatch that communicates with the sensors by receiving signals sent out by the sensors. When an elderly resident is in the indoor environment, within the range of the signals, her/his location can be tracked by the beacons that were installed on the walls. The system collected continuous location data for the entire month in March, 2017 when the weather is found to be the most pleasant in Hong Kong.

Although BLE technology is growing in popularity due to the ease of installation and affordability of the components, the technology still faces a number of challenges in accurately tracking the locations of participants in relation to the issues of signal fluctuations and refractions in the physical space (Cantón Paterna, 2017). That said, it is advantageous in its non-intrusive method of monitoring and its capability in continuously tracking elderly residents' movement data make it a new method to gather numeric data in evaluating person-environment relationships. The system leverages on collecting quantitative data that have the following characteristics in order to retrieve deeper insights in terms of spatial design and social interaction: (1) Ubiquitous location data – residents' movements were recorded in all the spaces of the study site - bedroom, washroom, common area, pantry and reception area - at random timeslots. (2) Continuous time data - residents' time duration data at each location were recorded randomly from 0 to 23 hour for 31 days, which were calculated into mean values by the hour in a day. (3) Personal tags – the system had the advantage of collecting the time and location data in a multi-user environment, permitting the identification of each elderly participant which was essential for observing individual movement patterns.

4.2 Study Sites and participants

A care facility of 200 residents was selected for this study. The care facility consists six floors in a building that was built in the 1990's. The ground floor contains the reception area and a workshop space for group activities. Residents lived between the first floor and fifth floor. Each floor has two living units that are connected by the staff station and pantry. Each unit, approximately 2000 square feet, accommodated 20 residents. Female and male residents

lived separately on different floors. The residents were able to go between the six floors in a lift and to exit the building through the main gate that was next to the reception area. The two units were in a symmetrical spatial layout and were connected in the middle by the pantry and staff room (restricted area).

In total, 50 participants (female, n=26 and male, n=24) were recruited for the experiment. The sampling criteria for the pilot study included two items; a balanced proportion of female (n=26) and male (n=24) residents, and higher functional abilities in terms motor and cognitive skills for the carrying out of the activities of daily living (ADL). Around 20% of the residents participated from each living unit on each floor. Each resident was assigned with a smartwatch which allowed the location data to be recorded by the beacons throughout the day. A one-day training was conducted on site for both the residents and the care staff in using and charging the wristbands.

4.3 Data Analysis

The study first examined residents' movements on all floors for particular trends. It then focused on the data recorded on the fourth and fifth floor where the highest numbers of female (n=13) and male (n=9) participants lived.

Before the analyses, the data were screened according to a set of criteria to ensure greater validity. Since BLE signals travel through walls and floor slabs, it sometimes results in duplicate or inaccurate location data in the indoor environment. Therefore, the data were filtered out in the following conditions: (1) when a resident was found back and forth in one room and the adjacent during the same hour (e.g., living/dining room right and room 1), (2) when a resident was found in other rooms that are directly above or below (e.g., a resident in room 9 on 4th floor was found in room 9 on 5th floor), and (3) when a resident was found in a location for under 3 minutes, which was observed on site to be the time required for signals to stabilize.

The analyses focused on how residents used spaces in relation to time and location, and what movement patterns were discovered in relation to privacy territory. Figure 5 illustrates a resident's access model to other rooms in the care facility and her/his movements through the four territory zones. Based on this model, the analyses explored the collective movements of all the residents in search of a general tendency.

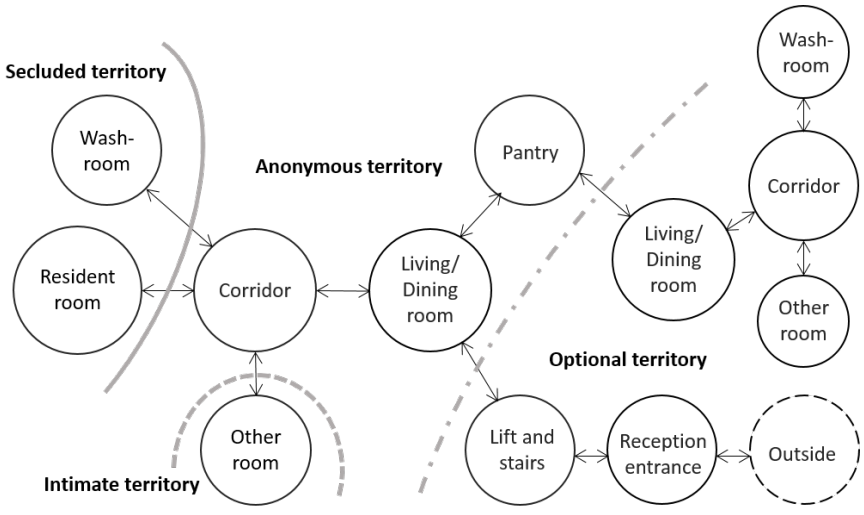


Figure 4. Access model to four territory zones from a resident's bedroom

4.3.1 Space use

Time duration results suggested a number of ways in which the residents use the spaces (figure 6). Analyses indicated that residents spent 92% of the day (around 22 hours) inside the boundary of their own living units (53% in the more private spaces of bedroom, washroom and peer room; 39% in the more public setting of common room 1 and pantry). A small portion of time was spent in visiting common room in the opposite living quarter (4%) and a significantly low amount of time was spent on the ground floor where the entrance was located (0.2%). No residents were found to have travelled to the living units of different floors.

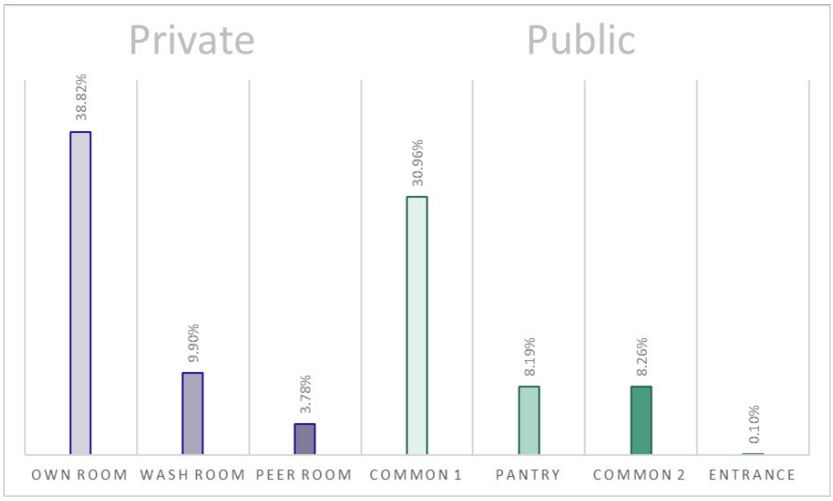


Figure 5. Percentage of time duration in each space

Residents spent around 9 hours of the day in the anonymous territory between 7 a.m. to 9 p.m. Participants generally spent under 2 hours in the optional territory usually between 3 – 5 p.m. Residents were found briefly in the intimate zone, spending time in peer's room. An hourly colour scale of duration (figure 7) indicates that residents' activities concentrated in the secluded territory throughout the day. The activity pattern in the secluded territory was characterized with irregular and brief movements while the activities in the anonymous territory were frequent and long. There was little activity in the optional territory near the entrance on ground floor.

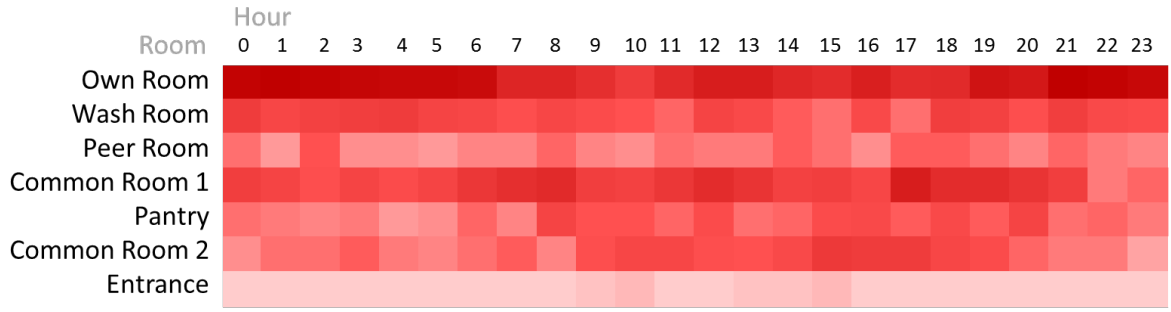


Figure 6. Percentage of time duration in each space

4.3.2 Movement patterns

Although each floor had its unique movement patterns, there was a regularity in the general patterns. Results showed that 80% of the residents travelled short range distances throughout the day. Long-ranged travels commonly took place at around 3-4 p.m., but

sometimes in the middle of the night. Longer range walks to the ground floor entrance usually happened at around 9 - 11 a.m. and 1-3 p.m.

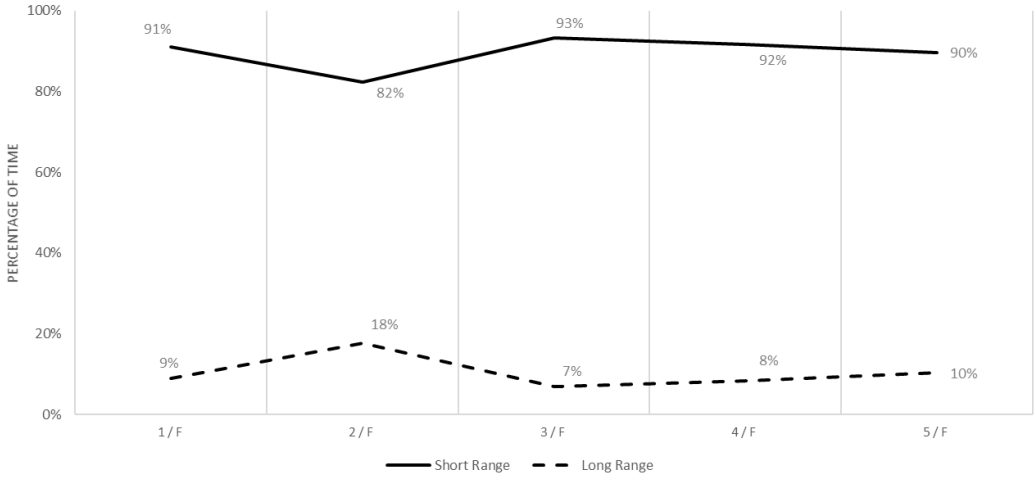


Figure 7. Short range and long range travels on each floor

In addition to the characteristic short-ranged travels, residents were also seen returning to their own rooms on an hourly basis. Figure 10 demonstrates the changes in the distances outside the bedroom in a time sequence. Depending on the location of the bedroom, results indicated that residents started the day moving within secluded territories near their bedrooms. The boundary of the territory expanded further at around 1 p.m. and the farthest at around 4 p.m.

5 DISCUSSIONS

The results suggested that privacy is not a linear experience, stretching from public, semi-public, semi-private and private. Rather the residents' movement was closely linked to the four privacy conditions (seclusion, intimate, anonymous or optional) depicted in the access model. In another word, residents would move around different rooms during different time of the day to find the desired privacy. For example, "seclusion" could be found in one's own room at 4 p.m. (when most people were seen out of the bedroom) or in the public common area at 2 a.m. (when most people were in their own rooms). Although privacy can be determined by metric distances, it is more to do with its temporal attribute and what activities the rooms enabled residents to do. Thus having the capability to access different privacy settings in one particular space is significant in a co-living environment.

Three movement patterns were synthesized below to discuss the impact of privacy design.

5.1 Pattern 1: withdrawal to bedrooms

Results show that the residents withdrew to their bedrooms on an hourly basis where they had more privacy. It suggests that having a higher level of privacy was often important for the elderly residents. However, this observation also indicates that the high use of bedrooms was due to the lack of privacy found between the bedroom (secluded territory) and the common area (anonymous territory). It is implied that incorporating other privacy experiences could encourage the residents to spend more time outside of the bedroom.

5.2 Pattern 2: short-range travels

Results show that the residents mostly stayed in areas that are within short distances from the bedroom. More specifically, a large part of the residents' day was spent in the common area and pantry (anonymous territory) with a small portion of the time in peers' rooms (intimate territory). It is fair to assume that the residents carried out most of the daily activities within the boundary of their living unit where only three types of privacy experiences were found. This movement pattern implies that the space mainly induced group activities offering little opportunities for personal or small group activities.

5.3 Pattern 3: Long-range travels

Results show that the residents spent very little time in the adjacent living unit or on the ground floor (i.e. optional territory). Therefore, this pattern is likely to suggest a change in daily routines. Residents were mostly located in the optional territory in late afternoon or just after midnight. It indicates that enabling this specific privacy setting would potentially encourage the residents to leave their own living unit. This pattern is worth noting as it implies that the residents travelled to a less familiar environment and were more likely to participate in different types of social activities.

6 CONCLUSIONS

The paper concludes that different privacy settings – secluded, intimate, anonymous and optional – have an effect on the movement patterns of elderly residents. Results show that three movement patterns carry the implications for the design of privacy for future co-living layout. It is also concluded that ubiquitous data could better inform designers and researchers in what ways the physical environment affects behaviour. In terms of methods, the indoor location-tracking system used in the field study provided 80% accuracy in collecting location and duration data. The study recommends that more research using the big data approach is needed to better explore the relationship between movement and architecture inside other long term care facilities.

Although current preliminary results only focus on the influences that physical designs have on mobility patterns in a nursing home, it is acknowledged that other factors such as daily activities and friendships will also affect how the elders move. In order to further explain the motivations behind the movement patterns, qualitative analyses such as focus group interviews will be conducted in the next phase to examine the interplay between privacy design and residents' social networks. Temporal dimensions will also be incorporated to investigate to what degree the weekday and weekend activities affected how elders moved.

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Could Participatory Design Offer A Revolution To Architecture? Field Notes from a Situated Action in Hasselt, Belgium.

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Architecture always involves people, but current architectural design methods continue to actively avoid involving people. Participation has been both applauded as the hero, and stigmatised as the enemy, of design methodology perhaps due to inevitable political entanglements. I subscribe to the notion that Participation and Architecture will always be political, in the sense that they both affect people's lives. Participatory Design (PD) methodologies, and their transformational power, can offer Architecture a more responsive approach of how to involve people.

For the purpose of this paper, I will reflect upon the findings of a Situated Action, called The Library of Engagements, included in the Participatory Design Conference held in Hasselt, Belgium in August 2018. The Library is a collection of PD methods that I have been gathering since 2010. It is shared through a performative dialogue, initially with the aim of inspiring more designers to employ participative methods in their processes, and has developed into a motivational toolkit for citizens to take action themselves. The paper focuses on two examples and uses descriptive field notes to summarise unintended but beneficial outcomes.

Keywords: participatory design; engagement; architecture; art; participation; transformation.

1 Introduction

The explicit aim of Participatory Design is to improve the quality of a designed product, service or even building, however the impact of PD methods have greater reach than on outcome alone. I believe engagement activities have an inherent transformative effect on both the participant, and facilitator (Till, 2005). Promoting architectural design activities that are carried out *with* people, as opposed to *for* them, challenges the current paradigm and contributes to the movement that Participation needs to become central to the practice of architecture. This also endorses a potential future for Architecture to become a form of affective labour, one that always directly constructs a relationship (Hardt & Negri, 2005).

The Library of Engagements evolved from a critique of methods of participation employed inside and outside the built environment as part of my Master's in Architecture. What started as a theoretical study has continued to develop over the last 10 years through my

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professional practice, community facilitation, research and teaching. I am interested in discovering ways of sharing and disseminating methods of engagement to both built environment professionals and citizens.

“The Library of Engagements is a Participatory Design tool for engaging citizens in the production of space, urban and architectural design in their cities. It is a collection of methods, techniques and tools used in Participatory Design. The physical archive consists of a catalogue index box, archive boxes and a selection of books. The archive has documents, photos and objects relating to examples of different methods catalogued in the index.” (Crompton, 2018) (fig. 1).



Figure 1. Image showing the Library of Engagement’s Archive (left) and the Library’s Catalogue or Index (right). Source: Author’s Own.

The Library offers a tonic to a consultation-fatigued public, providing examples of democratic design methods from role-play workshops to artist’s interventions. There are around 100 examples currently ‘held’ in the library, the majority of which are UK based. It is an ever-growing collection, activated by participants and curated by its owner, the librarian (Emily Crompton), who uses small illustrative examples to inform and possibly inspire an alternative way to practice architecture or approach Participatory Design. Participants can only access the library’s collection through conversation with the librarian, who through asking questions about the person’s life gleans an interest and selects an appropriate method of engagement to share. The personalised nature of the installation emphasises the importance of creating bespoke methods for each scenario, but also highlights a restriction of dissemination.

The Library’s index is ordered in multiple ways, meaning projects and artefacts can be found through various entry points. Through dialogue, the participant affects which examples will be revealed by the librarian from the collection, to ensure examples are relevant. The conversation between participant and librarian becomes a tool itself, demonstrating a desire to create space for a “negotiation of hope” (Till, 2005), which regards the interaction as important as the outcome. Here outcomes are unknown, no perfect solution (method) will be found, only attempts to make space for others to make sense of the actions of others, and

an acceptance that space is not created by a lone individual but by the very act of negotiation, of participation.

The Library of Engagements, as a Situated Action was part of the Participatory Design Conference (PDC) 2018. The Situated Action programme is a series of site-specific interventions instigated to address the debate on public space and on the politics of design. An exhibition of the fifteen Situated Actions, entitled *The Politics of Design: Act 1*, was curated as part of the conference, and held at Z33 House for Contemporary Art. It aimed to contextualise current participatory design practices that were part of PDC 2018 by placing Situated Actions in a dialogue with several local and international projects (fig. 2).

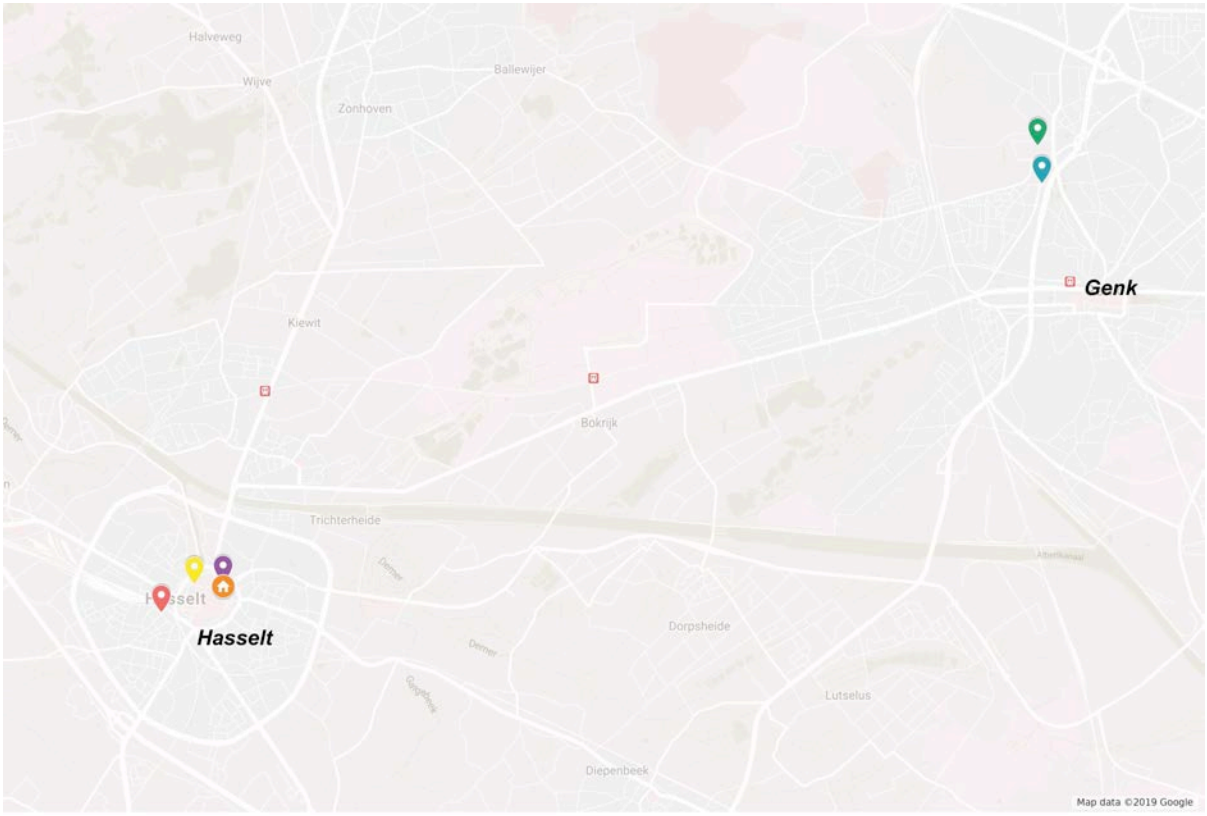


Figure 2. Map showing the location of the 5 'Situated Actions' at PDC18 which are local to Hasselt, the other 10 actions were internationally located, or hosted at Z33 in Hasselt (orange home symbol). Credit: Google Maps

2 Methodology

The Library of Engagements as a Situated Action took place over one day (21st August 2018) within the conference, and was located in a central bicycle café called Fietsbar to encourage an open dialogue with residents of Hasselt. It aimed to simultaneously gather information, stories and artefacts of methods of engagement from local citizens whilst also sharing information, stories and artefacts from the existing library's collection and archive. The ambition was to create a mutual learning exchange where both participant and facilitator were affected by the interaction, and as such produce a microcosm of 'transformational participation' (Till, 2005).

Rather than act as another “how to” guide, the library as a catalogue of methods responds to Doina Petrescu’s criticism that such guides are too prescriptive and rather than liberating, tend to control the participative process (Petrescu, 2005). When reviewing each method I distinguished different characteristics and aspects, which help categorise and form links between methods. While these descriptors help comprehend the practicalities of the method, they cannot alone describe all the aspects or outcomes of the activity. Field notes supplemented the descriptions to capture additional impacts the method had on the participant, facilitator or outcome.

Table 1 Showing the different categories of descriptors reviewed for each method

Engagement Descriptor	**Explanation**
Instigator	The person designing and leading the engagement activity. (e.g. workshop facilitator, protest leader, writer of survey)
Instigator Motivation/s	The motives of the instigator/ why they are involved.
Participants	The people taking part in the engagement (whether knowingly or not). Important to understand if they have self-selected or not.
Participant Motivation/s	The motives of the participants/ why they are taking part.
Organisational Motivation/s	Instigators are often (but not always) connected to or employed by an organisation. It is important to understand the organisation’s motives for carrying out an engagement activity, as this will impact upon the instigator’s actions.
Economics	How the activity is being funded, (e.g. whether it is created voluntarily, developer-led, or Local Authority-led etc). This impacts upon the involvement of instigator, participant, and affects potential outputs.
Location	Site of Engagement. As this library is created from the perspective of the architectural discipline, all methods are situated. The chosen location impact for engagements will impact on participants, economics, and output.
Theme	The overarching theme that the desired outcome is connected to (e.g. Heritage)
Topic	The specific topic of the method of engagement, or what is being talked about. (e.g. regeneration of a building)
Engagement Method	How the engagement was provided, or the type of engagement method (e.g. workshop, survey, meanwhile event, festival, talk, protest)
Engagement Medium	The style the method is carried out in (e.g. sets of diagrams, 3D model, drawings)
Timing	The length of activity, and when it took place. The timescale of methods is important to understand to glean what affect the engagement will have on the outcome (and sometimes if at all).
Output	What was the result. This may or may not have been affected by the engagement. (this may not be defined at the time of activity, and could be different to original aim)

The library accepts that no ideal participation model exists, and that there is no perfect method with which to engage all groups (Till, 2005). However, by looking at a wide variety of consultation practises and alternative methods of participation, the library provides a platform for discussion to define future participative processes.

In Hasselt, the Library was used as a tool to engage citizens in a discussion about their city, and I hoped it would also encourage them to instigate Participatory (Design) practices themselves. Ahead of the Action I carried out desktop research into various PD projects in and around Hasselt, and supplemented the Library’s existing catalogue of methods, projects,

groups etc. with 35 local projects. Examples selected for the Library were mostly ‘situated’; Participatory Design for Architecture is always located, positioned, in place (fig. 3). Where possible I contacted groups and individuals responsible for projects, including architects, practitioners, activists, artists, residents and academics and invited them to take part in the Situated Action, and contribute to the Library Archive.

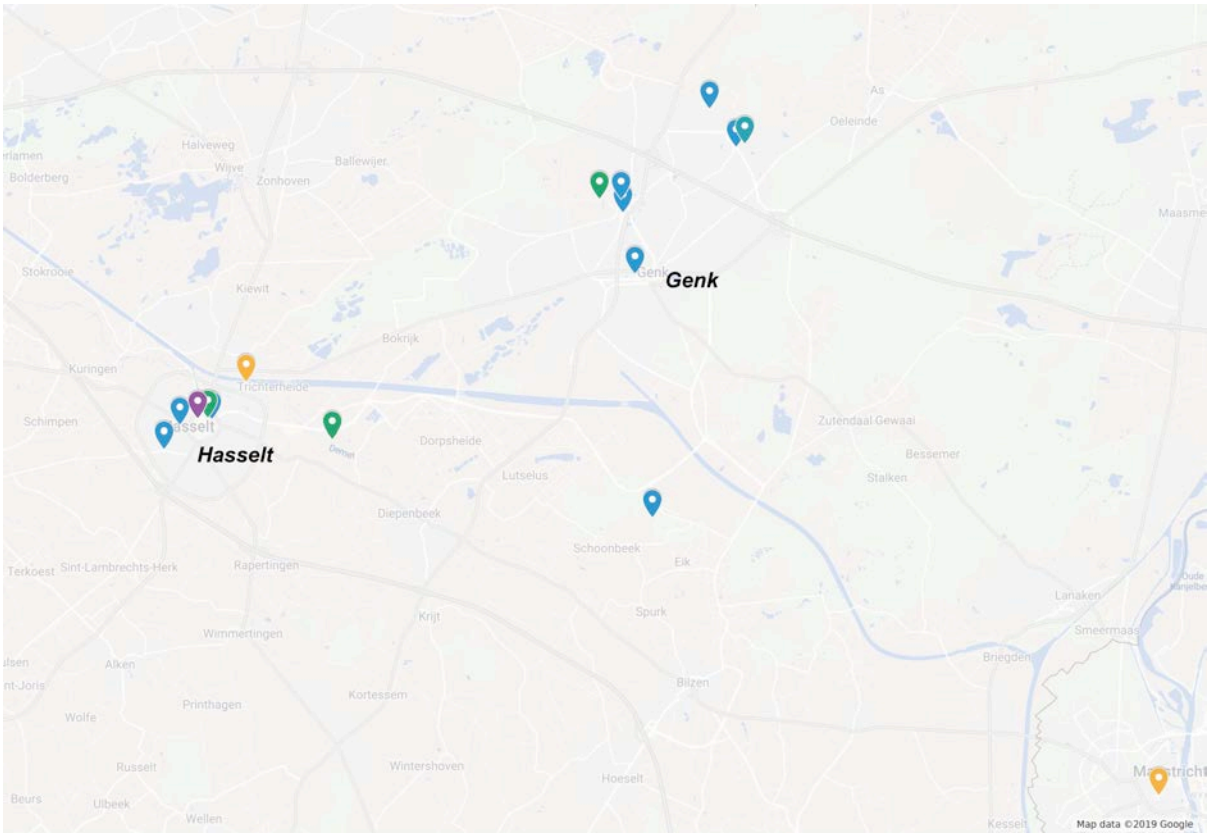


Figure 3. Map showing the locations of the newly entered projects local to Hasselt and Genk. Credit: Google Maps.

3 Results and Discussion

In its simplest form, the Action was a series of conversations or storytelling. Till (2005) discusses recognising the power and validity of an ordinary conversation as a new form of communication for participatory processes in the creation of ‘transformative participation’. He goes on to suggest how conversations are an appropriate new starting point to challenge normative architectural production and communication styles. Individual narratives often communicate how people navigate societal or organisational constructs, but they can move beyond description alone especially considering that “Telling a story about oneself can sometimes transform that self” (Wortham, 2001).

In this section, I will focus on two specific conversations with invited guests, which took place at the Situated Action (fig. 4). They told me some interesting stories, which allude to a ‘transformative participation’. The conversations in the Action were audio recorded with permission and interpreted into detailed field notes which are summarised below.

Using the earlier defined Engagement Descriptors, these explanations touch on the important aspects of each engagement event such as: who instigated the activity, who were the intended participants, where did it take place, what was the theme or topic of the participation activity, what were the motivations for involvement of both instigator and participant, the timing of the event etc. Field notes provide reflection on moments of transformation due to engagement activities.

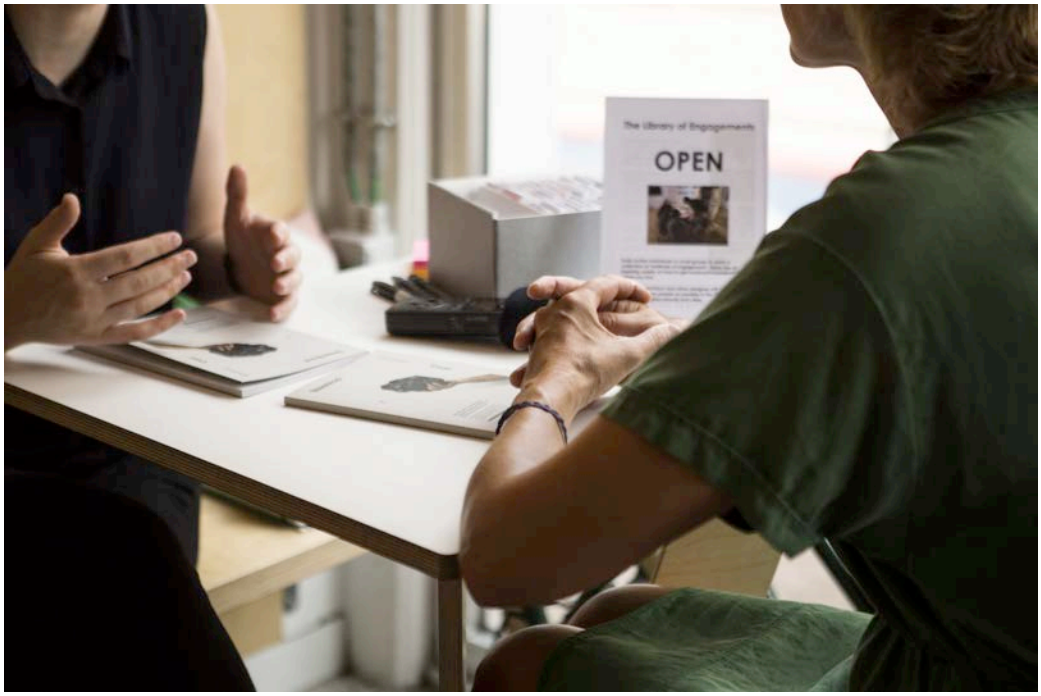


Figure 4. Author in Conversation with [S], an invited guest to the Library of Engagements as a 'Situated Action'. Photo credit: Seppe Moons-Z33

3.1 Chocoladefabriek, Nerem-Tongeren, Belgium, 2013 – 2016.

The desired outcome of the first example was a building design. Methods employed included meanwhile uses and artists residencies to challenge people's preconceptions of the building, as well as informal conversations with the architects using blank templates of the existing structure, and online tools to encourage discussion about the potential design of housing units. The engagement activities are summarised in Table 2 and a descriptive summary of the field notes from the conversation follows.

Table 2 Chocoladefabriek Engagement Description

Engagement Descriptor	**Chocoladefabriek**
Instigator	[B] as an Architect, part of an architectural practice, working with a communications agency (paid for by a developer).
Instigator Motivation/s	To bring a derelict building back into use.
Participants	Thousands of people from surrounding area, 900 Local Residents, Artists, event's organisers and others.
Participant Motivation/s	Public with a need for large event space/ to attend temporary events.
Organisational Motivation/s	Developer needed to make the development viable.
Economics	Developer paid architects to work on design; much of the engagement

	was self-initiated by Architects / Citizens.
Location	Chocoladefabriek, Nerem-Tongeren, Belgium.
Theme	Regeneration.
Topic	What can we use this building for?
Engagement Method	Temporary Interventions in a derelict building/ Meanwhile uses for an out of use building.
Engagement Medium	Architects used plans, drawings, websites and conversations.
Timing	Various events taking place over 4 years, construction started in 2017 (2013 – 2018).
Output	Renovated Building, including housing units, workspaces, event space and a restaurant.

From the developer's perspective, the only perceived re-use for a derelict Chocolate factory outside Nerem was housing, but the site had a poor reputation with the public due to its industrial past. It was a unique space for the area: 160m long, 2 storeys, with a 10 storey-high tower. "No one knew what do with it – we [didn't] know what to do with it either! Imagine if we just open the doors and ask people what they think to do with it. Neighbours, old factory workers." [B: Architect, and instigator].

A series of meanwhile events challenged the local community's perceptions of the building's potential, these included: an Easter egg hunt, a cycling games, artist's residencies, dance classes, parties, temporary installations, chocolate making competitions etc. Activities enabled people to visit the building, many for the first time, and almost as an aside to these activities, the architects would informally ask people what they thought about the future of the building through various tools such as websites, drawings and conversations. "We hosted a festival as part of a historic open building event in Belgium. It became so popular, over 7000 people attended! And with only 900 people in the town, they were amazed. It wasn't loved before, but the activities created a fondness" [B].

Naturally, instigating such events in a derelict building brought challenges, for example navigating strict regulatory frameworks for putting on a party for 1000 people (e.g. fire regulations, licences). [B] reflected that their developer client was wary of the risks of holding open events and activities, and even of asking people what they wanted to do with the space. However, without hosting the events, and having the conversations, [B] felt the factory would not have been brought back into use. The meanwhile and engagement activities created a demand for additional space for socialising, working and eating which may never have become a viable part of the development. The activities had an impact on the brief and built outcome, as well as on the participants (their perception of the building), on the developer (what was viable) and on the designers (what was important to people who may live there). "They [the community] asked us how did we do it, and we always say we did it together, we were all small ambassadors to make a new future for the building – that was our aim, it was the most important thing for us" [B].

For inclusion in the library of engagements, [B] donated a framed series of images depicting the project including the output of an artist's residency, the residents drawings, a computer model of the scheme and a photo of the factory under construction (fig. 5).



Figure 5. Image of framed set of image depicting the design process of Chocoladefabriek Artefact, donated by [B].

3.2 SteenKool / Forever Coal, Mine-Depot Waterschei, Genk, Belgium, 2012

Manifesta is a biennial arts festival, and for its 9th edition the organisers had a desire to include local residents. The outcome was not defined ahead of the engagement activity, and instead emerged through the participative process. The method employed was workshops that led to the creation of artwork by ex-miners and culminated in an exhibition. A brief summary of the method of engagement is below in Table 3 followed by the descriptive summary of the field notes.

Table 3 SteenKool / Forever Coal Engagement Description

Engagement Descriptor	**SteenKool / Forever Coal**
Instigator	[S] as an Art Mediator (paid by Manifesta 9 – an art biennial).
Instigator Motivation/s	To work with people (non-artists) to create art.
Participants	8 Local Ex-miners, all volunteers at mine heritage museum.
Participant Motivation/s	To take part, to make art, to reflect on the place of the mine.
Organisational Motivation/s	Manifesta's motivation appears to be partly to increase the museum volunteer's involvement, and partly to bring the museum's volunteers "on side" – to tolerate the Biennial's art activities.
Economics	Activity included as part of Art Biennial.
Location	Waterschei coalmine, Genk, Belgium. Engagement took place specifically in the mine museum.
Theme	Art.
Topic	Waterschei mine closed in the late 80s "how do we look back, how do we see their future, or how are they doing today." [S]
Engagement Method	Facilitated Workshop.
Engagement Medium	Art workshop
Timing	1 month to create artworks, participants and instigator met once a week
Output	Exhibition. Artworks by all participants exhibited as part of Manifesta 9.

The 9th edition of the Biennial was held in the old Waterschei coalmine in Genk, an industrial town East of Hasselt. A small heritage museum already existed at the mine, and while there was some communication between the Biennial's organisers and the museum's volunteers, the Biennial commissioned [S], an Art Mediator to carry out a project to involve them further. [S] already knew some of the ex-miners, having carried out public tours for Manifesta, and started the engagement "by inviting them for a Sunday morning brainstorm. I like to let it grow from the people themselves… by talking, asking, feeling, a lot of intuitive feeling." They became their own Art Group. The themes of the work displayed at the Biennial placed the local context centre-stage, and works regarded coal mining, energy production, and the associated labour. Work from The Ashington Group – a group of miners who took art classes in 1934, receiving international success – was exhibited, which tied in well with the creation of ART SCHOOL MINE HISTORY, as they called themselves.

The ex-miners began to make work, using collage, drawing, and materials they found or photocopied from the museum archive. Locating the group within the heritage museum helped them draw on the environment and influenced the work they created. [S] remembers that the ex-miners had their own way of communicating together. It was hard for her to pick-up on the hidden meaning of their conversations. It was intuitive, but also allowed them to have conversations together without her, which seemed important to the process.

For Manifesta, it was the first time they had invited local residents to become the artists, to display their own work. It concluded with an exhibition in the mine heritage museum. [S] recalled the exhibition as being "the most important thing of the project – it made them [the ex-miners] feel that they were full members of Manifesta." After the project, one participant created a painting every week; "it opened something in him and he developed as an artist". [S] continued to visit him for some years after and he would often gift to her his paintings. She donated his 191st painting, completed in 2015, to the library as an artefact for the Library Archive (fig. 6).

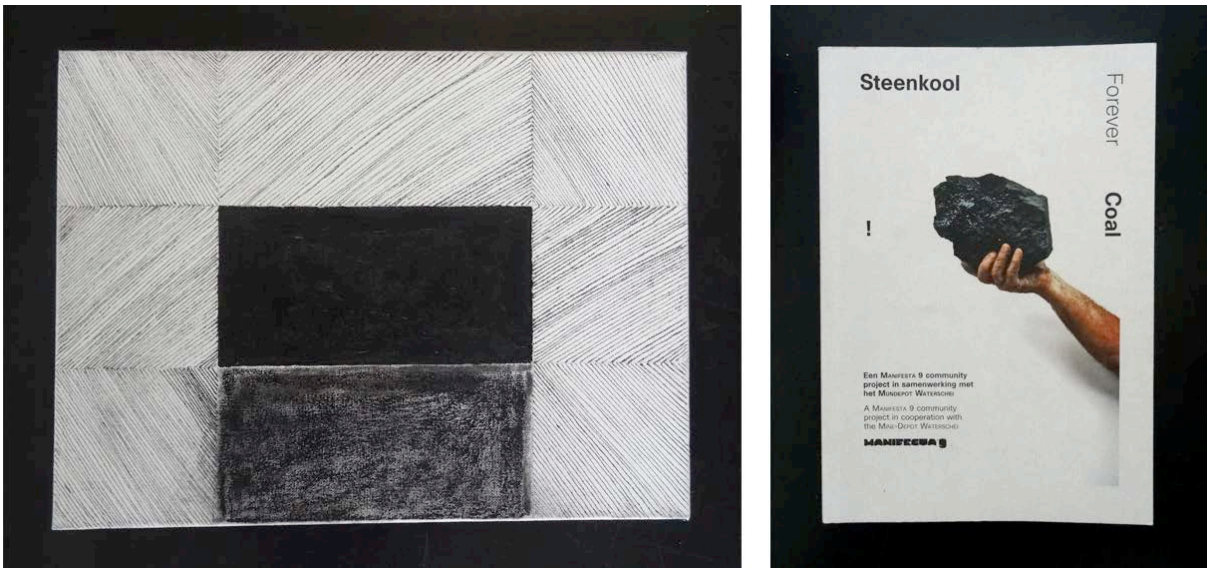


Figure 6. Image of a canvas made by a participant in Steenkool (left) and exhibition publication (right), donated by [S].

4 Summary

In both examples, the transformative moments were an unscripted or unintended consequence of the engagement activity. While the PD methods were carefully curated and planned, the transformational power of PD practice is how space can be provided to uncover unexpected outcomes. For example, the participant becoming an artist through their engagement in Manifesta's 1-month art project, or at Chocoladefabriek the newly created viability of event space in a housing-led development scheme. The two examples demonstrate that the effects of PD can be wider reaching than on design outcome alone. By continuing to investigate the methods of PD, I hope to encourage more Architects to use Participation in their own design processes, so the discipline can support the transformation of citizens, as well as designing suitable buildings.

To explore the Library of Engagements as a method of transformational participation in itself, I have reflected on the Situated Action using the engagement descriptors (table 4). Both conversations provided an opportunity for exchange between [S]/[B] (the participants) and myself (as instigator).The original aim of the library was to help architects and designers value unintended outcomes of engagement activities in their design process. I believe in both examples above this was achieved to some extent, though admittedly both were self-selecting and were practitioners who had already carried out PD activities. Both [B] and [S] acknowledged that PD was not their usual mode of operations in their respective fields, and identified benefits (and complications) of working in that way through the conversations. The dialogue gave the practitioners and myself time to reflect on using PD methods, and in the case of [S] provided encouragement to carry out more PD inspired projects – she vocalised having loved looking back over the project, and a desire to work again in this way. We discussed other Art festival's attempts at resident inclusion, including my own involvement in Liverpool Biennial's 2up2down participatory design process (van Heeswijk, 2017), further highlighting the unintended benefits of creating space for unscripted conversations, in this case a sharing of good practice.

Table 4 The Library of Engagement Situated Action Engagement Description

Engagement Descriptor	**Library of Engagement Situated Action**
Instigator	Researcher / practitioner/ educator (myself – Emily Crompton)
Instigator Motivation/s	To research methods of participation. To encourage more people to carry out PD in their practices. To take part in a international conference about participation.
Participants	Citizens of Hasselt, Practitioners and Academics.
Participant Motivation/s	To donate a method to the library and find out about the Library of Engagement. To take part in the PDC conference.
Organisational Motivation/s	The PDC 2018 conference organising panel's motivation to include Situated Actions was in order to address the debate on public space (in Hasselt) and on the politics of design.
Economics	MMU (the instigator's employer) paid for the instigator to attend. Their motivation is (partially) to support the production of research output from the instigator's activities.
Location	Situated Action: Fietsbar, Hasselt, Belgium. Exhibition: Z33 House of Contemporary Art.
Theme	Participation
Topic	Methods of Engagement
Engagement Method	Performance style event and Exhibition
Engagement Medium	Situated Action: Conversations. Exhibition: Artefacts, postcards, audio.
Timing	1 month desktop research. 1 day Situated Action. 3 month exhibition.

Output	Entries into the library, exhibition, this paper.

The resulting exhibition piece from this situation action, included in *The Politics of Design: Act 1*, was the first 'act' for the town of Hasselt, and is part of a longer trajectory that aims to stimulate conversation about new collaborations and will lead to the final 'act' in 2020 (PDC, 2018). Audio of conversations recorded during the Action became part of the exhibition along with artefacts, some given by participants and others from various PD or engagement methods researched in UK and Belgium, and an 'index' of methods were displayed as postcards. To mirror the exchange taking place in the Action, visitors were invited to 'eavesdrop' on the conversations, view selected artefacts from the collection, take away a postcard of a method which was relevant to their lives (fig. 7), as well being prompted to provide their own examples of engagement activities, for future research.

The notion of a 'transformational participation' taking place in the Action was fully realised when [S] attended the opening of the PDC 2018 exhibition a few days after the Action and began conversations on PD with other local practitioners and researchers. Both participant [S] and instigator (myself) had been transformed through the Situated Action of the Library.

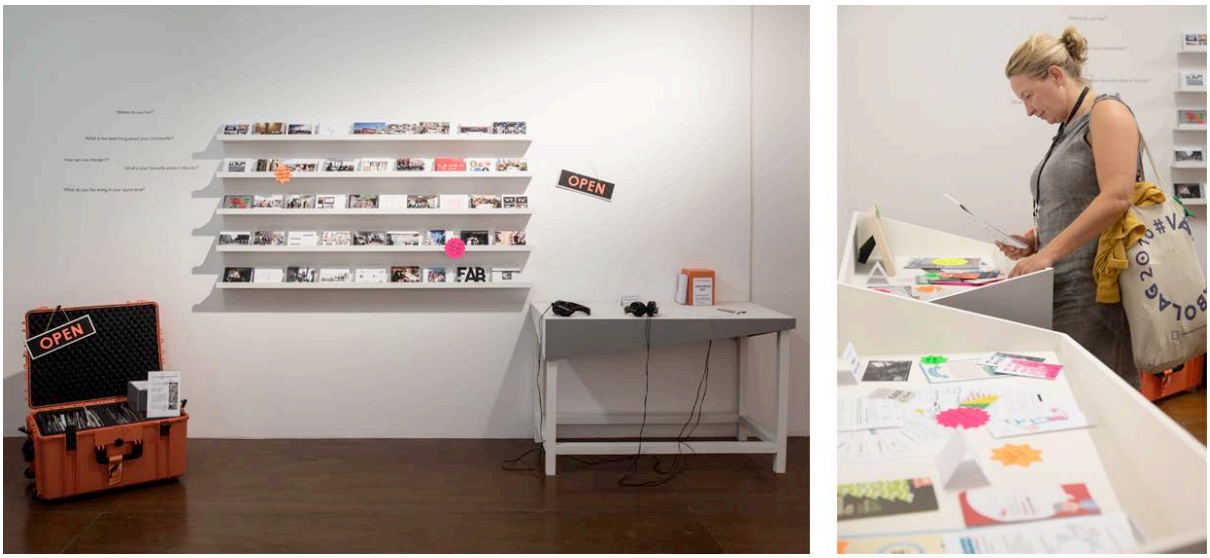


Figure 7. The Library of Engagements at Z33, as part of The Politics of Design: Act 1 exhibition which ran August – December 2018 (left) a visitor looking at artefacts from the Library's Archive (right). Photo credit: Kristof Vrancken-Z33

5 Conclusion

This Situated Action achieved the desired aim of increasing the methods included in the Library of Engagements by 35, and widened the geographical reach to include European examples. It also helped me to develop a better understanding of how to define each engagement activity through the elements of the methodology (the idea of each method in the Library having an instigator, participant, motivation, medium, topic, timing, etc.). Using conversation or anecdote as a tool to gather information or stories about engagement methods enabled me to glean richer material with which to analyse PD processes and interrogate moments of transformation.

Using the collection method of field notes has implications for future development of the library, and for understanding the impact of PD on architectural projects. The library's catalogue affords many inspirational examples to citizen and practitioner alike, however it was only through conversation with the librarian that potential applications were identified. Recording field notes helps to overcome this restriction on dissemination, as they can offer insight into the unintended outcomes of methods and assist design practitioners to value unplanned outcomes of participative processes.

Participatory Design in Architecture must be 'situated' for it to be of value to the knowledge or design outcome, as the traditional products (or outputs) of Architectural Design exist in real time for real people. I recommend that when Architects intend to use PD methods, those methods must be designed in context and with as much care as the buildings they create.

I believe the Library of Engagements adds value to the field of Participatory Design. The use of field notes also affords an opportunity to disseminate the less visible, unnoticed moments in engagement activities, which are often responsible for real transformations in people. If a revolution is what Architecture needs, maybe Participatory Design could be the answer.

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Cross-cultural design teamwork: researching at the edge between design and cross-cultural management

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This short paper is to present an emerging area of research at the boundaries between cultural studies and design discipline. People working or studing nowadays in the design field are increasignly involved in cross-cultural collaborations, where they are expected to co-create with highly diverse others (i.e. different ethnicity, religion, language, gender, nations, professions, religions, backgrounds). The paper promotes the exploration of novel design reserch area to gain knowledge about cross-cultural design teamwork. To achieve this goal, the theories developed by the consolidated field of cross-cultural management can inform design. On the other hand, the establishment of a new area of inquiry can possibly provide new insightful knowledge to fairly and effectively manage these teams. The case study of Mybias, a tool designed for cross-cultural design teams, is presented in the paper to show how research in design and cross-cultural management can be intertwined.

Keywords: cross-cultural design teamwork; interdisciplinary research; cultural studies; cross-cultural management.

1 Introduction

Over the past few decades organisations are increasingly adopting cross-cultural teams (i.e. cognitively diverse, demographically diverse or transnational and disciplinarily diverse teams) to effectively deal with contemporary complex challenges. Companies and higher education institutions in the field of design are outstanding examples of witnesses of this transformation. Assuming a holistic view on culture (Mahadevan, 2017), cross-cultural teamwork can be addressed as cross-cultural because it brings together people from different ethnicity, religion, language ("shared vocabulary within a specific context" see Patel & Salih, 2018) gender, nations, professions, religions, backgrounds. The presence of different worldviews in the team requires members to undertake cultural adaptation.

Cross-cultural collaboration manifests itself in the design education because, design-based learning (DBL) (Gómez Puente, 2014) is extensively employed and the field is increasingly international. DBL is intended as a pedagogical approach strongly related with problem-based and project-based learning (Dutton, 1987) where students collaboratively design of an artefact (Gómez Puente, 2014), learning the design practice by doing it (Tracey & Boling, 2014). Besides, the raising importance of internationalisation policies and the growing number of interdisciplinary curricula are transforming the classes into cross-cultural environments. Combining these two factors, it follows that cross-cultural teamwork is

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becoming the everyday reality of many students and teachers in the design field (i.e. Christensen & Ball, 2016).

Enterprises in the fields of innovation and design are already performing cross-cultural teamwork and this trend is likely to increase in the future (Chartered Accountants, 2015). Business reports show that there is a correlation between a company's high diversity and good performances and that the diversity of thinking enhances innovation (e.g. Deloitte, 2018; EY, 2013). This shift towards cross-cultural collaborative environments in the design field suggests that practitioners will be increasingly expected acquire a new set of soft skills related with intercultural competences, defined as the ability to interact with culturally diverse people. How do cultural diversity and design practice mutually influence each other? Which are the intercultural competences that support designers to overcome difficulties during cross-cultural teamwork?

Being in the midst of great change with regard to teamwork, design discipline is now urging to gain knowledge about how culturally-diverse individuals interact within the co-creation process (Christensen, Ball, & Halskov, 2017; Wilson & Zamberlan, 2015; Poggenpohl & Satō, 2009; Poggenpohl, 2004). Since the design discipline already counts a considerable number of cross-cultural design collaborations case studies and some researches related to the cross-cultural domain (i.e. Christensen et al., 2017; Lee, 2016; Vivek Gautam, 2012), both in the field of design education and practice, their in-depth analysis can contribute to the development of theoretical frameworks and to analyse the impact of cultural diversity on the design process. The achievement of an extensive understanding about the way culture has an influence on co-creation in design teams could contribute to

- assess teams' dynamics in cross-cultural design teams;
- foster the identification of the transversal competences that a designer must develop to perform and facilitate this type of teamwork;
- find new strategies to underpin the inclusion of diversity in design teams.

The resulting knowledge will hence hopefully foster a wiser management of teams and will contribute to the interdisciplinary discourse about cross-cultural teamwork. The presented research stems from the recognition that intercultural design teamwork is rarely evaluated by itself within the academic design discourse. The paper hence addresses the conference theme "Design Revolutions" tackling the relevant emerging theme of cross-cultural collaborations, inside and outside the discipline, and envisioning how design can play a role in its empowerment. Design research can shape new perspective for cross-cultural teamwork, supporting people to positively contribute to the collaboration, enabling them to bring their own unique worldview. The upcoming research that lays at the border between design studies and cultural studies will be introduce in the next paragraphs. The paper also provides a case study to show how design research can intertwined with cross-cultural management (CCM) and how they can mutually inform each other.

2 Cross-cultural design teamwork and cross-cultural management

The cross-cultural research domain is characterised by a high variety of disciplines that have been established to study culture. Cultural studies (Patel, 2018) cover a vast transversal area of academic inquiry which crosses boundaries between philosophy, anthropology, pedagogy, psychology and management. The literature review disclosed that these disciplines provide frameworks, methods and tools to understand cultural diversity.

In the present case further understanding can be provided by an interdisciplinary research between design and disciplines that relates with the cross-cultural research domain (i.e. social sciences, anthropology, cross-cultural management, cross-cultural psychology, intercultural learning). The research on cross-cultural design teamwork should be rooted in the solid ground provided by these existing fields. Interdisciplinary research is not a new concept in design research that is often addressed as an area of inquiry characterised by blurred-borders and therefore which is often influenced by other disciplines (Bremner & Rodgers, 2013).

Among the disciplines labelled under cultural studies, scholars in the field of cross-cultural management (CCM) are already merging theoretical contribution from other fields (such as organisational behaviour, anthropology, sociology) to create frameworks and hands-on tools to serve managerial practice (e.g. Patel & Salih, 2018). Moreover, the disciplinary proximity of several areas of design research with the managerial discourse further supports the idea that the CCM can be a valid consolidated discipline to establish the research on cross-cultural design. This area of inquiry within design can hence adapt theoretical and managerial frameworks outlined by scholars in the field of CCM to the specific context of creative collaborative processes.

On the other hand, scholars dealing with design practice and education are already developing know-how about the cross-cultural dimension of project-based collaborations. Design research methodology could possibly reframe the issues related with cross-cultural collaborations in a completely new light. For instance, a research through design approach could inform other disciplines, creating an effective synergy between theory and practice. Moreover, an investigation about cross-cultural design teamwork could provide understanding about the role of the creative process in the intercultural interaction between individuals. The interdisciplinary research between design and CCM could hence provide a stream of knowledge in both directions, opening new channels for the two disciplines to mutually inform each other.

3 Mybias, a case study

The development of a design tool, Mybias, is presented in the following paragraph to serve as a case study. The design process of the tool served to stimulate the research interest around the theme of cross-cultural collaborations in design. This paragraph is aimed at providing the explanation of how design clinical research can inform CCM with a bottom-up approach. Moreover, the tool itself constitutes an example of hands-on tool developed in the context of design research that can inform CCM and other cultural studies.

Mybias is a web-based tool designed for cross-cultural teams and aimed at representing team members' biases about any relevant topic related to the design brief (Mattioli, Ferraris, Ferraro, & Rampino, 2018). Using Mybias, all team members define a topic through three images and a short caption (140 characters). This standard representation, called *biascard*, is first created individually by everyone; then, once every team member has created her own *biascard*, everybody shares its content with the rest of the team.



Figure 1. Example of two biascards created by two participants about the topic "city"

The tool testing demonstrated either to support cross-cultural design teams to develop mutual understanding from the very beginning of the design process (i.e. exploration phase, divergent phase) (Mattioli, Ferraris, Ferraro, et al., 2018) and to potentially stimulate ideas generation (Mattioli, Ferraris, & Ferraro, 2018).

Mybias was firstly ideated as a master thesis project and, later, it has been further developed through a wider investigation. The insight that initially drove the whole project was that a wide variety of biases coexist within cross-cultural design teams. First hand experiences showed that biases can sometimes constitute a barrier for mutual understanding, especially if they remain implicit. A lack of mutual understanding becomes problematic (i.e. frustration, time loss, arguments) in the convergent phase of the design process, when the design team must co-create a solution for the issue at hand (Mattioli, Ferraris, Ferraro, et al., 2018). On the other hand, once they are explicit, biases could become shared knowledge between team members empowering the team rather than impeding it. Hence the initial insight has been to design a bias-sharing tool to improve mutual understanding and intercultural understanding of the topic at hand.

The project was initially situated in the context of a clinical research (Buchanan, 2001), meaning that the tool developed was aimed at solving the specific issue encountered in cross-cultural design teams. Clinical research is indeed defined as that research "directed toward an individual case" (Buchanan, 2001) and it must lead to the collection of all the information necessary to solve that problem. In this case the process of gathering information opened-up a wider unexplored research area. Indeed, while reviewing design literature to establish a sound theoretical background for the project, a lack of consolidated area of inquiry on the theme of cross-cultural design collaborations emerged. The research group interest moved from the clinical research question *"how to minimise the negative effects of biases in cross-cultural design teams"* to a wider class of phenomena connected with cross-cultural collaborations and the design practice. This described emerging focus indicates a change in the nature of the research from clinical to applied, because it the research question shifted from the solution of a specific problem to the discover of principles and/or rules-of-thumb to interpret a wider group of phenomena (Buchanan, 2001).

Mybias theoretical background become the presumption for this broader research. Rooting the design collaboration theory in hermeneutical epistemology proposed by Krippendorff (2005), design can be intended as a matter of creating meaning and designers must develop skills in understanding the way other people give meaning to things (Krippendorff, 2005).

The designer's profession is therefore about understanding needs and behaviours of people who are different from their selves, implying the ability of moving from the *self* to the *other and* vice versa (Steen, 2012). The movement from the self and the other become more challenging when it is spaced-out by a relevant cultural difference. Beyond design literature, the theoretical background of Mybias was also widely influenced by theories and insights coming from disciplines such as cross-cultural management and organizational behaviour (Mattioli, Ferraris, Ferraro, et al., 2018), reason why the tool can be listed as an attempt to inform design research by bridging it with cultural studies.

The testing of Mybias demonstrated that the tool gives to team member the opportunity to bridge their preconception and previous experience, creating a space for reciprocal intercultural understanding (Mattioli, Ferraris, Ferraro, et al., 2018). In addition to meeting the initial project objectives, this result also shows a possible future impact of the tool on other disciplinary areas, such as the CCM and the broader area of cultural studies. Indeed, Mybias could be considered as a case of a hands-on tool developed for cross-cultural design collaboration that can support cross-cultural teams operating in different fields.

4 Conclusion

The paper offers an introduction to cross-cultural design teamwork as an emerging area of inquiry in design research. Due to the extensive employment of cross-cultural design teamwork in practice and education, a deeper understanding about these collaborations is needed. The paper demonstrates that the knowledge developed in the consolidated field of CCM could constitute the ground for this new area of design inquiry to develop. Moreover, the knowledge coming from cross-cultural design practice could mutually inform CCM supporting the assessment and development of theories on cross-cultural collaborations.

The case study provides an example on ways in which design research is intertwined with the field of CCM. Mybias, the presented design tool to explore biases in cross-cultural teams, could be either a hands-on tool for practitioners in both fields and a research tool to gain understanding on the role of biases in cross-cultural collaborations.

The paper should be intended as a first attempt to raise attention on the relevance of cross-cultural teamwork in design, and it hence suffers from a lack of a consolidated literature in the design discipline. Additionally, the paper doesn't assess the strategies that researchers should follow to conduct such interdisciplinary research between design and CCM. Forthcoming contributions in this field should disclose the way the interdisciplinary research can be developed. Moreover, further research can identify the most relevant theoretical frameworks of CCM to adapt and apply them to the design practice.

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Cultural Blindness: Eye-tracking trial of visual attention towards Assistive Technology (AT) product, by students from the UK and Pakistan

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Culture is an influential predictor of the way people use their sensory (visual) perception to derive information through visual stimuli. The discipline of psychology is culturally-bounded, providing the dominant views of western societies, in relation to other cultural perspectives. This western bias in research is often termed cultural blindness. According to Nisbett's model of cognition, individuals from Asian (collectivist) and Western (individualist) societies have bias to employ holistic and analytic visual processing styles, respectively. The stigma or negativity associated with Assistive Technology (AT) products are instigated by the societal perception of the communicative (semantics/meaning) content of those devices. There has been little empirical evidence that shows how individuals from different cultures interact with a given visual of an AT product, whether they are motivated to attend specific component (graphemes) of the product; and, the sequence of the fixation within pre-defined Areas of Interests (AOI) of a visual stimulus. In this study eye-tracking in conjunction with Semantic Differential (SD) scale was used to explore the viewing behaviour of students (n=15) from the UK (individualist) and Pakistan (collectivist). Through data analysis using BeGaze™, the order of the fixations was checked. For the appraisal of identical product representation, the pattern of eye movement was noted to be different across cultural groups. The contradiction was discovered due to the amount of attention allocated to various AOI's. The paper further draws on the concept of 'cultural blindness' to indicate the role of culture in relation to socially acceptable product design.

Keywords: Assistive Technology; Cultural blindness, Cognition, Eye tracking, Product semantics, Visual attention

1 Introduction

The paper will underline some deficits/paucity of design research and practice to provide empirical evidence for underpinning investigation using a multidisciplinary perspective. The pragmatic research paradigm has been used for the extractions of insightful information relevant for design researchers and practitioners and those involved in New Product Development (NPD) process.

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Assistive Technology (AT) products – any, product, item, piece of equipment or a product for the use of disabled people to alleviate their physical capabilities –have been used as a vehicle to check those evidences within the domain of visual perception (psychology) through a cross-cultural viewpoint (Cook & Polgar, 2015; WHO, 2011). This marketing (AT) segment subsidises the economic development of countries, internationally (The Economist, 2014). According to World Health Organization (WHO), more than one billion people has some form of disability (WHO, 2011). The gradual but consistent increase in number of disabled and elderly people has resulted in growing demand of AT products in international market (Asghar, Torrens, & Harland, 2018, 2019; Lucintel, 2017; Newell, 2003; Routhier, Vincent, Desrosiers, & Nadeau, 2003; Sun, Wilson, Schreiber, & Wang, 2017; WHO, 2008, 2016). Subsequently, the international assistive technology market has an estimated worth of approximately $42,360.0 million (around £35,165.0 million) (BusinessWire, 2017).

With over 300 definitions, the notion of the culture has been discussed widely in literature. Williams (1983) stated, 'culture' is one of the most difficult word in English language to define precisely. The interventions concerning cultural perspective of disability tends to describe culture as a set of *beliefs, values, meanings and actions that shape the lives of a collective of people, influencing the ways people think, live and act* (Asghar et al., 2019, p. 2; Ripat & Woodgate, 2011, p. 88). Arguably, culture affects the thinking (cognition) processes at both societal and individual levels (Kastanakis & Voyer, 2014). While culture has been an extensive concept, the division of culture into individualist (Western) and collectivist (Asian) societies is a recurrent approach in studying this notion (Hofstede, 2001; Nisbett, 2003). Both societies have marked differences in terms of the formation of societal structure and their cognitive processes – the way by which individuals know the world (Nisbett, Choi, Peng, & Norenzayan, 2001). The values related to interdependent self-construal, complex social relationships with other members, group harmony, sense of belonging (other-focused emotion), are considered to be the hallmark of collectivist (Asian) societies (Kastanakis & Voyer, 2014; Masuda & Nisbett, 2001; Ripat & Woodgate, 2011). On the contrary, members of individualist (Western) societies exhibit independent self-construal, less complex social affiliation, personal autonomy, control (ego-focused emotions) (Kastanakis & Voyer, 2014; Masuda & Nisbett, 2001; Nisbett, 2003; Nisbett & Masuda, 2003; Ripat & Woodgate, 2011). Regarding cognitive styles, members from collectivist and individualist cultures have been reported to use distinct cognitive styles, holistic and analytical, respectively (Masuda & Nisbett, 2001; Nisbett & Masuda, 2003). Holistic and analytical systems of cognition can be defined as follows:

Analytical cognition embodies:

- A detachment of the object from its context.
- A tendency to focus on attributes of the object in order to assign it to categories.
- A preference for using rules about the categories to explain and predict the object's behaviour.
- Inferences rest in part on decontextualization of structure from content, use of formal logic, and avoidance of contradiction.

Holistic cognition entails;

- An orientation to the context or field as a whole, including attention to relationships between a focal object and the field.
- A preference for explaining and predicting events on the basis of such relationships.
- Experience-based knowledge rather than abstract logic and are dialectical.

- An emphasis on change, a recognition of contradiction and the need for multiple perspectives. (Nisbett & Norenzayan, 2002a, p. 19)

Despite the classification of culture (individualist/collectivist), psychological interventions persist to reflect dominating views of Western societies, in comparison to their counterparts (Asian) (Berry, 2013; Ijzendoorn & Sagi, 2001). The discipline of 'cultural blindness' highlights this prejudice and is often understood as *the incapacity to comprehend how specific situations may be seen by individuals belonging to another culture due to a strict alignment with the viewpoints, outlooks, and morals of one's own society or culture* (Bowers, 2013). The international perspective about the perception of disability by the societal member entails both collectivist and individualist societies. Using the principle of psychology, the term cultural blindness has, thus, been employed for this research to demonstrate the opinion of both societies regarding their perception of disability through associated AT products.

The use of AT products occurs in one's sociocultural environment which could play an imperative role for the acceptance of those product. Despite the increased demand of those devices, AT products are often abandoned (Pape, Kim, & Weiner, 2002; Shinohara & Wobbrock, 2011). This is due to the fact that the meanings assigned to these products do not match against the social and cultural prospects of the targeted user (Asghar et al., 2018, 2019; Pape et al., 2002; Shinohara & Wobbrock, 2011). This parallels with the consideration of more accepted social model of disability, that highlights the importance of society towards disabled person (Barnes, Oliver, & Barton, 2008; Oliver, 1990).

Crilly (2010) has compiled evidence to describe range of artefact's functions. Broadly, the explanation of these key aspects of product functions have been described by Jochen Gros in so-called 'offenbach theory of product language' (Gros, 1976). This conceptual model provides an indication of imperative communicative function (semantic content) of products. According to Krippendorff (2007), product semantics can be defined as a *vocabulary and methodology for designing artefacts in view of the meanings they could acquire for their users and the communities of their stakeholders* (Krippendorff, 2007, p. 03). Within the field of product design, product appearance offers clues for the semantic comprehension of the subject (product) (Crilly, Moultrie, & Clarkson, 2004). Henceforth, social significance coupled with the semantics, the meanings, delivered through cultural coding, are considered as an important predictor that instigates product related stigma (Vaes, 2014; Vaes, Jan, Standaert, & Vaes, 2016).

To address the topic of cultural blindness, practicing industrial designers hold the position to influence the individual's perception to diminish the product related stigma (Vaes, 2014). Meanwhile, those involved in AT product design and development process need to be well aware of the way individuals from diverse cultures appraise AT products. While, the role of engineers is vital for improving the practical functions of the product, yet, designers do not have sufficient evidence to predict and check the societal perception towards the semantic attributes of AT product.

This proposed study elicits insights on cultural difference between the individualist (United Kingdom) and collectivist (Pakistan) and inspects how the cultures affects the societal perception of designed AT product. This preliminary study included eye-tacking trials to capture eye-movement for the semantic, meaning, comprehension of the AT product with student samples from the UK and Pakistan.

Two questions guide this study;

Which visual component (graphemes) of an image of wheelchair designs capture relatively large amount of visual attention?

Are there any difference(s) in the semantic (meaning) assignment/given between individuals immersed in a collectivist or individualist society due to the use of a holistic or analytical cognitive processing of the image?

Eye-tracking was considered to be the most appropriate method to inspect the mechanism of visual perception as it offers insightful information about the way people use their sensory (visual) perception to derive information of the presented visual scene. Additionally, the Semantic Differential (SD) scale was developed to check how the individuals dictate their opinion when evaluating the presented AT product.

2 Method

2.1 Semantic Differential (SD) scale

The Semantic Differential (SD) scale has been reported as a method to measure an individual's perception of semantic content of the subject or concept (Ajani & Stork, 2013; Martin & Hanington, 2012; Osgood et al., 1957; Robson & McCartan, 2016). Formerly developed by Osgood (1957), this technique measures individual's perception of subject typically on a seven-point bipolar rating scale (Martin & Hanington, 2012). Participant's opinion about the subject(s) are assessed on a scale, typically one to seven, in relation with the provided pairs of antonymous adjectives. The response value reflects the positive and negative dimension being associated with the subject, where middle value (04) denotes a neutral position (Osgood, 1964; Osgood et al., 1957). When exploiting this scale in cross cultural innervations, the SD scale yielded three factorial categories, evaluation (good-bad), potency (strength-weakness) and activity (fast-slow) becomes more relevant. Several studies have shown to effectively use SD scale to inspect the issues related to disability and disabled people (Ajani & Stork, 2014; Carneiro et al., 2016; Davis et al., 1999; Fellinghauer et al., 2011). Meanwhile, researchers have been noted to modify and develop their own version (Photo Elicitation Semantic Differential, PESD) of SD scale (Fellinghauer et al., 2011). Based on evidences from previous studies, the SD scale method appears to be an effective way to evaluate a viewer's perception of an artefact or an image.

2.2 Eye tracking

The process of visual perception could be considered as an integral element to inspect the way individual interacts with the presented visual stimuli. The advances in eye-tracking technology enabled researchers to monitor, capture and analyses real-time eye movement of the respondents (Wang & Sparks, 2014). Meanwhile, the interventions using a psychological viewpoint to check the eye movement, combines cognitive processes with eye-tracking technology (Dong & Lee, 2008). From this standpoint, eye-tracking offers insightful information about the cognitive strategies that provide investigators with evidences of viewing patterns, which respondents do not consciously see (Dong & Lee, 2008). Moreover, the review of literature has shown eye-tracking as an effective method to be used in pan-cultural studies (Dong & Lee, 2008; Ho, 2014; Nisbett & Masuda, 2003; Wang & Sparks, 2014).

Considering the efficacy and effectiveness, both (SD scale and eye-tracking) methods are used to achieve the intended objective of this study. For this research, SD scale was developed through a Principal Component Analysis (PCA) for choosing appropriate pairs of

antonymous adjectives (see appendix A). For using the SD scale in eye-tracking trial, the visual layout was adopted from Photo Elicitation Semantic Differential (PESD) scale (Fellinghauer et al., 2011).

The purpose of present study was to answer the question, “Did distinct cognitive style affect the distribution of visual attention and viewing pattern of individuals from diverse cultures, when attending various graphemes of an image of the attendant wheelchair?” This was investigated by eye tracking, where the participant viewing pattern and sequence of fixation is captured, when assigning semantics, the meanings, to the AT product. This approach also suggested the amount of attention paid to each component of the product. For defining Area of Interests (AOI), this study adopted identical methodology as highlighted by Ho (2014). Based on object-oriented and feature-oriented theories of visual attentions, eight (08) attention-based AOI were coded to obtain the information about relevant eye-tracking metrics (Duration of First Fixation (DFF), Fixation Count (FC), Glance Duration (GD) etc.). AOI with their corresponding coded labels are presented in Table 3.

The size and shape of AOIs corresponds to the associated regions of the product (wheelchair). For example, the wheels and backrest AOI are relatively larger than other components of the products. All types of attention-oriented AOI are listed in Table 1 and illustrated in Figure 1.

Table 1: AOI's based on graphemes of the product

Defined Areas of Interest (AOI)	Labelled as
Wheels	A_1
Backrest	A_2
Seat-pan	A_3
Operating Handle (at back)	A_4
Footrest	A_5
Support Wheels (at front)	A_6
Armrest	A_7
Others (metal structure)	A_8

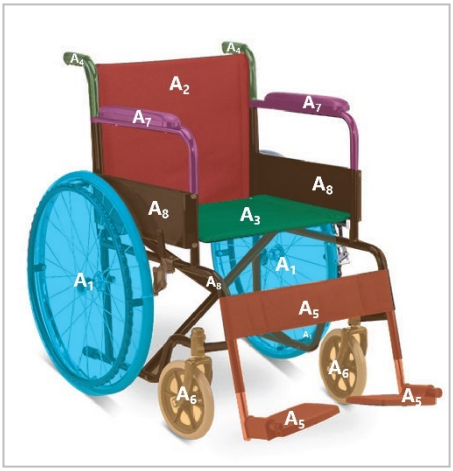


Figure 1: AOI's with coded labels

3 Procedure and post processing

The authors collected 70 images of a generic attendant wheelchair. The images were intended to be as neutral as possible with respect to sociocultural status. This was achieved by removing unnecessary variables (details of users, backgrounds). Of the 70 images, four images were selected based on the image quality, angle of orientation, and image size. The chosen images were further treated to remove any indications of brands. The gender ambiguous outline of an attendant was used to provide visual reference for scale and proportion of the product. Lastly, the non-colour and non-texture preferences were selected to avoid influence on participant’s opinions (Torrens, Storer, Asghar, Welsh, & Hurn, 2019). Figure 02 presents those standardised designs of the product used in the eye-tracking experiment.

For the experiment the authors used a screen based Tracksys supplied SMI (SensoMontric Instrument) eye tracker with an infrared corneal reflection system, integrated into 21.5-inch monitor (at 1680 x 1050 resolution). The SMI RED 120Hz equipment was selected as it gathers information of each 10 milliseconds (ms).



Image 01 Image 02 Image 03 Image 04

Figure 2: Designs of Wheelchairs used for the trials

The Experiment Centre 3.6 computer program in conjunction iView X™ was used to acquire data at the rate of 120 Hz. The distance between the computer screen and participants was ranging from 40cm to 50cm.

The size of the displayed map visual (stimuli) was 1680 x 1050 pixel to match with the monitor resolution. Finally, to acquire the valid data for the study, the experiment using the same equipment was carried out with the participants of the UK and Pakistan.

There were fifteen (n=15) participants in this preliminary study: eight (08) Asian volunteer from Pakistan and seven (07) Western volunteer from the UK. Volunteer from Pakistan sample were all graduate students recruited from University of Engineering and Technology, Lahore, and consisted of equal number of males and female (04 male, 04 female), having an age range between 18 to 21 years. Volunteer in the UK group were all British national graduate students and consisted of four males and three females (mean age 19.2 yrs.) recruited from Design School, Loughborough University, UK. The participants from both groups were matched on age and graduate fields of study. Participants were graduate students from design school in Higher Education's Institution (HEI) from both countries. Prior to data collection, the study received ethical approval from relevant committees of both institutions involved.

All subjects read and signed an informed consent form that had been approved by the Ethics sub committees at the University of Engineering and Technology and at Loughborough University.

Prior to the eye tracking trials, participants completed the demographics questionnaire. All participants were informed that they would be presented with a series of images to evaluate the product for the provided pairs of adjectives. Once sitting comfortably, the participants were asked to maintain their posture without moving their head or face. A calibration was performed followed by five-point validation test. The calibration with .5 degree of X and Y axis was achieved before introducing the mapping visuals. Each image was displayed for a period of 10 seconds (10000 ms). Participants were instructed to utter their response on a scale from one to seven. Figure 03 shows an example of such image used in the eye-tracking.

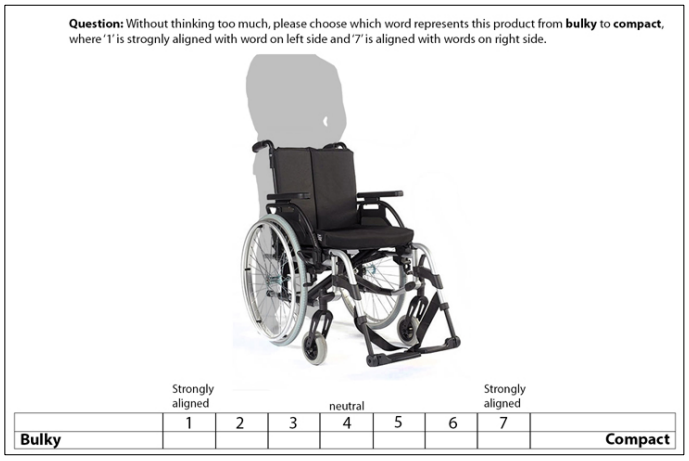


Figure 3: Example of visual stimulus used in the experiment

4 Result

The complete dataset associated with this study can be accessed at Figshare (Asghar, 2019). Regarding Duration of First Fixation (DFF) for each AOIs, Table 02 represents the sequence of viewing behaviour in ascending order for Pakistani participants was A_1, A_3, A_2, A_8, A_6, A_5, A_7 and A_4. While, this sequence was noted as; A_1, A_2, A_3, A_8, A_5, A_6, A_7, and A_4, for participants from the UK. With the exception of A_1, the sequence for DFF of participants was discovered as different across the groups. Similar difference of sequence for DFF was recorded for the other designs of wheelchair represented in image 02, image 03 and image 04.

The Fixation Count (FC) in descending order for image 01, for the participants from Pakistan was A_3, A_2 and A_1. This arrangement for FC does not match with the responses of other groups. For which the similar order of FC was noted as; A_8, A_3, A_1, and A_2. The similar fluctuation regarding FC were discovered, when participants were attending the rest of the designs of product (image 02, image 03 and image 04).

Table 2: Eye tracking data metric from the experiment

		Image 01			Image 02			Image 03			Image 04		
		DFF	FC	GD	DFF	FC	GD	DFF	FC	GD	DFF	FC	GD
Pakistan	A_1	164	1.49	428.66	218.15	2.28	746.53	140.60	1.43	475.46	217.7	2.20	737.36
	A_2	91.08	1.21	410.99	146.15	1.13	368.91	105.83	1.36	411.36	91.55	0.66	155.58
	A_3	142.5	0.9	249.73	188.03	1.13	358.45	257.23	2.10	897.03	218.27	1.73	611.05
	A_4	11.82	0.03	10.16	0.00	0.00	0.13	0.00	0.01	6.13	0.00	0.01	5.48
	A_5	18.77	0.05	14.08	41.03	0.28	75.35	62.53	0.25	55.78	63.60	0.23	64.09
	A_6	42.57	0.18	54.6	56.48	0.49	120.05	109.15	0.41	136.75	185.95	0.40	179.35
	A_7	18.25	0.10	23.85	31.28	0.24	95.03	8.35	0.01	6.64	10.60	0.04	13.69
	A_8	55.21	0.39	136.98	75.35	0.74	247.00	105.93	0.43	141.88	84.73	0.41	120.05
UK	A_1	150.23	1.55	605.68	231.87	2.56	789.60	235	2.5	927.05	281.3	3.14	1057.53
	A_2	141.92	1.90	602.01	143.07	1.48	467.79	123.70	1.26	416.53	118.97	1.29	384.75
	A_3	139.07	1.25	507.93	225.87	2.15	761.40	260.17	1.95	731.95	218.80	2.38	695.03
	A_4	0.00	0.01	9.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	A_5	76.43	0.10	62.40	100.90	0.23	105.45	18.00	0.05	18.28	11.90	0.08	24.13
	A_6	36.50	0.28	61.19	128.90	0.39	193.50	14.50	0.08	20.41	69.15	0.40	130.65
	A_7	26.83	0.08	30.40	62.23	0.33	82.15	69.92	0.21	98.46	73.30	0.26	76.85
	A_8	82.82	0.50	190.24	98.11	0.99	361.05	104.91	0.61	234.06	85.76	0.60	193.60

Mean values for 'DFF' and 'GD' are reported in milliseconds (ms).

For the first visual, the participants of both groups attended A_1, with maximum Glance Duration (GD). Regarding total GD, the order of viewing behaviour for participants from Pakistan was recorded $A_2 > A_3 > A_8 > A_6 > A_7 > A_5$ and $> A_4$. In contrast, the participants of other group allocated slightly varied sequence of GD ($A_2 > A_3 > A_8 > A_5 > A_6 > A_7$, and $> A_4$).

Similar trends of fluctuation (in the amount attention paid and recorded through GD) was observed when the participants of both groups were attending homogenous design of the wheelchair. The dissimilar numeral for the variables (DFF, FC, GD) and sequence with which the AOI were attended by the participants endorse the assertion; the distinct cognitive styles of individuals from diverse cultures potentially affects the distribution of visual attention and viewing pattern.

The eye-tracking data (heat maps) revealed further insightful information to inspect the relevance of vital visual graphemes in the product, for the assignment of the meaning(s). The findings from the heatmap suggested that participants of both cultural groups had attended different AOI when evaluating the product. For example, figure 4 shows a comparison of the amount of visual attention being allocated by the participants of both groups. For the appraisal of product between *bulky-compact*, the hotspot (based on the fixation length) was discovered on different AOI.

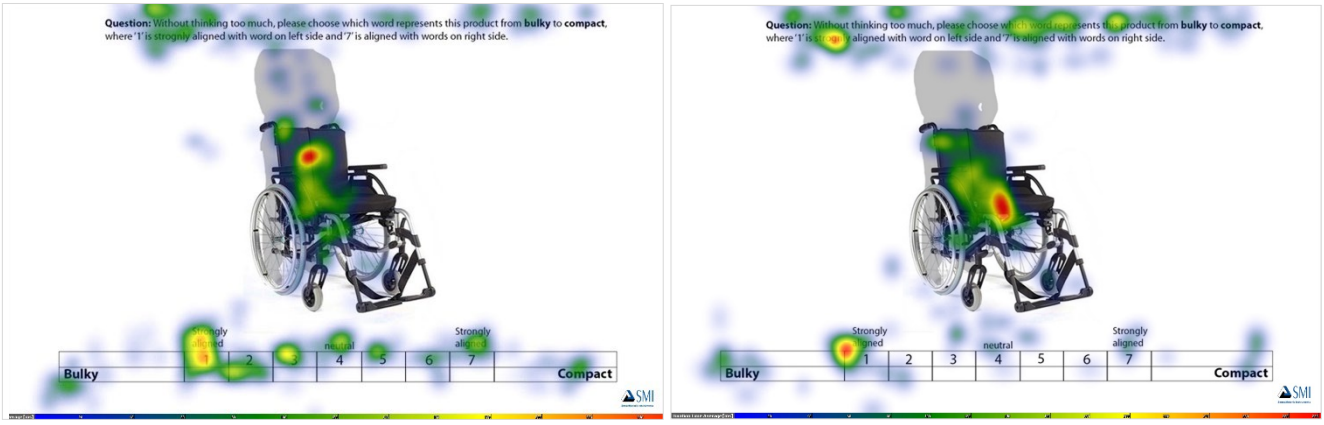


Figure 4: Heatmaps of participants from Pakistan (left) and the UK (right)

Finally, statistical assessments were performed to investigate the nature of overall response from both groups. The mean (M) standard deviation (sd) values of each groups were obtained and analysed. The responses from both groups may not necessarily depend on each other, for which reason, the responses can be considered as 'independent'. Consequently, the Independent sample t-test was performed through Statistical Package for Social Sciences (SPSS) computer program, resulting a reliability (p) value (image 01 (0.023), image 02 (0.04), image 03 (0.001), image 04 (0.0032)) less than 0.05. The p value (<0.05) from statistical analysis further supported the proposition of the difference between the viewing behaviour of individuals from both cultures.

5 Discussion

Previous interventions inspecting visual attention and viewing behaviour to extract information from the presented visual found cultural differences between collectivist (Asians) and individualist (Westerns) (Boland & Nisbett, 2015, 2015; Chua, Boland, & Nisbett, 2005; Markus & Kitayama, 1991; Masuda & Nisbett, 2001; Nisbett & Masuda, 2003).

This study aimed to investigate whether holistic and analytical cognition would be relevant in the context of visual attention during the product's semantic(s) attribution. In an attempt to

address the aim, this study found that Western and Asian perspectives differ in i) how much attention has been paid by the individuals of both groups to various AOIs, when appraising AT product's semantic(s), meaning(s), and ii) how viewing behaviour differs between the groups to attend the visual of an AT product. As noted by Chua *et al.* (2005) and Boland (2015) that differences in the formation of societal structure, experience and expertise may overtly influence the individual's unconscious behaviour (such as eye-movement). This account approves the assumption of cultural influence on cognition and perception. From this, it can be extracted that the distinct cognitive styles of the participants may have mediated their viewing behaviour which resulted to fixate different graphemes of the product. The variations in semantic attribution towards the product further offered authors with empirical evidence of explicit influence of culture on the cognitive processes (appendices B).

In conclusion, the results suggest that there are stable cultural differences in the viewing behaviour of Asian and Western societies. The participants from the UK had longer fixation duration on the product compared to the Pakistani participants, supporting the outcomes of relevant studies (Chua et al., 2005; Nisbett & Masuda, 2003). Likewise, when the UK participants reacted to the product, visual attention was mainly in response to the subject rather than other visual clues (question, rating scale, etc.). While, for Pakistani participants, the visual attention was also distributed on regions other than the focal object. Overall, those findings seem to be consistent with Nisbett (Kastanakis & Voyer, 2014; Nisbett et al., 2001; Nisbett & Norenzayan, 2002b) theories regarding holistic cognition of Asian cultural values and the analytical cognition in Western cultures.

It was important to note that when evaluating the product for new pairs of adjectives, the viewing pattern of individuals was distributed differently. For instance, for the appraisal of product between *comfortable-uncomfortable*, attention of participants was focused on the seat-pan (A_3). While for other pairs of adjective *attractive-unattractive*, A_1 was reported to be more important than A_3. It provides an indication that people preferences were altered for the semantic comprehension in relation to the different components within the product, which could be further validated/investigated.

A further experiment with large number of young adults from both cultural groups will be accomplished. At this point, the generalisability of the findings from this study is subject to certain limitations. Initially, the small population size considered for this study does not allows the authors to generalise the results. This preliminary study was intended with a limited number of participants, for which reason individual (e.g. gender, age) related influence could not be explored. Another limitation of this research would be the use of pictorial representation of the product in the survey. The use of actual product may produce further insightful results as it would convey more information than that of the visually represented product. However, this preliminary research focuses specifically on the visual aspect of the product using a cross-cultural viewpoint. Therefore, considering the research objective (user-product visual interaction) the use of visuals was considered appropriate for the survey. This research, using a visual of the product rather than the actual product, may also provide an indication for brands, manufacturers and associated stakeholders to check the value, credits and meanings of their products in global online marketplace (e-commerce).

Additional areas for future research may include; similar experiment comparing the opinions of both groups, when presented with coloured/textured designs. Further exploration may conduct semi-structured interview for validating the opinions of participants each group.

6 Appendices

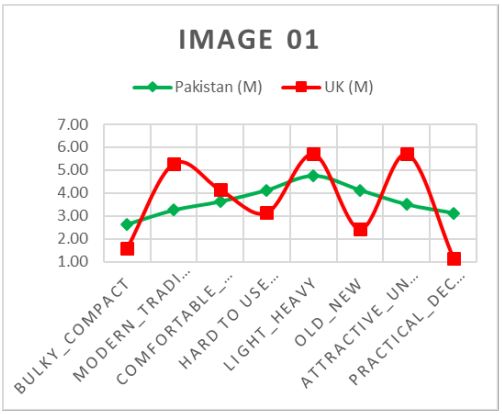
The study provides additional information underpinning investigations in following appendices;

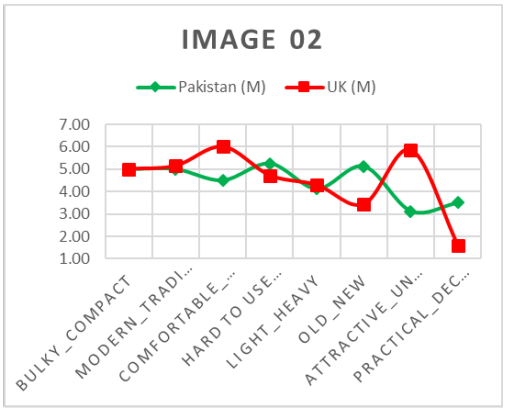
Appendix A: Pairs of antonymous adjectives selected for the study

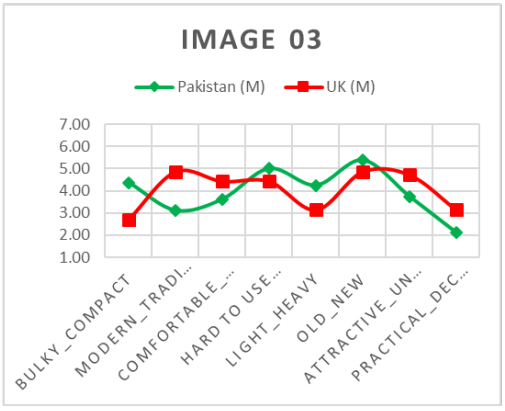
	Pair of adjectives	***Semantic Attribution***	***Reference***
P1 **P2**	Bulky – Compact Large – Small	Product feature (size)	(Taylor, 2006) (Chaves et al., 2004)
P3	Comfortable – Uncomfortable	Ease of utility	(Chaves et al., 2004), (Mann *et al. 1996)*
P4	Traditional – Modern	Modernity	(Petiot & Yannou, 2004)
P5	Old – New	Modernity	PCA
P6	Hard-to-use – Easy-to-use	Ease of use (usability)	PCA
P7	Practical – Decorative	Product feature (functionality vs language function)	PCA
P8	Attractive – Unattractive	Quality	PCA

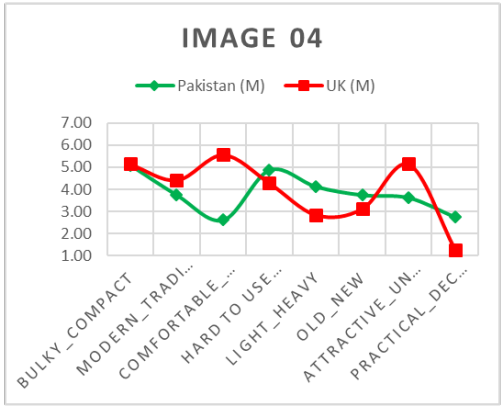
PCA: Principal Component Analysis,

Appendix B: Additional results: Comparing responses of both groups









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Design considerations for play experience in children's hospital: from perspectives of child inpatients, parents, nurses and hospital service experts

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Play is an essential element of cognitive, physical, social and emotional development of children. the space of hospital takes away play form children. When children face to unfamiliar environment, they act with specific strategies in order to control with own situation: they do things to relax such as taking a walk, watching television, they make drawing to control their emotion, or they fill surrounding with personal and recognizable thins to feel like a home. The goal of the study expends play experience in the hospital environment to create play experience for young inpatients regarding child development. This study conducted to total three sessions; expert interview with child hospital designer, focus group interview with guardian, and generative session with guardian and child. The results of this study figured out factors of play in child hospital in terms of child-patient, guardians, and experts. Based on these results, this study drew out design consideration which aids child development through play in child's hospital.

Keywords: Children's hospital; Play; Cognitive development; Emotion; Healthcare

1 Introduction

Play is an essential element of cognitive, physical, social and emotional development of children (Hayward, Rothenberg, & Beasley, 1974; Beltzig, 1998; Veitch, Bagley, Ball, & Salmon, 2006; Grillmeier, 2015). Children are offered thousands of delight of free play, so they can play, explore and interact with nature and playground without restriction or supervision (White & Stoecklin, 1998). In there, they learn how to solve problems by trial and error and grow stronger. In addition, they get to know how to cooperate with others for coping with difficulties and naturally absorb how to express and control their emotion in a community through play. However, such freedom of play is radically constrained in case a child is hospitalized in inpatient wards simply because care (her illness could get worse) and stability (she can hardly move due to her illness) are required. Losing playing in the children's hospital, staying at a ward can be a poignant experience for children (Verschoren, Annemans, Van Steenwinkel, & Heylighen, 2015). In particular, emotionally children inpatients suffer from considerable concerns and fears during hospitalization because of separation from family and friends in a limited space (Haiat, Bar-Mor, & Shochat, 2003; Coyne, 2006). In addition, children experience negative effects of hospitalization on the

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children development (SilavUtkan, 2012). However, play can help children development softening the negative emotions at the hospital (Aziz & Said, 2012; Grillmeier, 2015). There have been studies on making a children's hospital playful place in order to reduce children's concern as well as to help children development in a hospital environment (D'Antonio, 1984; Haiat et al., 2003). For example, the case of Yael, aged 10 years, was hospitalized to care burns. She visited the white room which made it possible for her to handle the pain, situation, and the odor of burn through play (Haiat et al., 2003). The example of American hospital, children's play is not a simple recreational activities supervised by volunteers but therapeutic programs implemented by professionals(Pruitt, 2016).

In addition, having a child hospitalized is not satisfying not only to children inpatients but also to caregivers because hospital environment is more difficult than their home in terms of hygiene, and treatments(Favara-Scacco, Smirne, Schilirò, & Di Cataldo, 2001; Haiat et al., 2003; Commodari, 2010). Even for those who like dynamic and physical play, inpatient wards in the children's hospital spatially provide a huge constrain. Even though caregivers already knew of the importance of play with their child(Miller et al., 2016), they do not make their child play freely at hospital which has limited play or space. As a result, children inpatients can only do limited activities such as a puzzle game or drawing in the ward.

1.1 Role of play and necessity of play

The verb of 'play' is about not a serious or practical but an engaging in the activity for enjoyment and recreation in the dictionary. However, this description is the general definition.

Play has five essential characteristics which are intrinsically motivated, freely chosen by participants, pleasurable, nonliteral, and actively engaged in by the player (Rubin, Fein, Vandenberg, Mussen, & Hetherington, 1983). First, in terms of characteristic of intrinsically motivated, play gives satisfaction itself. Second, children accept activities as a work without chosen, but they think same activities as play when they can choose it (King, 1979). Third, the most typical behavioral criterion is positive affect for observation of child play in terms of the character of pleasurable (Jenvey & Jenvey, 2002). Fourth, play is changeable according to the interest in the characteristic of nonliteral. Lastly, the child is involved not passively but physically, psychologically, or both what is doing so as to actively engaged in by the player.

Through summarizing play based on play theory, play consists of physical play, emotional play, social play, and mental health play (Metin, 2003) (Table 1). Diverse studies present the necessity of play and function of play.

Table 1. Theories in relation to play (Metin, 2003)

Theories	Reasons for play	Play benefits
Surplus Energy H. Spencer	Discharging the natural energy of the body	Physical
Renewal of Energy G.T.W. Patrick	Avoiding boredom while the natural motor functions of the body are restored	Physical
Recapitulation G.S. Hall	Reliving periods in the evolutionary history of the human species	Physical
Practice for Adulthood K. Groos	Developing skills and knowledge necessary for functioning as an adult	Physical, Mental health(cognitive)

Psychoanalytic S. Freud, A. Freud , E. Erikson	Reducing anxiety by giving a child a sense of control over the world and an acceptable way to express forbidden impulses	Emotional, social
Cognitive – Developmental J. Bruner, J. Piaget B. Sutton-Smith	Facilitating general cognitive development Consolidating learning that has already taken place while allowing for the possibility of new learning in a relaxed atmosphere	Mental health(cognitive), Social
Arousal Modulation D.E. Berlyne, G. Fein H. Ellis	Keeping the body at an optimal state of arousal Relieving boredom Reducing uncertainty	Emotional, physical
Neuropsychological O. Weininger, D. Fitzgerald	Integrating the functioning of the right and left cerebral hemispheres	Mental health(cognitive)

1.2 Historical child development and definition of child development

In this study, children are under 13 years in psychology, that is, we call childhood before adolescence. Especially, it is an importance to develop children's physical element as well as children's psychological element dependent on play activities (Bruner, 1972; Kohlberg, 1968). However, the period of children has quiet complex categorizations. Child development theories focus on explaining how children grow and change in childhood in terms of various aspects of development including physical, cognitive, emotional, and social growth. Throughout literature, this study defined the child development for under the 13 years old children.

In physicality development, it is related to a child's ability to perform tasks such as their motor skills or using their bodies(Piaget, 2013). Child development was consisted of four stages; Infant, Toddler, Pre-schooler, and School-aged child. During the first few weeks and months, child of infant stage acts reflexive or involuntary in nature. In detail, child makes sudden loud sound, changes position, and grabs object in hands or feet. During the ages of one month and one year, the child is able to hold head up on object, sit without support, creep or crawl, and walk (Hughes, 2009). Toddler stage is between one and three years of age to develop physical growth and motor skill slowly to expect to see the tremendous intellectual, social and emotional changes (Hughes, 2009). Children become pre-schooler during three to five years of age to focus on cognitive development(Piaget, 2013). In school-aged child, between five and 12 years old, child feels confident in the ability to meet the challenges. Child experiences in solving problems independently, being creative and getting results for efforts(Hughes, 2009).

In cognitive behavior development, Piaget's theory consists of five stages; Sensitive motor stage (0-2), Preoperational stage (2-7), Concrete operational stage (7-11), Formal operational stage (12-) (Piaget, 1964). Child expresses response to sensitive stimuli in Sensitive motor stage. Child increases understanding symbol or representation about the object, but the child is impossible to think logically in Preoperational stage. The child acquires cognitive operation to understand the relationship between objects in Concrete operation stage. In Formal operation stage, the child is possible to ratiocinate symbolic, so child utilizes abstract concept to think logically.

In emotional development, Erikson's theory of social psychoanalysis consists of six stages; Fundamental trust vs distrust (0-1), Independence vs shame or skepticism (1-3), Autonomy vs guilty (3-5), Assiduousness vs inferiority (6-12), Identity vs role confusion (13-18), Affinity

vs isolation (20) (Erikson, 1993). Children achieve their activity to feel trust, independence, autonomy, assiduousness, identity, and affinity in each stage, but they fail it to experience distrust, shame, guilt, inferiority, role confusion, isolation.

In social behavior development, the theory of animal behavioristics emphasizes nature role in child development with Lorenz' theory of carved seal and Bowlby's theory of attachment. Lorenz theory describes that child period is exposed to specific context to form the attachment of specific context. It can deeply influence social behavior. Bowlby's attachment theory consists of four stages; Reckless social response stage (0-3 months), Discriminative social response stage (3-6 months), Active approach and contact-seeking stage (6 months - 3), Goal modified companion stage (3-childhood end) (Bowlby, 2008).

Diverse child development theories focus on children's age level. To improve child development, it is important to support play for the child in terms of physical, cognitive, emotional, and social perspective. First, Physicality development is an indispensable factor in children's play (Bee & Boyd, 2012; Broto, Ockrassa, Krauel, & Noden, 2010; Kotnik, 2017). This play type contains motor skills, physical stamina, and confidence while promoting fitness and health. The definition of Play with physicality is developing a muscle through physical activity. Next, Play with sociality refers to the process that children learn to interact with others (Broto et al., 2010; Kotnik, 2017). Through this play type, children are able to understand game rules, sharing, friendships, and other relationship. Children master teamwork as well as competition for social interaction and communication skills. Third, Play is associated with creativity for children development (Broto et al., 2010; Russ, Robins, & Christiano, 1999). Through this play type, children acquire creative thinking ability and power of imagination through the play. Lastly, children who contact with natural environment tend to be more active and that supports a positive mental health (Brussoni et al., 2015; Lester, Maudsley, & England, 2007). Children do this play that is associated with language, perception, memory, problem-solving and thinking. The definition of play with mental-health is that children learn the sensory skill and improve knowledge for play.

In this study, we consider the basic child development for child in terms of physicality, cognition, emotion, and social behavior. In order that the four developments are important to child growths, this study consider exploring them in child's play.

1.3 Lack of play at children's hospital

In the 18th century, hospital architecture contributed to the patient's well-being, so this idea has been influencing health care facility design (Wagenaar, 2006). Also, the concept of hospital studies is attracted renewed attention such as healing environment (Dijkstra, 2009). However, many studies that would follow healing environment perception, few focus on child patients (Verschoren et al., 2015). During hospitalization, child patients suffer from fears and concerns because of being separated from family and their friends, staying in an unknown and unpleasant environment, undergoing treatment, and losing their self-determination (Adams, 1976; Coyne, 2006).

According to another the study, hospitalization is a variety of negative effects such as pain, fatigue, anxiety and, etc. on the development of children in the hospital environment (SilavUtkan, 2012). Children's hospital is designed to protect children's physical and psychological health (SilavUtkan, 2012). The author insists that child-space interaction is important in terms of children's hospital design based on children's requirement (physical and psychological) (SilavUtkan, 2012). Particularly, children who have a serious disability

have a high risk of emotional problems, behaviour problems, and reduced the ability of cognitive development(Tallon, Kendall, & Snider, 2015).

To improve hospitalization and child development, children can play diverse activities in order to reduce fear as well as becoming confident in playroom or play area, so caregiver can visit the playroom or play area frequently with the child to enjoy activities together ("Your child in hospital: The importance of play," 2013). About the role of play in hospitalization, children in the therapeutic play condition proved a significant reduction in hospital fears (Rae, Worchel, Upchurch, Sanner, & Daniel, 1989). Consequentially, play is the most powerful and effective tools so as to reduce tension, anger, frustration, conflict, and anxiety at the hospital (Haiat, Bar-Mor, & Shochat, 2003)

This study aims to provide design considerations in creating play experience in the children's hospital. The two research questions are formulated: 1) How can play experience be created in the children's hospital in terms of child development. 2) What concerns and wishes of stakeholders exist in the children's hospital regarding to play experience?

2 Methods

In order to figure out what needs and wishes about play stakeholders in the children's hospital have, three methods were conducted, expert interview, FGI, and generative workshop. First, through expert interview, this study had to figure out knowledge of child inpatients and understand situation of child hospital. Second, this study considered parents and nurses as secondary member of child hospital to be conducted to FGI session. Lastly, this study had a generative workshop for children because it is easy for children to embody their wishes based on experience rather than interview.

2.1 Expert interview

2.1.1 Experts

We recruited to experts who worked in service design team from tertiary care hospital at Seoul and secondary care hospital at Busan. Three experts who worked at hospital service team understood the design process to develop hospital space (see their detailed background in Table 2). Experts who were from diverse backgrounds had working experience average six years. They could understand not only design thinking but also medical knowledge in order to answer the design consideration for child inpatients.

Table 2. Experts profiles in the expert interview

Participant	Gender	Age	Backgrounds	Profession or expertise	Working place
A	Female	36	Designer	Hospital design management	Hospital in Busan
B	Female	38	Nurse	Hospital service design management	Hospital in Seoul
C	Female	28	Designer	Hospital place design management	Hospital in Seoul

2.1.2 Materials

The research conducted the semi-structured interview with experts. The questions of the expert interview consisted of three part. First, interviewees were asked features of child hospital such as target of child hospital, the percentage of each age group, the ration of infection inpatient and non-infection inpatient, and etc. Next, we asked experts of children's play in the hospital and current condition as below:

- Do the children in the hospital have lack of activity?
- If so, how do they solve their activity?
- What do children have difficulties related to play at the hospital?
- How do children express their dissatisfaction at the hospital and what do they want at the hospital?
- What does your hospital serve to release boring for child inpatients are current services or spaces satisfied to child inpatients?
- Lastly, they mentioned the effect of play for child inpatients and the solution of the current condition.

2.1.3 Procedure

The expert interviews were conducted to the children's hospitals which were located to the woman and child hospital in Busan, and the national hospital in Seoul. In order to explore an expert's opinion about the play in hospital, respondents were interviewed for one hour (Figure 1). We recorded their voice during interview session. First of all, we distributed interview question. Next, the expert described what they did in hospital as design perspective for 10 minutes. After then, they answered main problem in hospital for 10 minutes. We asked the solution for child inpatients in hospital to experts for 20 minutes. Then, they answered future play design for child inpatients for 20 minutes.

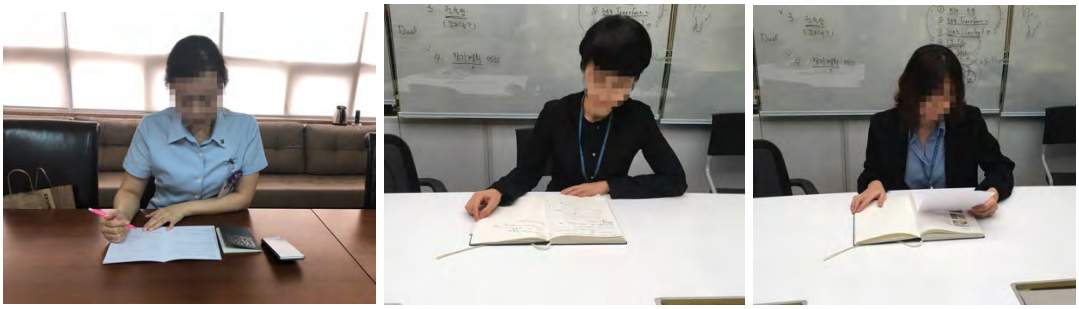


Figure 1. Experts read the interview questionnaires in the interview session.

2.2 Focus group interview

2.2.1 Participants

We recruited six nurses of the child's hospital from Busan and five mothers from Ulsan through recruit advertisement and social networking. Nurse team were woman who were between 28 to 48 years old and from the hospital for woman and child in Busan. Five mothers who were between 30 to 56 years old had the experience to care for their child in the hospital within one month.

2.2.2 Material

The main goal of the FGI was to obtain user needs about hospital play space. The session of collage was adopted as thinking for child play space in hospital context based on caregiver position. For the collage making, a A3 paper with a basic play room layout was designed to help the participants express their wishes in the space (Figure 2). We also provided pencils and sketch tools in order to express participants' idea freely on the paper.

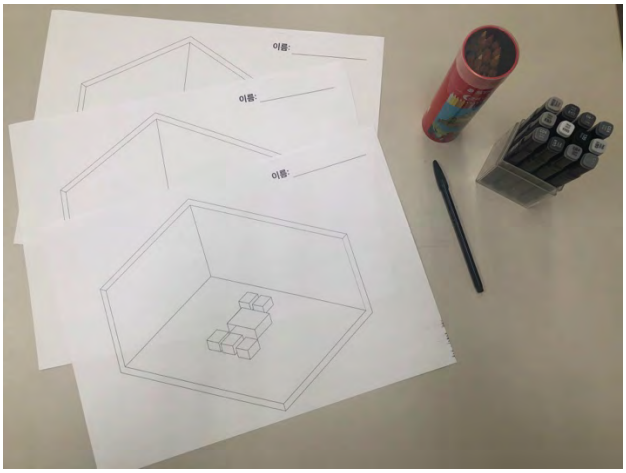


Figure 2. A paper with a play room layout used in the sesseion of the collage making and sketch tools

2.2.3 Procedure

The FGI was conducted at a room in hospital and in cafe. Throughout ice breaking, participants introduced themselves and shared hospitalization for 10 min. We asked what you want to design play room in hospital. To figure out the needs of the playroom in the hospital, participants drew or wrote what they designed for children during 20 min with pencil or drawing tools. Each team discussed the questions which were about what they want things at playroom and why they placed something at playroom on their drawing for 30 min (Figure 3).



Figure 3. Scenes of the focus group interview (above) and examples of collages of play room (below)

2.3 Generative workshop

2.3.1 Participants

Throughout mother's internet community in Ulsan, we recruited three children (one boy and two girls) and their mothers in this workshop. The average age of the children was seven years old. All of them had an experience to have been hospitalized for at least a week duration. The participants involved in the research had hospitalized in child hospital for one week. Also, they experienced hospitalization within 6 months before the time of the workshop.

2.3.2 Materials

The images of hospital were utilized to evoke experience of hospitalization. In order to express wishes for children and make detailed form of play, we prepared diverse thinkerring materials such as paper, clay, sticks, plastic bowls, woolen yarn, and so on. Before the tinkering session, participants evoked their hospitalization experience through sensitizing images which were projected on the wall. In the session the following questions were answered: What do you have negative experience during hospitalization, What and why do you design the play in hospital? and How to develop others play?



Figure 4. Examples of sensitizing images (upper) and materals provided for tinkering for the workshop

2.3.3 Procedure

This workshop was conducted in a home-like laboratory for 2 hours. Before the session, we took the nerves of child to do ice breaking and to talk about the memory of hospitalization. It consisted of two steps: one was sensitizing experience in hospitalization throughout hospital images, and the other was creating play space to use materials (Figure 5). Next, after watching hospital images, the children shared their negative experience of hospitalization

with others for 30 minutes. Next, they imaged to design play in hospital context for 50 minutes with assistances teacher because of issue of safety and focusing on hospital context. Assistance teacher helped child evoke thinking for hospital. Lastly, they presented and discussed their play for 40 minutes (Figure 5).



Figure 5. A scence of the workshp (above) and the outcomes generated from the workshop (below)

2.4 Data analysis

To figure out the result from interview data and generative sessions, the participants' data were transbribed into text. We used descripted coding as first coding frame because meaning sentences were cut from exeperts, nurses, parents, and children. All coding processes were conducted to three researchers, who were a PhD student and two graduate students together, in order to improve validity of coding and analysis. First of all, throughout affinity diagram on frequency percentile, the data of experts's interview were arranged to describe the reason of lack of play space and consideration of design in child hospital. Also, we anlyzed FGI data from nurses and parents in terms of needs for child play room. Lastly, this study figured out child's wishes of play to anlysis affinity diagram.

3 Results

3.1 Current play experience in the children's hospital

This study investigated the reason of lack pf play space through expert interview. Figure 6 shows the frequency percentile of reasons about the cause of lack of play space in hospital. The infection was the most frequently mentioned as associated reason of lack of play space in child hospital (46%). Because child inpatients have weak immune system, experts think

that child expose virus from others in play room. Physical safety (21%), Priority of healing (16%), and Lack of staff for play space (16%) were followed in this figure. In the hospital, experts mentioned that the removal of play space prevented safety accident. The characteristic of hospital, there was not playground, so most service or facilities focused on healing for child. In management perspective, it was hard to care play space for child because of limited of staff numbers.

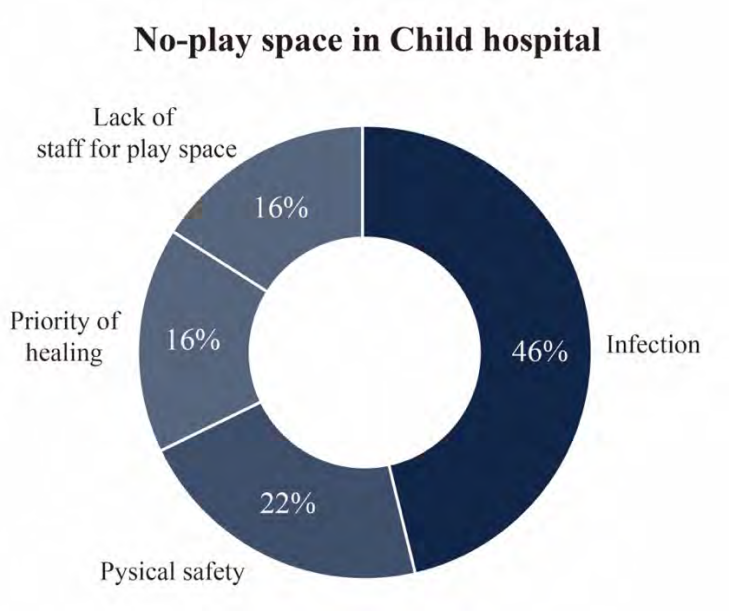


Figure 6. The reasons why play space has not been considered in children's hosptial

3.2 Considerations for play experience in children's hospital

Through expert interview, this study figured out consideration of design of play at the child hospital. Figure 7 shows the frequency percentile of reasons about the design consideration of play in hospital. The interactive play was the most frequently mentioned (23%) in order to reduce direct contact to others and to utilize interactive technology for play. Next, the emotional comfort (21%) and the therapy with play (20%) were followed. The emotional comfort was related to character design or colourful design to reduce fear of hospital for child. The 10 percentage was mentioned to the Outdoor play. For example, child inpatients could experience an exploration of nature. The child development (9%), the physical safety (8%), and etc (9%) were followed in this figure. Play design in hospital was considered for lack of part of child development. Also, because diverse play activities accompanied physical activity, paly has to prevent safety accident.

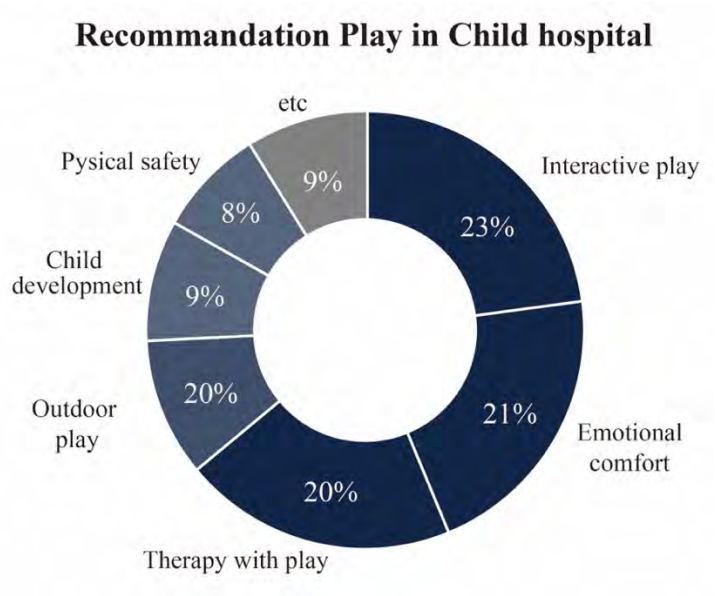


Figure 7. Factors to be considered in designing for play in children's hospital from experts' perspective

3.3 Guardian needs for child in hospital

To verify the difference between nurse and parent, the results of FGI were coded for qualitative analysis in terms of parents' and nurse's perception. Figure 8 presented important needs for child in play space. First, about the perspective of parents, the component of fun and hygiene are important as 37.5 % in this figure. Parents needed spending time for the child to get rid of boredom in hospital. Also, parents needed clean play space because this place was shared space with other child inpatients. Next, parents mentioned the needs of physical safety in play room because they did not want to hurt their child during play. In nurses' perception, physical safety for child was the most significant needs among others in playroom. Hygiene (28.6%), space (21.4%), and convenience for service (14.3%) were presented to figure. In nurses' perception, hygiene was related to prevention of infection from virus. Space was related to interior. For example, nurse wanted to change space according to purpose such as education, play, and etc. Convenience was related to service for parents to serve diverse facilities such as cosy sofa, snack bending machine and etc.

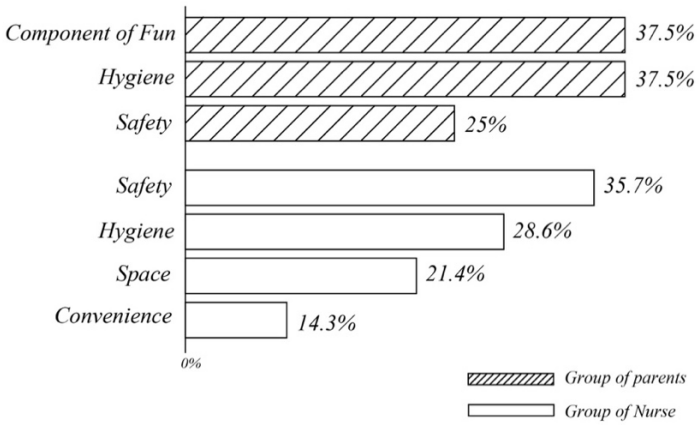


Figure 8. The needs for play experience in children's hospital from parents and nurses perspectives

3.4 Child perception of play in hospital & Guardians perception of play in hospital

Figure 9 presents the frequency percentile of play wishes associated with child in the hospital context. Among the results of play in hospital, the most frequently answered play was sensory and it occupied 17 percentage. Next, Physical (15%), creative (13%), interactive (12 %), exploratory (10%), free for monitoring (10%), Social (5%), Relaxation (5%), and Safety (6%) were followed. The table 3 shows the children's quotes which describe the example of participant's wishes.

Table 3. The example of participants' quotes

The results	Quotes
Sensory	A: "I want to touch soft for play…" B: "It is good at music song during the play because it is very glad to me."
Physical	C: "I make the climbing slide, so it is possible to slide at high site."
Creative	B: "I like drawing. When I am boring, I am happy to draw…."
Interactive	B: "I make big wall in order to draw electronic pen on the white wall..."
Exploratory	C: "I design car to tour the playground with friends…."
Free for monitoring	A: "There are no guardians. They just stay rest room to read book…"
Physical safety	A: "Every play should be safe…" B: "This sliding is high, but it has safe bar because I do not want to get hurt during play"

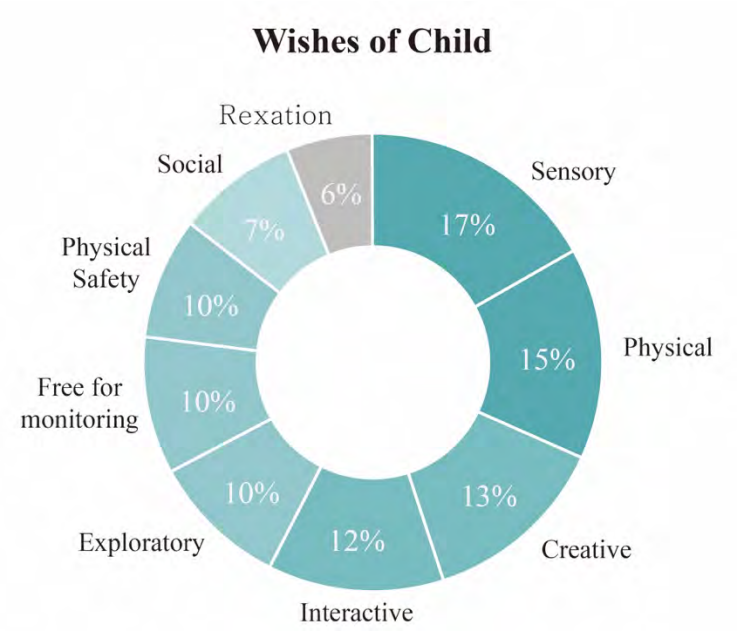


Figure 9. The wishes for play experience in chilren's hosptial from child inpatietns' perspetive

4 Discussion

Based on the results, design considerations for play experience in children's hospital were derived. The design considerations consisted of five categories: interactive technology, motivation, fun-therapy, social-physical play, and free from infection.

4.1 Interactive technology

According to the results of this study, interactive technology stands out play for child. It indicates that the interaction between person and product arouse diverse opportunities of play. In child perspective, child prefer to play interactive wall such as game, painting, and etc. in order to play with creativity. Experts and guardians would like to utilize interactive

projection for the child as playing with creativity. To provide interactive technology, it would help playing with creativity for the child. Especially, interactive play help to develop cognitive development for child at hospital context (Pykhtina et al., 2012). For example, there are interactive screen which children can play diverse activities thorough at the child's hospital in England.

4.2 Motivation

To design the play in hospital, motivation is possible to give the child inpatient fascinated play. For instance, Hospitals have a different interior like the concept of space flight in order to reduce the serious atmosphere for the child. Also, exploration stimulates child's curiosity which observes the intriguing things. It indicates that the child improves confidence throughout achieving the mission (Perry, Hogan, & Marlin, 2000). Throughout motivation in hospital, the child would be satisfied with playing with emotion development so as to relax hospital environment.

4.3 Fun-therapy

Therapy is scared course to children even though it is simple such as measuring temperature and having a shot. However, children would recognize a fun-therapy, which combines play and therapy, as a part of the play. For example, child inpatients refuse walking around an aisle of the hospital as a recovering, but they like to follow the colourful line of the floor. Through fun, emotional, social, and cognitive development are accelerated by the fun of play (Perry et al., 2000).

4.4 Social-physical play

In hospital context, the child spends their time during healing without play. Despite the main function of hospital is recovering of the body, experts of hospital mention the importance of playing during healing. Even though children experience insufficient child development in terms of physical and social development in hospital, guardians and experts of hospital want to give education for child development their child. To supply play with physicality and sociality, the play has to be designed by combining physicality and sociality. Particularly, it is important to play about social-physical for the older age child group (Smyth & Anderson, 2000). Because, the hospital has limited composition of space, it does not set a limit on inner space. The play space in hospital is extended to roof top park, which provide diverse opportunities. In the hospital, which has diverse space, it plays an important role in expanding play place for physicality and sociality of the child.

4.5 Free from infection

Infection is considered as not ignoring issue of play in the hospital. According to the position of guardian and experts, infection has not to occur in play space. Isolation of space is not a solution for child. It has to be easy to keep hygiene the play space as well as be possible to play indirectly connect for children as playing big block which makes children's hiding place. For instant, play equipment could be made of anti-bacterial material to protect infection.

5 Conclusions

The study aimed to figure out design considerations in creating play experience for child inpatients at hospital. Involving multiple stakeholders who were child inpatients, nurse and parents related to the study, five design considerations were derived from designing the playroom in the child hospital. The first consideration is 'Interactive technology' which is able to utilize interior products so that child inpatients can play diverse activities. The second is

‘Motivation’ which stimulates the curiosity of child inpatients in order to transform the serious circumstance of the hospital into a space experiencing positive emotion. The third, ‘Fun-therapy’ which is derived from the participation of child seems that child inpatients recognize the procedure of clinic as the experience of play. For example, child could explore spaceship during using therapy machine in order to experience fun. The fourth is ‘Social-physical play’ which provides to combine the physical development with the social development in such limited space so as to contribute to childhood development. Even though hospital has limited space in terms of physicality, child inpatients might want to experience with other age groups throughout new play experience. Lastly, it is ‘Free from infection’ that prevents child inpatients from infection of disease during play experience.

This study showed the design considerations for child inpatients in order to provide child inpatient with play experience. In other words, the play design consideration will be delivered to solve children wishes within the context in the hospital. Child inpatient could be satisfied during hospitalization through play as well as child development. Also, the other implication of this study is to understand diverse user experience where play in hospital to evoke children inpatients’ and guardians’ physical well-being as well as emotional it.

Although this study provides design implications for play experience in children’s hospital, it would be risky to generalize the findings considering some limitations of the study. First, the study was conducted with a small size of samples. Second, the focus of the study was only on children having experiences of short-term hospitalization. Considering there are also child inpatients who have to stay for long term period, the findings would not be applicable for the group of children. Therefore, follow-up studies are supposed to be designed in a way to take the limitations into consideration.

Overall, the findings are expected to make a meaningful contribution to design for play experience in children’s hospital because the design considerations were derived from diverse perspectives of stakeholders who are actively involved in children’s hospital. Therefore, the study can add values into the body of knowledge in healthcare for children inpatients and furthermore it could provide design practitioners with clear guidelines in case of design for play experience in children’s hospital.

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Design for civil society. The model project “Citizens connect neighborhoods – community development harnesses digital transformation”

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This paper reports on the practice-led design research project “Citizens Connect Neighborhoods: community development harnesses digital transformation” (2016-2018)[1], located at the intersection of participatory design, technology development and their political and social implications. The paper aims at situating the project’s processes and outcomes in the context of a currently renewed discourse on the potential of practice-based and transdisciplinary research for shaping new social practices and civic technologies that affect democratic developments in our everyday lives (Manzini 2014). The focus was on questions about who gets to shape and to take part in the digitalization of societal, political and cultural processes, and who determines the way we communicate or have access to information. The living labs/citizens’ workshops became the focal point, by which a series of intensive co-design workshops with initiatives of the civil society were conducted, as well as group discussions, informal and half structured interviews, meetings with different stakeholders and public presentations. These transdisciplinary processes engaged us critically in the urgent question of design’s agency within practices of collaboration and co-creation and provided us with a productive framework for the queries into the interdependence of digitalization, political participation and social cohesion, on which this paper reports.

Keywords: participatory design, digital transformation, civic tools, networked society, networking locally

1 Introduction: Digital divide, digital literacy and civic engagement

As new local practices and initiatives such as urban gardening, file sharing, repair cafés, and the like are on the rise, as well as alternative forms of living together such as co-housing, neighborhood initiatives and citizen networks are seeing greater acceptance and

[1] The project is a cooperation between the Berlin University of the Arts, the Neighborhood Academy NRW, IFOK and NRW.Urban, and was carried out together with 14 civil society initiatives with a wide variety of contexts – from refugee welcome services to co-housing; funded by the State of North Rhine-Westphalia/ Ministry of Regional Identity, Communities and Local Government, Building and Gender Equality of the Land of North Rhine-Westphalia (MBWSV): www.modellprojekt-nrw.de

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appreciation. As pointed out by Manzini, the groundwork for macro-transformations and for great systemic changes, is laid by micro-transformations and by local systemic discontinuities, i.e. through the kind of “changes in which design can play an important role” (Manzini 2014). Acting locally pushes the envelope of broad action effectiveness – reinforced and fueled by digital transformation: New networking opportunities, collaborations and movements are marching onward in areas such as open data, open source, open technology and digital commons. Digital platforms are becoming more and more important for civil initiatives, regional networks and face-to-face encounters. More and more self-organized associations and initiatives are focusing on how to use digital tools to connect neighborhoods in a more sustainable way.

Understanding the drivers for opportunities and risks of the digital transformation with regards to neighborhood development and civic engagement for creating a successful policy framework requests actively engaging with local community partners in the co-creation of knowledge, building alliances and recognizing their expertise around local challenges. Both policy and civil society actors must face the challenges of missing out on digital developments, digital disenfranchisement and digital literacy to adequately address key issues of participation and to address the growing digital divide within initiatives, especially the so called third-level digital divide (van Deursen, A.J.A.M., & Helsper, E. J. 2015) that frames the digital inclusion not only around access, skills and usage, but in relation to the tangible outcomes.

Against the backdrop of the rapid development of technological possibilities, not only digital infrastructures need to be adapted for the success of digital development (OECD 2015); the education and training landscape must also take account of this development. “The population is meeting the digital future with little digital literacy” is the result of the D21 Digital Index (Initiative D21 e.V. 2016). One demand that has been made for some years now is that citizens should help shape the developments of and through digitization themselves, instead of only participating as users (Brandt 2017). Competencies must also be “promoted at all levels in the population” to ensure that no one is left behind by digitization. “If digitization is not developed by citizens, but solely from the technological side, there is a danger that people will be excluded from digital transformation” (Joost 2017). Academia and policymakers have also increasingly been trying to address this demand.

Against this backdrop, the model project “Citizens connect neighborhoods – community development harnesses digital transformation” (2016–2018) was launched the Berlin University of the Arts, Design Research Lab, and the State Government of North Rhine-Westphalia (NRW), the most populous state of Germany. The aim was to engage civil society, academia and policy makers into a participatory process in order to address the opportunities for social cohesion, the strengthening of civil society and for inclusive, participatory engagement in an increasingly networked society. In collaboration with the actors involved, the idea was to work out how the digitally accompanied world can be brought in to respond to social problems, specifically in terms of neighborhoods, villages and city districts. A major concern in the model project was to ask how to engage citizens in these developments so as to sustainably promote digital and social participation. In the research framework, these new formats of cooperation, collaboration and co-creation underwent evaluation, which in turn aimed at providing new knowledge for trans-disciplinary urban development processes. The project thus focused on bridging the gap that frequently

opens up between the objectives of process and/or technology development and the needs and expectations of users' participatory methods. The results of the model project can finally be used as a contribution for civil society actors and for policymakers on the municipal and state levels, as well as a scientific contribution to academic-oriented research approaches.

2 What is the model project?

Initiatives from North Rhine-Westphalia (NRW) were given the opportunity to respond to a call for proposals in early August 2016 to participate in the project. Fourteen candidates were selected out of 45 applicants and became part of the model project in support community development through digitization. Since October 2016, they have been participating in so-called "citizens' workshops." The project's aim was to help each individual initiative work towards their community development goals by providing them with the relevant tools and communication instruments. It developed (or continued development on pre-existing) platforms and participatory methods. It further accompanied the initiatives with scientific expertise and worked with them in an iterative process to implement and evaluate what they accomplished. For the citizens' workshops, the concept "communities of practice" Lave and Wenger (1991) served as a basis. CoPs represent an "arena of problem solving" – they provide quick answers to questions and produce higher quality decisions (Oakley et al. 2010).

Within the framework of self-organized networks, there is a high degree of informality, fragmentation and readiness for transformation. The future challenges and potential both lie in balancing free cooperation with targeted steering through policy. Steering such a coexistence of different competencies and tempos requires a governance practice both the municipal and state level that knows how to counter short-termism and heterogeneity as well as unstable financial conditions. This is because mechanisms of self-regulation and self-steering alone cannot provide complex community services; they therefore require the strengthening of structures that make self-regulation possible.

Therefore, we apply the perspective of "project ecologies" developed by Gernot Grabher (2001; 2004), which are mostly temporary alliances for dealing with problems and questions that lead to the provision of solutions through explicitly heterogeneous competences in specific contexts: for example, when IT experts work together with legal experts and politicians as well as local experts to provide solutions that fit a specific situation.

The model of trans-disciplinarity (Nowotny/Scott et al. 2001) can be a guiding principle for social innovations. Practice-based design research and trans-disciplinarity describe a practice of knowledge production by which the boundaries between academic/scientific work and the layperson's practice/application-oriented approaches increasingly dissolve. At the same time, the blurred lines take new shape – delimitations between expert, non-expert and domain-specific expertise are reorganized. The focus on application and practice points towards social networks and the social responsibility that underlies such processes. Temporary and application-oriented teamwork in which researchers, experts and practitioners with varying expertise and interests come together is what underlies this conception of research, as it is currently being practiced in design research. In practice-based design research, the scientific reference cannot be separated from the context of the practice.

Therefore, design research is important for future-oriented research into social, ecological and gender-specific contexts as well as everyday cultural contexts. A context-dependent understanding of innovation is characterized by trans-disciplinary cooperation with heterogeneous interest groups, flat decision-making structures, application-oriented

research and social relevance. At the same time, it requires specific infrastructures that allow the various interest groups, e.g. university or public institutions as well as actors from civil society, to participate in the research process. Such infrastructures for innovation development in research are not unique to universities; there are also rich intermediate areas between university and industry, the public sector, informal networks and the private sphere. Models that enable such cooperation and make the infrastructures and resources available have great potential to be motors of social innovation development.

3 Design and participatory research

The early involvement of citizens in a process of joint identification and handling of problems is an important concern in participatory design. The research approach in the model project works with an extended understanding of design as process and system design. Since the 1960s, design has not only been understood as the design of individual things or signs and symbols. Rather, contexts and conditions for complex production and uses became more important and now justify the current approach to design as an “interdisciplinary and cooperative task” (Erlhoff 2007). “Participatory Design” and “Social design” as working areas within the design discipline have seen an ongoing shift for some time now, whereby the disjointed design of artifacts is less important than the question of user involvement in the design of processes (cf. Joost 2014, Margolin/Margolin 2002, Björgvinsson et al. 2012).

In practice as well as in research, it is the inter- and trans-disciplinary qualities of design that are required. This role brings the interaction relations within the disciplines of design into focus, also in terms of political strategy development, as well as for the interfaces to other socially relevant fields of activity. This is why we consider the trans-disciplinary research approach of the model project to be essential. It is above all a matter of gaining scientific knowledge through practice-based research, in order to counter the risk of unilateral measures going nowhere at all. For implementation, this means bring the actors involved up to speed in terms of knowledge base, integrating them into the development process and aligning it with institutional requirements. The approaches developed in processes of co-design and co-production should lead to the shaping/steering of transformation and generate results that are relevant for both social practice and scientific discourse.

4 Methodology for the model project

The topic of the model project requires discourse among administration-specific, planning-design and socio-cultural perspectives. The challenge of such a collaborative research environment is to build a common understanding of the problem context and foster a productive environment. This in turn enables knowledge generation as well as knowledge integration.

The participatory practice and research approach pursued here is characterized largely by contextuality and flexibility. Integration of perspectives, skills and experience of living and working practices served to build the knowledge base as well as to create new self-efficacy and extend the action horizon of stakeholders (von Unger 2014).

A procedure was developed that allowed for ongoing adjustment of the intermediate results and at the same time carried out an intense dialogue with all the stakeholders. Various formats allowed for all the partners to communicate in a multi-tiered, qualitative practice and research process: co-design workshops, project meetings, advisory board meetings, various dialogue and exchange formats as well as a digital platform for internal communication and exchange among the participants. Results were delivered through several data sources and

based on a mix of methods. The intensive cooperation with the citizens' workshops within the framework of practice-based research included:

- All-day workshops in which existing knowledge, potential and needs, structural weaknesses and thematic problem areas as well as approaches to solutions were identified and jointly worked out in detail
- Onboarding surveys and one- to two-hour telephone conversations with the heads of the citizens' workshops in the various phases of the model project with a focus on the current use of digital services and the effects of digitization, infrastructure, organizational structure and commitment
- On-site visits addressing local policy support and regional networking
- Structured and semi-structured interviews in the networks of citizens' workshops to trace the correlations between media use and communication behavior with age, education and occupational factors
- Analysis of the state of research in the field of digitization and civic engagement in order to compare and validate the findings of the model project on the basis of qualitative and quantitative studies

From October 2016, the project team developed a joint agenda together with the selected citizens' workshops. The agenda specified the digitization topics and areas. This presented quite a challenge due to the diversity of topics and concerns for concrete support. Meeting it required a process of mutual information exchange between the citizens' workshops and the project team, in the course of which the needs of the individual citizens' workshops crystallized.

Building on this, networking and cooperation at very different levels followed: from joint workshops, to planning meetings and training. The advisory board brought the project social and political recognition as a multifaceted expert body and was important in the process beyond its role as a multiplier: The board also acted as an internal evaluation committee and as a companion to the citizens' workshops. The aim of evaluations was to ensure continuity and a long-term approach by providing support, for example in the form of training courses and consultations. After an initial phase, the focus of the model project shifted to the practical establishment of a network and then to ensuring that outcomes were properly recorded in the final phase.

On this basis, the results emerged as a building block in the process of digital transformation and as a practical contribution to the use of digital means in civil society contexts of community development and shaping its constitution. Already in the first months, our research and cooperation framework began to focus on three action fields: digital infrastructure, digital literacy, strengthening of civil society initiatives through municipal policy.

5 Survey

In the fall of 2017, a survey was carried out on the use of digital media among the citizens' workshops. The 66 responses gave a clearer picture of the use of digital media in everyday private life and in work for the initiative. The information on community concerns, digitization and volunteerism as well as communication behaviors improved the last phase of the project in terms of needs orientation. Survey results also informed suggestions for action recommendations and strategies. The results showed that, despite digital communication, establishing face-to-face contact among neighbors is a priority. With regard to the question of which technical aids are still needed for communities, existing tools and their use must improve first and foremost, instead of developing further aids.

There is also a direct correlation between the level of education and community involvement. The 66 respondents represented generally active participants in the model project. Almost half of the participants were female (44%), and ages ranged between 22 to 75 years. The educational levels were above average among survey participants (more than half of them had an Abitur – German A-levels or high school degree –, a university degree or a doctorate). People with higher education have the necessary resources to advance their initiatives and also maintain a critical attitude towards privacy, data handling and security, especially with regard to mass surveillance. Changing the behavior of users is key in the face of data disenfranchisement – e.g. through obligations to hand over data to third parties in conjunction with more permissive/careless attitudes towards data privacy. At the same time, appropriate data protection standards must be established. In-depth discussions following the survey have led to the three core fields that need to be addressed strategically: social and digital networking, digital literacy and trust.

6 Handbook: Tips and ideas on how to help shape the community & digital tools for communities

In 2018, we published a handbook, intended as an introductory instructional guide that lists and describes a range of digital tools and alternatives. It is designed as a working aid for newcomers as well as experienced people in the digital world of civic engagement. The focus of interest is on possible development processes for communities initiated by citizens. These processes range from integrating different generations, cultures and nationalities to the jointly implementing concrete projects. This handbook comes from the impetus provided by the citizens' workshops involved in the model project "Citizens connect neighborhoods." Digital transformation and its potential in the hands of civic initiatives is the topic of this handbook. It deals with the way the citizens' workshops handled their undertakings and propositions and how these could be enriched through concrete digital and real-world tools. Here the focus is on project management, public relations and proximity to the citizens and activities within the communities/neighborhoods. This is followed by a brief presentation of one or more of the digital tools that can be useful for citizens' workshops in this context. These "profiles" are intended on the one hand to provide an overview of the digital application presented and on the other to facilitate its adoption with introductory instructions. The handbook is a central result of the model project, both in print and digital form (in German language)[2].

7 Takeaways

7.1 Analogue-digital networking

The importance of close spatial, social networking for civic engagement in the age of digitization is now widely recognized, and with it is the need for further development of social neighborhoods using digital resources at regional and national levels. It is considered a motor for sustainable development in urban as well as in rural areas – given the variety of challenges in the 21st century, like demographic change, pluralization and diversification of communities and realities and global shifts. It is even more important to link community development and digital transformation in ways that are social and sustainable, i.e. thinking about social and digital practices in conjunction – not least because the social divide is reflected in the digital divide.

[2] DOI: https://doi.org/10.25624/kuenste-gg31; Link: https://opus4.kobv.de/opus4-udk/frontdoor/deliver/index/docId/1182/file/QuartiersentwicklungUndDigitalerWandel.pdf

The savvy use of online services and network platforms can promote information sharing, collaboration and commitment. Digital media and online services help to increase the visibility of initiatives, to increase the range and to promote the scale of activities and projects that are in the public interest. Initiatives can disseminate their ideas through platforms and digital networks and attract new stakeholders to their cause. Digital tools enable participation independent of time and place and are important for organizational and project development, networking and bundling of resources and supporting exchange of knowledge and experience. At the same time, the use of digital means also entails risks: Platforms and social networks can amplify targeted disinformation (keyword “fake news”) and endanger data protection. This makes an informed use of digital means all the more important. It is therefore crucial to counteract the digital divide with targeted, municipally supported programs against social division. This can be done through the creation of public & advisory products and services, communication tools, interaction formats and services, user-friendly information portals.

Also, volunteer work must continue to be celebrated adequately and to an even greater extent, through political and social recognition as well as appropriate incentives, so that citizens get involved on a voluntary basis and in the public interest. Digitization can play an important role in repositioning volunteerism in the 21st century. This also means that volunteer work becomes the task of the local administration.

7.2 Digital literacy

The core area of effective, broad-based participation and co-design of digital and real-world networking is digital literacy: competent handling of digital means as well as the necessary abilities and skills for handling information, sources and data. Plenty of action is needed in the area of digital literacy in terms of public welfare options: The use of digital information and communication technologies, the use of digital tools and the associated ability to manage data also requires a willingness to lifelong, independent learning (cf. Gutachten Digitale Souveränität des Sachverständigenrates für Verbraucherfragen [German Consumer Council] 2017). As tested in the model project, this core competence can be addressed with training courses: Measures for further and continuing education and training in questions of dealing with the content of digitization can ensure that committed people and population groups, even those unfamiliar with technology, become convinced of the diverse opportunities offered by digitization. Digital literacy is a decisive means of countering the digital divide.

For the co-design of living spaces in the sense of an open society, the various civil society actors, such as local politicians, have the opportunity and the potential to engage in creating offers for collaborative learning processes to promote digital competency in the future. Just like reading, writing or arithmetic, digital literacy should be a cultural technique that makes it possible to experience a self-determined life, undertake professional activity and engage in social participation. Concrete suggestions: Create and expand assorted learning opportunities that promote digital literacy in the context of civil society engagement with appropriate incentives (e.g. certification), such as a statewide initiative for future-oriented competency promotion; develop targeted training initiatives and demand-oriented offers for all educational institutions for collaborative learning and facilitate access to high-quality learning materials (bundling of webinars and information in the digital and media literacy, resource pools); generate confidence in digital tools and online services.

7.3 Trust

In addition, a third field of activity was identified in the model project: trust in digital tools and online services. This topic field covers two levels: 1) confidence based on data security, in

particular with regard to one's own "digital footprint" and the handling of personal data (data protection and privacy protection); 2) confidence with regard to content and information disseminated through online platforms and social networks.

In view of the growing number of online services whose business model is based on the collection and analysis of large amounts of data (cf. Christl & Spiekermann 2016; Destatis 2016), questions about data security are coming to the fore. Details on individual consumer behavior, social environment and preferences are revealed on the basis of the data and traces left behind in the digital world. Correspondingly, tailored forms of targeted address (political opinion-forming, commercial advertising etc.) or personalized pricing can be exploited (cf. Gutachten Digitale Souveränität des Sachverständigenrates für Verbraucherfragen [German Consumer Council] 2017). Predictions using Big Data are also possible, but above all the concentration of market power with providers such as Google, Facebook or Amazon is problematic. Attention should therefore be paid to alternatives. Using a variety of platforms is crucial. Questions must be considered, such as what an infrastructure or platform might look like that does not depend on the sale of user data. There are already proprietary as well as open source alternatives for most commercial products. However, these are often not attractive enough (e.g., not user-friendly enough), or there is a lack of translation competency between open source and use (e.g., installation and adaptation for one's own purposes of community work).

Against this background, the question arises as to what influence civic initiatives and social movements can have on digitization processes and what is needed to contribute more strongly to democratization processes in technology development. Because digitization can be co-designed, steered and regulated. An important goal is to regain and strengthen confidence in the digital world. Digitization can promote transparency, for example in political processes, through access to data and information and through participation processes. Therefore, it is important to foster trust based on target group-oriented information and communications on the sides of supra-local, state authorities as well as municipalities, educational institutions and foundations; to promote open-source technologies and knowledge transfer between the specialized expertise of the open-source community and civil society activists. One suggestion would be to certify online services according to user friendliness, transparency in the handling of data and privacy policy, and hence the credibility of sources, and to train in the use of disinformation, fake news and ideologically motivated websites.

7.4 Collaborative work and expectation management

The close cooperation between various actors (academia, local authorities, state politics and civil society practice) made it possible to address problems in everyday life from different perspectives. At the same time, a basic issue was identified: The close cooperation among different disciplines and actors from practice can be a source of conflict and difficulties, because different goals and interests are pursued, which need to be communicated as transparently as possible and coordinated with each other. In addition, considerable communication and translation difficulties can arise due to the different language uses and internal logics in the respective disciplines and participants' fields of action. In addition, there are structural differences and internal conditions/requirements, from flexible and dynamic working methods to formalized processes, audit and approval procedures and institutionally anchored behaviors. In order to facilitate these labor- and communication-intensive processes, institutional change in the administration is also necessary, with regard to opening up forms of communication and participation as well as to the political-administrative conditions. One of the challenges of such a work process is the development of a common, meaningful agenda that also accommodates appropriate expectation management. It is

important to have competent project management and to create a pleasant climate of cooperation that is motivating and beneficial to the project as a whole; this also includes early regulation/definition of internal and external forms of communication. In order to smoothly coordinate the different tempos and workflows, it can make sense to have the process moderated externally. Here, the additional effort must also be taken into account, for example in the planning and preparation of transdisciplinary cooperation. Despite the open-ended process, awareness of the increased effort and thus the costs for trans-disciplinary and participatory design projects is important, since these are often underfunded, since many results are difficult to grasp (cf. Rogga et al. 2018); for this purpose, it is important to establish problem-oriented research and collaboration and to institutionalize transdisciplinary research and provide it with the corresponding resources.

8 Summary and outlook

In times of complex structural crises, technology-induced transformation processes and uncertain forecasting conditions, it is particularly difficult to give generally valid strategy recommendations. The present paper shows that it is precisely under these conditions that a specific process of governance of digital transformation in community development is required, characterized by iterative surveys and dialogue-based rectification.

The results of the project show that civil society initiatives can be significantly strengthened in their actions by means of digital tools. The project reveals how civic engagement and digitization can complement and stimulate each other when different factors are taken into account. These factors range from equal social and digital networking, the need to see (critical) digital literacy as an obligation for society as a whole, to the creation of trust through holistic advisory practices.

State-wide and local support services can promote the use of digital opportunities to strengthen social cohesion in communities if the framework conditions are in place – for example through training courses or platforms that ensure trust and guarantee security in the use of digital structures, i.e. support the use of digital means in a targeted and demand-oriented manner, and develop bottom-up strategies that counteract the digital and social divide. This also includes the further development and promotion of existing free software (tools) useful for civil society initiatives.

In order to be able to exploit the above-mentioned potential, concrete measures for action and a pooling of knowledge are required. With regards to the connection between community development, participation and digital opportunities, the Design Research Lab recommended within the here presented project that dedicated competency centers be founded. These centers would accumulate knowledge and serve to mediate between locally engaged citizens, local and state policy, as well as providing a base for scientific research and technological innovations. The connection from the model project can in principle be established for all fields of action.

Further cooperation as well as between the centers located in the municipalities would be in a position to inform about local specific knowledge and to establish peer-to-peer networks by providing best practice examples from other municipalities or communities; they could accompany developments and prepare knowledge that facilitates the practical manageability of digital means and tools, explaining how to deal with open source and open interfaces. This would then result in competency offerings that are not only for technology-savvy citizens but also for those who are unfamiliar with technology. In addition, discursive competency can be strengthened with regard to the critical handling of information as well as to the possibilities of spreading knowledge and helping to shape digitization.

As for further investigations, it will be necessary to deal more intensively with the critical or negative aspects of digitization, especially with regard to the theses that structural inequalities are amplified and augmented by the digital.

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Design for empowerment: A case study of using information visualization to support and promote college students' subjective well-being

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Mental health issues among college students are on the rise across the United States. Improving college students' subjective well-being (SWB) is a crucial issue. Although some theoretical insights are available about how design can contribute to well-being topics, no research has focused on the role of information visualization in promoting SWB. This is the first research study that proposed using information visualization as an empowerment tool to influence college students' emotions and behaviors in positive ways. In this paper, we examined the capabilities of information visualization to elicit empowerment and identified the research focus. A case study was conducted to investigate a personalized social support visualization system with the explicit intention to enhance college students' empowerment experience in support for their SWB.

Keywords: information visualization, personal visualization, design process, subjective well-being, empowerment, social support system, college students

1 Introduction

Mental health issues among college students are on the rise across the United States. The 2017 annual report from the Center of Collegiate Mental Health (CCMH) shows that higher education counselors are treating more students than ever before who are dealing with various mental health problems (Penn State, 2018). Also, half of all students at universities reveal feeling hopeless at some point, according to a report published in USA Today, and two-thirds of students who struggle with mental health challenges do not seek help (Simon, 2017). The timeliness and seriousness of these concerns has become a priority on most college campuses across the country. Because of the high demands, university counseling centers have a harder time keeping up with their students' needs. Also, simply providing counseling services doesn't necessarily solve the problem. More efforts to prevent mental health problems from arising are inevitable. For example, more life skills-based education, *i.e.*, a form of education that focuses on cultivating personal life skills such as self-reflection, critical thinking, and problem-solving skills, should be provided to students. It will empower students to cope with stresses and increase their quality of life and positive affect to enhance their SWB (Bird & Markle, 2012; Diener, Inglehart, & Tay, 2013; Lyubomirsky & Lepper, 1999).

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Subjective well-being (SWB) is defined as “a person’s cognitive and affective evaluations of his or her life” (Diener, 2002, p. 63). Design for SWB has propelled in the last decade. It aims to “design with the explicit intention to support people in their pursuit of a pleasurable and satisfying life” (Pieter M. A. Desmet & Anna E. Pohlmeyer, 2013, p.1). Several methodological approaches have emerged in the area: Emotional design (Norman, 2003; Jordan, 2002), Capability approaches to design (Oosterlaken, 2009; Oosterlaken and van den Hoven, 2012), Positive design (Desmet & Pohlmeyer, 2013), and Life-Based design (Leikas, 2009; Leikas et al., 2013). Currently the well-being driven design has been mostly applied in the domain of product design, interaction design, experience design, and service design (Bertolotti, Di Norcia, & Vignoli, 2018; Calvo & Peters, 2012; van de Poel & Vermaas, 2015). In the field of information design and information visualization, visual computing methods are used to amplify human cognition with abstract information. However, no research to date seems to have explored the power of information design and information visualization on communicating and tackling SWB issues, as well as its ability to specifically reach college students. Therefore, how information visualization influences user behaviors, emotions, and the entailed environmental and social effects presents an important opportunity for investigation.

The aim of this paper is to gain a better understanding of how information visualization (infoVis) can play a constructive role to elicit positive emotions and positive behaviors and support SWB for individuals and communities. We first propose the research focus of design for empowerment in the realm of infoVis. Then we discuss the design stages of a case study that follows the proposed design research focus. The case study presented in this paper intends to illustrate how the concept of SWB and empowerment can inform design research and design processes. With this paper we hope to take a step in exploring how infoVis can be used as an empowerment tool that enables positive emotions and supports college students’ subjective well-being.

2 InfoVis design for empowerment

One facet of SWB is psychological empowerment*, i.e.,* a person believes that she has the resources, energy, and competence to accomplish important goals (Diener & Biswas-Diener, 2005). Empowerment is a process that is rooted in personally meaningful goals, which means that facilitating empowerment requires an understanding of the priorities and values of the individuals (Brodsky & Cattaneo, 2013). Since different people have different personal goals and require different knowledge, skills, and resources to support their needs, it’s important to find a means of communication that can stimulate greater engagement and personal connections.

InfoVis is acknowledged for its ability to *make the invisible visible* and amplify our cognition (Card, Mackinlay, & Shneiderman, 1999). Successful InfoVis can make raw data digestible and turn information into knowledge and actionable insights (Baškarada & Koronios, 2013; Kard, Mackinlay, & Shneiderman, 1993; Yi, 2008). In recent years, the popular applications of personal visualizations (PV) attempt to enhance people’s self-awareness and motivate people’s positive behavior changes in the field of personal healthcare (Huang et al., 2015; Schneider, Schauer, Stachl, & Butz, 2017). Health apps such as FitBit and MyFitnessPal demonstrate successful cases of using design and visualization to help users achieve their health goals. Although design considerations of InfoVis have generally been focused on

visual forms and their analytical functions, we argue that users' emotional and behavioral responses should also be considered as objectives in the process of creating infoVis that abides by principles of human-centered design philosophy (Figure1). Human-centered design focuses on understanding the needs of the people, and creating design solutions to solve their problems and meet their needs effectively. Giving users the perception of control - the sense of empowerment- means maximizing the human-centered function of infoVis. Therefore, we suggest that when conducting design research aiming to cultivate people's SWB, positive emotions and behaviors from the users should be considered as much as needs and problems are. Specifically in this design study, how infoVis design enables the positive attitudes of gaining power to change the situation becomes a key objective.

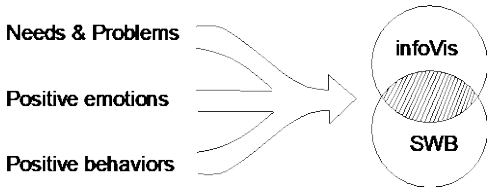


Figure 1. Research focus of information visualization design that supports sujective well-being

By combining quantitative and qualitative research, and infoVis techniques we conduct an explorative study into three main stages as shown in figure 2:



Figure 2. Design process to explore the role of InfoVis in empowerment

The following case study that investigates how infoVis may serve as an empowerment tool that supports SWB on college campus will describe the design stages in more details.

3 Social support system case study

In this section we describe a design case in which we aim to explore the relationship between infoVis design, and the empowerment affect in the context of promoting college students' SWB. The Ohio State University in the United States is chosen as the location of this case study. After conducting a scoping study, discussing with the target users, and comparing with different medium approaches, we find that infoVis on a tablet or desktop device (Starting in 2018, all freshmen in OSU receive an iPad from the university) seems accessible and with potential to include high quality graphics and functions.

3.1 Exploration

3.1.1 Define the problem

The exploration stage consists of both primary and secondary research. The literature on happiness and SWB has provided various dimensions of strategies that empower people to reach their full potential (Fredrickson, 2004; Lyubomirsky & Lepper, 1999; Ryan & Deci, 2001; Seligman, 2008). For example, meditation-based stress-management practices are helpful to reduce stress and enhance forgiveness among college students (Oman, Shapiro, Thoresen, Plante, & Flinders, 2008). Strategies from positive psychology, such as optimism,

gratitude, goal setting, altruism, and hope are helpful for promoting positive emotion, reducing stress, and improving quality of life (Seligman, 2004). However, it seems that the knowledge of how to manage stress is not widely accessible for most students. For example, many students use avoidance and self-punishment to cope with academic and daily stresses (Brougham, R. R et al., 2009), which will increase the negative effect instead of solving problems (Pritchard et al. 2007).

To understand the current undergraduate students' daily life stresses and how they currently manage stress, a general survey is conducted. The survey results show some common stress triggers among all students such as time management, academic performance, social relationships, etc. Only a few people (8 out of 100) visited the on-campus counselling service and the ones who had been put on the waiting list were told that their problems were not severe. The survey also reveals that students' knowledge of on-campus service resources is limited. Most of them rely on self-coping strategies rather than seeking external help and some of the strategies could result in negative impact, for example, eating ice cream or junk food, watching stimulating YouTube videos, or even self-harm.

3.1.2 Design opportunity- social support

Two undergraduate classes are also set to explore the subject of "happiness" with their semester-long creative projects. In one class, second year design major undergraduate students are asked to design Digital App concepts that promote positive psychology strategies to support SWB. The App concepts students proposed are based on user research and their own experiences. Among the 16 projects, Apps that focus on relationships and community support are the most desired subjects chosen by students (44%), follow by gratitude (31%), mindfulness (25%), and self-expression and emotional release (25%). The other class, Information Design for non-design majors, is focused on self-reflection and self-empowerment through data. Students are asked to acquire their own life data, and visually represent those data. Student projects, as demonstrated in figure 3, concern their daily lives and their consumption of time and things; their tracking of gratitude through journals and summaries of the positive and negative aspects of life; and visual explanations of how and what enable their own SWB. These infoVis projects (Figure 3) display some trends among students' lives on campus: the importance of friends and family, striving for healthy lifestyles and better time management. The survey results also reveal that talking and spending time with friends is one of the top strategies that students consider managing their stress effectively.

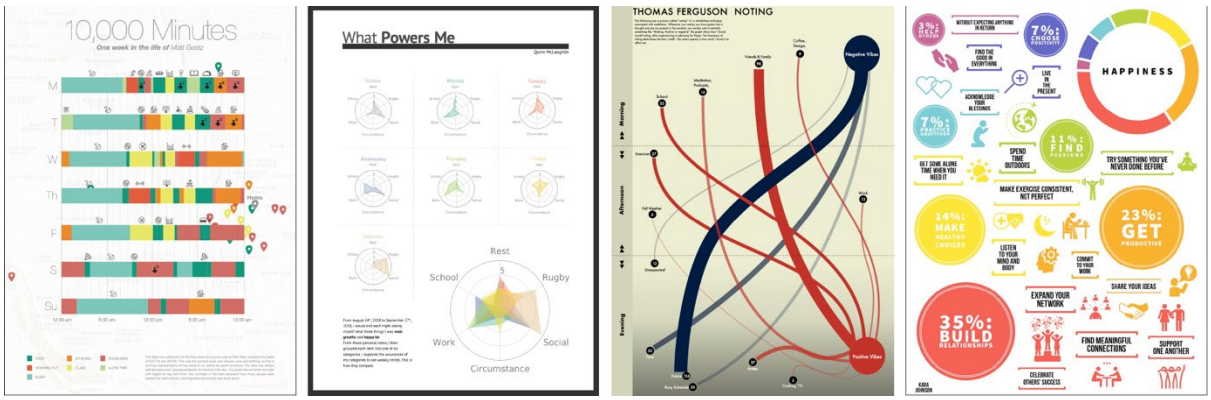


Figure 3. Left to Right: 10,000 Minutes by Matt Goetz, What Powers Me by Quinn McLaughlin, Noting by Thomas Ferguson, Happiness is… by Kara Johnson

3.2 Concept Development

3.2.1 Objectives

Based on the most significant insights and most recurring themes from the stage one exploration, we conduct a co-analysis discussion with some undergraduate students. We share the information gathered from the research and the key findings we identify with the participants and ask them to review the information while reflecting on their own experiences. The discussion allows us to deepen the concepts that emerged from the research, analyze them from different viewpoints, and prioritize issues that relate to campus SWB and infoVis.

We identify that the feeling of having strong social support is a key notion and a crucial meaningful goal to college students' SWB. Several studies state that social support can contribute to happiness and life satisfaction (Lundberg, Hansson, Wentz, & Bjorkman, 2008), and social support is negatively related to stress and other mental health problems (Brown, Wallston, & Nicassio, 1989). The perceived social support, defines as the perception that one feels cared for, esteemed, or otherwise closely involved with other people, is exceptionally important for maintaining good physical and mental health (Ozbay et al., 2007). If one has meaningful social ties, she can envision a world of relationships mapped inside her mind – a map that will lead to those who can be called on or nurture and support in times of need. Research on the empowerment process has found that with positive social support, people can move from a state of powerlessness to having more power (Baxter & Diehl, 1998; Lord & Hutchinson, 1998; Young & Ensing, 1999; Nelson *et al*., 2001). This process is enhanced through knowledge and awareness, skill development, relationship building, and supportive community contexts (Lord & Hutchinson, 1998; Lucksted, 1997; Nelson *et al*., 2001), all of which are available as different networks on most university campuses. However, as the undergraduate participants in this study confirmed, university campuses are large and complicated environments where it's hard for people to navigate these support resources.

Therefore, we recognize the design opportunity of providing better tools to help people on campus navigate the system of programs, organizations, or activities that are intended to support subjective well-being effectively. In light of the prevailing students' awareness of their social support system, several agenda questions present themselves:
How can our students:

- Be more aware of the existence of the support they have
- Find more meaningful and relevant support
- Develop more positive attitudes and behaviours

How can campus wellness services:

- Increase awareness of the existence and services they provide
- Measure service coverage and popularity that will assist in their decision making and participatory planning process.

In order to be of use to individuals and make them feel like their interests and preferences are actually being considered, personalized visualization of the social support system will better serve the goal of empowerment: gaining the power to make changes.

3.2.2 Content

Based on the objectives above, we design the social support network by including three layers of support. They are:

1. support from yourself: some self-empowerment strategies
2. support from available on-campus service centers
3. support from people close to you.

From the survey data, 20 most common stressors experienced by college students are identified. The stressors are grouped into four categories: learning, living, connecting, and planning. Self-empowerment strategies are chosen according to theories from positive psychology (Seligman, 2004) and the effectiveness and practicality among students (for example, “learning to forgive” is not a strategy that can be taken into immediate action based on students’ feedback, so we didn’t include it). The available services and resources from the community are a crucial component of a social support system for students in a large-size campus. In this case study, we have identified and collected the on-campus service centers in a U.S. public university of large enrolment (>50,000). Each center is coded with relating stressors based on the services it provides. The social support system functions as a tool for students to match their struggled stress points with on-campus service centers. In addition to the suggested self-empowerment strategies and on-campus service centers, an interactive personal support layer also allows students to input and visualize the support from people close to them. It makes the social support network more personalized and helps to promote people’s awareness of the support network in their lives.

To ensure the map functions efficiently as a tool for navigating resources, all support elements are categorized into four types identified by James House in his book *Work Stress and Social Support Study*: emotional (the provision of caring, empathy, love, and trust), instrumental (the provision of tangible goods and services or tangible aid), informational (information provided to another during a time of stress), and appraisal (the communication of information which is relevant to self-evaluation rather than problem solving) (House, 1981).

3.2.3 Interaction and Visualization

The interactive experience is designed as a linear process prompt by different questions. Visualizations are progressively generated as answers to these questions. The structure of the narrative enables the micro and macro aspects of the information being presented to the user. Analytical tasks of retrieving, filtering, and clustering assist users to take full advantage of available data and information in local context therefore providing real help and solving real problems for students’ SWB.

In addition to considering the information and its hierarchy, design efforts are also made to allow information presented in a clear, attractive, and digestible way. Low-poly forms, organic shapes and bright colors are chosen to achieve an energetic, uplifting and relaxing sensation. Flower metaphors that suggest life and growth were adapted to shape the system map. For a personalized user experience, a student user first identifies her own stress points from the 20 stressors to create a unique “stress portrait”. Then as the result of user interactions, a complete social support map would be presented in front of the user to demonstrate her individual power and the social power that may enable her subjective well-being. Pictograms and textures are also used to be superimposed on the color regions to

encode categorical data in order to accommodate users with visual impairment. Figure 4 shows some mock-up screens of this interactive visualization project.

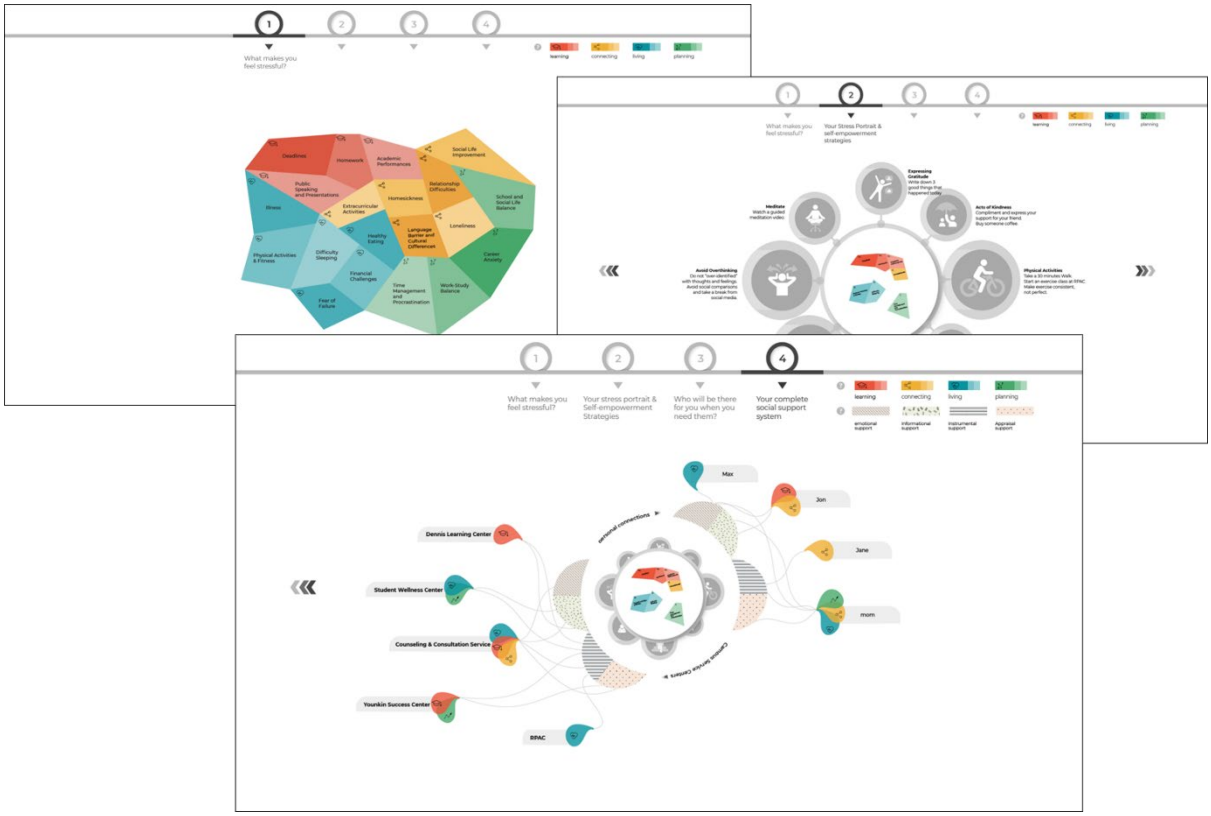


Figure 4 "Our Social Support System" information visualization concept mockup

3.3 Assessment

The assessment process is still ongoing by the submission time of this paper. The assessment stage is orchestrated to test both usability issues and users' emotional and behavioral responses. The usability aspect will be tested through a series of set questions following ISO's usability test guidelines (ISO, 2013). Questions relating to users' emotional and behavioral responses will mainly focus on the empowerment affect that facilitates SWB (Nelson, Lord, & Ochocka, 2001):

Table 1 User assessment plan.

Effectiveness	Does the social support map successfully produce the intended result? Questions relate to: theme, target user, purpose, initial reaction, aesthetics, overall impression and impact
Efficiency	Does the social support map successfully achieve maximum understanding with minimum wasted effort? Questions relate to: speed of reading and understanding the information, identification of information hierarchy, color-codes, pictograms, typography
Satisfaction	Does the social support map successfully fulfil user expectations and needs? Questions relate to: learning of new information, confirming existing information, reusing potentials, chances of recommendation
Awareness	Does the social support map raise more awareness of issues related to SWB and the available social support?
Emotion	Does the social support map elicit more positive feelings from the users? Choosing words from an Emotional Words Chart, e.g. Plutchik's wheel of emotions (Karimova, 2017)
Behaviour	Does the social support map motivate users to increase community participation, set better goals for themselves, take more initiatives in peer support and self-help?

4 Discussion

This research study investigates the opportunities to use information visualization to communicate and tackle SWB issues, as well as its ability to elicit feeling of empowerment from the users. It describes a design case in which a personalized social support visualization system is created with the explicit intention to enhance college students' empowerment experience in support for their subjective well-being. Although some theoretical insights are available about how design can contribute to well-being topics, this is the first research study to propose using information visualization as an empowerment tool to influence college students' emotions and behaviors in positive ways. The design process of the case study deliberately envisions an empowerment affect from the target users. The design solution intends to not only serve as a bridge between an individual and her social surroundings, but also makes one feel capable of reaching a particular goal, i.e. coping with daily stress, while gaining knowledge about systems, resources, and the power dynamics related to the goal.

The assessment results will tell us whether this design for empowerment approach of information visualization is a valid one. In addition to the current assessment plan, it will also be valuable to compare and measure the emotional impact of information content versus the visual forms. If users have an overall positive emotional response to the visualization products, which factor contributes more to the affect? Does a customized visual design increase positive feelings and the sense of empowerment? Also, in addition to this design approach in which using infoVis to close the gap between what is available and those who need access to the resources, we will explore other design solutions that can empower college students to address issues of SWB.

This research has the potential to be a significant contribution to information design research in general, and information visualization and design for well-being specifically. It offers research-based and human-centered design guidance for information visualization designers. Scientific studies are able to provide concrete evidence regarding the problem and needs of the user. Design research and design practice, on the other hand, are able to bring human-centered solutions to the problem. The considerations of human emotions and behaviors are as important as form and function in the design of information visualization.

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Design for human connectivity: A framework and research agenda

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Human Connectivity is one of the most important social challenges affecting individuals, communities, institutions and organisations worldwide. Despite volumes of literature making a compelling case for the benefits of being better connected and the detrimental effects of being poorly connected, comparably little work explains how successful human connectivity outcomes might consistently be achieved. This paper addresses this gap by introducing designing for human connectivity as an important design research challenge, presenting a model for analysing connectivity interventions and suggesting an agenda for future research. Human connectivity outcomes may be categorised as emotional, cognitive or functional and we propose that their successful attainment across the four distinct phases of the connectivity process is a function of the interplay between motives, enablers and barriers. A review of extant literature and the analysis of existing connectivity interventions results in a list of critical factors that may inform the design of more effective interventions, to consistently deliver improved human connectivity outcomes.

Keywords: human connectivity; societal challenges; design principles; motives

1 Introduction

Human connectivity is one of the most important social challenges affecting individuals, communities, institutions and organisations worldwide. Seismic shifts in the way we live, work and play are straining the very fabric of the networks that have sustained us in the past, suggesting a need to rethink the types of connections we require and the ways in which they can best be established. With an ever-growing body of evidence making the case for *why* people require relevant and meaningful connections to thrive, this paper presents both a challenge and initial guidance for designers to instead consider *how* this might be achieved.

According to Dan Schawbel at Forbes magazine, society is experiencing a "crisis of connection" (Schawbel, 2017). Taking an organisational perspective, the former Surgeon General of the United States, describes what he calls a "loneliness epidemic" in the workplace (Murthy, 2017). Whether we describe it as a crisis, an epidemic or simply an important societal and organisational challenge, the effects of people being poorly connected can be devastating for individuals and organisations alike. There are millions of people across the globe who suffer from feeling isolated, as well as countless organisations performing sub-optimally where innovations are stifled by silos and key stakeholders are unwilling to collaborate. Feeling poorly connected can detrimentally affect a person's health,

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happiness and prosperity as well as an organisation's performance. Interest in the negative consequences of being poorly connected seems to have intensified in the past few decades, with books like *Bowling Alone: Americas Declining Social Capital* (Putnam, 1995) and *Loneliness: human nature and the need for social connection* (Cacioppo, 2009) attracting widespread public and academic attention.

Humans are strongly motivated to connect with others. This stems from a fundamental need to belong (Baumeister & Leary, 1995). People expend a large amount of energy satisfying the need for strong relationships (Wesselmann et al., 2016), in order to derive a range of benefits which may be categorised as either emotional, cognitive or functional. While the need to connect to others appears to be universal, deeply rooted in the evolution of humans as social creatures (Dunbar, 1998), approaches to connecting to others varies across cultures, situations and settings (Meyer, 2014).

The aims of many design initiatives are to encourage, enable, facilitate or manage connectivity between people – sometimes intentionally but often by accident, as a by-product of meeting some other primary objective. However, there is little, if any, extant literature showing why and how some design interventions seem to work well and others do not. As such, there is a gap in the literature prescribing how to design for improved and consistent human connectivity outcomes.

The contribution of this paper is threefold. Firstly, we begin to shift the conversation from one that has been primarily descriptive – explaining and making the case for the need to connect and be connected – to a prescriptive one in which we focus on how improved human connectivity outcomes may more consistently and predictably be achieved. Secondly, we present a model for considering connectivity interventions in order to understand and predict human connectivity outcomes. Finally, we suggest a research agenda to inspire and advance future research in this field.

We begin by defining connectivity and describing the process and its outcomes, both positive and negative. Next, we present a model for analysing and understanding the effectiveness of human connectivity interventions. ‘Design for connectivity’ as a domain is introduced and an agenda for future research is suggested.

2 Human Connectivity: Definition, process and outcome

Human connectivity is both a process (the act of connecting) and an outcome (being connected). The extant literature contains many connectivity-related terms often used interchangeably including *network*, *relationships*, *relations*, *contacts*, *connections*, *community*, *links* and *ties* (e.g. Baker, 2000), *bonds* (Adler & Kwon, 2002; Healey, Hodgkinson, Whittington, & Johnson, 2015) and *pipes* (Baker, 2014). *Bonds*, *ties*, *pipes* and *links* are synonymous with *connections* which we refer to as a direct or indirect social contract or other agreement, exchange or structure that connects two individuals. It does not refer to the individuals themselves, who may be considered *contacts* (e.g. Susan is a *contact* of Pedro. Susan and Pedro have a strong *connection*).

2.1 The process of connecting

Understanding the distinct phases of the human connectivity process should enable us to prescribe interventions that address the specific needs of individuals in each phase. A review of the literature reveals a variety of frameworks that divide the human connectivity

process into distinct phases. There exists a general distinction between organisational contexts – where the focus is on key stakeholder connections such as buyer-seller relationships (e.g. Dwyer, Schurr, & Oh, 1987; Morgan, 2015), and personal contexts – where the focus is on romantic relationships (e.g. Gillath, Karantzas, & Fraley, 2016; Knapp, 1978). Although the labels and number of phases vary widely across the various frameworks, they all tend to include the full life cycle of the connection, beginning only once a potentially relevant other has been identified and ending with the termination of the connection.

Building on the literature, we propose a four-phase framework of connectivity (Figure 1), namely finding, forming, maintaining and leveraging. Finding refers to the discovery or identification of another person with whom one connects. Forming refers to the actions taken and investment made in establishing the connection to a point that it may ultimately deliver value of some kind to one or both of the connected individuals. Maintaining is required when the value inherent in a connection is ongoing or otherwise not immediately recognised or realisable, and the connection must be kept intact until such time that it is. Leveraging refers to the realisation of the value gained from the connection. This list differs from existing frameworks in the inclusion of finding (where others assume individuals know of each other) and that it ends with the broad term leveraging rather than context specific outcomes. Although 'termination' is acknowledged to be a distinct phase, it is omitted as the intention here is not to design for termination. Both unintentional termination such as failures in other phases and intentional termination may be subject for separate analysis.

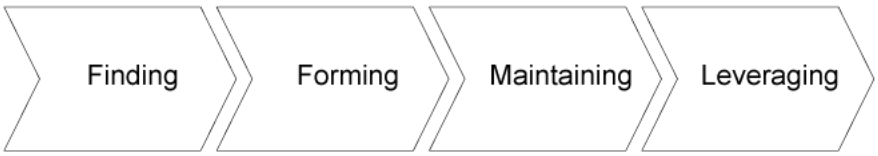


Figure 1: The Four Phases Comprising the Process of Human Connectivity

The ultimate objective of human connectivity is deriving value from those with whom one is connected. It is in the leveraging phase of the process that the value inherent in the connection is realised. This value may be emotional (e.g. feeling a sense of belonging to a person or group), cognitive (e.g. learning something new), or practical (e.g. receiving assistance with a problem). These categories of value are not mutually exclusive.

The process of connecting generally follows these phases in sequential chronological order but not always. For example, in the case of purely transactional encounters, a person may identify a relevant target (finding) and establish contact with them (forming) in order to request something from them (leveraging). Minimal time is spent forming the connection and no maintenance is required. Such connections are generally short-lived. In the case of particularly valuable connections (e.g. strategic business relationships or best friends) the connection may be maintained and leveraged repeatedly over a long period of time. When people fail to connect to others, it may be the result of failing to find people to connect with in the first place, or a failure to form a connection once a relevant other is found. Interestingly, once connections are formed, they will rarely be broken intentionally. People seem to go out of their way to keep connections intact (Baumeister & Leary, 1995).

2.2 Connectivity outcomes

Being connected to others is a fundamental human need, suggesting that people derive value from being connected to others and/or experience loss or pain from being

disconnected. This section discusses the benefits and detrimental effects of being well and poorly connected, respectively.

As introduced above, the benefits of being well connected can generally be categorised as emotional, cognitive and functional. That is, being better connected makes us feel better and/or delivers some kind of useful information or practical benefit. Generally, people who are socially well connected are happier and tend to live longer (Holt-Lunstad, Smith, Baker, Harris, & Stephenson, 2015; Miller, 2011). Examples of the cognitive and functional benefits of better connectivity include: more successful career (e.g. Useem & Karabel, 1986) – for example the publishing success of academics (e.g. Newman, 2004; Servia-Rodríguez, Noulas, Mascolo, Fernández-Vilas, & Díaz-Redondo, 2015); more effective task completion (e.g. Kadushin, 2004); access to valuable information (e.g. Inkpen & Tsang, 2005); being included in new opportunities (e.g. Burt, 2000); and ability to exert influence over others (e.g. Burt, 2000).

Whippman (2017) suggests that the strength of one's relationships is the best way to predict how happy they are in life. However, It is worth noting that connections between individuals need not be strong to have a positive effect. In a study that explored the effect of brief social interactions with strangers – in this case, baristas at a coffee shop – Sandstrom and Dunn (2013) found that people who simply engaged in a quick interaction with the barista were happier than those who did not.

Conversely, the psychological and physiological effects of being poorly connected or socially isolated (often referred to as 'loneliness') can be devastating. In an extensive meta-analysis of studies of social isolation and loneliness spanning a 34 year period to 2014, Holt-Lunstad et al. (2015) found that loneliness increased a person's likelihood of mortality by 26%. This is comparable to the detrimental effects of smoking and worse than other known causes of mortality such as obesity and sedentary behaviour (Holt-Lunstad, Smith, & Layton, 2010). Crumpacker (2008) makes a direct link between social connectedness and the likelihood of elderly people in the United States to commit suicide. Similarly, there appear to be cognitive disadvantages to being poorly connected. In a study designed to explore how a person's sense of belonging may affect their intelligence, researchers found that even when people simply believed they would end up alone later in life, their performance in cognitive tasks suffered (Baumeister, 2002). It is important to note that feeling lonely (generally referring to a psychological state) is not the same as being alone (a physical state of solitude) (Epley & Schroeder, 2014). It is possible to be alone yet still feel very connected to others. Likewise, it is possible to be surrounded by others and yet still feel very lonely.

While the extant literature, including mainstream media and organisational press, makes a compelling case for the fundamental need of people to be connected in order thrive in all aspects of their lives, our review of the literature emphasises that work to date is primarily descriptive in nature. The few examples that do exist provide semi-prescriptive advice regarding subjects such as 'how to network' (e.g. Casciaro, Gino, & Kouchaki, 2016) and how to improve social matching on online platforms (e.g. Terveen & McDonald, 2005). In her experiments with performative objects, Niedderer (2007) suggests that we might create "mindful interaction through the use of objects in social contexts" (p.3). Although the extant literature may inspire designers to recognise a lack of human connectivity as a problem worth solving and provide confidence that positive outcomes may be achieved through design (Desmet & Pohlmeyer, 2013), it does not go far enough to prescribe how this might

be achieved in this specific context. Lacking such guidance, our observations and conversations with a range of practitioners suggest that designers rely on intuition, their own experience and anecdotal evidence. We therefore propose that a better understanding of what drives people to connect with each other as well as the factors that help and hinder them in this process is needed. Armed with this knowledge, designers might then be in a position to take a more human-centred approach to "gain and apply knowledge about human beings and their interaction with the environment, to design [experiences, systems,] products or services that meet their needs and aspirations" (van der Bijl-Brouwer & Dorst, 2017, p. 2).

3 A model for predicting human connectivity outcomes and designing to improve them

Designing for human connectivity centres upon guiding people through the connectivity steps found in Figure 1. This may be achieved through the creation of interventions to fulfil each connectivity phase as well as means to make such interventions more efficient. Human connectivity (C) successfully occurs when a motive (m) is coupled with a net positive opportunity (Figure 2). If a person is not motivated to connect, efforts to help them to connect will be futile. Similarly, if barriers (b) outweigh enablers (e), even motivated attempts to connect will fall short. Finally, the degree of motivation and net opportunity moderates the success or efficiency of connecting.

$$C = m\,(e - b)$$

Figure 2: A model for predicting the likelihood of successful human connectivity

Behaviour settings offer a theoretical framework to understand contextual factors leading to behavioural occurrence and success. Using behaviour settings as a guide to analyse human connectivity, we can begin to identify key components of the environment influencing the success of the target connectivity. Adjusting these behaviour setting components such as motives, infrastructure, props, scripts, norms and roles can lead to reasonable design interventions and generalisable intervention principles (Aunger & Curtis, 2016). In this section, we simplify such an analysis into the three components of motives, enablers and barriers to connectivity, drawing insights from extant literature and observations from a sample of connectivity-related design intervention examples. The sampled example interventions are provided in Table 1 including a summarised exploration of the behaviour setting dimensions, connectivity enablers and (overcome) connectivity barriers. Motives, enablers and barriers are explored in more depth in the sections that follow.

Table 1. Behaviour setting theory as framework to analyse human connectivity interventions (experiences, services and products)

Connectivity Intervention	**Behaviour setting dimension and example features of intervention design**	**Connectivity enablers**	**(Overcome) connectivity barriers**
Wok+Wine is a social experience designed to 'connect participants to people they didn't know they were looking for'.	Stage: Unique and unexpected venues serve to disarm participants and provide conversation starters. Unfamiliarity of venue means the setting is neutral to most people. Nobody has a 'home-turf advantage'.	Unique environmental cues Neutral territory	Fear of rejection Negative ingroup/outgroup biases Mistrust

McCracken (2013) describes Wok+Wine as "an experiment in social chemistry". 40-50 participants (mostly strangers to each other) stand around a long communal table covered in newspaper and banana leaves peeling and eating jumbo prawns with their hands. The prawns are paired with one type of wine.	Props: Central communal table brings participants together. Labels around necks of wine bottles state "Serve yourself… and someone else", encouraging participation.	Shared experience Behavioural prompts	Lack of perceived relevance Limitations of emotional information processing ability Low self-efficacy Poor proximity / propinquity Lack of legitimacy Inappropriate form
	Roles: Absence of waiting staff means participants are required to assume that role. Serving others equates to small acts of kindness that help to establish trust.	Role disruption	
	Norms: Participants stand very close to each other (literally touching shoulders) and eat with their hands thereby breaking two conventional social norms. Stepping outside their comfort zones is made comfortable by being part of the group. Food is cooked in full view of participants, in a huge (60cm) wok over a custom-built gas burner, adding theatre.	Intimacy Collective discomfort Transparency	
	Objective: Events typically have no set objective or agenda. This removes pressure on participants to perform according to metrics set by the organisation. Participants encouraged to find value in their own way.	Authenticity Individual's purpose (not that of the organiser)	
Brain Dates is a service, typically offered at conferences, that matches participants for interesting conversations. Conference goers sign up in advance, indicating the types of people they wish to meet. On arrival, a matchmaker introduces the two attendees and they are offered a range of both usual and unusual settings for their conversation.	Stage: Participants given options regarding the setting in which they would like to meet, from typical (e.g. café) to unusual (e.g. on a lake).	Unique environmental cues	Fear of rejection Negative ingroup/outgroup biases Mistrust Lack of perceived relevance Limitations of emotional information processing ability Low self-efficacy Poor proximity / propinquity Lack of privacy Lack of legitimacy Inappropriate form
	Props: Settings enhanced by unique props that distract or stimulate participants (e.g. they may sit on an exercise bike while chatting).	Behavioural reframing	
	Roles: In some cases, roles are traditional (e.g. expert / novice) but as many pairings are not made to solve specific problems, participants may take on a range of different roles as conversations progress. This requires being open to unexpected opportunities.	Open mindedness	
	Norms: Regular social norms are partially challenged. The uniqueness of the experience allows participants to "be themselves" rather than necessarily performing to their	Authenticity	

	job title for example.		
	Objective: Each pair and every participant may have a different objective for taking part. In some cases there is a practical need to be met (e.g. help with a problem) and in other cases simply a curiosity to be satisfied. What all individuals share is a desire to leave more informed, inspired or enlightened.	Individual's purpose (not that of the organiser)	
	Routines: The regular sequence of events required to establish a connection is positively facilitated by matching participants prior to their arrival. Removes challenge of finding someone with whom to connect.	Matchmaking	
Social Cups are a product designed to help people to connect in networking settings. Imagine a silver champagne flute with no foot or stem and you have Kristina Niedderer's experimental "social cups" (Niedderer, 2007). What makes them social are the small hooks on the side of the cups which allow them to be clipped together. Due to its rounded base, a single cup will not stand on its own. However, when clipped together with two or more others, the cups stand perfectly well. If a	Props: The social cups themselves are the most critical connectivity factor of this product. They are functional (users can drink from them) but they are also unique in how they otherwise function as they require cooperation if they are to be set down on a surface (e.g. table).	Engagement Uniqueness	Mistrust Lack of perceived relevance Poor proximity / propinquity Discomfort Lack of Legitimacy Inappropriate form
	Roles: As well as the 'networker' role assumed by people in networking-type gatherings, social cups also give all participants the subtler role of 'collaborator'. It is in everyone's best interest to be willing to collaborate with others in order to be able to put their cups down.	Role disruption Collaboration	
	Norms: Social cups make it necessary for participants to place their cups unusually close to each other. They literally must be touching, breaking norms of personal space and creating discomfort due to potential contamination.	Intimacy	

person wants to put their cup down therefore, they are required to find two or more other people to connect to.	Routine: Regular routines are interrupted. When holding a typical wine glass, if a person wishes to enact a standard routine such as visiting the restroom or reaching into their pocket for business cards, they just need to put their glass down. With social cups, these routines are broken as a person first had to find someone to cooperate with.	Cooperation	

3.1 Motives of human connectivity

The study of human motivation as it relates to the pursuit of human connectivity outcomes has a long history in various domains. Maslow (1943) included 'belongingness' as a fundamental human need, second only to basic physiological needs. In Self-Determination Theory, 'relatedness' (the need to belong) is identified as one of the three fundamental innate needs that motivates humans (Ryan & Deci, 2000). Motives from these frameworks focus on emotional outcome of belonging resulting from connectivity. Broader explorations of motives extend thinking to other types of outcomes. For instance, in their interpretation of human needs from a behavioural evolutionary perspective, Aunger and Curtis (2013) identify 15 distinct motives, namely: lust, hunger, comfort, fear, disgust, attract, love, nurture, hoard, create, affiliate, status, justice, curiosity and play. Examples could be identified for the application of many of these 15 motives for a given connectivity experience. For example, considering one of the sampled interventions presented in Table 1, a person might be motivated by lust (seeking to find a lover), hunger (seeking food) or curiosity (seeking interesting conversations) to attend Wok+Wine.

In order to design for improved human connectivity, the true and complete understanding of a person's motives in the setting in question is required, including how such motives link to the individual's desired outcomes. In all cases, the motives may be relevant in a range of applications. Thus, we do not try to specify some discrete set of motives here for connecting but rather seek to emphasise the need to explore many possible motives for connecting that can lead to emotional, cognitive and practical outcomes. The motives employed and means of embodiment may also differ according to the human connectivity phase in focus.

3.2 Enablers of human connectivity

Features of design interventions that promote the creation of a connectivity phase or make the completion of such a phase more efficient are called enablers. Having identified the features of the behaviour setting dimensions that enhanced the likelihood of people connecting (Table 1), we generalised the nature of the enablers and ascribed them labels. Generalised enablers were then grouped according to their function (Table 2). Four functional categories of enablers emerged: those that *disrupt expected patterns*; those that *build trust*; those that *stimulate interaction*; and, those that *provide inspiration*.

Table 2. Enablers of human connectivity

Function of Enabler	Label	Generalised description
Enablers that disrupt expected patterns	Unique roles	Having users take on a new or different role to the one they would usually take in such settings.
	Unique environmental cues	Choosing a setting that is different to that which users might expect.
	Unique behaviours	Ask users to engage in behaviours that are different to what they would usually engage in.
Enablers that build trust	Collective discomfort	Help users to venture safely, as a group, outside of their comfort zones.
	Authenticity	Encourage users to 'be themselves' rather than expecting them to conform to a pre-determined role.
	Open mindedness	Create conditions in which users may be curious and explorative, accepting all views and perspectives.
	Purpose set by individual	Avoid focusing users' attention on a single outcome that is the priority of the organisation rather than their own.
	Intimacy	Create safe environments in which users may get closer to each other, physically and emotionally.
	Neutral territory	Select settings that do not invoke incorrect assumptions or give any individual or group the upper hand.
	Shared experience	Ensure that all users feel that they are 'in the same boat'.
	Transparency	Be open about the process. Invite users 'behind the scenes' to witness the creation of the experience.
Enablers that stimulate interaction	Engagement	Allow all users to participate. Do not discriminate in favour of or against any one group.
	Behavioural prompts	Visual or physical prompts that suggest and permit the desired behaviour.
	Cooperation	Include interventions or activities that require people to work together.
	Matchmaking	Connect users to each other so they don't have to find connections on their own.
Enablers that provide inspiration	Environmental cues	Use the environment to provoke users and provide inspiration stimulates conversation.

3.3 Barriers to human connectivity

Features of a system that hinder connectivity are called barriers. Although there is limited extant literature focused explicitly on barriers as they relate to human connectivity, a broader review of relevant (mainly psychology and organisation studies) literature provides useful insights. Here, we summarise two key categories of barriers that emerge from a review of the literature, namely psychological and physical barriers (Table 3). Psychological barriers stem from the beliefs that a person has about their ability to connect to others, as well as their general beliefs about the person with whom they might connect and the relevance or value of that connection. Physical barriers refer to aspects of the physical environment that may hinder the process of connecting.

Table 3. Psychological and Physical Barriers to Human Connectivity

Psychological Barriers	**Description**	**References**
Fear of rejection	Being afraid that the other person will turn down one's attempt to connect with them.	(Downey & Feldman, 1996)
Negative ingroup/outgroup biases	Avoiding or treating with suspicion a person who does not appear to one's own group, often perceiving them as having less value.	(Castano, Yzerbyt, Bourguignon, & Seron, 2002)
Mistrust	A person is generally likely to trust close connections more than people who are less familiar or strangers.	(Wu, Leliveld, & Zhou, 2011)
Lack of perceived relevance	Misunderstanding or underestimating the value of people with whom one is less strongly connected.	(Granovetter, 1973)
Limitations of emotional information processing ability	Suggests a limit to the number of people with whom a person can maintain connections.	(Dunbar, 1998)
Low self-efficacy	Using past experience in order to form expectations about future success due to ability or lack thereof.	(Jones, 1986)
Mental energy	Limited capacity to dedicate energy to forming a connection when engaged in another activity.	(Fayard & Weeks, 2007)
Physical Barriers		
Poor proximity / propinquity	Proximity to others has a significant effect on the likelihood of connecting and the strength of connection between them.	(Allen, 2007)
Lack Privacy	When there is no space that affords a sense of privacy, people are less likely to open up.	(Bernstein & Turban, 2018)
Discomfort	Feeling uncomfortable in a setting reduces the likelihood of connections forming effectively.	(Fayard & Weeks, 2007)
Lack of Legitimacy	The setting fails to afford people a sense of legitimacy for being there.	(Fayard & Weeks, 2007)
Inappropriate form	The form of an object may reduce connectivity potential or increase effects of social isolation.	(Blumenthal, 2007)

The identification of motives, enablers and barriers of human connectivity provides a foundation for a more human-centred design approach to the creation of new interventions that focus on one or more of the phases of the process of connecting, to consistently deliver improved human connectivity outcomes.

4 Design for connectivity: a research agenda

The four phases of the human connectivity process (Figure 1) provide a framework on which to propose an agenda for further research. Although sometimes overlapping, each phase presents a set of unique challenges for which a human-centred design approach may deliver meaningful solutions (Table 4).

Table 4. Designing for human connectivity: challenges and research questions

Connectivity phase	**Key challenges**	**Possible research questions**
Finding	• The best source of relevant connections • Sorting / sifting / selecting	• How are peoples' most valuable connections initiated? • What are the most effective approaches / platforms / techniques for finding relevant

	• Identifying unexpected valuable connections	connections? • What is it about the design of those interventions and techniques that makes them so effective? • What mindset characteristics best prepare someone to discover unexpected connections? • What factors, including trends, are positively or negatively impacting peoples' ability to find relevant and meaningful connections? • What routes to connectivity exist and how are these embodied in design interventions?
Forming	• Connecting with outgroup others • Understanding the factors that most influence the likelihood of connection formation	• What factors most contribute to the likelihood of connections forming and the speed at which they form? • How do the enablers and barriers to forming human connectivity differ across personal and professional contexts? • How formed must connections be in order for them to be leveraged and is this different for different types of connection or forms of value?
Maintaining	• Network size / overload • Connection atrophy	• What factors impact the ease by which connections may be maintained? • What effect does digital technology have on (perceived) connection strength and longevity? • Under what circumstances are connections terminated and how is this generally achieved? • What (if any) are there benefits of managing network size, including terminating connections?
Leveraging	• Recognising and realising value in unlikely connections • Old vs new connections • Reciprocity of exchange • Authenticity-Value trade off	• What factors increase the likelihood of connections being leveraged and what facilitates this process? • Is leveraging mostly considered to be a one-way or reciprocal exchange? • In the case of one-way leverage, what is the experience of the 'helper' vs the 'helpee'? • To what extent does extracting value from a connection influence perceived authenticity?

Additional general research questions include:

- How and to what extent do human connectivity needs and the motives to satisfy those needs change over time and by life stage?
- What are the design principles that effectively guide in the creation of interventions (experiences, services, products, systems) that improve human connectivity outcomes?
- To what extent are design principles for human connectivity generalisable across settings?

5 Conclusion

It is clear from a study of the extant literature that human connectivity is an important societal challenge that affects much of the world's population. From national governments to commercial organisations to individuals themselves, many institutions, organisations and people have a vested interest in finding solutions. Despite this, relatively little dedicated attention or effort has been paid to the evidence-based design of experiences, systems, services or products that have the explicit aim of improving human connectivity outcomes. While examples do exist of interventions that are meant to connect people, little is understood regarding what specific design decisions or principles lead to their success or failure. Subsequently, our understanding of how their effect may be generalised to other initiatives or settings is insufficient. Taking a more intentional and prescriptive approach to the design of interventions that directly or indirectly improve how people find, form, maintain and leverage connections to each other has the potential to positively affect the lives of millions of people. Only by more fully understanding the connectivity needs and motives of people as well as the enablers and barriers that support or prevent connections being made may we begin to take an effective human-centred approach to the design of more effective interventions.

The experience of human connectivity is subjective, and the realisation of an outcome is often not immediate. As such, measuring the effectiveness of existing and new interventions remains a challenge. That said, with this paper we have taken a first critical step in addressing this challenge. We have hereby placed design for human connectivity on the design research agenda. Rather than simply taking a descriptive approach to understanding how connected people feel as the result of experiencing certain interventions and what the implications of that are, we suggest taking a more prescriptive approach to include connectivity-related factors in the conception of new interventions. By dividing the process of connectivity into four distinct phases, acknowledging that the value derived from connections may take multiple (emotional, cognitive and/or functional) forms, and identifying the factors that affect the likely success of achieving desired connectivity outcomes, we have provided a way to focus attention on specific aspects of the process. The ideas presented in this paper are particularly relevant for the designers of experiences and systems intended to foster human connectivity and researchers seeking to better understand the nuances of this increasingly important field. The suggested research questions present a starting point for future research that should focus not only on deepening our understanding of the factors that affect human connectivity outcomes, but also on the relevance and respective weighting of those factors across a range of different settings.

We acknowledge that there is still much work to be done. While the motives, enablers and barriers identified here are grounded in extant literature and real-world interventions, the lists presented in the various tables of this paper are by no means exhaustive. The nuanced differences present in a range of other settings must be better understood for the development of truly generalisable design principles. Human connectivity is a challenge in almost all settings where people interact. While people in different settings may appear to have very different needs, the fact that those needs are limited in number and their pursuit is driven by a limited set of motives suggests that they may in fact have more in common than we think. Ultimately, a better understanding of key factors across a variety of settings will assist in the identification and prescription of a universal set of design principles that – when

applied to the design of interventions meant to connect people – may consistently improve the likelihood of achieving successful human connectivity outcomes.

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Design Interventions against Trolling in Social Media: A Classification of Current Strategies Based on Behaviour Change Theories

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Trolling in social media has become a serious social issue, and as a result, most social media services have introduced various design interventions to combat it. This study aims to identify effective design interventions against trolling in popular social media services and investigate their approaches based on behaviour change theories in this paper. We have collected 13 representative design intervention cases in six widely popular social media services, and identified their strategies and related design patterns based on existing theories in design for behaviour change. We found two important dimensions—moment of action and required level of user engagement—and classified the 13 design intervention cases based on the two dimensions into four types. The classification of current strategies can serve as an instrument for researchers and designers to analyse and evaluate designing tools against trolling in social media.

Keywords: trolling; social media; socially responsible design; behaviour change; user experience

1 Introduction

Trolling can be defined as “deliberate, deceptive and mischievous attempts to provoke reactions from other users” (Golf-Papez & Veer, 2017). In many contexts of public commenting within social media, trolling is seen as an antisocial behaviour that disrupts discussions within communities. Recently, as the number of social media users has grown rapidly (Statista, 2017b), trolling has become a critical social issue. Recent research (Gammon, 2014) found that trolling frequently happens on chat boards such as Reddit, blog services such as Lifehacker and Jezebel, and popular social media services such as Facebook and Twitter. According to the results of a recent survey in the United States, 38 percent of respondents reported that they saw trolling on social media on a daily basis and 26 percent considered themselves having been victims of trolling (Statista, 2017a).

In response to trolling in social media, designers have created interventions to prevent and constrain it. While some of these interventions and strategies are straightforward by allowing users to use the functions and vary the settings, others take more subtle and hidden approaches in informal and ad hoc ways, such that users might not need to consciously use the features (Shaw, 2018). While there has been much effort and a long history of

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developing tools to combat trolling in social media, little academic research has been conducted to identify the design interventions and strategies in this area.

This study contributes to the field of socially responsible design by examining the current efforts against trolling in social media with the goal of revealing and classifying their strategies. In analysing a corpus of design intervention cases, we attempt to answer two questions: What kinds of design interventions have been implemented for preventing and reacting to trolling in social media and how do these interventions trigger users to combat trolling according to behaviour change theories? Through this study, we arrive at a set of feasible guidelines about how four types of interventions are effective in combating trolling in different contexts of social media services.

2 Backgrounds

2.1 Online trolling

The term “trolling” is defined by Phillips (Phillips, 2014) as “disrupt[ing] a conversation or entire community by posting incendiary statements or stupid questions onto a discussion board...for [the troll’s] own amusement, or because he or she was a genuinely quarrelsome, abrasive personality.” Hardaker (2010) suggests four distinct elements of trolling: aggression (maliciously annoying others), deception (manipulating online anonymity), disruption (frustrating community members), and success (receiving responses from others).

Hardaker (2010) also differentiates trolling from other online misconduct such as cyberbullying. Cyberbullies often know their victims in real life (Dooley & Cross, 2010), and most of the time, cyberbullying involves a very specific target (Steffgen, König, Pfetsch, & Melzer, 2011). Recently, trolling has become an umbrella term which covers all types of negative online discourse (Golf-Papez & Veer, 2017), including cyberbullying. This study adopts trolling as a specific term which follows Hardaker (2010)’s definition and does not include cyberbullying.

Trolling behaviour happens across diverse subjects, especially sensitive ones such as gender and racism (Mantilla, 2013). The topics that are prone to draw attacks vary from serious ones such as politics and religion to more casual ones such as celebrity and sports (Statista, 2017c). Phillips (2014) suggests that since there is a range of trolling behaviours, from identity-based harassment to political activism, the specific context around each type of trolling should be examined.

Previous studies have discovered that trolling motivations are extremely diverse and depend on context. Sanfilippo et al. (2017) argue that the motivation behind trolling often varies through multiple factors, and the motivation can also vary across the types of trolling. For example, while the motivation behind light-hearted or humorous trolling is mainly to seek enjoyment via disruption and disagreement, more serious trolling is often motivated by ideological or social factors (Sanfilippo, Fichman, & Yang, 2017).

Baccarella et al. (2018) suggest that the main motivation is simple amusement, not pursuit of sharing thought-provoking opinions or discussing about the topics seriously (Baccarella, Wagner, Kietzmann, & McCarthy, 2018). Buckels et al. (2014) discovered that Dark Tetrad traits such as narcissism, Machiavellianism, psychopathy, and sadism positively correlate with the motivation behind trolling (Buckels, Trapnell, & Paulhus, 2014), and Cracker and March (2016) reveal that trolls often regard making social harm as their reward (Craker &

March, 2016). The multidimensionality of trolling implies that the tools against trolling need to be equally diverse.

2.2 Design for behaviour change

The term 'design for behaviour change' emerged in the mid 2000's (Niedderer, 2013). Since then, the power of design as a tool for behaviour change has been discussed by many researchers (Tromp, Hekkert, & Verbeek, 2011) and there have been many types of approaches taken in design for behaviour change.

There are various related terms within design for behaviour change such as nudge, persuasion, and behaviour change theories (Cash, Hartlev, & Durazo, 2017). One of the most developed concepts is persuasive technology. The concept of persuasive technology was introduced in 2003 along with the software-based design for changing behaviour and attitudes through persuasion (Fogg, 2003). In his 2003 paper, Fogg defines persuasive technology as an "interactive technique that is designed to change the attitudes or behaviours or both." Fogg also suggests that current interactive technology can provide many advantages over traditional ones such as broadcasting and print media, because the latter can interact immediately with users' input or intention. Therefore, he argues that designers can use this interactive experience to influence users' motivation and behaviour. Fogg proposes a framework about how technologies can influence users' behaviour through the elements of Tunneling, Tailoring, Suggestion, Self-monitoring, Surveillance, Conditioning, and Reduction. These elements can be foundations in the following studies of design for behaviour change.

2.2.1 Design for responsible behaviour

Two application areas of design for responsible behaviour that are related to this research are Design for Sustainable Behaviour (De Medeiros, Da Rocha, & Ribeiro, 2018) and Design against Crime (Press, Erol, Cooper, & Thomas, 2000).

Design for Sustainable Behaviour (DfSB) "aims to reduce products' environmental and social impact by moderating how users interact with them" (Bhamra, Lilley, & Tang, 2011). DfSB is related to both providers and consumers. Providers are encouraged to produce more sustainable products and to reduce the number of environmentally harmful products they offer, while consumers are educated to make environmentally better choices when they purchase goods (Thorpe, 2010). Tang and Tracy (2008) suggest seven strategies to influence consumer behaviour in order to reduce negative social or environmental use: (1) eco-information (2) eco-choice (3) eco-feedback (4) eco-spur (5) eco-steer (6) eco-technical intervention and (7) clever design (Tang & Bhamra, 2008). Since these strategies intend to reduce negative users' behaviour, this study can refer to their scheme.

Design against Crime, introduced by Press et al. (2000), proposes that design against crime aids crime prevention by implementing features to make criminal behaviour less appealing, e.g. by setting up physical barriers against criminal targets or reducing the reward from a crime. This approach discourages a potential criminal's motivation. In the terms of trolling as a type of cybercrime, this current study can partially benefit from this approach.

Based on users' experiences around design for responsible behaviour, Tromp et al. (2011) propose a classification of influence which looks at two important dimensions: salience (apparent or hidden) and force (strong or weak). Based on these two dimensions, they classify four types of influence (see Figure 1): coercive (strong and apparent influence),

persuasive (weak and apparent influence), seductive (weak and hidden influence), and decisive (strong and hidden influence).

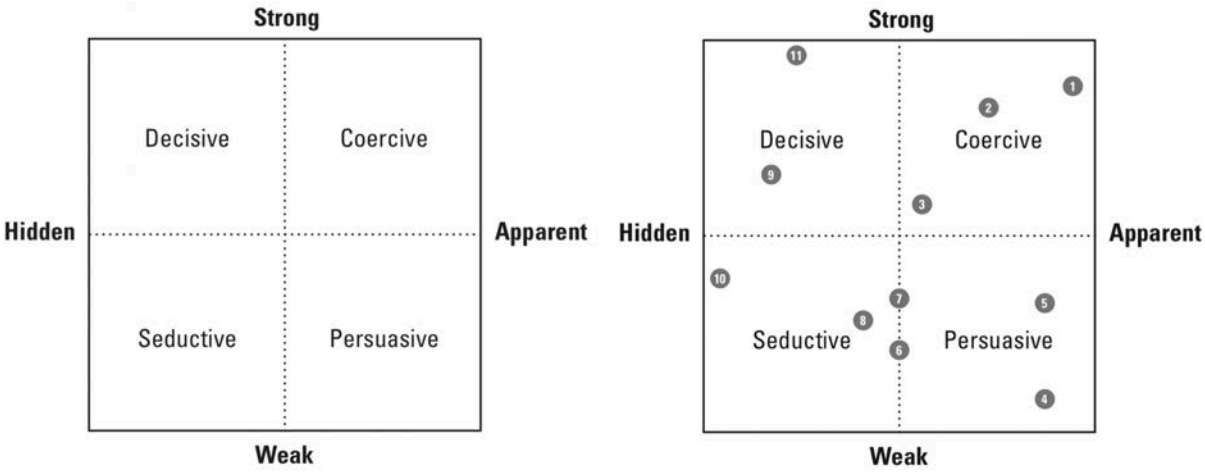


Figure 1. The classification of influence based on intended user experience (left)

Figure 2. Eleven strategies based on the classification of influence (right)

(Source: Tromp et al., 2011)

Based on this classification, they propose 11 design strategies which are effective in influencing responsible user behaviour:

(1) Create a perceivable barrier for undesired behaviour (pain)

(2) Make unacceptable user behaviour overt (shame)

(3) Make the behaviour a prerequisite action to make use of the product function

(4) Provide the user with arguments for the specific behaviour

(5) Suggest actions

(6) Trigger different motivations for the same behaviour

(7) Elicit emotions to trigger action tendencies

(8) Activate physiological processes to induce behaviour

(9) Trigger human tendencies for automatic behavioural responses

(10) Create optimal conditions for specific behaviour

(11) Make the desired behaviour the only possible behaviour to perform.

Figure 2 demonstrates the classification result of the above 11 strategies. We will use these 11 strategies in examining our findings to analyse how they take specific approaches to combat trolling.

2.2.2 "Design with Intent"

Lockton et al. (2010) presented the Design with Intent (DwI) toolkit with 101 design patterns which includes a set of strategies to encourage positive behaviour change. These 101 patterns are grouped under eight lenses: (1) architectural lens, (2) errorproofing lens, (3) interaction lens, (4) ludic lens, (5) perceptual lens, (6) cognitive lens, (7) Machiavellian lens and (8) security lens. In each lens, there are 10 - 15 patterns. This toolkit is an effective

approach to generating initial ideas, conducting brainstorming, and analysing existing products, services, and systems. We will utilize the toolkit to examine the approaches taken by the interventions we have discovered.

3 Method

In this paper, we use 'intervention' as a term to describe a specially designed feature to combat trolling in social media services. We apply the qualitative methods of case study and contents analysis to examine existing design interventions in popular social media services that constrain trolling or help users react to trolling effectively. Our analytical lenses are developed from the 11 behaviour-changing strategies (Tromp et al., 2011) and the Design with Intent toolkit (Lockton, Harrison, & Stanton, 2010). Using these lenses, we investigate the strategy used by each intervention to influence users' experiences and behaviour. Based on the strategies emerged from the investigation, we summarize the results as guidelines for future research and development of socially responsible design.

For our cases, we selected six popular social media services as research objects: Facebook, YouTube, Instagram, Twitter, Tumblr, and Naver. The first five services were selected because of their global popularity (Statista, 2019), while Naver was included because it is the most popular social platform service in South Korea (Statista, 2018) and it has introduced manifold creative and effective interventions against trolling. During the case study, each intervention has been labelled either as proactively preventing trolling (such as muting and blocking) or for restraining trolling (such as deleting and reporting). These two dimensions were discovered from a grounded approach based on the identified interventions through this study.

Our case study included three phases to examine interventions in each service. First, we examined the timeline page (i.e., the main page) and comment sections in each service to discover the general atmosphere and characteristics of each service. Second, we searched several popular news content providers (e.g. the BBC account in Facebook) in each social media service and looked for controversial postings about particularly controversial topics such as racism and gender, as mentioned in section 2.1. We then characterised the kinds of interventions employed to deal with trolling in that comment section. Last, we also studied privacy and security pages in a setting page in each service to look for specially designed interventions against trolling.

4 Results

We have identified the 13 most representative and effective interventions used by six popular social media services against trolling: (1) Real-ID verification, (2) Muting, (3) Disabling comments, (4) Blocking comments from, (5) Comment thread, (6) Thumb up and down, (7) Like, (8) Emotion, (9) Link to profile, (10) Statistics, (11) Report, (12) Automatic filter, and (13) Deleting.

Table 1 presents the 13 design interventions ordered from proactive to reactive and shows which service makes use of which interventions. Comment thread (5) and Report (11) are the most commonly used interventions, being adopted by all six services, while Link to profile (9) and Deleting (13) are the second most used, being adopted by five services. Table 2 summarises the user experiences related to each of the 13 interventions, and analyses

them using Tromp et al.'s 11 behaviour-changing strategies and the 101 patterns in the Dwl toolkit of Lockton et al.

Table 1. Social media services and their interventions against trolling. An "o" indicates that the service makes use of the intervention.

		Facebook	YouTube	Instagram	Twitter	Tumblr	Naver
Proactive	1 Real-ID verification						o
	2 Muting			o	o		
	3 Disabling comments		o				
	4 Blocking comments from			o			
	5 Comment thread	o	o	o	o	o	o
	6 Thumb up and down		o				o
	7 Like			o	o		
	8 Emotion	o					
	9 Link to profile	o	o	o	o	o	
Reactive	10 Statistics						o
	11 Report	o	o	o	o	o	o
	12 Automatic filter				o		
	13 Deleting	o	o	o	o		o

Table 2. 13 interventions against trolling and user experiences

1 Real-ID verification



Adopted by Naver

How it works

- Users verify their real names with id numbers in order to join the designated online community.

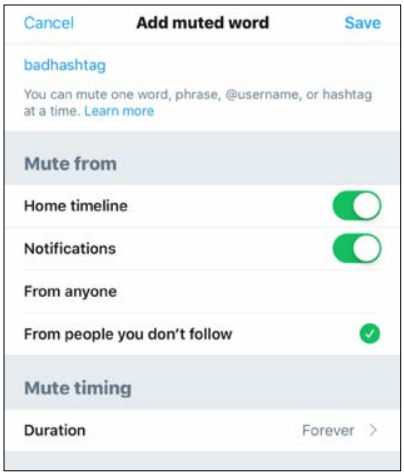
Strategies/Classifications adopted from Tromp et al.

- (3) Make the behaviour a necessary activity to perform to make use of the product function (Coercive): Without verification, users are not allowed to join the online community.

Lenses/Patterns adopted from the Dwl toolkit

- Errorproofing lens (Defaults)
- Cognitive lens (Do as you're told)
- Security lens (Who or what you are, Surveillance)

2 Muting



Adopted by Instagram, Twitter

How it works

- Users can register specific hate words to be muted; comments containing the muted words are not shown.

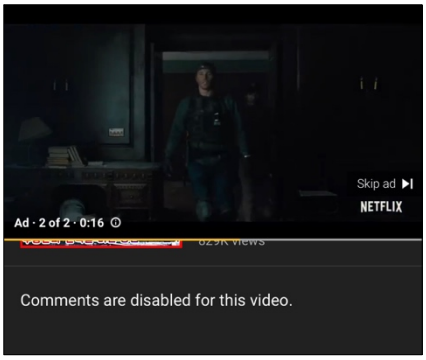
Strategies/Classifications adopted from Tromp et al.

- (5) Suggest actions (Persuasive): Suggest to users the way to avoid trolling.

Lenses/Patterns adopted from the Dwl toolkit

- Interaction lens (Tailoring)

3 Disabling comments



Adopted by YouTube, Instagram

How it works

- Contents providers who do not want to allow any negative comments can disable all comments.

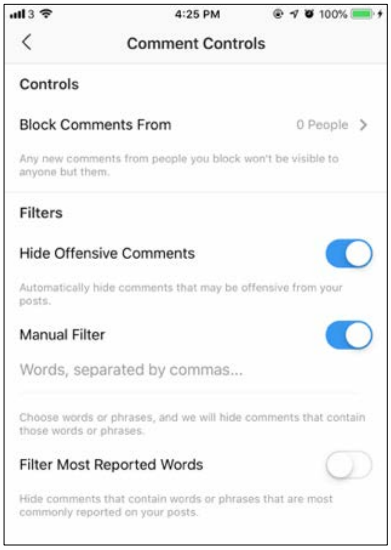
Strategies/Classifications adopted from Tromp et al.

- (1) Create a perceivable barrier for undesired behaviour (Coercive): Disable possible undesired behaviour.

Lenses/Patterns adopted from the Dwl toolkit

- Architectural lens (Feature deletion, Hiding things)
- Security lens (Surveillance)

4 Blocking comments from



Adopted by Instagram

How it works

- Users who want to avoid comments from a specific source can specify the source id and block all comments from that source.

Strategies/Classifications adopted from Tromp et al.

- (5) Suggest actions (Persuasive): Suggest to users a way to avoid a troll.

Lenses/Patterns adopted from the Dwl toolkit

- Interaction lens (Tailoring)
- Security lens (Peerveillance)

5 Comment thread



Adopted by Facebook, YouTube, Instagram, Twitter, Tumblr, Naver

How it works

- Users can reply to comments they want to discuss, sharing their opinions as to whether the comments are from trolls.

Strategies/Classifications adopted from Tromp et al.

- (4) Provide the user with arguments for specific behaviour (Persuasive): Users can argue with trolls using this feature.
- (6) Trigger different motivations for the same behavior (Persuasive & Seductive): By expressing their own ideas, users can discuss controversial topics, and find compromising points.

Lenses/Patterns adopted from the Dwl toolkit

- Interaction lens (Peer feedback)
- Ludic lens (Playfulness): Sometimes users interact with each other, and they can create unexpected results.
- Security lens (Peerveillance)

6 Thumb up and down



Adopted by YouTube, Naver

How it works

- Users can evaluate each comment with this feature. By looking at the evaluations as they accumulate, users can possibly tell if a comment is trolling.

Strategies/Classifications adopted from Tromp et al.

- (6) Trigger different motivations for the same behavior (Persuasive & Seductive): by deploying their own ideas, users can discuss controversial topics, and find possible compromising points.
- (7) Elicit emotions to trigger action tendencies (Persuasive & Seductive): users can express their feelings about comments.
- (9) Trigger human tendencies for automatic behavioural responses (Decisive): People enjoys rewards and praises by getting thumb ups.

Lenses/Patterns adopted from the Dwl toolkit

- Interaction lens (Peer feedback)
- Ludic lens (Playfulness): Users can interact with each other, creating unexpected results.
- Security lens (Peerveillance)

7 Like



Adopted by Instagram, Twitter, Tumblr

How it works

- This is a simplified version of thumb up and down. With it, users can tell which comments are most popular. However, it does not communicate negative reactions.

Strategies/Classifications adopted from Tromp et al.

- (4) Provide the user with arguments for specific behaviour (Persuasive): users can argue with this feature.
- (7) Elicit emotions to trigger action tendencies (Persuasive & Seductive)

Lenses/Patterns adopted from the Dwl toolkit

- Interaction lens (Peer feedback)
- Ludic lens (Playfulness, Levels, Rewards, Scores) Security lens (Peerveillance)

8 Emotion



Adopted by Facebook

How it works

- Users can express diverse emotions with this feature: like, love, haha, yay, wow, sad, and angry. By looking at the three emotions most chosen, especially if they are angry emotions, users can detect trolling.

Strategies/Classifications adopted from Tromp et al.

- (2) Make unacceptable user behaviour overt (shame) (Coercive)
- (7) Elicit emotions to trigger action tendencies (Persuasive & Seductive)

Lenses/Patterns adopted from the Dwl toolkit

- Interaction lens (Peer feedback)
- Ludic lens (Playfulness, Levels, Rewards, Scores) Security lens (Peerveillance)

9 Link to profile



Adopted by Facebook, YouTube, Instagram, Twitter, Tumblr

How it works

- These five social media services provide the commenters' profile picture, and a link to their profiles as well. So, commenters may feel more responsible than if they were commenting anonymously.

Strategies/Classifications adopted from Tromp et al.

- (2) Make unacceptable user behaviour overt (shame) (Coercive)
- (3) Make the behaviour a necessary activity to perform to make use of the product function (Coercive)
- (11) Make the desired behaviour the only possible behaviour to perform (Decisive)

Lenses/Patterns adopted from the Dwl toolkit

- Perceptual lens (Transparency, Watermarking)
- Security lens (Peerveillance, Threat to property)

10 Statistics



Adopted by Naver

How it works

- Demographic statistics are shown to reflect all comments. These are especially effective in detecting gender-trolling by providing the gender ratio of the commenters. The male-to-female ratio is usually extremely high after an article that attracts many gender-trolling comments.

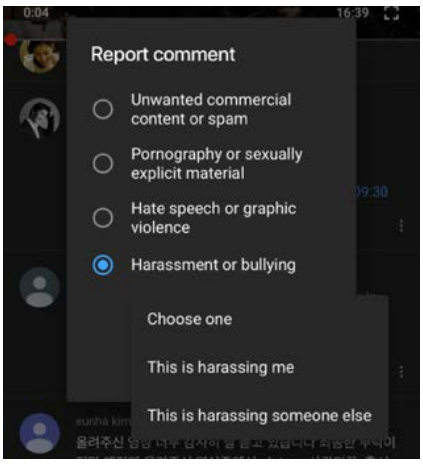
Strategies/Classifications adopted from Tromp et al.

- (4) Provide the user with arguments for specific behaviour (Persuasive): the user is provided with objective information about the demographic of previous commenters.

Lenses/Patterns adopted from the Dwl toolkit

- Interaction lens (Real-time feedback, Summary feedback)
- Perceptual lens (Transparency)
- Security lens (Peerveillance)

11 Report



Adopted by Facebook, YouTube, Instagram, Twitter, Tumblr, Naver

How it works

- Users can report a trolling comment by clicking a link, and they can provide their reasons.

Strategies/Classifications adopted from Tromp et al.

- (4) Provide the user with arguments for specific behaviour (Persuasive)
- (5) Suggest actions (Persuasive): the report feature can be a trigger for users to behave more consciously and carefully, since otherwise, the comment might be reported.

Lenses/Patterns adopted from the Dwl toolkit

Security lens (Peerveillance)

12 Automatic filter



Adopted by Twitter

How it works

- When the service detects trolling, it hides the comments; the comments are shown only if a user asks to see them.

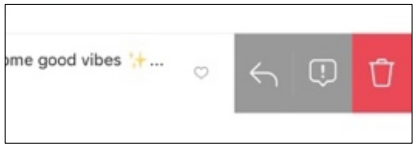
Strategies/Classifications adopted from Tromp et al.

- (5) Suggest actions (Persuasive): when something undesirable happens, suggest an option not to face it.

Lenses/Patterns adopted from the Dwl toolkit

Architectural lens (Hiding things)

13 Deleting



Adopted by Facebook, YouTube, Instagram, Twitter, Naver

How it works

- When the contents provider detects trolling, it can delete the comments by its authority.

Strategies/Classifications adopted from Tromp et al.

- (10) Create optimal conditions for specific behavior (Seductive): force the comment area trolling-free by service provider

Lenses/Patterns adopted from the Dwl toolkit

Security lens (Surveillance)

Figure 3 classifies the 13 interventions along two important dimensions: ‘Moment of action’ and ‘Required level of user engagement’. ‘Moment of action’ describes at which moment the

intervention is used for trolling management. ‘Required level of user engagement’ describes the degree of user engagement required for each intervention, ranging from active engagement (e.g. comment thread, report) to a more passive attitude (e.g. statistics, link to profile). Figure 3 then identifies four types of design interventions against trolling in social media: *Preventive, Precautionary, Participatory,* and *Administrative*, which can serve as guidelines for each of the four types of design interventions for future designers. In the following, we describe the four types in relation to their intervention types that are numbered in Table 2 and Figure 3.

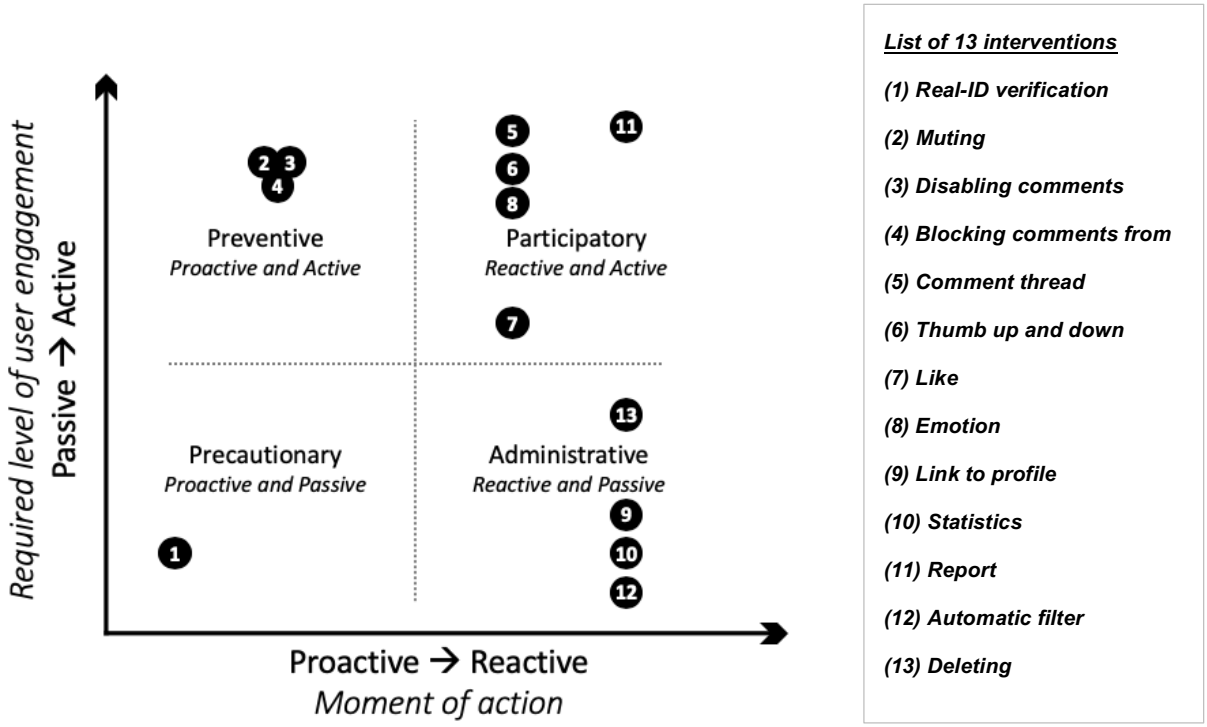


Figure 3. Four types of design interventions against trolling in social media

Preventive interventions (proactive and active): *Muting (2), Disabling comments (3), Blocking comments from (4)*. These interventions help users avoid trolling with predictable patterns or hate wordings. If some visible pattern of trolling is identified, then a tool to prevent it should be provided. If the contents provider wants to avoid all possible kinds of trolling, then a comment disabling option should be provided. These types of interventions are necessary for all kinds of social media, because they help users use the service in a safe and secure way.

Precautionary interventions (proactive and passive): *Real-ID verification (1).*
This type of intervention functions proactively to track down and control commenters, making users feel that they are under the control of the service provider (surveillance). However, service providers should be careful in adopting this intervention and avoid designing complicated steps so that it does not interfere with users’ access in the early stages of service usage.

Participatory interventions (reactive and active): *Comment thread (5), Thumb up and down (6), Like (7), Emotion (8), Report (11).* Since social media is a platform that congregates many users, it can utilise the users' active participation and collective intelligence (peerveillance) to deal with trolling. Social media can provide tools for users to express their feelings or emotions in a simple and easy way (e.g. positive or negative). Once expressed, it is important that the feelings and emotions are presented effectively to other users. This strategy will make trolling visible to users so that they themselves can take the authority to constrain trolling. We recommend this type of intervention for services where user participation actively occurs.

Administrative interventions (Reactive and Passive): *Link to profile (9), Statistics (10), Automatic filter (12), Deleting (13).*
Service administrators can decide to enter the comments area and provide relevant information or surveillance to make the area clean from trolling. Service administrators should watch what is happening there and react in proper ways. They can adopt an Artificial Intelligence filter to hide trolling automatically or delete trolling comments manually. They can provide informative features to help users recognize trolling easily. This strategy might require intense administrative time and effort, and therefore it is most appropriate for those social media services where severe trolling often happens.

5 Discussion

We expect designers of social media services to use our proposed classification and strategies in a way that depends on the particular stage of development of the social media.

In the initial stage of service development, designers can refer to our 13 representative interventions against trolling for ideation or design decision making. They will learn how these interventions might work in their service and affect their users' experience. Our findings can also be used as the basis for brainstorming sessions leading to new interventions against trolling.

If a social media service is already in its mature stage, designers can utilize our strategies as a tool to examine their existing anti-trolling interventions with regards to the contexts and characteristics of their service. For example, if the users of a service have a tendency to participate actively in comment sections, designers can check whether they embody *participatory* interventions in their service by empowering their users in an effective way.

This study has the limitation that certain social media applications might not be covered by our framework of strategies. Crucially, our findings mainly focus on users who want to avoid and constrain trolling. Future study can be carried out to reveal possible interventions to moderate both the motivations and behaviour of online trolls themselves.

With our findings, this paper can be a foundation for future work. To broaden the study, possible future directions include: (1) adding an empirical user study to examine the effectiveness of proposed strategies, and (2) including other types of social media service platforms besides mobile applications, such as mobile web or PC web-based ones (e.g., GeoExpat). Our classification and findings should stay fluid and be updated over the time with new design phenomena emerging.

6 Conclusion

This paper presents the analysis of 13 design interventions against trolling in social media and describes the user experiences and the interventions' implications based on existing design strategies for behavior change. As a result, we propose four intervention types—*preventative, precautionary, participatory,* and *administrative*. We hope the classification can not only serve as an evaluative tool for design researchers but also inform social media designers who want their designs to be socially responsible.

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Designing Design for Safety: How emergent methods indicate new safer future design practices

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A series of research projects by the authors has supported an understanding of a new type of design practice geared towards ensuring a safer relationship between people and technologies in a number of contexts including rapidly changing dynamic environments. Here we report on the research methods, tools and approaches that were created and adapted for investigating what emerged as a new approach for design in dealing with human behaviours and complex relations between physical and digital technologies. In particular these methods were used to research across both applied and strategic focus areas ranging from saving lives at sea to a future safety foresight review. A particular consideration was to ask whether current design principles and practices were adequate in order to tackle mature and emerging design for safety risks from local to global levels. Our methods emerged across a series of projects in a grand challenge and a foresight review. The first aimed to tackle loss of life at sea while the foresight review investigated the more specific strategic interdisciplinary role of design in tackling major future global risks. We report here on the thinking involved in developing the methods, how these were adapted and changed throughout the process and report on findings at key stages alongside insights from the data captured. The results from this research have been significant in helping to frame what may become a new approach to design practice, one that is capable of enabling change for increasing safety through new methods, practices, ethics and cultures.

Keywords: design methods; design for safety, global risks, methodology, design risks

1 Introducing design for safety

Safety and reducing risk are considered intrinsic aspects of industrial design yet when we look at the design methods and approaches used for training designers and used in industrial practice it is difficult to identify specific methods of designing for safety. Products and designs are tested to ensure they are safe for use either during or after a design and prototyping process. In this respect the design is tested and refined according to its failure to meet standards, as such design becomes an application of conformance to top down safety procedures and policies. In engineering we are familiar with the concepts of designing for safety and safety factors being applied to structures, however these methods are used in a specific context and do not include the full range of factors that concern design and designing. They tend to be largely concerned with the development of technical products

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and systems and assume that humans' interface in predicted ways that can be prescribed in advance. The type of design for safety that concerns us here, in effect the knowledge gap, is design for safety as a holistic activity that is strategic in its aims and anticipatory in both recognising and responding to complex dynamics between shifting human and environmental states in the presence of digital and physical technologies.

The Royal College of Art (RCA) was commissioned by the Lloyds Register Foundation (LRF) to explore safety in the broader context of design, initially through a grand challenge focussing on tangible implementable solutions to saving lives at sea and on rivers, and a follow-on strategic Design for Safety (DFS) foresight review that investigated the role and readiness of design in tackling the top major future global risks. This was to be the first design research projects commissioned by the LRF and that aimed to show how tangible and strategic design led innovation can bring new insights for a safer future. Comparing these projects allowed the research team to develop a perspective that identified evidence at both applied and strategic levels for a new focus on future design methods and practices positioned in a landscape of complex combinations of environmental change, human behaviour and technology revolution. The role of the authors was in developing, delivering and guiding the design research projects with authors Cooper (Lancaster University) and Ross (QinetiQ) providing academic and industrial guidance and oversight as co-chairs for the DFS foresight review.

In effect, a repositioning of the relationship between design and safety is proposed at a fundamental level so that safety itself is designed and practiced in a way that can respond more efficiently to current and future challenges. Our focus in this paper is to describe and provide evidence for how our emerging notion of design for safety as a new practice has itself been developed from design research methods and practices. Many of the methods and combinations of methods resulted from emergent new needs deriving from action, observation, discussions and discoveries rather than prescriptive pre-specification of methods. The pattern recognition of methods that emerged from the research is described here and in many ways is a work in progress. We do not make a claim that we have universally identified a new field for practice as many questions remain unresolved. Furthermore, as is the case in these circumstances overlaps with existing methods inside and outside of design exist.

The background meta-level drivers for change that suggest a reappraisal of the relationship between design and safety fall into three main areas. The first involves research in behavioural science and the emerging bridges being made into design where we now have models for designing for behaviour change including COM-B (Mitchie, 2011) and design practices (Lockton, 2010). These have allowed us an insight into the complexities, motivations and triggers that can be applied through design to human behaviour in a way that can enable safer partnerships when engaged in complex system relationships, particularly in the presence of wicked problems (Rittel, 1973; Buchanan, 1992; Conklin, 2006). The evolution of technology itself and its interdependencies on other systems have resulted in risk emerging in unexpected places and the realisation that unknown risks may emerge unexpectedly in the future are a major concern. For instance, as we develop technologies like AI, the working of which are not fully known to software engineers and computer scientists we see that subtle influences like gender and background can result in unconscious biases emerging in alarming instances (Devlin, 2017). Allied to this driver the nature of conflict has changed over time from physical impacts in geographically distinct

locations affecting relatively small numbers of people (Beard, 2018) to large numbers of people frustrated or inconvenienced by digital risks impacting diverse locations. Finally, the global context has shifted as climate change and the Anthropocene (Waters, 2016) have affected climate balances and new weather patterns have fundamentally changed the nature, level and timing of the risks that we are exposed to in major events. Designing the flexibility, resilience and new perspectives to visualise, locate and manage risk requires new methods and approaches of designing for safety.

2 Grand Challenge

In 2016 the Lloyds Register Foundation commissioned the Royal College of Art to develop a Safety Grand Challenge research project (Hall, Ferrarello & Kann, 2017a) to develop innovations capable of saving lives at sea and on rivers. The project focused on two issues; the ship's pilot ladder that for the last 300 years (Hignett, 2012) has been used by port pilots to transfer from pilot vessels to ships and a second project that explored designs capable of responding to the increased demand for future safety on the river Thames by the year 2030 (Fig.1). In order to explore these new design for safety issues, the project considered action research (Lewin, 1946; Hopkins, 1985; Susman, 1983; Kemmis,1988; Venable, 2006; Kemmis, 2007) and participatory design research (Crabtree, 1998; Kensing, 1998; Sanders, 2002; Spinuzzi, 2005; Ivey, 2006; Juhani, 2009; Sanders, Brandt & Blinder, 2010; Simonson, 2013) as potential research methods.



Figure 1. Port of London Authority pilot ladders transfer and Thames 2030 safety field trips

What emerged across the project was the need to blur boundaries and "unsilo" expertise across the collaborative network including designers and researchers. This came about through design acting as a vehicle of engagement, interaction and participation. Design as both strategy and object was mainly perceived by the experts as a mode of changing tangible practices. Nonetheless its intangible strategic value was instrumental and also recognised as potentially supporting cultural change. Under this lens design led a framework of interaction by developing a new methodology to tackle complex design for safety problems and real-life issues.

Although we had identified action research and participatory design research as potential methods, the interaction of these methods only became clear as the project progressed. The pattern of a participatory engaged framework emerged through developing the dialogue amongst experts from the Royal National Lifeboat Institution (RNLI), Lloyd's Register (LR), the United Kingdom Maritime Pilots' Association (UKMPA), the International Maritime Pilots' Association (IMPA), Confidential Hazards Incident Reporting Programme (CHIRP), the Royal Navy and Port of London Authority (PLA), the research team and the 35 postgraduate design and research students working in interdisciplinary groups from across the RCA Schools of Design, Communication, Architecture and Art & Humanities. The outcomes helped introduce new design led innovation connections into the maritime field which supported the development of new concepts for port's pilots in dealing with safety issues from new perspectives via collaborative methods. One successful method used to identify the need of participatory design was an initial literature review that we thematically analysed to support creative practice rather than academic analysis (Fig. 2). The concept for selecting the topics, sub-topics and themes was driven by the researcher's industrial design experience and understanding the information, inspirations and knowledge that could support new design innovations.

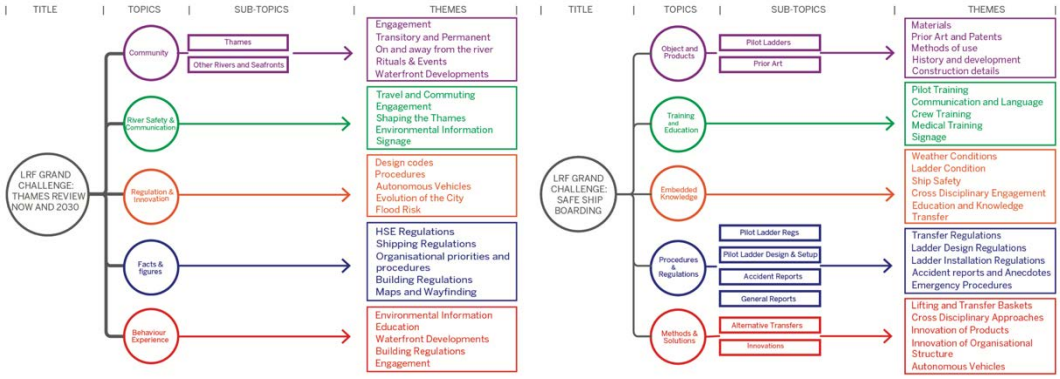


Figure 2. Grand Challenge literature review structure.

The interactions between experts, stakeholders, partners, researchers and students fostered trust and promoted an emerging idea of a new culture of safety through design, whether acting at a strategic or at product level. To achieve this RCA researchers constructed a strategy guided by design research methods that helped gather momentum across the parties involved in the process and gradually gain their trust and participation. Action research emerged through the activities, methodology construction, facilitation, reflection, dialogues and regular design support and critique by the researchers (Fig. 3). This developed knowledge of the topic by observing the pilot's and Thames river environments as a whole (wellness, stress, eating habits, transfer dynamics, weather, tides, daylight levels, fatigue, equipment, etc.) and visiting key location for field trips including RNLI headquarters and Thames lifeboat station and observing pilot transfers on the Thames via the PLA (Fig.1). Action research helped identify the key research topics to focus on which supported the framework of participatory design. This also helped include the partners, stakeholders and pilots' experience and develop a strategy that increased their ownership of the project (Ferrarello, Hall, Kann & Hee Lee, 2017). As a result of this, the role of partners, experts and stakeholders moved from the periphery to the very centre of the project. One outcome of action research was the realisation that increasing creative risk could reduce risk to life (Hall, Kann, Ferrarello & Pulley, 2017b), a reflection that in some ways flies in the face of the logic

that safety methods should in themselves have little risk attached. Combining action research and participatory research enabled the emergence of our new understanding of design and helped give shape to design for safety, i.e. an applied approach that reframes safety away from product driven solutions and that instead takes account of a much wider set of variable environmental and technological conditions.

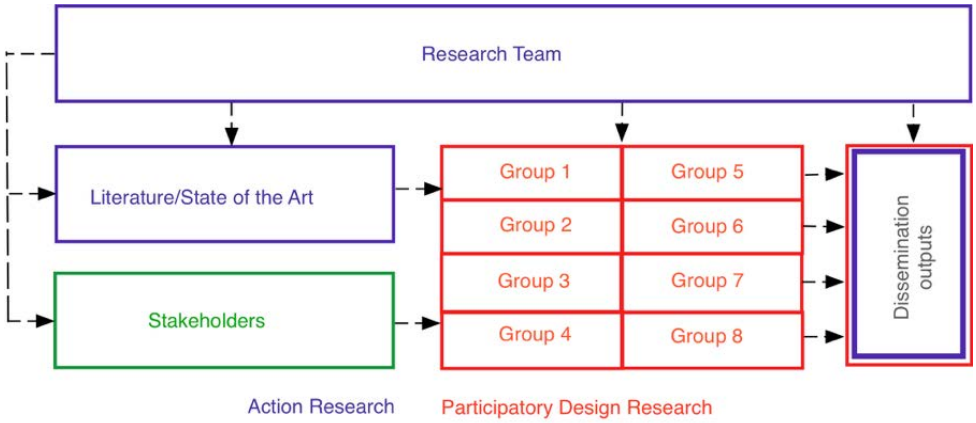


Figure 3. Grand Challenge Research Methods

Alongside action research and participatory design research we also included a number of other interacting design research tools and techniques which in combination allowed us to develop a new perspective on design and safety. The table below (Table 1) captures the findings and impact of each.

Table 1. Grand challenge Methods Analysis

Method	Finding	Impact
Thematic Literature Review	Extracted 5 themes, sub-themes and topics for each project covering the human to technology risk gap.	Helped design teams quickly source contextual insights and concerns and to use these to support creative methods.
Action Research	Capability to iteratively design research and to distil weak from strong design for safety signals by engaging experts.	Helped researchers team to build, develop and sustain a collaborative relationship between designers, experts and context.
Participatory design research	Creative design partnership with experts who became champions of change.	Developed trusted relationships between researchers and experts.
Interviews	Navigate existing knowledge to identify the key design topics for tackling risk on water.	Designing and analysing relationship between risks and design potential.
Field trips	Experience tangible risk and complex human-machine interactions in changing environments on water	Developed context-aware design solutions that incorporated environmental complexity and changing conditions.

Global Pilots Survey	International feedback on the prototypes.	Outline the viability of the prototypes in a global context of different cultures and climactic environments

The methods culminated in the dissemination of outcomes via seven physical prototypes exhibited at the Lloyds Register Foundation, HMS Wellington IMPA headquarters, Lloyds Register Global Technology Centre in Southampton and the RNLI headquarters in Poole, Dorset. The cross-sector collaborative spirit endures as Dynaweb and Cross Lock System (now Dynalock), two of the award-winning groups have combined their projects after successfully bidding for start-up funding in the InnovationRCA incubator as Helm (Fig. 4). The company combines designers and maritime industry experts as a design for safety platform ensuring that the relationships created by the project develop solutions that tackle real life safety issues in new ways.

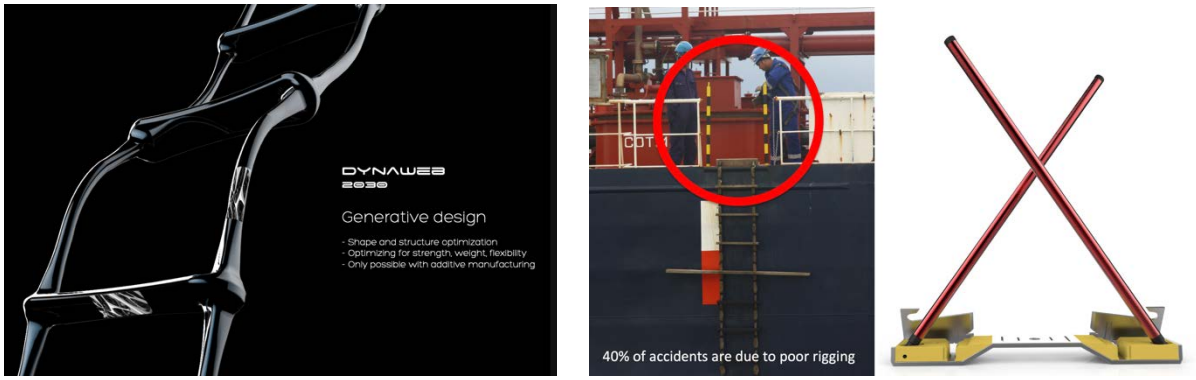


Figure 4. Dynaweb and Cross Lock System combined as the Helm start-up

The Safety Grand Challenge initially began with a practical motivation to develop new safety solutions to save lives at sea and on rivers. However, the approach of allowing methods to emerge and combine has allowed us to reflect and recognise a new potential for how design for safety can be practised. This has been possible through a design for safety research methodology emerging throughout the projects. The combined approach of action research and participatory design and research combined with other tools and techniques listed in Table 1 constructed the design for safety methodology that enabled a new proposed practice for safety.

3 Foresight Review

Following the successful conclusion of the grand challenge and reflections suggesting new value in how design engages with safety, a Design for Safety Foresight Review (Anderson, Hall, Ferrarello, Cooper & Ross, 2018) was commissioned by the Lloyds Register Foundation in 2017 to investigate the strategic role that design could play in tackling significant future global risks. The foundation has been a major funder in new research and initiatives for tackling risk and safety issues, and as part of this activity has commissioned a series of foresight reviews on a number of subjects ranging from the public understanding of risk through to big data and energy storage (LRF, 2019). The Design for Safety Foresight Review was to be the first to investigate safety from a design perspective. At the centre of this effort was research that explored the opportunities design can address in improving

complex future problems between people and technology. In order to achieve this the Foresight Review planned to connect a range of international experts across disciplines and industries to examine the strategic future relationship between design and safety at a global level. This future orientated perspective engaged the understanding of existing and emerging practices together with knowledge and experience of safety from diverse fields. The challenge was to understand how design in the global context of safety could be explored and to consider how this could be investigated across industrial sectors. For this reason, the research looked at the potential learning between emerging and mature industries from a human and technological perspective and selected six representative sectors including: Manufacturing Technologies and Services, National Infrastructure Technologies and Services, Food Technologies and Services, Healthcare Technologies and Services, Transportation Technologies and Services and Consumer Products Technologies and Services.

In order to focus the foresight review the research team developed an initial design for safety statement that served as an initial position aiming at capturing the scope of the review. This was inspired by the findings of the grand challenge that tangibly investigated the interaction of design and safety alongside research and the industrial experiences of the co-chairs (Cooper & Ross) and the research team.

> "We believe design for safety enables people and technology to operate safely. Design for safety is the actions taken to ensure that an item, system, system of systems or network is free from adverse impacts on individuals, organisations, communities and the environment, whether these happen as a result of implicit or explicit risks”

This was augmented by a matrix diagram that aimed to capture and visualise the risk relationship between people and technology cross referenced with the potential learning that could be exchanged across emerging and mature industrial sectors (Fig. 5 below).

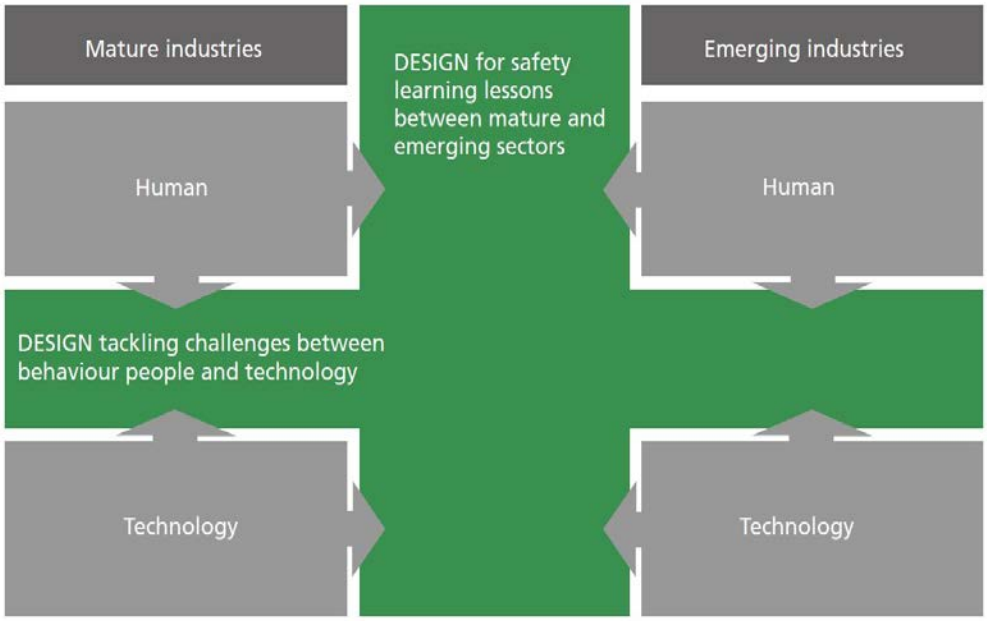


Figure 5. Design for Safety Relationships Matrix

Both the Design for Safety (DSF) statement and matrix were reviewed and developed throughout the foresight review process and functioned as a foundational point of reference to articulate design for safety and its strategic role in relation to industry alongside orientating our network of global experts.

Although we had some success in allowing methods to emerge from practice in the grand challenge the strategic future oriented nature of the foresight review presented a new challenge. One of these was to embrace complexity, whether this was in the form of people, machines, systems or environments. The challenge was to ask if it was possible to test the same set of methods (action research and participatory design research) in a strategic context and build on the design for safety approach that emerged in the Safety Grand Challenge. Following a literature review which pointed towards a major gap in design for safety as a global community of practice (Anderson *et al.*, 2018, p.41) we engaged an international cross section of more than two hundred experts across the six selected sectors through an online questionnaire which allowed us to test insights gained from the literature review in industrial scenarios. The questionnaire helped engage with the experts and identify the knowledge gap that design for safety can tackle to increase safety across sectors. It also identified knowledge gaps and paradoxes in safety procedures across the six sectors globally, as shown in Fig. 6. For instance, Consumer Product experts believe that safety is something they have tackled, while prominent examples of fire risk from washing machines and hair dryers clearly evidence the opposite (Anderson *et al.*, 2018, p.10).

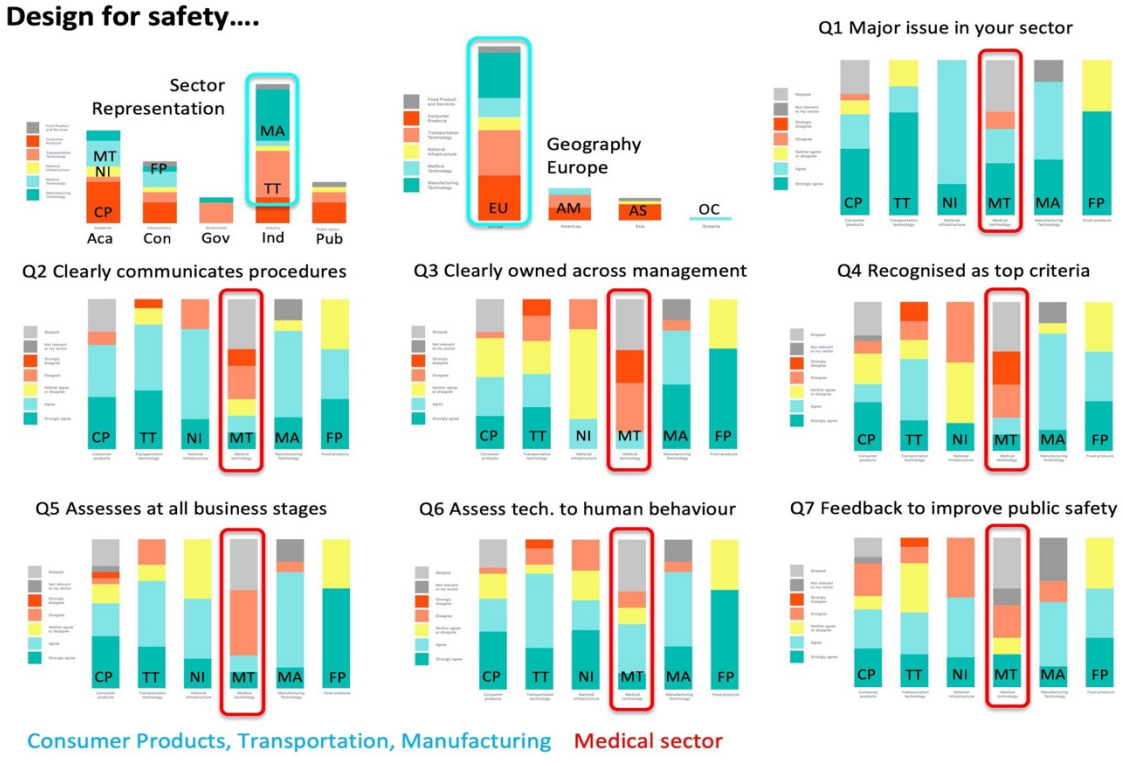


Figure 6. Design for safety questions, data and analysis. CP=Consumer Products, TT=Transport Technologies, NI=National Infrastructure, MT=Medical Technology, MA=Manufacturing Technology, FP=Food Products.

The questionnaire was followed by a symposium where forty selected global experts across the six sectors participated in co-developing (with the foresight researchers) a list of major future design risks and explored their relationship to design.

The symposium was organised around four facilitated activities each of which used a different method to focus future design for safety issues:

- Online questionnaire data review.
- Mapping safety case study examples from each expert to ask where should design operate and what is missing from design.
- Design future scenarios based on future forecasting techniques, which outlined future global risks that cross-sectors experts need to tackle through design.
- Strategic sessions where experts prioritise future design risks.

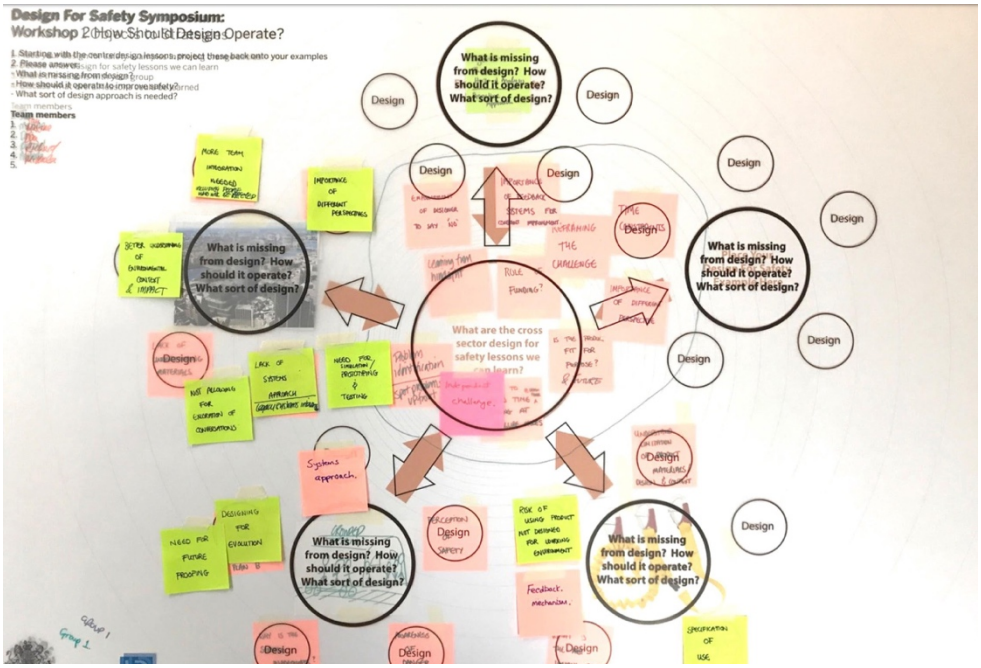


Figure 7. Example of DFS mapping tool exploring issues asking where design should operate.

This facilitated discussions, questioned the prevailing safety culture and promoted the adoption of a new safety culture via exploring what was missing. Under this particular aspect design was not only the action needed to facilitate interactions across participants, design as method, became the communication vehicle that made the changes visible and tangible. An example of this is where experts were asked to bring to the symposium an object representing a design for safety issue in their sector. The mapping tool (Fig. 7) was designed to allow participants to work together comparing and synthesising thinking across disciplines to bring to the surface new and existing relationships between design and safety and to ask fundamental questions around how design operates. These issues were discussed in cross-sector working groups. This exchange of knowledge through tangible objects was an emerging method that enabled a shared language across disciplines via tangible physical examples. Even though safety became tangible through the objects, design for safety as a method took on an intangible form. The objects were perceived as placeholders for further conversations that visibly connected the forecasting of future safety issues.

The review process evidenced the key value that design can play in addressing future global issues and complex risks through the interaction of methods as described in the table below (Table. 2). Through future forecasting techniques, participation and co-design methods evidenced the capability to articulate experts' thinking across time and space through

existing knowledge (Sanders, 2008). In addition, experts across sectors brought their own understanding of design from the individual to a cross disciplinary approach built on a cohesive system of conversations aimed at learning from each other and exchanging knowledge.

Table 2. Foresight Review Methods Analysis

Method	Finding	Impact
Sector Literature Review	Revealed knowledge gap in global design for safety practices, network, principles and ethics.	Suggested the need for a new approach for design in relation to safety (as captured in the onion diagram below)
Action Research	Identified the unknown knows and the DFS paradoxes in the sectors.	Identified the gaps in knowledge across sectors and engaged experts willing to collaborate further in the research.
Participatory Design Research	Design for safety future issues, gap in ethics and design practices, confirmed missing global design for safety culture.	Developed and used collaborative tools for issue mapping and forecasting to create a cross-sector future design for safety issues
Online Questionnaire	Highlighted difficulty of sector risk self-analysis and comparability across sectors. Healthcare self-analysis of risk highest.	Raised global issues of design for safety across the six selected sectors.
DFS Issue Mapping	Outlined the most significant future global issues and relationship to design.	Enabled cross sector and cross disciplinary dialogues on design for safety
Future Forecasting Design for Safety Issues	Used design for safety as a probe to tackle future global risks.	Provided future contextual topics to enable discussions across human-technology risk gaps.

The findings and recommendations from the foresight review were derived from the methods we applied and can be listed under the following points:

- The necessity of developing a DFS observatory that can help monitor knowledge and insights across sectors, in particular within emerging fields and global issues.
- The need to develop training methods that different sectors can implement. This could develop an educational approach where new generations can be trained to develop design methods that tackle future risks.
- Growing a global design for safety network initiated in the review and use this as a basis for knowledge exchange.

The findings from the methods employed across the research project are:

- The balance designed across Action, Participatory and Co-Design methods, along with the other techniques listed in Table 2, helped develop focus, as well as co-define solutions participants could use to focus design for safety issues across disciplines.
- The impact the research had on participants evidences the validity of working with design research methods (which in this case defined design for safety) to tackle complexity aimed at social change at a strategic level.
- Engaging experts across the process shaped the research methodology from existing knowledge mediated through design methods and a combination of tangible and strategic design.

These findings are collected under a common umbrella, which constructs the DFS principles that are deliberately cross sector in their scope. The main overarching principles (Anderson *et al.*, 2018, p.36) are: Design for Safety is environmentally sustainable, Design for Safety actively reduces societal risk, Design for Safety achieves these through the holistic delivery of its outputs. The principles proposed by the review are preliminary and need testing and development through practice, however they act as guideline to navigate the design for safety journey from sector activity via a culture of design for safety ethics and practice to achieve safer design. Figure 8 illustrates the design for safety gap between the relationship of industrial sectors to design for safety culture, towards safer designs.

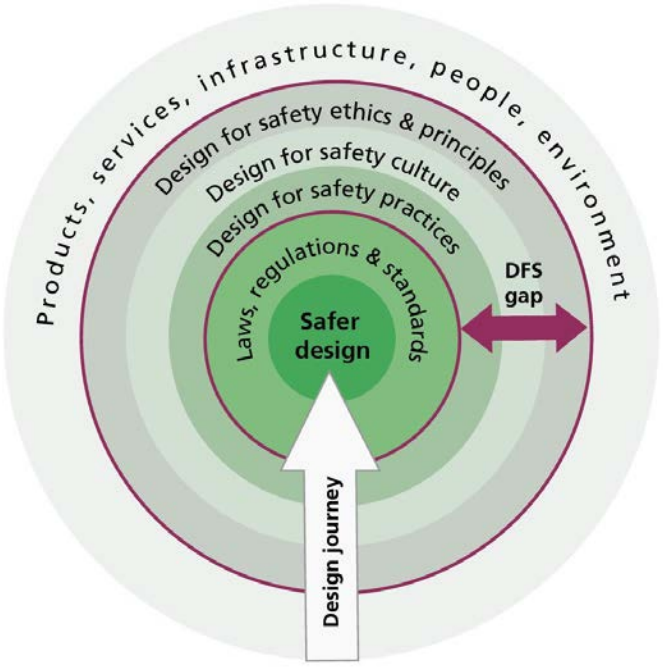


Figure 8. Onion diagram illustrating the design for safety knowledge gap of ethics and principles, cultures and practices between technology and people and safer design.

4 Findings and Discussion

The design for safety methodology emerged from a combination of recognising the emergence of existing design methods and new tools that were developed in response to research needs. This allowed us to explore the value of design for safety as a new approach for empowering people and providing increased cross disciplinary agency to tackle complex

dynamic systems, like safety at sea and risks from consumer products to give just two examples. Design for safety seamlessly engaged experts across sectors in the discussions and created new bridges across boundaries in the form of good practice, successes and failures. This methodology has allowed design research to begin engaging with the complexity of human behaviour for strategically questioning how we deal with the top future global safety issues that we identified from a design perspective.

Methods included future forecasting scenarios to develop safer design interventions that explore the context. Field trips, symposia and workshops were also key methods to facilitate synergy between the parties. Hence both projects succeed in mapping existing knowledge and valuing the exchange for further studies. As a result of the practical and tangible outcomes the grand challenge succeeded in generating design impact in the short term, whereas the foresight review is projective. By working with cross-sectors experts we evidenced the need of new design methods with a specific safety focus that are capable of moving across industries tackling cross-sector safety issues.

The researchers recognised action research and participatory design research as higher-level research methods that emerged during the grand challenge project and also during the foresight review. In the grand challenge these methods were relatively distinct as participatory design applied to prototypes developed in the four ladder projects and three River Thames 2030 design projects. Whereas the iterative process of network generating, facilitation and participant observation by the design research team over an extended period of nine months emerged as action research of a more social and systemic nature. In contrast the foresight review activities were blended and we can see a stronger action research pattern from sourcing and generating the global partner network facilitated through participatory events knitted into the symposia. The lack of tangible artefact generation in the foresight review makes it more difficult to claim a distinction between action and participatory methods and this aligns very much with the findings of Foth and Axup (2006) who identify a significant overlap between both. The interaction and overlaps between action driven and participatory methods facilitated the creation of a new platform for creative participation focussing on an interdisciplinary approach to designing safety and enabling change. The diagram in Figure 9 below captures the DFS methodology flow illustrating the relationships between the tools and methods between both projects showing how insights have informed the knowledge gaps in the findings.

The recognition of design for safety as a potential new culture of practice emerged between the grand challenge and foresight review and was confirmed by a literature review. This evidenced the need for defining new design methods capable of tackling safety through a lens take encodes environmental variability, behavioural differences and unforced errors. Nonetheless there is further research to be done to be able to articulate the limitations across different fields, in particular at the implementation stage. The contrast between the applied nature of the grand challenge compared to the future strategic goals of the foresight review created the space, differences and comparisons that allowed a view to emerge that connected gaps in current practices to the need for a new global community of practice.

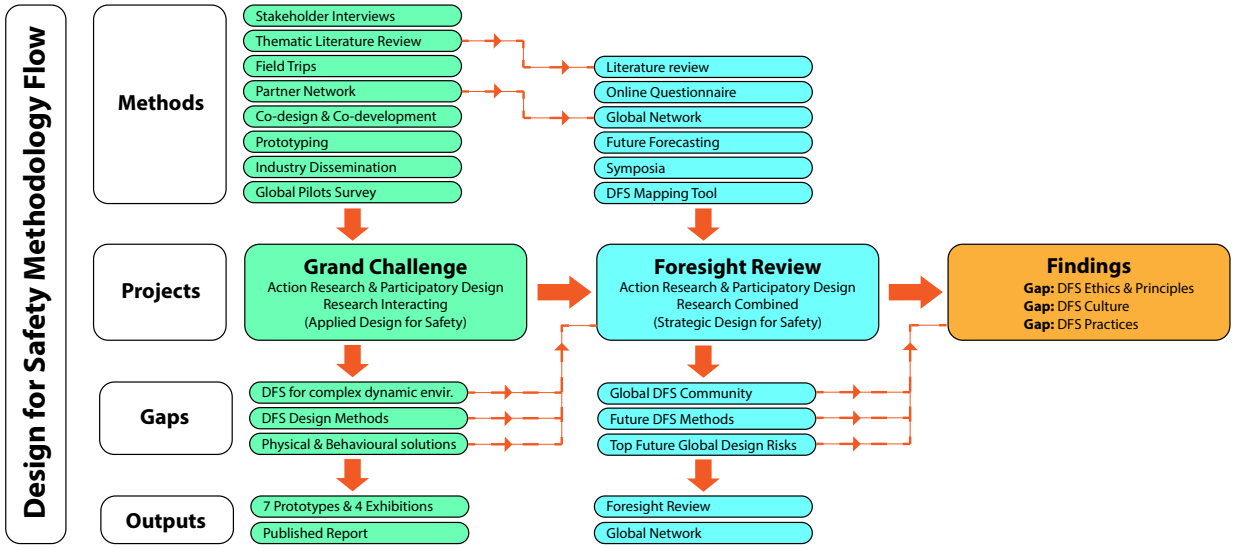


Figure 9. Design for Safety Methodology Flow illustrating how methods have interacted to generate findings that articulate the knowledge and capability gaps.

5 Conclusions

Designing design for safety has described how we developed a methodology in action that identified the need for new design methods that are able to tackle safety issues and challenges through a new global community of practice underpinned by ethics, principles, methods and cultures of design for safety. This methodology is the result of a process that understands human behaviour and increased risk leading to errors in the practice of safety procedures when we assume that humans have to interact with technology through fixed sets of instructions, regulation and practices. When humans interact with technology in complex changing environments either as result of unforeseen circumstances, variable behaviours or environmental change then risks can increase to unacceptable levels. As new complex ‘black box’ technologies like AI are introduced into dynamically changing environments we need new practices and methods to foresight risk and mitigate this through new creative design methods.

Both the grand challenge and the foresight review illustrate how design for safety enables the definition of a new culture of safety that supports a holistic observation of people in their working environment. Factors playing a role in safety environments list a range of elements including wellness, weather, behaviour patterns, etc. By bringing the human to the centre, the grand challenge and the foresight review outlined the importance of responsibility that each individual at any level needs to take to respond to risky events. This acknowledges the need of universal design for safety principles that are applicable to different sectors and that can be adopted globally to foster a culture that discusses issues in place of delegation. The design for safety methodology asks new ethical questions from experts across sectors working at the intersection of people and technology.

Reviewing across both projects we uncovered the need for a new design for safety culture, principles and practices. This evidences that methods for DFS practice need to be developed for engaging specifically for the variability of human behaviour in responding to environmental and technological complexity. Future design for safety methods will need to put safety at the centre of practice rather than consign it to prototype testing stages or

assigning it to other disciplines. At an applied level we will need to understand how to envision safety impacts, evaluate the balance between creative risk taking and safety gains, and how models of behaviour change can interface with safety. At a global scale design for safety methods will need to collaborate with international agencies and other domains in order to deliver the creative variety required to contribute to global safety issues ranging from climate change and food security to conflict and migration. The future will ask for major contributions from design in solving global safety problems, our research has found that design is wanting in this regard.

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Designing the User Experience for New Modes of Electric Vehicle Charging: A Shared Vision, Potential User Issues and User Attitudes

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ELECTRIC VEHICLE (EV) uptake has been increasing greatly and steadily over recent years. Vehicle-to-Grid (V2G), is an emerging energy system, with the potential to reduce peak loads and support the balance of the electricity grid. To benefit the 34% of the UK population without off-street parking, street furniture charging solutions have been developed. This requires the design of new services and digital interactions for buying, and selling back, electricity to the grid, leading to new customer experiences. The ultimate goal of this research is to understand and design these new user experiences. The overall system is complex, involving energy flows, financial flows, new technology, consumer interaction, and consumer acceptance. To explore the potential issues of a V2G-supported EV charging system and examine consumers' attitudes towards such system, a mixed-methods approach was employed. Part 1 of this paper specifically explores the creation of a holistic vision of consumers, EVs, street furniture charging solutions, and V2G. A workshop was organised with 22 participants from across the different specialisms within the project team. Consumer motivations, enablers, and barriers were explored. Part 2 of this paper examines consumer attitudes and intention-to-buy based on a scenario of V2G system, which was created with the foundation of the outcome from Part 1. Consumers showed positive views towards EV adoption, while the intention-to-buy V2G-supported EV charging system varied. Consumers tended to be cautious about making a full commitment to V2G packages. This paper also discusses the design implications for future research and practitioners.

Keywords: Vehicle-to-Grid; electric vehicle charging; street furniture charging solutions; user experience; mixed-methods approach

1 Introduction

To reduce the significant dependence on fossil fuels, discussions about how decarbonisation can be achieved through electric vehicles (EV) have been raised worldwide. The International Energy Agency suggests that EVs must make up at least 40% of new vehicle sales globally by 2040 (Axsen et al., 2017). Consequently, the increased adoption of EVs will invariably impact the local electricity grid due to the increased electricity demand. Smart meters and time-of-day tariffs can incentivise EV owners to charge at off-peak times, when wind and solar power are plentiful, and electricity is cheaper (The Guardian[1], 2017). However, even with the temporal shifting of demand peaks, the National Grid has warned

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that (The Guardian[2], 2017) by 2030, electric cars could require 3.5-8GW of additional capacity, on top of the current peak demand of 60GW. To further lower the pressure on the grid caused by EVs, the batteries in these EVs are perfect external storages, to store electricity when it is plentiful, and give it back to the grid when it is in high demand. Researchers have explored an integration of EVs, which enables EVs to switch between the roles of electrical loads and energy resources. This integration is known as vehicle-to-grid (V2G) (Guille & Gross, 2009). V2G utilises bi-directional power transfer, so that the electricity grid can maintain reliable operations in a more economic manner. However, V2G remains at a nascent stage of technical development and research efforts in recent years mainly focus on solving technical problems. Very few have explored social acceptance, consumer needs, narrative visions of V2G as a future system (Sovacool et al., 2018), and it is still uncertain in which form V2G will be introduced to end consumers. In this paper, we intend to create a holistic vision of how V2G will be embodied and examine potential issues and consumers' attitudes towards the new EV charging system.

To achieve widespread EV and V2G adoption, V2G needs to penetrate commercial and residential markets. An important challenge is to deploy widespread V2G charging infrastructure that enables bi-directional charging and billing for EVs. A 2010 survey shows that 34% of the UK population does not have access to off-street parking (English Housing Survey Home, 2010), so on-street charging infrastructure is needed. Meanwhile, on-street charging infrastructure is facing a chicken-and-egg problem that people will not buy EVs if they cannot see that infrastructure is available, and local authorities will not install infrastructure if they cannot see the demand for EVs. Technically, *street furniture* charging solutions are viable: pilots have proven their optimal flexibility and space-saving features above standard charging points (Ubitricity, 2018). However, there is still a need for more understanding of consumer perception in terms of launching services to the market.

In our overall research, the ultimate goal is to design the user experience of a future EV charging system, which involves digital interactive technology and V2G technology delivered through street furniture charging solutions. The first step is to investigate consumer understanding and opinions. The aim of this paper is to:

- Create a holistic vision of how V2G will be embodied.
- Explore potential issues for the end-users of a V2G-connected EV charging system.
- Examine consumers' attitudes and intention-to-buy towards the new system.

At the inception of this research, a major challenge was how to sensitise people to a scenario of a grid-connected EV concept with street furniture chargers, such as lamp posts. This scenario does not currently exist which makes it difficult to ask people's opinions on them. Therefore, we decided to take a mixed-methods approach, in which Part 1 aimed to create a shared vision of V2G and provide materials for user engagement and Part 2 aimed to explore consumers' attitudes towards a V2G-connected EV implementation. This paper contributes to the knowledge of how diverse stakeholders view the new EV charging system at a high-level and how end consumers view such a system in terms of their attitudes and intention-to-buy towards this system. This paper provides detailed discussion about how this study can benefit future empirical researches and design practitioners in the context of V2G, EV charging, and street furniture chargers.

2 Related Work

2.1 The V2G Concept

Vehicle-to-grid (V2G) refers to efforts to bi-directionally link the electricity grid and the transportation system in ways that improve the sustainability and security of both. It describes a system in which EVs communicate with the electricity grid to import electricity from the grid and export electricity back to the grid. V2G creates a flexible and decentralised power system that supports load balancing, reduces peak loads, and helps to integrate intermittent renewable electricity generation to the grid. Research efforts in recent years mainly focus on exploring V2G at a theoretical and technical level, such as creating a conceptual framework for V2G implementation (Guille & Gross, 2009), developing an inductive power interface for EVs in V2G systems (Madawala & Thrimawithana, 2011), exploring an autonomous distributed V2G control scheme (Ota et al., 2012), modelling the cost of EV battery wear due to V2G application in power systems (Zhou et al., 2011), and estimating the achievable power capacity from EVs for V2G frequency regulation (Han et al., 2011). Very little existing research has focused on understanding consumer attitudes to EV-related technologies (Axsen et al., 2017). There are a number of demonstration projects that have brought V2G into the real world and have physically deployed V2G technology for a specific use case. A V2G global report has been produced to review the on-going and existing V2G-related projects (UK Power Networks, 2018). This report shows that almost all projects had a technical element (98%), while few focused on social aspects or the perspective of end consumers (27%) (UK Power Networks, 2018). This report emphasises the need for greater focus on user behaviour. For example, in the commercial project 'Parker' in Denmark, charge points and EVs were provided to the consumers. A fee per month was required which provided charger, maintenance, and tools to manage charging. The study demonstrated the importance of understanding detailed aspects of consumer behaviour, such as schedules, to manage when and how much to charge or drain the EV batteries. In this paper, we intended to create a holistic vision of how V2G will be embodied and test this vision via consumer engagement.

2.2 Street Furniture Charging Solutions

The implementation of charging infrastructure is a prerequisite for the diffusion of EVs and for a widespread V2G network. Studies show that the most commonly used charging location of EV owners is at home (70%), while 5% of them use the charging spots at their work place (Vassileva & Campillo, 2017). However, 34% of the UK population does not have access to off-street parking (English Housing Survey Home, 2010) and up to 85% of households in some urban residential areas must park on the street (Fleetworld, 2018). To encourage increased EV adoption by residents without off-street parking, on-street charging infrastructure is planned to be widely developed and deployed. Currently, researchers and companies have started to work on developing and testing on-street EV charging facilities. One promising type of on-street charge point is that installed on existing lamp posts (Warwick News, 2017), resulting in no requirement to add another power supply or dig up the road or pathway. In this project, we aim to focus on street-furniture, such as lamp post charge points, and how consumers perceive them in the context of the V2G concept. This paper intends to create a vision of a V2G-connected EV concept, where the electricity is delivered and retuned back to the grid through lamp post charge points.

2.3 Research Challenges

V2G is currently at a research and development stage with only a few pilots globally (UK Power Networks 2018), so the concept of V2G is not yet common knowledge (Axsen et al., 2017). The major challenge in this research is how to ask people to respond to questions regarding a future technology system, which does not yet exist and is rarely heard of. Axsen et al. used an interview protocol where researchers verbally explained to participants how utility-controlled charging (UCC – a new smart charging system) works, then directly followed by asking participants' opinions about UCC. They reported that participants could not easily conceptualise UCC, that more than half of the participants had trouble understanding how UCC would facilitate the electricity grid when researchers tried to explain the concept in basic terms. As they have addressed this problem in the paper that "*some of this confusion could be attributed to an inability of the researchers to successfully describe the UCC concept in an easy to understand manner*", this paper intends to take a different approach – Design Fiction. Design fictions can take the form of narratives, short stories, and semi-working prototypes. They have been used to re-consider existing or emerging ubiquitous computing technologies (Dourish & Bell, 2014) and to illustrate potential technologies and services (Briggs et al., 2012). In addition, visualisation has been proved to be an effective method in various fields of studies (Salter et al., 2009; Kantola & Jokela, 2007). Therefore, this paper intends to employ visualisation and design fiction, making the best use of sensitising concepts (Bowen 2006), to make it easier for participants to understand the new EV charging system.

3 Part 1

3.1 Study design

In Part 1 of the mixed-methods approach, we aimed to create a holistic vision of V2G-connected EV (V2G-EV) charging system and identify potential issues. A workshop was organised with 22 participants, representing stakeholders in this project. The holistic vision was created to show common understanding towards this new EV charging system among stakeholders. The potential issues were prompted in the workshop and framed into three topics – 'motivations', 'enablers', and 'barriers' to consumer adoption of V2G-EV technology. The three topics have been explored in the contexts of perception of new technology and willingness to engaging in a certain activity, such as bottom-up grassroots innovation in transport (Ross et al., 2012), voluntary participation in an online crowdsourcing platform (Baruch et al., 2016), and learning and knowledge sharing in virtual communities of practice (Ardichvili, 2008). The holistic vision was further used to generate a scenario for the purposes of sensitising participants in Part 2.

3.2 Participants

We organised and delivered a workshop with 22 participants from diverse backgrounds - design researchers (5), regulatory researchers (2), energy supplier (2), distribution network operator (1), local authorities (4), smart energy management (3), EV charging (3), and car club (2).

3.3 Study procedure and data analysis

The workshop consisted of two sessions. The first session aimed to form a high-level vision of how stakeholders and infrastructures are connected together within a V2G system. To encourage and stimulate discussions, a diagram was prepared (see figure 1). This was based on an existing schematic basic sketch of a V2G system (Ebbs and Flows of Energy

Systems) on which to scaffold participants' discussions. 22 participants were divided into three groups and each group had balanced backgrounds of expertise. During the 15 minute discussion, three questions were explored: (i) are the terminologies right in this diagram? (ii) are there any missing components or links? (iii) Where do the participants see themselves in this system? 5 minutes' presentation was allocated to each group to explain their understandings and opinions towards the V2G-EV diagram. The second session of this workshop aimed to enrich the vision of how the V2G system will be embodied, taking a consumer perspective. Participants were asked to discuss: (i) what are the main motivations that would drive consumers to consider V2G-EV charging system? (ii) what are the user enablers to consumer adoption of V2G-EV charging system? (iii) what are the user barriers to consumer adoption of V2G-EV charging system?

Three sets of data were collected from the three groups in the workshop. The data was qualitative in nature. Thematic analysis and Affinity Diagramming (Britz, 2000) was employed to group similar ideas together as a theme.

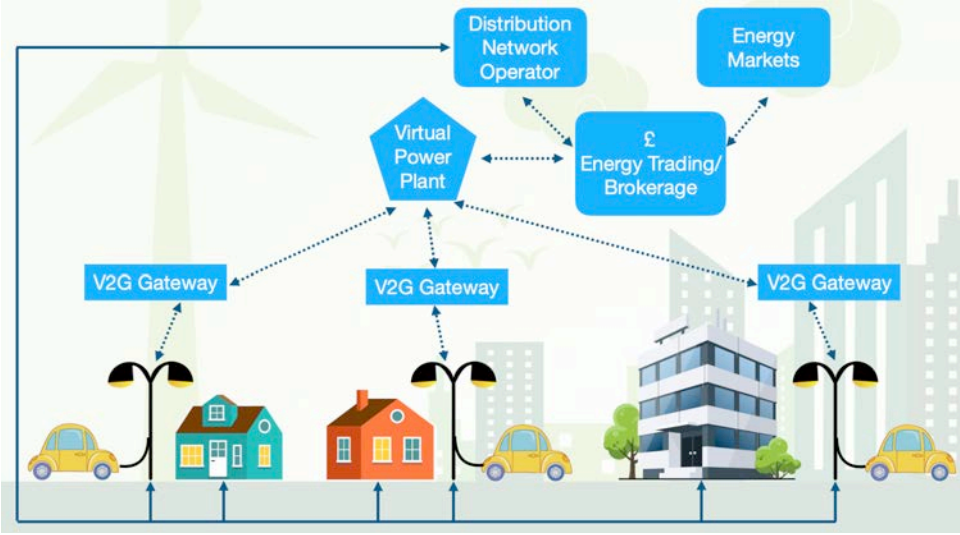


Figure 1. Diagram of how V2G stakeholders and infrastructures are connected.

3.4 Results

3.4.1 Shared vision of V2G at a high level

In the first session of the workshop, participants had a thorough discussion based on the V2G system diagram (see figure 1). This was an open-ended discussion, with participants representing the different stakeholders all exhibiting different perceptions. As shown in figure 2, firstly, street furniture charge points such as lamp posts are V2G gateways. These lamp post charge points can potentially be installed in residential, work, and leisure areas. When an EV is plugged in through a lamp post charger, this EV is connected to the electricity grid, where bi-directional charging can occur. At this moment, smart energy management companies (also known as aggregators in the context of V2G) play a part in controlling when to charge or discharge an EV. However, there are different levels of flow amongst all the stakeholders. The most important three levels of flow are energy flow, data flow, and monetary flow. In other words, the structure of how stakeholders communicate may vary, according to which virtual product is in discussion and which stakeholder is playing the 'interface' role of connecting V2G and end consumers. For example, if a consumer signs a contract with an EV charging company, the consumer only talks to this company in terms of

payment, electricity, and data sharing. At the back-end, this company will then work out the rest (e.g., electricity flows, how revenues are shared, and who has access to consumer data) with councils, aggregators, energy suppliers, and network operators. If the consumer signs a contract with an energy supplier, the whole package and cooperation agreements will change accordingly. But these agreements should not concern the end consumer. From a consumer research point of view, the vision shown in figure 2 does not need to illustrate the details of the aforementioned agreements (i.e. the green box can be 'hidden' from the consumer).



Figure 2. Shared vision of how V2G is embodied at a high level.

3.4.2 Motivations, enablers, and barriers

Motivations. To put flesh on the vision shown in figure. 2, the first topic that the participants were required to focus on was "What are the main motivations that would drive consumers to consider V2G-EV charging system?" Table 1 shows the most important five motivations in order of importance. The first motivation, financial benefit, was mentioned by all participants and ranked fairly high in everyone's list. Financial benefit refers to any form of income generation or cost saving, such as government incentives, savings in vehicle usage cost, cheaper electricity for charging, etc. Although participants have given explanations from different perspectives, they all strongly agreed that financial benefit is a significant motivation. Another major motivation is that consumers are looking for a better user experience, most importantly, the convenience of parking on street and charging through street furniture. There are three more motivations mentioned: environmental considerations (e.g. reducing carbon footprint and reducing emissions), interest in technology capabilities (e.g. trend setters and attractiveness of EVs), and social influence (e.g. peer influence and word-of-mouth).

Table 1 Motivations, enablers, and barriers to consumer adoption of V2G-EV systems

Motivations	**Enablers**	**Barriers**
1. Financial benefit	1. Competitive package	1. User unawareness
2. User experience	2. Reliability & Convenience	2. Fear/Uncertainty
3. Environment	3. Future regulation	3. EV market
4. Technology	4. Technical challenges	4. Current & future regulation
5. Social influence	5. User experience	5. User engagement

Enablers. The second topic that the participants were required to focus on was "what are the user enablers to consumer adoption of V2G-EV charging system?" The first enabler, a competitive package of EV charging, was mentioned by all participants. A competitive package is comprised of a financial aspect (e.g. costs of charging and charging cable, financial incentives, exemptions from road tax) and a functional aspect (e.g. guaranteed minimum level of battery, required plug-in length per day). Whether a package can meet a consumer's needs or not will significantly influence his/her opinions towards EV/V2G adoption. The next important enabler is the reliability and convenience of infrastructure, such as parking conditions and charging availability. The remaining three enablers are future regulation (e.g. government schemes), technical challenges (e.g. charging speed and battery performance), and user experience (e.g. ease of use, ease of registration, and flexibility of contracts).

Barriers. The third topic that the participants were required to focus on was "what are the user barriers to consumer adoption of V2G-EV charging system?" Table 1 shows the most significant five barriers, in which the top three are the most mentioned. User unawareness refers to the lack of knowledge and public information on V2G related topics, such as how V2G works, different packages of V2G, stability of electricity grid, performance of EVs, etc. For people who have some knowledge of EV/V2G, they may have fears and uncertainties that will deter them from adopting EV/V2G. For example, people worry about the degradation of battery caused by repeated charging and discharging, people fear the loss of control in terms of when to charge and discharge. Market factors such as the cost of EVs and limited options of EV models also play as barriers to consumers. Other barriers mentioned in the workshop are current & future regulations towards V2G and how consumers will finally behave and engage in the EV charging system.

4 Part 2

4.1 Study design

In Part 2, we aimed to explore consumers' attitudes to the V2G concept and their intention-to-buy. We conducted semi-structured interviews with 20 participants. The interview contained two parts: (i) an introduction to the new EV charging system in a set scenario, (ii) a paper-based questionnaire that contained questions about attitudes and intention-to-buy, followed by a brief interview to obtain participants' opinions towards this system. To sensitise participants to the V2G-EV concept, a scenario was created based on the outcome from Part 1 and current literature. The questions designed in the survey were developed from TAM (Park, 2009) and existing works that explore attitudes to, and intention-to-use, new technologies (Pavre et al., 2014). This paper only reports the results of the questionnaire.

The scenario used in Part 2 (see figure 3) was created on the foundation of the output from Part 1. The scenario was limited to an 'on-street parking only' community. Lamp post charge points were the gateways to access to the electricity grid, while there was a virtual organisation taking control of when to charge and drain the battery, along with how much battery. In this scenario, participants had owned an EV with a driving range of 270.04km, which is the minimum driving range of a fully charged Nissan Leaf. To better sensitise participants to this V2G-EV concept, a V2G package was presented with more details. The items in the packages were generated based on literatures (Hidrue et al., 2011; Parsons et al., 2014). In this scenario of signing up to a V2G package, consumers would: (i) get a free

cable to plug in, a reserved parking space at certain time slots, and the ability to plug in at any available lamp post charging point; (ii) get discount on charging rate and rewards on selling electricity back to the electricity grid; (iii) need to plug in a certain amount of time per day and pay monthly for all the services; (iv) get a guaranteed minimum level of battery and an App to view live battery updates and plan *ad hoc* journeys. The details were provided to the participant one at a time, thus 'building' their understanding, rather than overloading them with new information.

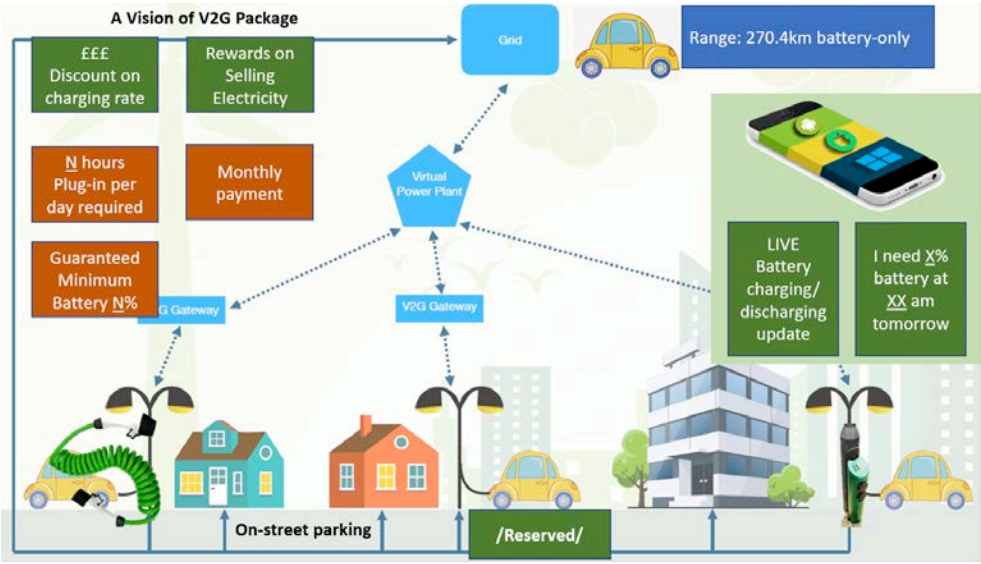


Figure 3. Design fiction of V2G-EV concept used in Part 2.

4.2 Participants

20 participants were recruited (male = 10, female = 10). The participants were from the area of Loughborough in Leicestershire, UK. A screening survey was used to select participants with a range of characteristics. It was challenging to recruit participants who had 'on-street parking only' and were 'interested in buying an EV'. This study was carefully designed to be accessible to participants who had little experience with EVs and/or related energy technologies.

Table 2 Participant information

Current vehicle	Conventional: 19	95%
	Electric vehicle (hybrid and pure battery): 1	5%
Drive to commute	Yes: 16	80%
	No: 4	20%
On-street parking only	Yes: 6	30%
	No: 14	70%
Interested in buying an EV	Would consider buying one: 18	90%
	Have not given it a thought: 2	10%
Knowledge about EVs	Nothing about EVs: 1	5%
	A little about EVs: 10	50%
	Fair amount about EVs: 6	30%
	A lot about EVs: 3	15%

4.3 Study procedure and data analysis

Face-to-face interview was employed, plus a Likert scale, to elicit participants' attitudes and intention-to-buy towards the V2G-EV charging system. This method allowed dynamic

interaction between the researchers and participants. Each interview was completed within one hour. All interviews were conducted between January 2019 and March 2019. The interview protocol included two sections (see table 3). The attitudes towards a new technology and intention-to-use a technology have been examined in related works, such as using E-learning (Park, 2009) and using automated cars (Pavre et al., 2014). In terms of the data from the questionnaire, descriptive analysis was employed since the sample size was too small to allow statistical analysis. To see the statements used to measure attitudes and intention-to-buy, please refer to Table 4.

Table 3 Part 2 study protocol and data information

Study 2 Protocol		Variable	Data type	Analysing method
Section 1	Scenario	See figure 3	N/A	N/A
Section 2	Questionnaire	i. attitudes ii. intention-to-buy	Likert scale	Descriptive analysis

4.4 Results

A V2G package was presented to participants to give them a view of a future V2G-EV concept. This paper only reports the results of the survey. 5 point-Likert scale questions (1 – strongly disagree to 5 – strongly agree) were asked. Table 4 shows the survey statements and the results of the descriptive analysis. The participant sample size was relatively small and the collected data did not show normal distribution, so the median value was used in data analysis since it is less affected by outliers and a skewed dataset.

Overall, consumers' attitudes towards EVs and V2G scheme (statements 1-6) were positive (median values = 4 or > 4), that they liked the idea of having more EVs in the future and believed that the V2G scheme had more advantages than disadvantages. However, the intention-to-buy showed variations. Participants were cautious about buying EVs (median values = 3 in statements 7-9). It could be explained from the brief interview that participants had uncertainties about EVs, such as the driving range, the ease of getting access to charging points, and whether EVs are as 'green' as advertised. On the other hand, participants showed an intention to sign up to V2G packages and a willingness to use V2G features to some extent (median values = 4 in statement 10 and 12). Most participants expressed an intention to sign up to V2G, that they liked the idea of using EV batteries as distributed electricity storage to reduce the overall use of fossil fuels to generate electricity. However, participants also expressed that V2G would bring inconvenience and they would need to re-plan their driving patterns before-hand to function better with such V2G packages.

Table 4 Attitudes and Intention-to-buy towards V2G-EV system

	Statements	Median
Attitude – EV	1. I like the idea of encouraging more pure battery EV adoptions.	4.5
	2. To me, increasing of pure battery EV adoption has more advantages than disadvantages.	4
	3. I like the idea of having a pure battery EV.	4
Attitude – V2G	4. I like the concept of V2G scheme.	4
	5. To me, the concept of V2G scheme has more advantages than disadvantages.	4
	6. I like the idea of having a pure battery EV and signing up to V2G scheme.	4
Intention-to-buy – EV	Imagine, When I do not have a pure battery EV:	
	7. I intend to buy one for my next vehicle.	3

	8. I intend to buy one that supports V2G for my next vehicle.	3
	9. I intend to pay more for a pure battery EV that supports V2G, compared to a pure battery EV that does not support V2G.	3
Intention-to-buy – V2G	Imagine, When I have a pure battery EV that supports V2G:	
	10. I intend to sign up to V2G scheme.	4
	11. I intend to use V2G features to the fullest.	3
	12. To the extent possible, I would use some V2G features when my situation allows.	4

5 Discussion

5.1 Study methods

With regard to the method used in Part 1 to reach the shared vision, the diagram (figure 1) was an effective starting point to stimulate discussion. Different components and structures in the diagram were mentioned amongst groups, such that it was challenging to combine the three group diagrams and create a universal version of the holistic vision. This reflects the complexity of this V2G-EV charging system and this workshop with stakeholders helped to reveal the different possibilities of V2G-EV. With regard to the method we used in Part 2 to examine consumers' attitudes and intention-to-buy, a visualised V2G-EV concept (figure 3) that illustrated a potential V2G package played an effective role in sensitising participants and enabling them to express opinions. The outcome from Part 1 acted as a foundation to feed into the design of this vision of V2G-EV concept.

5.2 Design implications

With relation to how the findings from this paper can guide practitioners to design user experiences of a future V2G-EV charging system, this section summarises the following implications:

(1) Consumer segments and needs should be studied at the beginning of consumer research, because individuals have different attitudes and lifestyles and what they need from a V2G-EV package may vary. Based on the existing research (Axsen et al., 2017) and the findings from this workshop, four types of consumers are identified according to motivations. The four types of consumers are cost-, convenience-, environment-, and technology-motivated. What they need from a V2G-EV package will differ. Cost-motivated consumers consider financial benefit as the top priority. They would potentially choose a V2G-EV package that will give them the maximum financial reward. Convenience-motivated consumers care about whether charging or parking is convenient, and they might be willing to pay more for a reserved parking space to plug in their EVs. Environment-motivated consumers care more about the biophysical environment and they might be sensitive to sources of the electricity they consume and whether it is 'green' (renewable). Technology-motivated consumers pursue the 'cool' factor of new technology, so they might want to be updated with live EV data, such as charging status, battery status, etc.

(2) Part 1 also enabled the identification of a number of *neglected dimensions for V2G transition*. These are: an effective approach to tackle consumers fears that they will lose control of their EV's charge level if they sign up to V2G-EV packages; a reserved parking space if V2G-EV packages require EV owners to plug in for a fixed length of time per day; a good education scheme so that more people are aware of how V2G works and its

capabilities; and a positive word-of-mouth about V2G, which is the best free advertising tool. We recommend considering and incorporating these dimensions into future practice.

(3) Part 2 found that consumers tended to be quite open in terms of using V2G scheme but feel cautious about signing up to contracts and making a full commitment to V2G packages. We recommend considering the factor of flexibility in V2G packages, such as allowing consumers to switch between packages or to change driving plans with very short notice. The V2G system should also have the ability to learn from consumers' driving patterns and link this to the consumers' schedule, so that the V2G system can automatically plan out the reasonable level of battery needed and provide information such as available charging points en route.

6 Conclusion

This paper presents a study with a mixed-methods approach that aimed to investigate consumers' views towards a new electric vehicle charging system with street furniture chargers. Since it was challenging to verbalise the concept of V2G to participants, a holistic vision of how V2G will be embodied was created among stakeholders in Part 1. This vision was re-designed in Part 2 to create a V2G-EV concept with a hypothetical V2G package for the purposes of sensitising participants. In Part 1 of the study, we organised a discussion among stakeholders and identified five 'motivations' to consumer's adoption of V2G-EV system: financial benefit, user experience, environment, technology, and social influence; five 'enablers': competitive package, reliability & convenience, future regulation, technical challenges, and user experience; and five 'barriers': user unawareness, fear/uncertainty, EV market, current & future regulation, user engagement.

In Part 2 of the study, we measured 20 consumer's attitudes and intention-to-buy towards the V2G-EV charging system. Given the limited number of participants of this part of the study, caution should be taken in generalising results to a wider population. Our results show that consumers had positive views towards more EV adoptions, while the intention-to-buy towards V2G-EV system varied. Consumers tended to be cautious about making 100% commitment to V2G packages because they needed to consider other factors, such as convenience of the use of car, financial incentives, flexibility of V2G packages, and the policing of reserved charging points. The findings from Part 2 revealed the perceptions of end consumers and they complemented the findings from Part 1, which viewed consumer needs from the perspective of stakeholders.

In the future studies, we intend to examine how potential consumers perceive V2G packages, in terms of overall perception, positive and negative aspects of V2G, uncertainties of V2G, and suggestions to improve V2G services.

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Developing a questionnaire to explore people's attitudes towards emotionally-driven prostheses: a pilot study

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The literature shows that societies' attitudes towards people with disabilities are negative, as a consequence of stigma. The design of the products (e.g. prostheses) can affect the attitudes of the people as products elicit emotions. However, research suggests that people have difficulties expressing their emotions. Therefore, the conduct of a pilot study, based on an interview-based survey questionnaire, was essential before conducting a full-study to test whether prostheses evoke emotions in non-prosthetic users (feasibility of study). The objectives were: to gain insights regarding aspects of the structure of the questionnaire; to examine whether people's attitudes towards people with limb-loss can be affected by the design of prostheses; to identify whether people's attraction towards prostheses can be affected by their level of emotionally-driven design; to investigate if prostheses can elicit emotions in non-prosthetic users, and; to explore if there is any relationship between the level of attractiveness and the emotions prostheses elicit. The findings cannot be considered as representative, since the sample was small (23 participants). However, they showed that prostheses elicited emotions in non-prosthetic users; the most frequently expressed emotions were sadness, admiration, and serenity. The level of emotional-design of prostheses appeared to affect the level of people's attractiveness and implied the existence of a relationship with the emotions that were elicited. These findings highlighted the importance of conducting a full-study and suggested the existence of an opportunity for altering the negative perceptions towards people with limb-loss into positive ones through the design of prostheses.

Keywords: emotionally-driven; emotional design; prostheses; amputees

1 Introduction

Stigma is based on the relationship that exists between the person who is considered to have a difference (e.g. homosexuality, people with limb-loss) and other people who evaluate and understand this difference negatively (Green et al., 2005; Riddell & Watson, 2003). From this interaction, there are two types of stigma; *public* and *self-stigma*. According to Werner and Shulman (2015), public stigma derives from the opinion of society towards stigmatised people, while self-stigma is a consequence of the opinion that the individual forms, based on society's attitude.

The literature around disability studies suggests that societies' attitudes towards people with disabilities are affected by the culture in which they live. For instance, the study of Westbrook et al. (1993) was conducted in a multi-cultural society (Australian) with 665 health practitioners

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from six different communities (Chinese, Italian, Greek, German, Arabic speaking and Anglo-Australian) and showed that people from different communities had different attitudes towards the twenty disabilities that were investigated such as diabetes, amputated leg or arm, cancer, facial scars, and blindness. Westbrook et al. (1993) pointed out that participants from the collectivism communities, where people present strong bonds with groups and try to maintain the group harmony (e.g. Arabic, Greek, Chinese), had more negative attitudes than the participants from individualistic communities, in which people act independently and are motivated by personal goals (e.g. German, Anglo-Australian). As Westbrook et al. (1993) stated, that happened because of stigma that affected their behaviour. However, although people from the individualistic communities showed higher levels of tolerance and comprehension towards people with disabilities, they still discriminated and separated them from able-bodied people (Westbrook et al. 1993). Another study concerning the attitudes of 138 Chinese college students towards people with different disabilities showed that the Chinese (collectivism) presented more positive attitudes than the Americans (individualism) towards people with physical problems and less towards people with psychiatric problems (Grames & Leverentz, 2010). This study suggested that discrimination between people with disabilities and able-bodied people still exists, in both individualism and collectivism societies. Therefore, in order to eliminate stigmatisation, it is necessary to alter the negative attitudes into positive. One way that this could be achieved is through the design of products.

Products elicit emotions in users; nevertheless, the emotions that are elicited do not derive from the products as such, but by the meanings that people assign to them (Desmet et al., 2001; Demirbilek & Sener, 2003; van Gorp & Adams, 2012). Desmet (2012) showed that people experienced various positive emotions during their interaction with products and although these emotions were all positive, they differed regarding the influence they had on people's behaviour and thoughts. Coates (2003) widens the importance of the meanings of products from the individuals to society by pointing out that the form and appearance of products have "moral and cultural significance that reflects not only its creators but also its audience. More important, it reinforces or reshapes the values, beliefs, concerns, and preoccupations of its audience… In turn, a product's design reflects and affects its surrounding culture" (p. 4). In accordance with that, Pullin (2009) stated that traditionally, the design of medical devices aimed to be discreet to hide and undermine the disability and for that reason, hearing aids for example usually had skin tones to match the users' skin colour. Based on the design principles that medical products follow in order to conceal users' disability problem, Pullin (2009) posed the following question:

"But is there a danger that this might send out a signal that disability is after all something to be ashamed of?" (p. 15)

In this case, the use of these products displays a negative image of disability, through their design, which enhances stigmatisation and creates unpleasant emotions in users. Therefore, Pullin (2009) declared that "a more confident and accomplished design could support more positive images of disability" (p. 15). In agreement with Pullin (2009), Vainshtein (2011) and Hall and Orzada (2013) proposed that if prosthetic limbs adopt an emotionally-driven approach, social statements can be made that would reject the "societal pressure to conform to the normative embodied ideal… and highlight yet another aspect of diversity within the contemporary society" (Hall & Orzada, 2013, pp. 26-27). Desmet and Dijkhuis (2003) also stated that the design of wheelchairs, a product that is usually connected with feelings of discrimination and marginalisation, is mainly focused on the principles of ergonomics,

usability, and technology, without taking into consideration the emotions that wheelchairs can elicit in users. Additionally, they suggested that further studies with non-wheelchair users, would also give valuable insights regarding the stigmatising aspects of wheelchairs. Although these arguments indicated the existence of a non-linear relationship between products, users and people around them (users' environment), to date, only one paper focused on people's interaction with prostheses, with respect to their design. More specifically, Sansoni et al. (2015) tried to understand people's attitudes towards prostheses which have a realistic or non-realistic appearance, by using the Uncanny Valley, a Japanese theory which posits that artificial devices with a high level of human-likeness create negative feelings towards people. The findings of their study were contrary to Uncanny Valley, as prosthetic limbs with a high level of human-likeness were considered more attractive by participants than those with more robotic or abstract designs (Sansoni et al., 2015). Nevertheless, although Sansoni et al. (2015) investigated the level of attractiveness of prosthetic limbs, their study did not explore the emotions that prostheses elicited in people.

Previous studies in the area of emotional design suggested that it is difficult for designers to investigate the emotions that products elicit in people, as the extent to which people can verbalise and express their emotions varies (Desmet, 2012; Yoon et al., 2016). As Desmet, (2012) stated about participants's capability of expressing their emotions, based on a study he conducted, "almost half of the reported words did not actually refer to distinct emotions, but instead to only the positive nature of the emotions (e.g., good, fine, pleasant, up, great, and nice), or to expressions or behaviour (e.g., smiling, laughing, getting goose bumps)" (p.13).

Based on the difficulties people have with expressing their emotions, a pilot study was considered essential before the conduct of the full-study, which consisted of an interview-based survey questionnaire.

1.1 Aim and objectives of the pilot study

The aim of the pilot study was to test if prosthetic limbs could evoke emotions in non-prosthetic limb users (feasibility of study), and whether participants were able to express these emotions (insights regarding the structure of the full study). As in this study, the participants were non-users, the word 'design' referred only to the appearance of the prostheses.

Therefore, the objectives of the study were:

1. To gain insights regarding various aspects of the structure of the questionnaire that could be improved, to make it easier for participants to complete.
2. To examine whether people's attitudes towards people with limb-loss can be affected by the design of prostheses.
3. To identify whether people's attraction towards prostheses can be affected by the level of emotionally-driven design of them.
4. To investigate if prosthetic limbs can elicit emotions in non-prosthetic limb users, with respect to their design.
5. To explore if there is any relationship between the level of attractiveness of prostheses and the emotions these prostheses elicit.

2 Research Methods

2.1 Interview-base survey questionnaire

In order to understand people's attitudes towards people with limb-loss, with respect to the prostheses they wore, an interview-based survey questionnaire was developed in the Bristol Online Survey (BOS) software, which consisted of five sections, with Section 5 being a repeat of Section 2 (see Figure 1). The Section 1 of the questionnaire had six demographic questions (sex, age, area of residence, educational level, occupation, and nationality) and two disability related questions (e.g. 'Do you have any disability problems?' and 'Do you know any person close to you who has a disability problem?'). The aim of the two disability related questions was to explore whether people's familiarity with disabilities influenced their attitudes towards people with limb-loss or their attractiveness towards prostheses, in comparison to those who were not familiar with any disability.

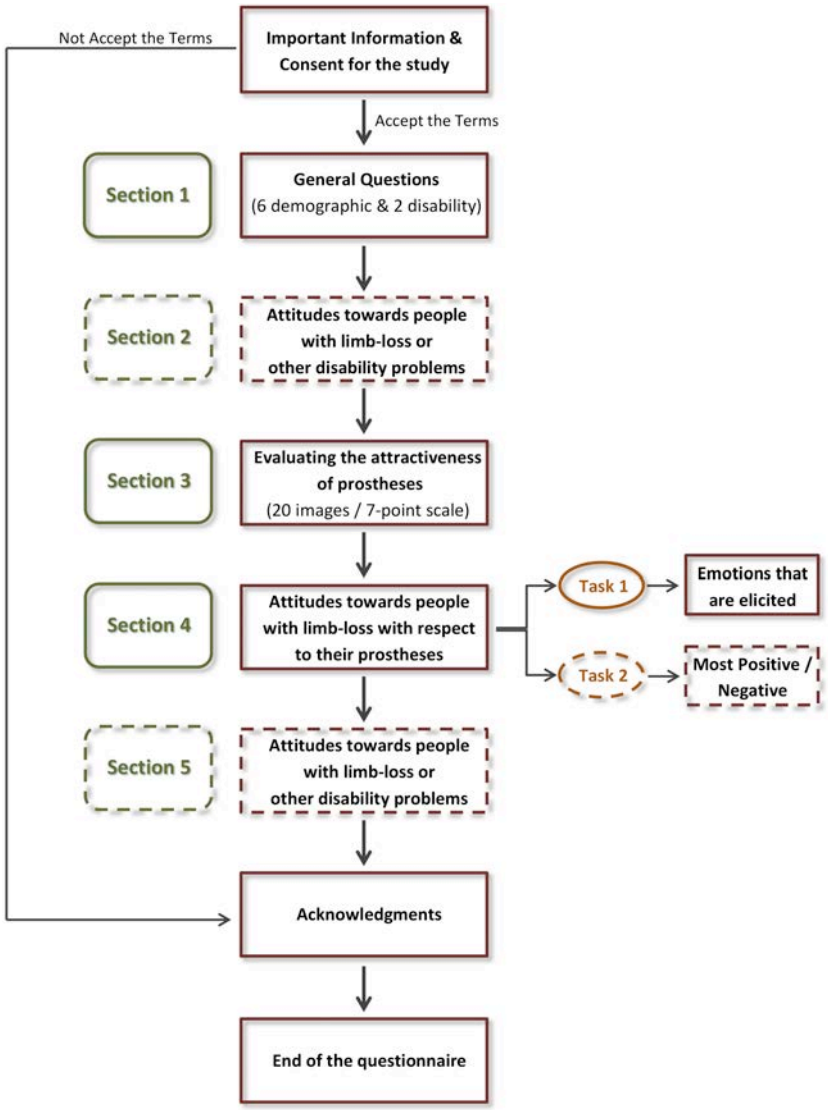


Figure 1 The structure of the interview-based survey questionnaire. The boxes with the dashes depict the sections of the questionnaire that were removed after the conduct of the pilot study, since they were considered unnecessary

In Section 2 of the questionnaire, participants were asked to explain what they thought when they saw a person with limb-loss (see Figure 1). This question was asked before participants saw any image of prostheses to avoid being affected by the design of prostheses. The same question was asked again at the end of the questionnaire (Section 5, Figure 1) and was intended to identify whether people's attitudes towards people with limb-loss were affected by viewing prosthetic limbs.

In Section 3 of the questionnaire, participants had to evaluate the design of twenty prosthetic limbs (see Figure 1) by using a seven-point scale (1='Not attractive at all' to 7='Extremely attractive'). The prosthetic limbs were separated into three categories based on the level of the emotionally-driven design they had. Since there was no previous research to separate prostheses into different types based on the level of their emotionally-driven design, their division into each type was conducted by the authors, based on the theories in the area of emotional design. The first type was the *Realistic Prostheses* (RP), which are considered to have a low level of emotionally-driven design, since their appearance imitated the appearance of natural human limbs and they offered limited functionality. The second type were the *Functional Prostheses* (FP), which presented a moderate level of emotionally-driven design, as their appearance differed from the one of human limbs in shape and colour, and they offered great functionality. Finally, the third type was the *Expressive Prostheses* (EP), which had a high level of emotionally-driven design, since their appearance showed various patterns, decorative elements, colours, and it was inspired by user's unique personality. Not only did EP present a high level of emotionally-driven design because they communicated meanings about their users to people around them by expressing their personality, but also because users actively participated in design process. The images of the prosthetic limbs that were used were chosen from websites and they were cut and edited on Adobe Photoshop CC 2017 in order to present a neutral (white) background, have high resolution, and depict only the prosthetic limb on that area of the wearer's body to avoid participants' distraction from other elements that could affect their evaluation (e.g. the style of their clothes).

Finally, Section 4 was separated into two tasks (see Figure 1). In Task 1, nine images were given to participants who were asked to write the emotions that were elicited in them, when they were looking at the person in each image, with respect to the limb he/ she wore. These images depicted the same prosthetic limbs as those that were used in the Section 3; however, in that case, the wearer's body was shown entirely, apart from his/ her face, which was hidden, as it was considered that facial expressions and characteristics may affect participants' emotions. In Task 2, the same images that were used on Task 1 were given to participants, and they were asked to choose the one that created the most positive emotions, and the one that created the most negative, and specify the reasons these emotions were triggered. The reason for using the same images of prosthetic limbs in Sections 3 and 4 of the questionnaire was to be able to compare the data and investigate whether there was any relationship between the level of attractiveness of the prostheses and participants' emotions towards the users, with respect to their prostheses.

2.1.1 Validity of the questionnaire

According to Bryman (2012), validity is relevant to "whether a measure of a concept really measures that concept" (p. 170) and as it is related to the integrity of the results, it is the most important criterion. Various ways can be used to test the validity of a study, such as those of face, concurrent, or predictive validity. In this study, face validity was used and

therefore, the questionnaire was tested by six experts; three experts in the area of prostheses, two experts in the area of statistics and one prosthetic user.

2.2 Ethics

The study was approved by the Ethics Sub-Committee for Human Participants of Loughborough University. In the introduction page of the questionnaire, the Participant Information Sheet and the Informed Consent Form was presented to participants.

2.3 Participants

Participants were recruited electronically through e-mails and social media (e.g. Facebook, Twitter). Participation in the study was completely anonymous and the only inclusion criterion of the study was for participants to be over eighteen years old.

The questionnaire was completed by twenty-three participants; eighteen participants were men and the mean age of participants was 34. Two of the people who participated in the study answered they had a disability problem, with one of them being an above knee amputee; eleven participants replied they knew a person close to them with a disability problem, with four of them referring to people with limb-loss. All participants had a high educational level (degree or higher), whilst the number of participants who were living in a city was the same with those living in a town (11 participants respectively). Participants' nationality varied including the UK, Italy, Portugal, Greece, Cyprus, Spain, China, Pakistan, the Netherlands, and USA.

2.4 Data Analysis

As the sample of the study was very small, statistical analysis could not be conducted; therefore, the analysis of the quantitative data was conducted by using Microsoft Excel 2010 software, whilst NVivo Pro 11 was used for the analysis of the qualitative data (open questions and emotions).

2.4.1 Internal Reliability

Internal reliability was conducted to test the internal consistency of the images that belonged to each type of prostheses (Table 1) by using Cronbach's Alpha. The results of Cronbach's Alpha for the images that belonged to Realistic Prostheses (prostheses with low emotionally-driven design) was 0.944, whilst the one for the images of Functional Prostheses (prostheses with moderate emotionally-driven design) was 0.919; finally the results of the images on Expressive Prostheses (prostheses with high emotionally-driven design) was 0.932. These results indicated that the internal consistency of the images belonged to each type of prostheses was very high. The internal reliability of the study was conducted by using the Statistical Package for the Social Science software (IBM SPSS Statistics 23).

3 Results

The analysis of participants' answers regarding their attitudes towards people with limb-loss and other disability problems showed that almost all of the participants (n=22) felt sadness, pity, compassion and sympathy towards them regarding their situation, the difficulties they need to confront in their daily lives, and the fact that in many societies, people with limb-loss are restricted and marginalised. More specifically, one of the participants said that "I feel pity, I emphasise towards their sense of pain or discomfort. I do not know how to fairly approach them", whilst another one mentioned that "I feel sad for the unfortunate person". Participants' attitudes remained the same after the completion of the questionnaire.

Table 1 depicts the images of the twenty prosthetic limbs that were given to participants in Section 3 of the questionnaire to rank the level of attractiveness based on the design they had. The results showed that Expressive Prostheses (EP) presented the highest mean value of attractiveness (MA_{EP}=4.45), whilst Functional Prostheses (FP) the lowest (MA_{FP}=3.06). The level of attractiveness towards prostheses of the people who answered they knew a person close to them with limb-loss, showed that FP had been ranked as the least attractive. On the other hand, the ranking order of attractiveness of the participant who said they did not know any person with limb-loss was different; EP had been ranked as the most attractive (MA=6.44) and the one of Realistic Prostheses (RP) as the least attractive (MA=3.33).

The emotions that were elicited in participants towards the prosthetic limb users, with respect to their prosthetic limb, were separated into pleasant, neutral, unpleasant and unspecified (see Table 2). In the category 'Unspecified' were emotions that could be considered as both pleasant or unpleasant (e.g. surprise), or descriptions that could not be considered as emotions (e.g. the limb looks robotic, the limb is not apparent). As Table 2 shows, the prosthetic limbs with MA close to two (FP_3) appeared to evoke mainly unpleasant emotions, whilst the one with MA more than 4 (RP_3, $EP_{2,6,7,8}$) evoked pleasant emotions. Prosthetic limbs with a MA around 3.5 ($FP_{2,7}$, EP_3) presented almost the same number of pleasant and unpleasant emotions.

The prosthetic limb that is depicted in image RP_3 was chosen as the one that creates the most pleasant emotions, by seven participants; second was the limb in image EP_8 (5 participants) and third the one in the image EP_3 (3 participants). None of the participants chose an image from the prostheses that belonged to FP. The analysis of the reasons these emotions were elicited showed that the seven participants chose RP_3 because, as they said, it looks 'normal' and the user does not seem 'disabled'. On the other hand, the prosthetic limbs from EP created the most pleasant emotions in the participants, because they were considered stylish, fashionable and attractive. This evoked admiration from participants and created the impression that the user felt confident with his/ her appearance and situation. As one of the participants answered about the prosthetic limb in image EP_2, "The prosthesis is stylish without trying to conceal it and the posture shows confidence and therefore she deserves respect". Regarding the prosthetic limbs that created the most negative emotions, nine participants chose the prosthesis in image FP_3; second were chosen the limbs in images FP_2 and FP_7 (four participants equally). None of the participants chose the limbs in images EP_6, EP_7, and EP_8 as the ones that created the most negative emotions. The analysis of the reasons that the negative emotions were elicited in participants was more relevant to the shape of the limb, which looked artificial and external to wearer's body. Additionally, some participants mentioned that the design of the limbs that belonged to FP were more robotic and medical and therefore, more connected to 'disability'.

Table 1 The Mean Attractiveness (MA) of prostheses and the type they belonged

Realistic Prostheses (RP) MA_{RP} = 4.13	Functional Prostheses (FP) MA_{FP} = 3.06	Expressive Prostheses (EP) MA_{EP} = 4.45
 RP_1 MA_{RP1}=4.30	 FP_1 MA_{FP1}=4.17	 EP_1 MA_{EP1}=4.17
 RP_2 MA_{RP2}=3.48	 FP_2 MA_{FP2}=2.87	 EP_2 MA_{EP2}=4.52
 RP_3 MA_{RP3}=4.30	 FP_3 MA_{FP3}=2.39	 EP_3 MA_{EP3}=3.57
 RP_4 MA_{RP4}=3.70	 FP_4 MA_{FP4}=2.04	 EP_4 MA_{EP4}=5.04
	 FP_5 MA_{FP5}=3.00	 EP_5 MA_{EP5}=4.61
	 FP_6 MA_{FP6}=2.35	 EP_6 MA_{EP6}=4.26
	 FP_7 MA_{FP7}=3.61	 EP_7 MA_{EP7}=4.57
	 FP_8 MA_{FP8}=2.35	 EP_8 MA_{EP8}=4.91

Table 2 Emotions that were elicited with respect to the design of prostheses. The numbers represent the frequency with which the emotions were referred to by participants.

Images of prostheses	Mean Attractiveness (MA)	Pleasant emotions	Neutral emotions	Unpleasant emotions	Unspecified emotions
RP_3	4.30	9	13	1	0
FP_2	2.87	8	4	9	2
FP_3	2.39	3	4	12	4
FP_7	3.61	8	6	8	1
EP_2	4.52	9	3	5	6
EP_3	3.57	10	2	9	2
EP_6	4.26	18	2	1	2
EP_7	4.57	16	2	2	3
EP_8	4.91	13	2	4	4

In order to identify the most frequent emotions that were elicited in participants, with respect to the level of emotional-driven design of prostheses, a word frequency analysis was conducted by using NVivo Pro 11 software. Participants' answers, regarding the emotions that were elicited to them, were exported in a word document. Emotions which were considered the same, such as 'sad' and 'sadness', 'happy' and 'happiness', were grouped together. Additionally, emotions that could not be classified, neither as pleasant nor as unpleasant (e.g. 'surprise'), were excluded from the analysis. From the analysis were also excluded words that did not describe emotions, but pleasant or unpleasant nature of emotions, such as 'cool', 'good', 'weird', and 'awkward'. The findings of the analysis are presented in Figure 2. As it can be noticed by Figure 2, 'sadness' (N=19) and 'admiration' (N=15) were the most frequently used emotions, followed by 'serenity' (N=7), 'amazement' (N=6) and 'joy' (N=6).

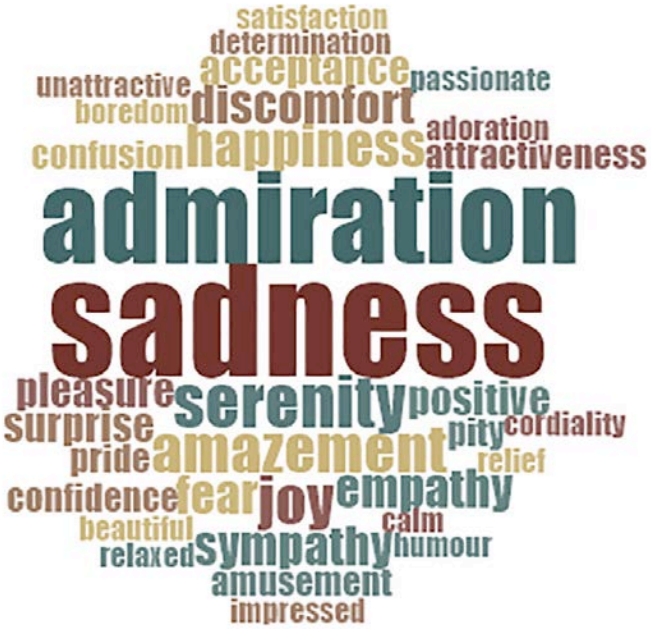


Figure 2 Results of the emotions that were elicited based on the word frequency analysis

4 Discussion

This study was a pilot which aimed to test the feasibility of investigating the effects of prostheses on non-prosthetic limb users. Although, the sample size was small and the findings could not be considered as representative, they gave valuable insights regarding the objectives of the study.

The results of the pilot study regarding people's attitudes towards people with limb-loss, or other disability problems, were in accordance with literature and showed that participants' attitudes were negative; participants answered that they mainly felt compassion, sadness and pity towards people with disabilities and the problems they confronted in their daily lives, and in some cases, people also felt respect regarding the efforts of people with disabilities. The fact that participants' attitudes remained the same after the completion of the study suggested that participants' attitudes were not affected by the images they saw and the design of the prosthetic limbs (Objective 2). Consequently, it was considered that this part of the questionnaire (Sections 2 & 5) would not be included in the full-questionnaire (Objective 1).

Although statistical analysis could not be conducted, because of the small sample size, the findings suggested that the level of emotionally-driven design of prostheses affected people's attraction towards prostheses. EP which is considered to have the highest level of emotionally-driven design presented the most pleasant emotions (Objective 3). The researcher assumed that the fact that RP (low level of emotionally-driven prostheses) presented high mean attractiveness (MA) was not related to the level of aesthetic appeal they had, but to the fact that these prostheses looked realistic and its design imitated natural human limbs. Therefore, since their design was familiar to people, they could analyse and comprehend it more easily. These findings were also in accordance with the findings of the study that Sansoni et al. (2015) conducted and showed that non-prosthetic limb users were more attracted by prostheses with a high level of human-likeness.

Previous studies in the area of emotional design suggested that people cannot easily express their emotions. The results of the pilot study partly agreed with them; although participants expressed emotions, they mentioned they had difficulties with comprehending and writing the emotions that were elicited in them, with respect to the design of prostheses (Objective 4). Additionally, in many cases, participants did not write emotions but words that described the nature of emotions, which was also in accordance with Desmet (2012) and Yoon et al. (2016). Due to these difficulties, it was decided that in the full-questionnaire, a list of various emotions will be given to people, based on the one that the participants of the pilot study wrote, together with an open-ended question, where participants could write further emotions that may not be included to the given options (Objective 1). However, it is important to mention that the difficulties participants had with expressing and writing their emotions could also be a result of the fact that they were asked to write the emotions in English, although most of them were not native English speakers. Additionally, although the emotions of empathy and sympathy were considered pleasant in the literature (Desmet, 2012), in this study, they were considered as unpleasant, since participants who reported them, also reported sadness. Furthermore, since participants could not clearly explain the reasons why the pleasant or unpleasant emotions were evoked, it was considered that Part 2 of Section 4 of the questionnaire did not give valuable and useful insights and as a result, it was decided to be excluded from the main questionnaire (Objective 1). These changes could

also reduce the time of completion of the questionnaire and increase the number of participants as they made the questionnaire shorter and its completion easier.

Finally, the analysis of the study showed that a relationship between the level of attractiveness towards prosthetic limbs and the emotions that were caused could exist; the more attractive the design of the prostheses, the more positive the emotions were evoked (Objective 5). However, as the number of participants was very small, a statistical analysis could not be achieved to test the significance of this relationship, and further research is necessary with a larger sample size.

4.1 Limitations of the study

One of the main limitations of the study was the fact that participants had to evaluate the design of prosthetic limbs through images and not through physical products. This may have affected the level of attractiveness as emotions that are elicited by important senses (e.g. touch, smell) could not be evoked through the images. Another important limitation was the fact that the background of the images, which depicted people wearing prosthetic limbs, as well as the clothes of the people and other elements that were illustrated (e.g. users' body postures), could also affect the emotions that were created in people. However, as in real life people's emotions and attitudes towards prosthetic limb users can be formed and be affected by similar factors, this limitation was considered acceptable for the purpose of the study. Finally, although the participation in the study and the completion of the questionnaire was anonymous, it could have affected participants' answers regarding their attitudes towards people with limb-loss and the emotions that were elicited in them.

5 Conclusions

As it was pointed out in the introduction, products, through their design, create meanings which can change the values, beliefs and concerns not only of their users, but also of the people who are around them. Although the sample of the study was small and the results cannot be considered as representative, they showed that prosthetic limbs could create various emotions in non-prosthetic limb users. Additionally, the level of emotional-driven design that prostheses had, appeared to affect the level of people's attractiveness. Furthermore, the findings indicated that a relationship may exist between the level of attractiveness and the emotions that were elicited in people; the higher the level of attractiveness, the more pleasant the emotions were. These findings were considered valuable since they implied that an opportunity may exist to alter the negative perceptions of people towards people with disabilities into positive, through the emotionally-driven design of prostheses.

As all the objectives have been met, the aim of the pilot study was achieved. Not only did the pilot study test the feasibility of investigating the effects of prostheses on non-prosthetic limb users, but it also highlighted the importance of conducting a full study and gathering data from a large sample size which will give useful insights on the area of prostheses.

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Does Roleplaying Facilitate a Holistic Perception of the User? An Exploratory Study on Simulating the Elderly Experience

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Empathy is an essential skill for user-centered design, as it can give access to users' perspective to create more usable products and services. Roleplaying has been proposed as a tool to facilitate empathy in the design process, but the effectiveness of this technique is not yet so clear. In this preliminary study, we assessed the effectiveness of roleplaying in acquiring a more holistic perception of elderly people by simulating everyday activities in a roleplaying exercise with 15 undergraduate students. We will present the results of this exploration as well as propose new questions and directions for future work regarding the use of roleplaying in user-centered design.

Keywords: Empathy, schema, Roleplaying, Elderly people, Props.

1 Introduction

Empathy refers to the process of understanding what another person is experiencing by applying perception or imagination to access a similar affective state (Baron-cohen & Wheelwright, 2004). This skill gained relevance in user-centered design as it can enable a better understanding of users (Gaver, Dunne & Pacenti, 1999; Kaufman & Libby, 2012; Koskinen, Battarbee, & Mattelmäki, 2003; Kouprie, Visser, 2009), which provides insights to make products and services more usable, besides helping to frame new design opportunities (Koskinen et al., 2003; Leonard & Rayport, 1997).

To date, different techniques have been proposed to facilitate designers' understanding of users. One set of techniques rely on data collected directly from users by observing, interviewing (Kobayashi et al., 2011), and co-creating with them (Gaver, Dunne, Pacenti, 1999; Demirbilek & Demirkan, 2004). Other techniques collect data from the designers' own experiences through roleplaying. An example of roleplaying is Patricia Moore's empathy experiment (Moore & Conn, 1985) in which she dressed like an elderly woman to go through her daily experiences for almost three years. This experiment enabled Moore's broader understanding of what it meant to be an elderly person in an urban environment and to design many products based on this experience. However, since this technique involves extensive periods of collecting and analysing data, it would be inconvenient to use it on short

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design projects. Other roleplaying techniques, such as age simulations (Brock university, 2017; The Change Foundation, 2017) and experience prototyping (Buchenau & Suri, 2000), have been proposed to overcome this downside, allowing designers to approach users in more resource-efficient ways.

Roleplaying techniques aim to complement designer's perceptions of users, which are based on designer's personal experiences and knowledge, with the ones acquired after a simulation of users' experiences. However, these techniques present other constraints since they are perceived as unsystematic and often misunderstood (Buchenau & Suri, 2000; Carey et al., 2017). Furthermore, the extent to which these tools facilitate a more holistic perception of users (i.e., acquiring a more complete understanding of the users' experiences in comparison to a more stereotypical one (Fiske, Cuddy, & Norton, 2005; Hummert, 2011)), is not yet so clear.

Addressing this gap, we conducted a roleplaying exercise in which 15 undergraduate university students simulated elderly people's everyday experiences by using various props (i.e., earplugs, gloves, glasses and ankle weights). We assessed roleplaying's effectiveness by comparing the schemas about "*being an elderly person*" the students had before and after the exercise. Schemas are mental representations on how someone perceives and makes sense of a complex environment (Axelrod, 1973), including objects, people and their context. Individual's existing schemas get constantly updated with new incoming information to develop new interpretations of these environments (Axelrod, 1973). So far, schemas in design have only been studied from the user's perspective (Hurtienne, Klöckner, Diefenbach, Nass, & Maier, 2015), conducting studies to make products more understandable and approachable for users' schemas. Diverging from this work, we set out to understand how roleplaying, as a design research technique, influences designers' existing mental representation about users. In this paper, we present the results of this roleplaying exercise, and propose new questions and directions for future work.

2 Roleplaying Exercise

We organized the roleplaying exercise as part of an event related to accessibility, human dignity and people with disabilities conducted at our university in November 2018. The event was open to all university students. 15 students, between 20-25 years, signed up through the event website. They were students from media and visual arts, industrial design, computer engineering, psychology and business administration who had previously taken basic design and design thinking courses. The exercise lasted for two and a half hours during which students formed teams and enacted different everyday tasks of an elderly person. As the exercise was held at the university campus, we chose these tasks accordingly (Table 1).

Table 1. Description of tasks for each team

Task	Description
1	*Search for a book on the library's web page and go to the library to borrow it*
2	*Go to the minimarket, search for grocery and buy it on the self-checkout*
3	*Go the garden, take a picture with a mobile phone and send it by email*
4	*Put on a shirt and shoes with laces. Then, sew to fabrics together*
5	*Call someone to chitchat and read a newspaper article to another elder participant*

Each team was composed by three students, each of which was assigned a different role to simulate: an *elderly person*, a *caregiver*, or an *observer*. The purpose was to discover whether playing different roles would create a different impact on participants' schema about elderly people. The participants playing the role of the *elderly* had to accomplish one of the tasks listed in Table 1. During these activities they wore props to experience some sensory barriers that come with aging, such as diminished sight, diminished mobility and diminished hearing (Fig. 1). The task of the *caregiver* was to prevent the elderly from suffering accidents and could only intervene in case of a safety issue. The *observer* played the role of a researcher, making observations about the user and was required to fill out two templates with information collected during the exercise. The first template was a journey-map linking activities performed by the elderly to the emotions expressed while carrying them out. The second was a guide to define the identified problems, painful situations and possible points of intervention.



Fig. 1. *Props used to simulate the elderly experience and student's wearing them.*

2.1 Assessment *Method*

Assessing the extent to which this roleplaying exercise influenced students' schemas about elderly people, we compared the mental representation they had about "*being an elderly person*" before and after the exercise. We did this by asking each participant to write five words they associated with elderly people at three different time points: before the exercise, right after the exercise, and a month after the exercise. At each time point they had 2 minutes to write down the words.

These words reflected participants' schema at those moments (Kawakami, Young, & Dovidio, 2002). We asked if there would be a change in the words selected before and after the exercise, and if the direction of this change would reflect a shift on how the participants perceived elderly people. We collected 225 words, 140 of them were unique, 85 were repeated. We first clustered the words applying affinity diagramming (Hanington & Martin, 2012; Kawakita, J., 1991) thus we obtained 5 different dimensions related to the words selected: *appearance, behavior, character trait, context and feelings* (Table 2).

Table 2. *Dimensions and their definition*

DIMENSION	DEFINITION
APPEARANCE	to what extent the word makes reference to the elder's outward aspect.
BEHAVIOR	to what extent the word makes reference to how the elder conducts him or herself.
CHARACTER TRAIT	to what extent the word makes reference to personality characteristics
CONTEXT	to what extent the word makes reference to situations elderly people live.
FEELINGS	to what extent the word makes reference to feelings of elderly people.

We asked 52 undergraduate students, from the same departments and with similar demographics, to evaluate how the collected words were related to these dimensions (Table 2). Filling up an online survey, these students rated on a 5-point Likert Scale to what extent each word was related to the aforementioned dimensions (1: not related – 5: highly related). Thus, each word obtained an average score for each dimension. For instance, the word soft was more related to *appearance* (average 3.85) than *feelings* (average 2.62) (Table 3).

Then, we recreated each participant 'schema for each time point (Table 3) by applying these scores to the set of words selected by each participant. With this, we obtained an average score for each dimension per participant. As an example, a participant having set of words with more *appearance* related words would get a high score on *appearance* dimension, and a lower score on other dimensions.

Finally, we assessed the change in schemas for each time point for all participants and across roles (Fig. 3). Our aim was to explore whether the roleplaying exercise led to a more holistic perception of elderly people, which was characterised by schemas having a more evenly distributed rating of dimensions, as opposed to a more stereotypical perspective, characterised by schemas having a dominant dimension.

Table 3. *Example of a participant's schema before and after the workshop. Table shows the selected words and their rating on each dimension, and arithmetic mean for schema. AP: appearance, BH: behavior, CT: character trait, CO: context, FE: feelings.*

Before the workshop				
AP	BH	CT	CO	FE
Bruised				
3.50	2.65	2.31	2.88	2.88
Insufficient				
3.5	3.32	2.55	3.09	3.14
Soft				
3.85	2.73	2.73	2.62	3.08
Slow				
3.35	3.69	2.85	3.19	2.5
Irritated				
2.83	3.67	3	2.75	3.5
Arithmetic mean				
3.41	3.21	2.69	2.91	3,02

After the workshop				
AP	BH	CT	CO	FE
Lonely				
3.17	3.08	2.92	3.54	3.79
Wisdom				
3.48	3.67	3.81	3	3
Harder conditions				
3.23	3.32	2.73	3.55	3.05
Not understood				
2.8	3.5	2.6	3.05	3.2
Cautious				
3.23	3.88	3.65	3.38	3.31
Arithmetic mean				
3.18	3.49	3.14	3.3	3.27

3 Results

3.1 Recurring schemas of the elderly

Regarding individual choice, we observed 2 main schemas before the workshop. *Appearance-dominant schema* corresponded to a higher average on *appearance* and lower average on *feelings* and *character trait*, whereas, *behavior-dominant schema* corresponded to a higher average on *behaviour*, and lower average on *feelings* and *character trait*. After the workshop, we observed an increase in *feeling's* average for both schemas. The other dimensions changed differently, presenting more similarities within teams than in-between teams.

3.2 Overall

Comparing the selected words across all the participants, the roleplaying exercise appears to lead towards a more holistic perception of the elderly. Comparing student's schemas, while *appearance* got the highest average across all the participants (3.18) before the workshop, after the workshop *behavior* (3.04) acquired the highest average, followed by *context* (2.96) and *feelings* (2.91) (Fig. 3). In addition, a month after the workshop *behavior* still had the highest average (3.13) followed by *appearance* (3.03). This means that the roleplaying exercise helped students to acquire a more holistic perception by integrating new information on dimensions that initially got a lower average and, also, by leveraging the other dimension's averages.

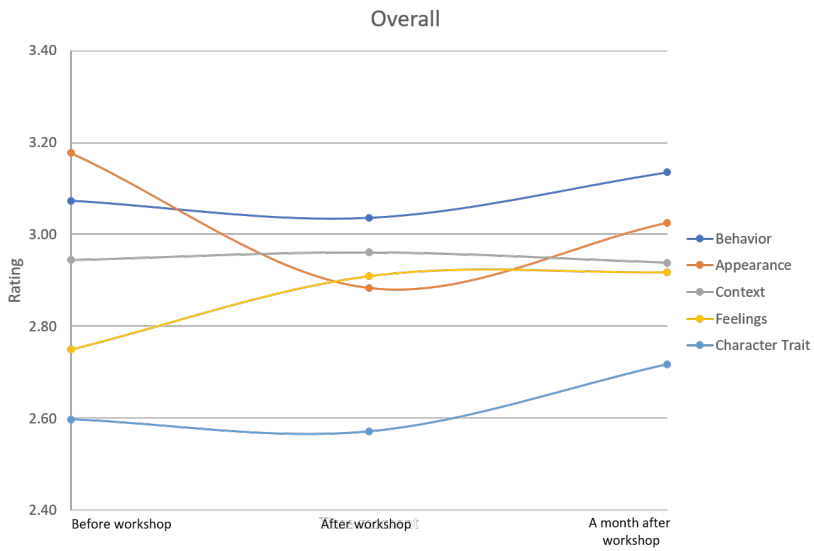


Fig. 2. *Dimension's averages per time moment. 1: before workshop, 2: after workshop, 3: a month after workshop*

3.3 Across roles

Comparing the schemas across roles, we found different effects related to the highest scored dimension (Fig. 4). While before the workshop *appearance* obtained the higher average for *elderly* and *observers*, after the workshop and a month after the workshop, *behavior* had the highest average for the same roles. Diverging from this pattern, *caregivers* maintained a higher score on *behavior* for the three time points. With this, *caregivers*, who had a less active role as they could intervene only in case of safety issues, seemed to be less impacted by the exercise.

Comparing number of dimensions that increased their rating after the workshop (Table 4) the *elderly* role presented an increase on the rating of 4 dimensions, *observers* on 3 and *caregivers* on 2. Which also supports the idea that different roles experienced differently the roleplaying exercise. Also, after the workshop, all roles experienced a decrease on *appearance-related* words and an increase on *feelings-related* words, which reflects a more empathic approach towards the user. Finally, for all roles, *character trait* presented the lowest rating on the three time points, which could suggest that not all dimensions of the elderly people's life are equally accessible through roleplaying.

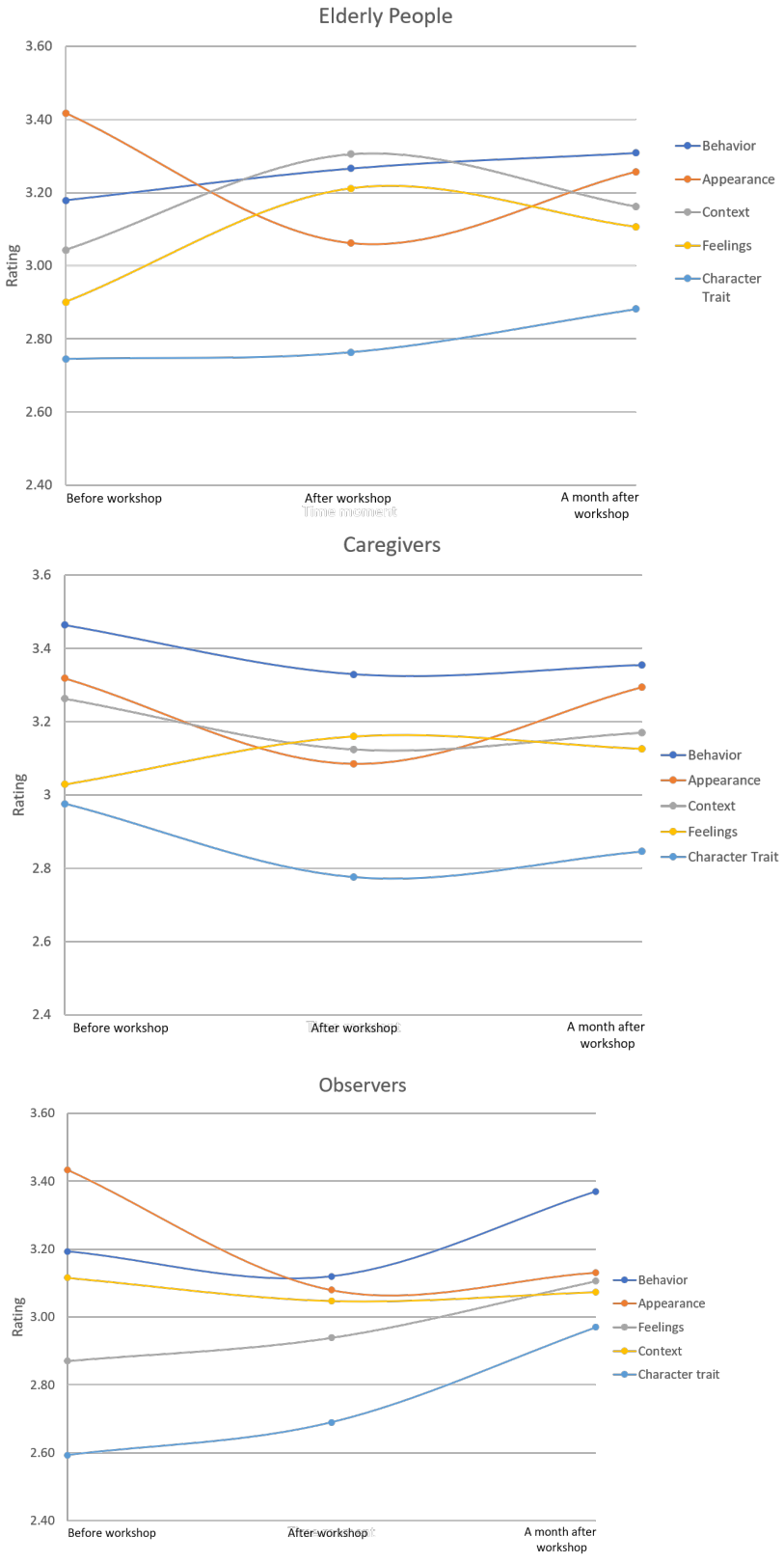


Fig. 3. *Composition of schemas per role and per time point*

Table 4. *Change in the average rating or each dimension, per time moment, per role. AW: after workshop, MW: a month after the workshop.*

	Elderly		Caregiver		Observer	
Dimensions	AW	MW	AW	MW	AW	MW
Appearance	↓	↑	↓	↑	↓	↑
Behavior	↑	↑	↓	↑	↓	↑
Character Trait	↑	↑	↓	↑	↑	↑
Context	↑	↓	↓	↑	↓	↑
Feelings	↑	↓	↑	↓	↑	↑

4 Discussion and Conclusion

Empathizing with users is essential when designing for the elderly. Previous work has developed theories and various tools to achieve a more holistic perception of the user (Carey et al., 2017; Detweiler, 1980; Kaufman & Libby, 2012; Koskinen et al., 2003). In this paper, we aimed to assess roleplaying in terms of the extent to which it can help designers achieve a more holistic perception of elderly people. Below, we revisit the three important findings of this work along with new questions indicating novel research directions for design researchers.

First, we observed that using props to simulate the elderly experience can help design teams have a more holistic perception of the elderly people. We initially observed 2 main schemas before the workshop (i.e., *appearance-dominant* and *behaviour-dominant*), which changed into more balanced ones. Thus, such exercise can be useful when designers' initial schemas are *appearance/behavior dominant*. But, this might not directly transferable to other schema types. Also, we observed that schemas changed differently in regard of the activities, so different roleplaying activities might help achieving different schema types. The latter makes us think that, evaluating schemas pre-roleplaying can be beneficial to select the roleplaying activity in accordance to reach a more holistic perception of the user. As it was stated, schemas get updated when new information arises. As the roleplaying activity determines the experience, it also influences the new information that will be integrated to schemas. In this sense, we could speculate that some activities are more related to some dimensions that others. Thus, if the designer present a schema that *appearance-dominant*, then a roleplaying activity that is highly related with *feelings* could have a bigger effect on this dimension, while an activity highly related to *appearance (e.g., shopping clothes, dying their hair)* would lead to increase *appearance* dimension. Regarding this point, a new research question is:

a. how can we match the roleplaying activities with designer's existing schema to reach a more holistic perception of the user?

Second, the results indicate that dimensions present different changes, for example *character trait* had the lower increase for all roles and for all time moments. So, not all dimensions of the life of elderly people are equally accessible through this tool. Also, we observe that *appearance* tends to decrease when other dimensions increase, for example in the case of *feelings* that consistently increased. Finally, the effect of roleplaying is not necessarily maintained for all dimensions after a month (Table 4). These observations triggered new research questions. These are,

a. how can we facilitate designer's accessibility to all the dimension of the user's life and maintain it through the design research process?

b. how can we refine and complement roleplaying to facilitate a more balanced distribution of "*hard-to-reach*" dimensions (e.g., *character trait*)?

Third, we discovered that the different roles experienced roleplaying differently regarding their immersion level. For example, participants who had the role of the *caregivers* seemed to have been affected less by the roleplaying experience. This implies that a holistic perception may not be directly transferred to other members in the design team. Regarding this point, we propose the following research question:

a. how can we share, with each member of the team, the holistic perception reached through this experience?

5 Limitations and future work

This work has limitations. For example, the experiment was experimental in nature and was not done with professional designers and it was only related to elderly people's experience, thus the results may not be generalizable. Thus, our future explorations will address these issues, along with further developing schema development and its impact on the design process.

We will continue this work by focusing on the research questions raised above. We plan to apply roleplaying exercises to contexts that present a bigger challenge to approach the user due to bigger social and cultural distance (Allport, 1954; Detweiler, 1980; Pettigrew, 1998) as in the case of undermined groups who are marginalized by conventional design practices (Pettigrew, 1998), for example when designing with and for refugees.

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Eight practice issues in design knowledge transfer: a case study

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Driving renewal in the public and private sector through design at a local scale requires that the local agents go through a revolution of themselves. Supporting local entities in changing by design with and for people is what the Design Research Lab (DRLab) at the University of Trento (Italy) is practicing by facilitating the transferring and application of design knowledge to the educational, production, and public policy systems in Trentino. This paper refers to two experimental design experiences (DXs) that were performed with the Design Studio format (one of the DRLab formats) in collaboration with local stakeholders with the aim to encourage the usage of service design as a human-centred approach for designing. The DXs were analysed as a case study through an analysis of the gaps according to the identification of twenty-two items. Data gathered with the involvement of the DXs participants in focus groups, semi-structured interviews and questionnaires, were matched with data emerged in the analysis of the DX with the Logical Framework tool. Fifty-three gaps were identified and they were described in eight crucial areas for the efficiency of the design knowledge transfer through DXs performed with formats such as the Design Studio. Also, the process allowed to identify five criteria for the development of this kind of DXs. Finally, this paper allows to reflect on how local actors are perceiving ‘design’, how they can be involved in future experiences and how these aspects can influence a local design research development in the next future.

Keywords: Design Knowledge Transfer; Service Design; Complexity

1 Introduction

The attention on design as a strategic resource for supporting the transition from the economy of the product to the economy of services and knowledge is growing in public and private entities. Partially, this follows what the European Commission has been encouraged through the Action Plan for Design-Driven Innovation (European Commission, 2013) where “the Commission seeks to actively promote design’s relevance and value as an enabler of innovation amongst Europe’s enterprises, public sector organisations, policy-makers” (Evans & Chisholm, 2016). Despite these recommendations are not so recent, the implementation of these kind of plans for supporting strategic areas such as “the adoption of design to drive renewal in the public sector” (European Commission, 2013) at a local scale, is still not considered as an essential systemic change in every geographical and cultural context. This requires that entities and organisations, and thus people, are ready to accept the change, embracing the new and in some cases make a revolution of themselves. This change is even more complex in contexts where ‘design’ is not systematically adopted. Universities

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should play the most impactful role in preparing the background and supporting local entities in changing by design with and for people.

The Design Research Lab (DRLab) at the Humanities Department of the University of Trento (Italy) is practicing this vision for the first time in the region in a combined initiative with Confindustria Trento, the Bruno Kessler Foundation (FBK), and the Pavoniano Artigianelli Institute. DRLab is a research centre funded by the autonomous Province of Trento and since 2017 has the mission in facilitating the transferring and application of design knowledge to the educational, production, and public policy systems in Trentino. Following a Research Through Design (RTD) approach (Frayling, 1993; Findeli, Brouillet, Martin, Moineau, & Tarrago, 2008; Godin & Zahedi, 2014; Jonas, 2007; Manzini, 2015; Reeker, van Langen, & Brazier, 2016; Zimmerman, Stolterman, & Forlizzi, 2010) in the field of study of the design research (Archer, 1981; Findeli et al., 2008; Findeli, 2010; Jonas, 2014; Manzini, 2015), DRLab is adopting service design as a strategic stimulant to be encouraged for innovation in public and private entities and associations of the Province.

1.1 The DRLab Research Framework and the action model

This paper refers to the first year of the DRLab activities between the end of 2017 and the 2018 when DRLab was engaged in the first of three research phases (figure 1) i.e. (i) setting-up; (ii) experimenting; (iii) modelling. The 'setting-up' phase has the objective in encouraging the usage of service design as a human-centred approach for designing in contexts where it is not systematically adopted.

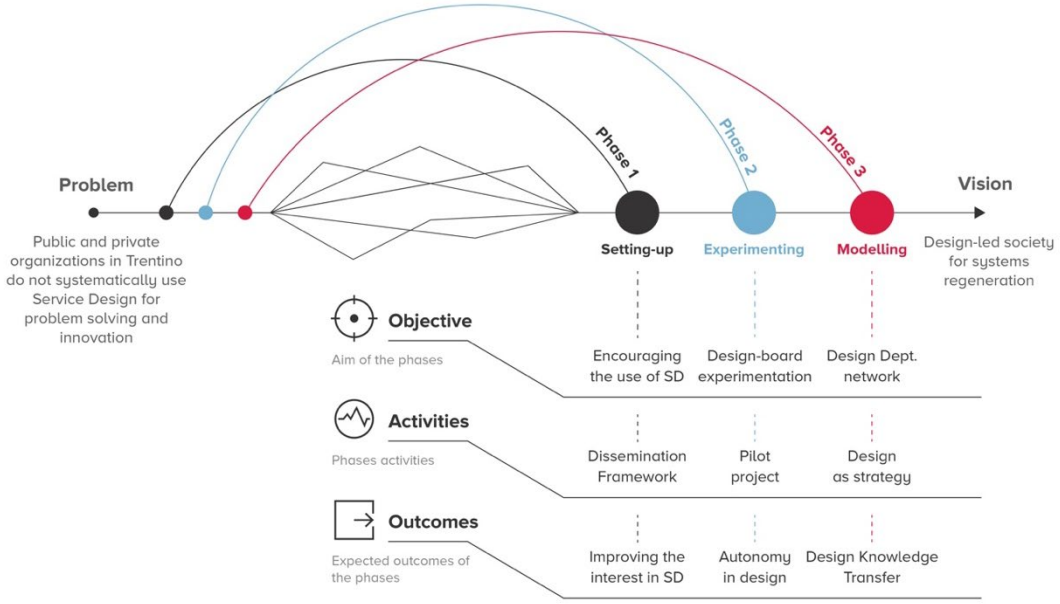


Figure 1. A visual abstract of the DRLab Research Framework.

1.1.1 The action model

To reach the objectives of the first research phase, DRLab followed an action-based model developed according the following phases (figure 2):

- the Engaging phase for creating design partnerships with local stakeholders;
- the Analysing phase for optimizing design praxis and theoretical workshops and seminars about design and related field;

- the Applying phase for applying a series of theoretical seminars, workshops and design experiences (DXs) with local agents and design partners;
- the Evaluating phase for analysing and reflecting about the data gathered in-field activities in the previous phases.

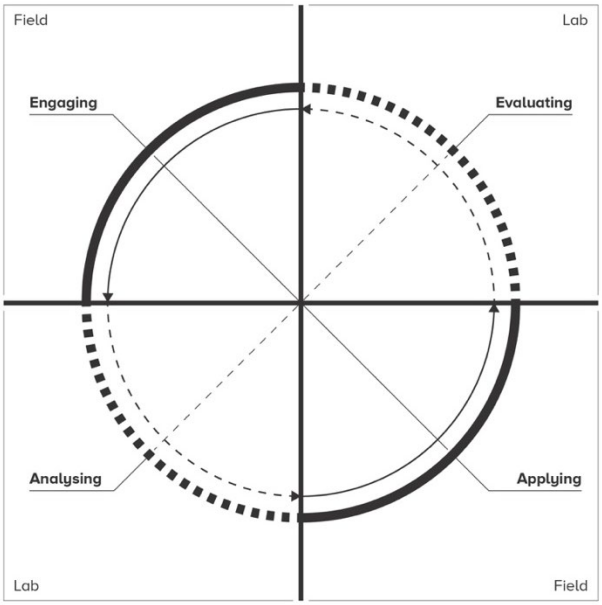


Figure 2. The DRLab action model.

This paper will focus on the activities developed as DXs that are intensive action-led experiences in collaborative design with local stakeholders not trained in design. Five partners among public and private entities in the Province were engaged in different kind of DXs provided for free (see figure 3 for an overview of the activities data).

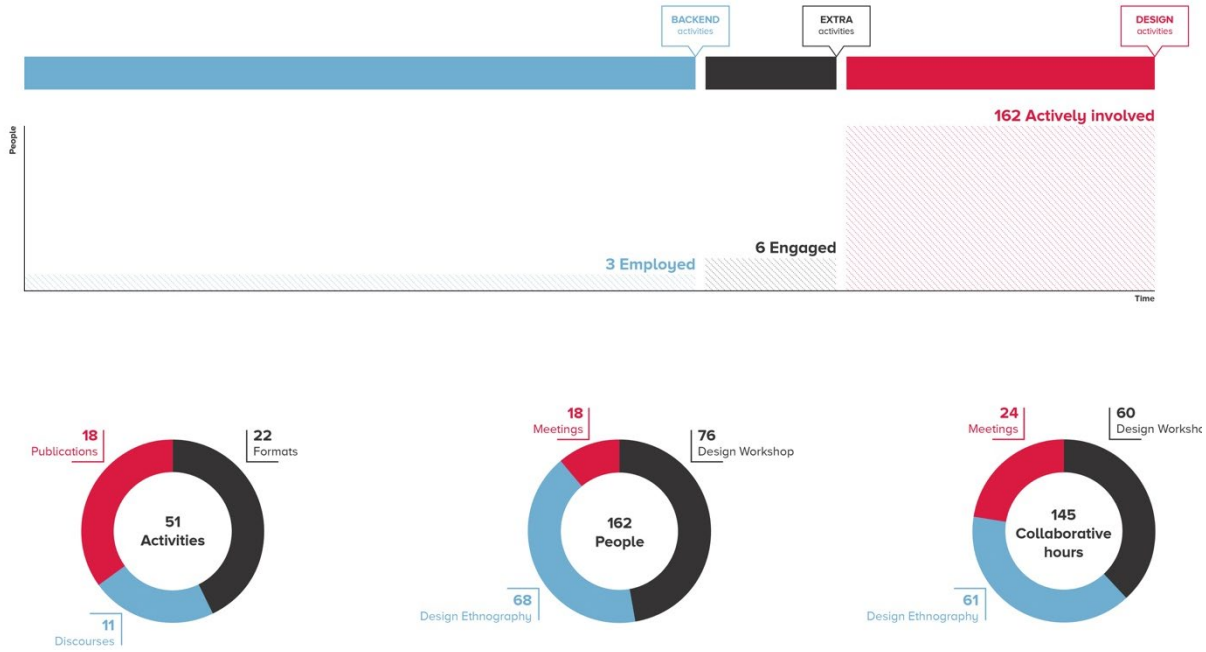


Figure 3. DRLab activities overview.

1.2 The early results

From the activities developed on field and following an inductive reasoning process, a Dissemination Framework was identified as a set of action-led research activities for a setting-up phase (see figure 4 about the outputs) in a wider Design Knowledge Transfer process. The three main cores of the DRLab Dissemination Framework are (i) discourses; (ii) publications; (iii) formats.

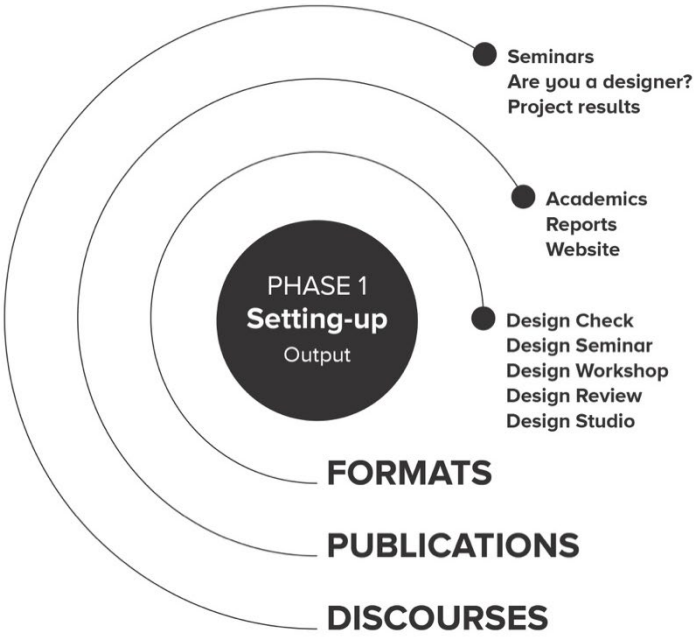


Figure 4. The main output of the 'Setting-up' research phase.

'Discourses' are activities such as seminars, workshops (named 'Are you a designer?'), and project presentations that have the aim of disseminating the theoretical and practical aspects of design in order to create and maintain an open 'local design discourse'.

'Publications' are all the media (i.e. website contents, technical reports, and academic publications) that have the aim of communicating the design contents and results, theoretical aspects of all the different subjects at different levels of expertise, and research works.

'Formats' are participative design formats that have the aim of engaging local agents to apply basic human-centred design knowledge with learning-by-doing approaches. Five design formats were identified and thirty-two design tools were selected and optimised to be used in co-design activities with people not trained in design. Every format differs for the objective of the DX, the participants profile and number, the minimum of collaborative hours and the maximum number of design tools to be used in the whole DX. According to these indicators it is possible to identify five design formats (figure 5):

- Design Check;
- Design Seminar;
- Design Workshop;
- Design Review;
- Design Studio.

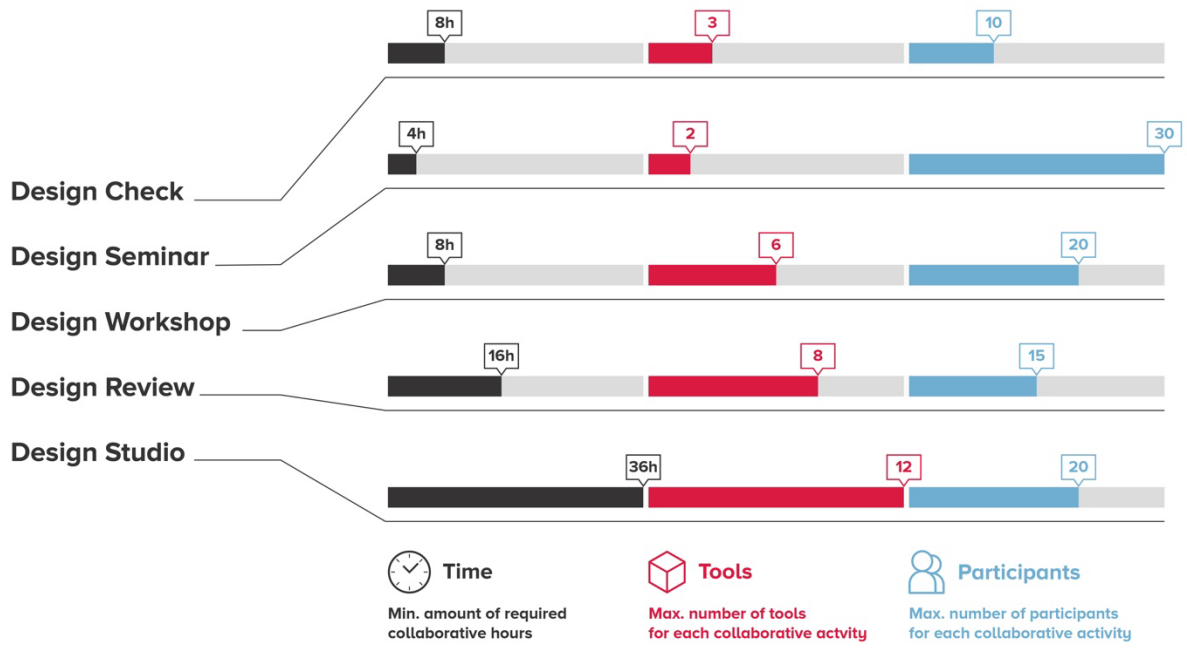


Figure 5. Design Formats of the DRLab Dissemination Framework.

1.3 The DXs with the Design Studio format

This paper describes a part of the evaluation phase related to two DXs developed with the Design Studio format that was applied to two different local entities. The first (DX1) was a public entity in the educational system; a technical/technological high school of the Province. The second (DX2) is a trade association (production system) that groups around one hundreds of micro, small and medium private enterprises engaged in the food system of the Province. Both of the DXs were developed for around three months with activities such as design setting and briefing (pre-meetings), design ethnography, and co-design activities.

The Design Studio is a format developed in a minimum of thirty-six collaborative hours with a maximum of twelve design tools used with twenty participants. The objective of this design format is exploring the design contexts with real data and a setting simulation in order to understand real problems and opportunities as well as stakeholder needs. As defined by this format, a Collaborative Project Management Team (CPMT) and a Co-design Team among the participants' groups were formed. The CPMT is a group between four and eight people among the design partners. They have the aim to co-design with DRLab team the early phases of the DXs before the starting of the main co-design activities. They are mainly involved in what, according to the Design Studio format, are named "pre-meetings". Also, the Co-design Team is a group formed from a minimum of six to a maximum of twenty people for each collaborative activity. They assume the role of co-designers in the whole DX. Finally, a group of participants, experts and other kind of users were involved in design ethnography activities for both the DXs.

This paper focuses on the analysis of the gaps in the development of the DXs through the Design Studio format. Also, this research work allowed the identification of a set of critical areas and criteria for future experimentations.

2 Methodology

The application of the Design Studio format in two different contexts was analysed as a case study through an analysis of the discrepancies between what was planned as design format and what was really experienced in-field activities.

Studies about ‘service quality’ provide models (Brown & Swartz, 1989; Hakatie & Ryynänen; 2007; Parasuraman, Zeithaml, & Berry, 1985; Parasuraman, Zeithaml, & Berry, 1988; Zeithaml, Berry, & Parasuraman, 1988) for developing gap analysis. However, the Design Studio format is the result of combined needs such as (i) producing tangible results in a short range of time; (ii) respecting the lack of time of all the involved agents; (iii) affecting as much entities as possible with the DXs in a short range of time and with limited resources (i.e. three employees with different backgrounds such as philosophy, design, design research and a very limited budget for one year). Therefore, this format has still an experimental status and it is still not possible to consider the two DXs as an implementation of a set of services. For this, applying the service quality gaps model was evaluated as a premature step.

Therefore, a first analysis was provided through the Logical Framework (LF) (European Commission, 2004; Sartorius, 1991; Tache, 2012; United States Agency for International Development, 2012) of the Design Studio format by reading the DXs as they were experienced with the LF items. This highlighted a series of incongruences and the data were embedded in an analysis of the gaps (figure 6) developed as a matrix that matched ‘planned’ and ‘experienced’ status. The matrix was completed with (i) data emerged through the analysis of the DXs with the LF; (ii) data gathered during the development of the DXs; (iii) data gathered with the participants after the DXs through focus groups or semi-structured interviews, and anonymous questionnaires.

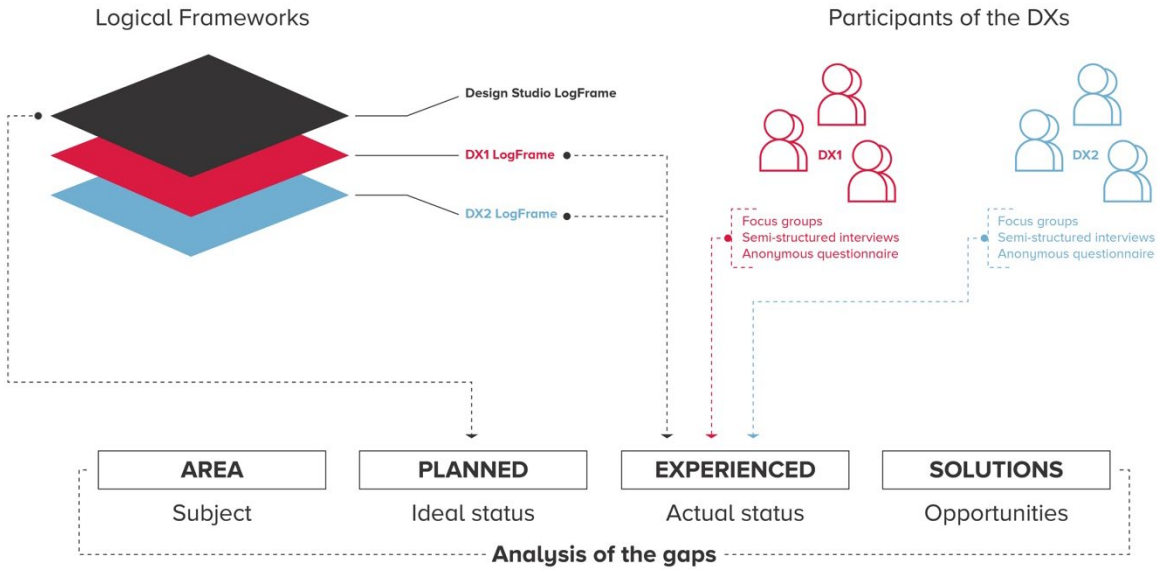


Figure 6. The analysis of the gaps through the data gathered by the DXs.

The first column of the matrix describes the main areas to be analysed; the second and the third column reports specific elements of the area to be analysed as they were ‘planned’ (ideal status) and ‘experienced’ (actual status) in the real world. Differences between

‘planned’ and ‘experienced’ status identify the gaps for each subject. In the last column were identified solutions to reduce the gaps.

A total of twenty-two subjects were identified to be analysed according to three macro-areas (figure 7). For gaps where a direct solution resulted unsatisfying, alternative techniques such as cause and effect diagrams, the Problem Tree (Department for International Development, 2003; European Commission, 2004; Snowdon, Schultz, & Swinburn, 2008), and the Five Whys (Kohfeldt & Langhout, 2012; Ohno, 1978) were used for a better understanding of the causes of the gaps.

Finally, all the gaps were described according to a set of “crucial areas” as it will describe in the results paragraph of this paper.

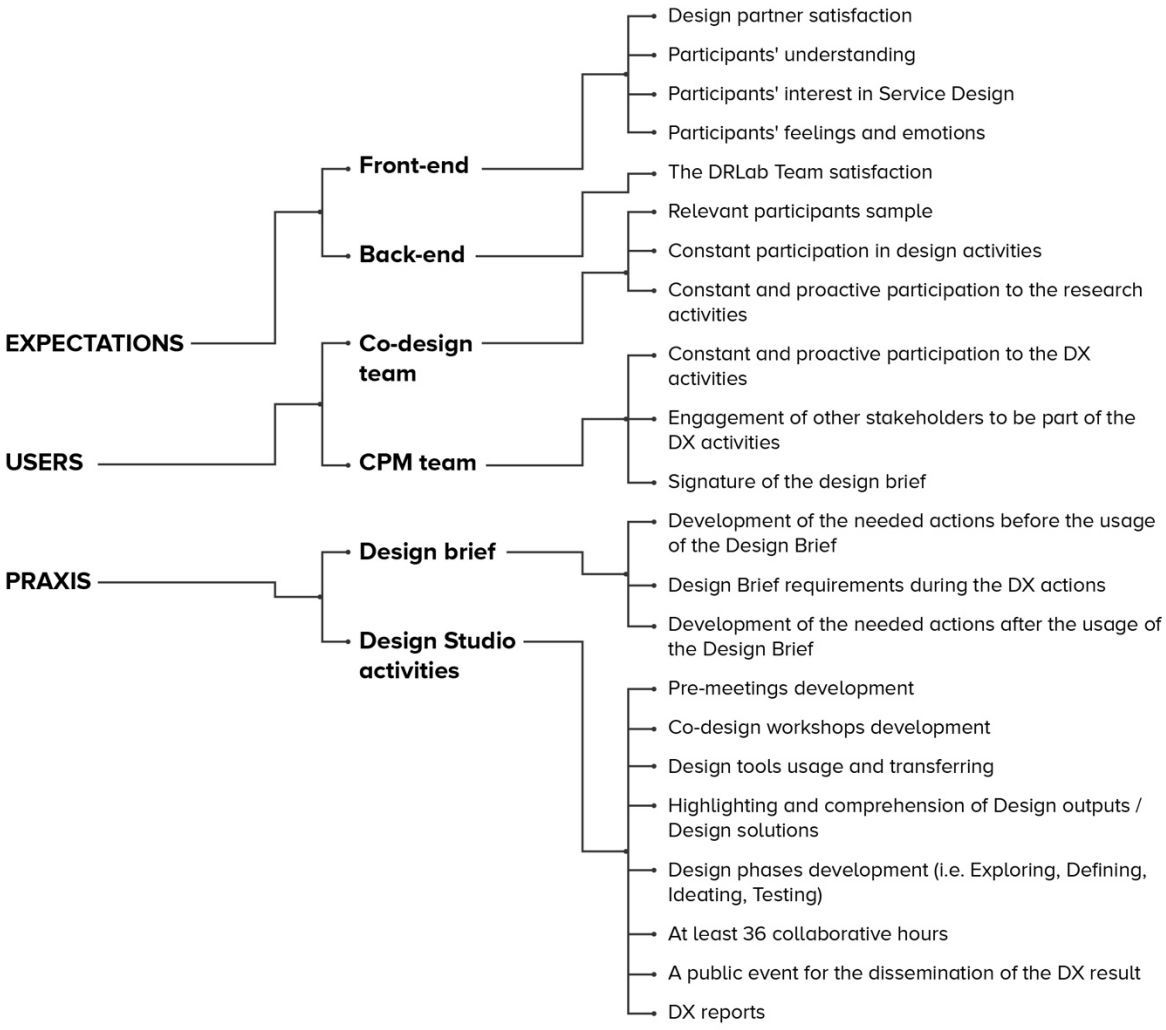


Figure 7. Subjects map of the analysis of the gaps.

3 Results

Fifty-three gaps were identified and the analysis allowed to underline the presence of eight critical areas that result as crucial for the efficiency of the DX through the Design Studio format. Finally, five criteria were identified for implementing a more effective DX and having more chances to reach the aim in disseminating design knowledge at a local scale.

3.1 Crucial areas

The following paragraphs describe eight critical areas and the related opportunities according to the identified gaps.

3.1.1 Participants sample

'Quantity', 'profile' and 'constancy' of the participants are the three indicators for a relevant DX for disseminating the design knowledge through a learning-by-doing approach. Reaching a relevant participants number does mean reaching a relevant participants profiles representation among the stakeholders. At the same time, if the participation of the involved actors is not constant in doing all the planned collaborative activities, the DX can be negatively affected.

The Co-design Team is generally the group more affected by this kind of discrepancies. Indeed, an average of twenty participants in this kind of group for each DX was expected but less than two thirds of them for each DX resulted constant in participating to all the activities.

About the profiles, in the DX1 three on six profiles of actors were not or not constantly represented. In the DX2, one of the four profiles among the actors group was not represented. Motivations and expectations of the participants are the two most influential identified causes. These can have an interdependence with the motivation and the expectations of the representatives of the design partners that were the responsible for the involvement of the participants after knowing the Design Studio requirements.

Therefore, more time is needed to collaborate in advance with the design partners for (i) guiding the involvement of the participants step by step; (ii) providing more touchpoints for respecting the requirements of the whole DX. These actions should be developed in at least one third of the time of the whole DX and mainly before the starting of the experience. This requires a time reframing of the Design Studio setting.

About 'motivation', if every DX could be recognised as a socially relevant experience for the quality of the daily design activities of the participants, it should be in the interest of the local institutions (e.g. the local government) to provide recognitions for those that participate to a DX.

3.1.2 Research data

The observation of all the interactions between people and the DX activities, as well as the feedback of the participants provided during and after the design activities through surveys, interviews, focus groups are the crucial data that it is possible to easily gather through a DX. However, some participants demonstrate a very low level of interest in giving feedback through these activities. This creates some gaps in gathering data. Some participants declared to be busy with their job or generically without 'extra time' for answering and giving feedback.

This is proved by some indicators such as:

- the number of participants equal to the 70% for the DX1 and the 58% for the DX2, that answered to the questionnaire after every co-design workshop despite the response rate was expected between the 80% and 90%;
- the number of the actors among the Co-design Teams that participated to the focus groups or the semi-structured interviews; around the 95% of the participation was

expected while only the 66% in the DX1 and the 63% in the DX2 participated in to this kind of activities.

Accordingly, integrating more research techniques as much as possible inside the DX process, in loco after every activity, as an essential DX touchpoint, can represent a strategy to cover these gaps. Also, increasing the involvement of the actors in the research matters can be a strategy for enhancing their awareness and increasing the participation.

3.1.3 DX outputs and design results.

Finished design tools, activity reports, and other kind of design outputs of the DX were not considered by the participants as it was expected. Short tutorials and documents for the comprehension of the design results were requested from the participants. In addition, almost all the participants found it difficult to understand the whole logic of the design process and the specific outputs of the DX such as a finished design tool that suggests design solutions or opportunities.

The followings are the identified measures for reducing these gaps:

- providing short resumes about theoretical aspects of design to be consulted by the participants before, during and after the DX in a step by step process;
- providing summaries (schemes and graphs) about the adopted procedures and the results of the DX emphasising basics aspects such as “how getting insights from a finished design tool”;
- encouraging the self-training and providing an extra support for the usage in autonomy.

3.1.4 Contents for all

The participants of the DXs were people not trained in design and with very different backgrounds, educations, skills and attitudes. Despite all the contents of the format were designed and optimised in an inclusive way, a few gaps emerged in understanding them with a systemic and holistic way. The three following aspects underline the main gaps about these topics.

First, the design process was simplified and a comprehension of the 75% of the whole logic was expected in the participants. However, the following aspects generate gaps:

- participants understood the sequence of the phases but the whole comprehension has been made complicated by a few basics aspects such as the advanced terminology in English language;
- the efficacy of the single design phase resulted not easy to understand;
- misunderstanding about the logic affected the application in autonomy.

Second, during the development of the DX, data for the design process gathered during the co-design workshops and the design ethnographies were processed in laboratory in order to save time and simplify the process to the participants. However, this simplification did not allow the participants to understand how data gathered in co-design or user research activities can be autonomously processed.

Third, all the design tools for the DXs were optimized for people not trained in design. A few tools were undervalued; others were well used but not fully understood to be used in autonomy. Finally, despite the design tools were well performed by the participants, the

quantity of the used tools (three tools for each co-design session) resulted a bit stressful for the participants learning process.

Premise that all the theoretical and practical contents of the DX should be continuously redesigned with an inclusive approach and an iterative process, to cover these gaps a particular attention is needed for the following points.

The main strategy is to focus on:

- people not trained in design;
- people that can generally be considered the opposite of those have a proper design attitude or 'design comfort';
- people that may have a very difficult access to the contents of the DX;
- people that are particularly critical with the design practices.

About the design process, it should be always co-designed with the design partners and participants of the DX. If not possible, it should follow simple and clear rules reaching a balance between a simplified process (avoiding to underpower it) and an advanced detailed process; new ideas are needed on how transferring the design process as a holistic body of praxis. In addition, new ideas, tools and praxis are needed for developing collaborative sessions with the participants for data analysis and getting insights from the data gathered during the co-design and user research activities.

About the design tools, it is required to (i) select the right number of tools for each activity avoiding an overload for the participants learning experience; (ii) maintain a dynamic and very easy logic between the design tools and the design process; (iii) support with theoretical contents the learning process about the tools reinforcing proper aspects of the design attitude such as how gathering insights through the tool and gaining design results.

3.1.5 Balancing the learning-by-doing approach

Some gaps are related to the participants that needed more theoretical training and support. Indeed, most of the activities were provided with light theoretical introductions with the aim to compensate the short time, and the desire of the participants to identify practical answers to their problems. This approach only partially did work because at the end of the DXs the participants manifested the needs in understanding more theoretical aspects for closing the learning process.

The learning-by-doing remains a useful approach for introducing beginners to design-led approaches. If adopted, at least the 25% of the time should be spent to introduce theoretical aspects about design (e.g. the approach, the design process, the design tools) highlighting apparently easy issues for experts that are for instance how, when, and why using a specific design tool.

Without taking anything for granted, a particular attention should be reserved to:

- significant case studies that explain the relevance of the process and the tools;
- the practical implications of the DX applied in the real world;
- examples of applications on the same system of the DX.

3.1.6 Collaborative activities planning

Some gaps in the previous paragraphs depend on how the main collaborative activities of a DX (i.e. pre-meetings, co-design workshops, design ethnography, final event) are organised in terms of specific objectives and timing.

The pre-meetings were planned as activities before the kick-off of the design activities for (i) introducing the DX to the design partners and to the CPMT group, (ii) filling the design brief and (iii) co-planning the subsequent activities with the design partners. The highlighted gaps suggest that too much activities are required in the pre-meetings.

The co-design workshops were oriented to identify specific design results. The highlighted gaps suggest that a few theoretical aspects were missed for the whole understanding of the workshop as a training collaborative activity in a design process.

The design ethnography activities were conducted as an in-field inquiry by the DRLab team due to the less time, the limited resources and the scarce availability of the participants. The gathered data were analysed in laboratory. Process and results were reported to the participants as data for designing. The highlighted gaps suggest that this praxis is not enough for transferring the basic elements of the design ethnography in order to encourage human-centred approaches to the participants.

The final event is a fundamental activity to be developed for disseminating the DX results to the local audience and it was ideated as a collaborative activity to promote service design and its local applications. The analysis of the gaps highlighted that the final events were transformed as a not fully collaborative activities oriented to promote the design partners rather than the value and the results of the DXs.

Therefore, pre-meetings should be more oriented to only fill the design brief with the CPMT and a few activities for orienting the design partners are required before this step.

The co-design workshops should be redesigned as following:

- 25% of time to be spent for theoretical aspects;
- 50% of time for co-designing with the design tools;
- 25% of time for analysing the collaborative design activity and reading data gathered through the used design tools as well as to frame the value of the activity in the whole design process.

Also, design ethnography should be treated as a full collaborative activity. Therefore, the participants should have experience of this kind of in-field exploration as ‘researchers’ supported with theoretical and practical insights.

Finally, the events at the end of the DXs should be co-designed during the DX focusing on the goals that are the promotion of the adopted design disciplines and the presentation of the design results to the citizens. Any form of self-promotion during the event should be avoided as design partners can easily fall in this kind of gap as shown by the analysis.

3.1.7 Expectations

A DX has the objective in transferring basic design knowledge through a collaborative approach and the identification of design concepts are the best results that is possible to be expected from a design point of view. However, the design partners expected to find developable or partially developed design solutions for their problems with minimal

participation. This highlighted gaps in the engagement phase with the design partner's representatives. But most of all, this shows that the design partners understood with many difficulties that the DX is based on a participative model rather than on a traditional 'consulting model' where there is a client that requires a design solution from a professional.

At the same time DRLab expected (i) to increase the interest in service design to the DXs participants and (ii) allowing them to use design tools autonomously. However, the interest of the participants in service design is just at the beginning and the autonomy in using the design tools is still under the expected level.

These gaps underline needs in providing specific training actions addressed to the design partner's representatives before the starting of the core design activities of a DX. The actors learning process start from the understanding level of the design partner's representatives. Requirements, DX criteria (focusing on collaborative models) as well as theoretical and practical aspects should be the focus of the training of the design partner's representatives.

3.1.8 Time scheduling

The previous gaps had underline needs in redesigning the process of the DX with a different distribution of the time and providing changes such as:

1. Implementing additional tutoring phases for the design partner's representatives, the CPMT group and the co-design team before the pre-meetings;
2. Starting the engagement phases of the participants during the tutoring phases;
3. Developing pre-meetings and co-design workshops in a less range of time;
4. Starting the design ethnography activities before the pre-meetings;
5. Providing an analytical phase at the end of the DX for discussing about the design results and DX outputs.

Giving flexibility to the design of the DX process in order to be co-designed with the beneficiaries is the best strategy for ensuring the respect of the DX criteria and reducing the gaps shown in this paper. However, in figure 8 a proposal of the DX process redesign is reported with the aim to fix a first structured reflection on the DX process.

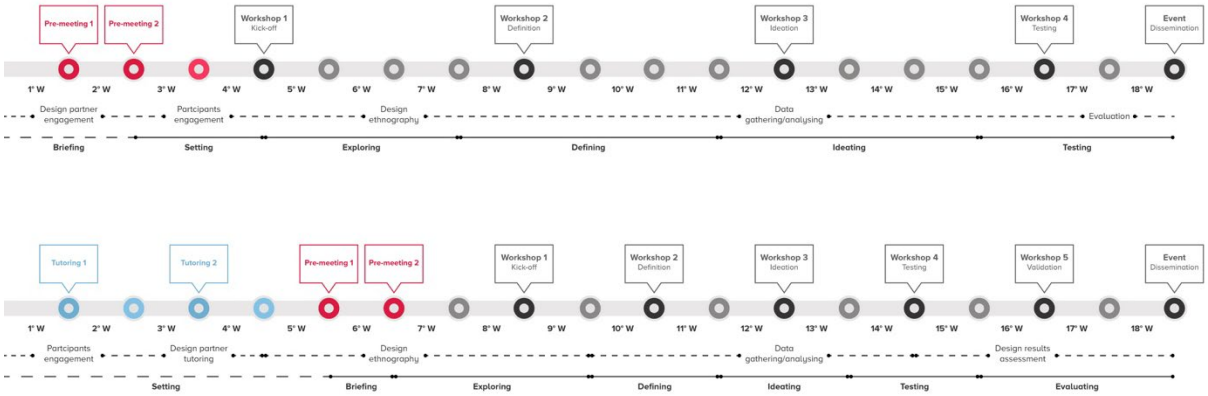


Figure 8. Redesigning of the Design Studio format experience flow. Above, the format as it was planned; below, how it was redesigned after the analysis of the gaps.

3.2 DX Criteria

The empirical observation of the DXs and the analysis of the gaps allowed to identify criteria for the development of DXs through the Design Studio format in future experimentations and with the aim to transfer design knowledge in a practice way. Therefore, a DX provided through a Design Studio format implicates the following criteria.

3.2.1 It adopts human-centred approaches through inclusive principles

Every action, output and content planned and performed by a DX should be designed and developed with an inclusive approach favouring all the possible situations for understanding the context and iterating. All the DX components must be accessible for the wider number of potential local beneficiaries; especially for people not trained in design.

3.2.2 It is a simulation of a design process with real data gathered in-field

A DX is only a part of a design knowledge transfer process that is a complex, long-term, and expensive process. It is possible to identify hypothesis, concepts or elements to be transferred in a logical framework for a longer and more complex action plan but it is not plausible to solve problems and implementing solutions.

3.2.3 It is a training experience

A DX is a way for disseminating the design culture through collaborative approaches with people not trained in design. It is the chance to understand in a context how people design, supporting their way to design and exposing alternative approaches for developing their own design attitudes.

3.2.4 Design research is the theoretical reference

A DX is designed and developed with the objectives of (i) transferring design knowledge and (ii) creating the occasion for doing in-field studies and reflecting on how these actions produce a contribution on design knowledge, design practice and design education (Findeli et al., 2008).

3.2.5 It is based on learning-by-doing and collaborative models

Co-design is the main approach for conducting design activities with the participants. A DX is not based on a consulting or a top-down model, therefore all the main decisions are the results of a collaborative process with the participants. Activities provided in laboratory as back-end activities have the only aim to optimise complex contents and results for increasing the learning process about design knowledge.

4 Conclusions

The case study presented in this paper allows to identify three levels of reflections related on how people perceived design and the DX, how they can be involved in future experiences and how these aspects should influence design research experiences in the next future.

The first is related to the difficulties that DRLab met in promoting service design engaging local design partners for doing DXs as experiences provided for free. Every DX does not make sense without an intense and proactive participation of different kind of people that with their differences represent the main resource of the whole experience. However, promoting service design in entities where it is not systematically adopted sometimes entails to resort to forms of recompenses (e.g. highlighting the possible political connections; advancing unsustainable design solutions; promoting marketing results). But this approach completely transcends from the sense of the DX as a way to transfer knowledge. This

underlines that it is still difficult to prove the efficacy of the adopted design discipline in neophyte contexts and that ‘design’ for the local public opinion is still linked to the aesthetic aspects of the artefacts. In other words, the experiences described in this paper highlight the requirement for design research to assume a political role in the society and giving answers on how influencing the daily cultural dimension of a context.

The second is related on how design is perceived at a local level by entities that do not systematically adopt service design. The analysis of the gaps has shown some needed steps before applying a DX that should focus on promoting and transferring the collaborative design values and principles. This implicates the identification of supportive formats or the integration of this kind of activities to formats such as the Design Studio. This main objective is to support a local cultural shifting from perceiving design as an action provided by professionals (consulting model) in favour to participative models.

The third reflection is related to the praxis that more concern the DRLab as a strategic entity for developing a local design research. From a practical point of view DRLab has to activate iterative processes for optimizing its design formats in terms of timing, processes and logic also adopting a more experimental role rather than an applicative role. Practically, needed next steps are the validation of the DXs among the identified design formats including *placebo controls* (Cash & Culley, 2015) as short and mid-term steps to be implemented in the research framework.

Also, according to the DRLab Dissemination Framework, the identified design formats should be experimented with more DX and design partners with the aim to improve the dissemination phase in terms of time and 'local knowledge'. Improving these kind of actions with more test formats and experimental DXs is a way for improving a local design discourse that actually is a prerogative of only a few advanced entities in the territory without a diffuse impact.

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Encoding from Visual Content Analysis in Cultural Design Research

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This study investigated the development of inspirational design research based on encoding from the visual content analysis. Approaches were proposed for conducting cultural design research. Cultural research often involves complex issues. These issues combine the complexities of humanity, social behaviour, science, technology, and business. Some scholars have proposed content analysis as the most appropriate tool for conducting aesthetic design research. The principles of such analysis have been developed in recent years. However, there is still a lack of knowledge about how to manipulate the research process with visual research materials. Hence, there is a need to investigate potential code-compliant approaches, especially in relation to visual research material. This study was conducted in cultural design research on typography in Hong Kong with a practical application of content analysis. The goal was to establish the challenges and opportunities related to typography in Hong Kong. The unique culture of the city was investigated and described in detail. The interactions between East and West and its city lifestyle influenced the changes in Hong Kong's design and typography as the city expands further. It was expected that the significance of the development of Hong Kong design and typography provided some insights into how a unique culture was created and expanded. Hence, this project aimed to investigate proper approaches for conducting visual content analysis around changes in Hong Kong typography. The research aimed to provide a detailed picture of how Hong Kong typography has developed, the ways in which it represents the Hong Kong spirit, and how it may be developed in the future.

Keywords: encoding; visual material; content analysis; cultural design research

1 Introduction

The study of culture is no longer a unique discipline – if it ever was. It involves a shifting multiplicity of symbolic practices and value systems. It provides vast potential resources of academic investigation and ethnographic research for understanding difference, autonomy and power. As such, culture has become one of the most productive resources for various innovations in areas such as design, art and technology. These relationships have led scholars to rethink the nature of culture. Instead of accepting cultural identity and recognition as single forms, scholars have proposed new features of the culture concept. The goal is to find better ways of improving society with innovations and developments in various aspects. Some studies have proposed that social recognition can affect how learners generate ideas and the manipulation of their thinking processes. Based on the importance of understanding

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culture and lifestyle in the improvement of society, much research has been conducted. Approaches were proposed for conducting cultural design research. Cultural research often involves complex issues. These issues combine the complexities of humanity, social behaviour, science, technology, and business. Some scholars have proposed content analysis as the most appropriate tool for conducting aesthetic design research. The principles of such analysis have been developed in recent years. However, there is still a lack of knowledge about how to manipulate the research process with visual research materials. Hence, there is a need to investigate potential code-compliant approaches, especially to visual research material. This study was conducted in artistic design research on typography in Hong Kong with a practical application of content analysis. The goal was to establish the challenges and opportunities related to typography in Hong Kong. The unique culture of the city was investigated and described in detail. The interactions between East and West and its city lifestyle influenced the changes in Hong Kong's design and typography as the city expands further. It was expected that the significance of the development of Hong Kong design and typography provided some insights into how a unique culture was created and expanded. Hence, this project aimed to investigate proper approaches for conducting visual content analysis around changes in Hong Kong typography. The research aimed to provide a detailed picture of how Hong Kong typography has developed, how it represents the Hong Kong spirit, and how it may be developed in the future.

2 Content analysis

Content analysis is an empirical approach for the systematic analysis of multimedia material (Han, 2015) – textual, visual, audio, and so forth. Unlike other, reactive research methods, content analysis requires the determination of a sample for analysis (Jewitt & van Leeuwen, 2001). It is necessary not only to assemble material but also to codify it, all at an affordable cost. The content analysis must be undertaken under conditions of objectivity, and scientific criteria need to be applied to ensure reliable sampling and generalisability (Knippendorf, 2004; Jewitt & van Leeuwen, 2001). Visual material can include photographs, magazines, packages (Go & Wu, 2003), books, and so forth. Although both the mentally visualised and the visually materialised are essential materials for visual communication, the latter is much more appropriate for content analysis (Atkinson, Coffey, Delamont, Lofland, & Lofland, 2001). Visual materials provided the foundation for scientific understanding. Insights gained from the content analysis may be transferable to various media (Bennett & Frow, 2008). Such analysis usually involves five stages. In the first stage, the main topics need to be identified. Researchers need to determine the number of samples required and select the material for analysis. In the second stage, researchers need to encode the visual material. In the third stage, cultural and social issues need to be established as a reference for the encoding process, followed by further analysis. In the final stage, insights are summarised and conclusions are drawn.

During the process of content analysis, categorisation was the critical tasks. They were the mean for deducing answers those related to the interest of the study. It provided the foundation of developing code. It was possible to develop theories into variables. Therefore, as described by Rose (2001), every level of visual with which the research was started from categorisation. A content analysis started from examining formal categorisation included the size of visual material, position in the media, the space allocated around the visual materials. This information supported conclusions related to the priority of visual material. Also, count vial of the same topic in various media (such as magazines, books, and so forth) provided data and information about the frequency of visual material. After determining the objective principles of categories, the approaches of coding might be then involved subjective categories of the visual material. Content analysis of the visual material started with

questions about aesthetic design research (Krippendorf, 2004). Questions involved the target audience natures, the application of the visual material and so forth. The communication process of visual material was characterised by the vast influence of their producers. In the content analysis of visual material, researchers had to consider potential selecting options, interpretation, reducing, and constructing visual material. Personal experiences, various socialisation processes, cultural backgrounds were example influence for considering the approaches of content analysis. The process of visual material with various contexts was collected and prepared for content analysis. The process of communication on the visual materials was therefore proposed from the concrete foundation. Such foundation then created the visual in audience mind as well as their cognition thinking. Thus, the researcher had to evaluate the relationships between the process of communication, visual in the audience's mind and their cognition thinking directions those reflected the personal experiences, various socialisation processes, cultural backgrounds. Underlying assumptions of visual material thus were developed. The data and information gathered would be linked with the research questions. As a result, the effort of researchers and the complexity of information were involved in the context analysis. Through the process of content analysis, more intensive finding thus would be prepared for more investigation.

3 Model of visual cultural content analysis

Based on the practices of collecting visual material, a specific model of visual content analysis from the cultural research field was developed, as shown in figure 1. Visual materials were collected and then categorised by various media types. Different media types were determined according to the audience, location, and communication objectives. The objective of the visual materials was providing essential information (Mattern, 2017). Therefore, the publishing time of the media types had to be considered to form the historical sequence of the events that happened in society. It, also revealed how the relationships between society, communication and technology worked together in a particular period. As a result, more comprehensive findings could be presented.

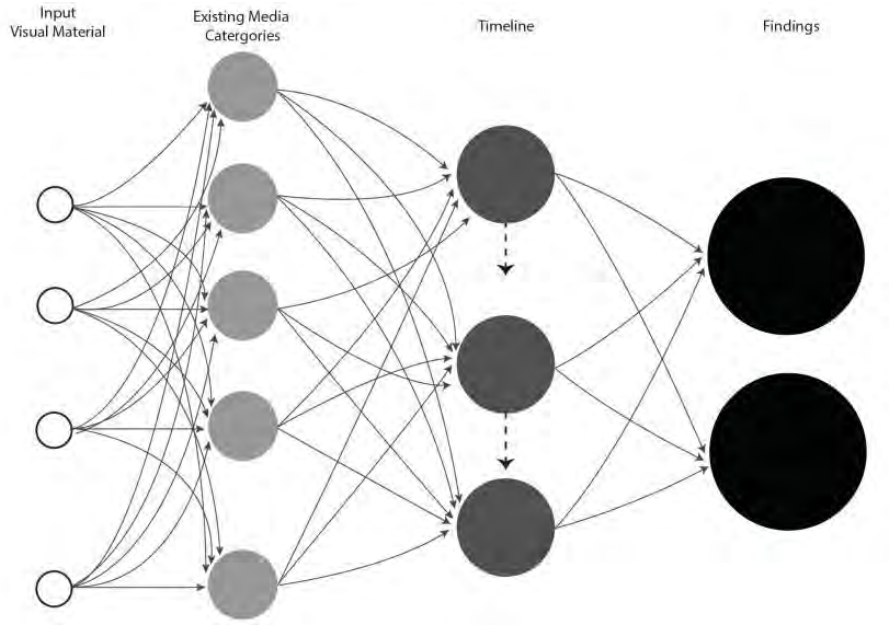


Figure 1.Model of visual content analysis in the cultural research field.

4 Practical application of content analysis in cultural design research on the typography in Hong Kong

4.1 Research methods

This study explored how Hong Kong's design history developed, with a particular focus on aspects of typographic design through a survey of the image (Margolis & Pauwels, 2011). The relationship between Hong Kong's typographic design and design concepts from Japan, South Korea and China had yet to be investigated. This study was expected to compile a historical archive of Hong Kong typographic design for Asian academics, presenting another perspective on the design history of Hong Kong. It is hoped that this study will lead to further research examining the value of Hong Kong's typographic designs and language as a response to the resolution to adopt simplified Chinese.

This project conducted a visual content analysis (Gwinner & Eaton, 1999; Martin & Eroglu, 1993) for understanding the development of Hong Kong typography. This research aids understanding of Hong Kong typography's development and how it embodies the spirit of Hong Kong. It also provides a glimpse into how it might develop in the future.

Table 1 Research procedures

Stage 1	Preparation of Research	• Collect the information • Plan for the idea
Stage 2	Set research questions and aims	• Organise research rationale, background and significance • Plan for the research schedule
Stage 3	Reviewing and Analysing the Literature on Hong Kong Design	• Survey the literature • Evaluate the literature critically
Stage 4	Gathering different applications of Hong Kong Typographic Design from various museums, collectors and Historical locations	• Contact the museums, collectors and Historical locations • Arrangement meetings with museums, collectors and Historical locations • Purchase and record the research material
Stage 5	Categorising and Documenting the collected Applications of Hong Kong Typographic	• Categorising collected Applications of Hong Kong Typographic • Prepare notes for the details of the Hong Kong Typographic design
Stage 6	Analysing the influence and changes of Hong Kong on its typographic design	• Match the features of Hong Kong Typographic design with the development. • Write a summary of the collected research material
Stage 7	Determine findings	• Organise research findings • Write and report research result

4.2 Research Process

Total of six hundred and six pieces of visual materials about different stages of the Hong Kong typography was collected from museums, collectors and historical locations. They were categorised into different groups. The categorised stages were developed according to the Hong Kong significant historical milestones. According to the investigation of Hong Kong history, some scholars developed the timeline of Hong Kong historical development. The place was ceded to Great Britain as a colony in 1842; English has been an official language of Hong Kong in the old days and could be easily found in official government documents. Since Qin's unification of China, the people of the Central Plains have moved southward in vast numbers, bringing more advanced culture and skills to the south. The development of

the Guangdong region influenced the development of Hong Kong. Some visitors have begun working in Hong Kong, learning the Cantonese dialect and adopting the Hong Kong lifestyle. Some studies have explored how the Cantonese dialect has developed in Hong Kong; however, Hong Kong typographic design, which has developed in close connection to the Cantonese dialect, has not received much attention from scholars. Hong Kong is characterised by a unique culture, which has emerged thanks to the interactions between East and West and its city lifestyle. After 1974, with the anti-colonial movement, Chinese was elevated to the co-official language status as important as English. Hong Kong culture reached its peak of influence among other Asian countries, such as South Korea, Japan and China, during the 1970s–80s. In the same period, Japanese comics, music and drama brought Japanese typographic design to Hong Kong. Japanese design firms, even design foundries such as Monotype, influenced the further development of Hong Kong's typographic design. Its influence spread through mass media platforms, such as cinema, TV and music. These historical stages were developed as the main categories for visual materials content analysis. The six hundred and six pieces of visual materials were categorised as shown in table 2.

Table 2 Distributions of visual materials collected for content analysis

Categorised Stages	No. of visual materials collected for content analysis
The Birth of the Hong Kong Typography	20
The early growth of Hong Kong Typography in the Colonial era (1900-1920)	26
The development in the early 20th century (1920-1970)	45
The development in the late 20th century (1970-1990)	157
The contemporary Hong Kong Typography (after 1990)	358

4.3 Research result

Before investigating how Hong Kong had developed and influenced by local living and foreign cultures such as British and Japan in its long typographic history. Theoretical background and analysis of the historical development of Hong Kong Typography of different designers were conducted (Lee, 1997; Xie, 2002).

4.3.1 The Birth of the Hong Kong Typography

According to Xie's described, Hong Kong was ceded to Britain as a colony in 1842 (Xie, 2002). As described by Lee (1997), English has been an official language of Hong Kong in the old days and could be easily found in official government documents. Since Qin's unification of China, the people of the Central Plains have moved southward in vast numbers, bringing more advanced culture and skills to the south. Lee (1997) pointed out that the development of the Guangdong region influenced the development of Hong Kong. The establishment of the Guangdong and Guangxi regions was followed by that of the Nanhai, Hui and Guilin counties. During this time, Hong Kong was under the jurisdiction of Panyu in Nanhai County. Hong Kong was affected by the Central Plains culture as early as the Qin Shiming. During the years of the Northern and Southern Dynasties, Buddhism was introduced and became one of the most important Chinese religions. Xie (2002) revealed that books about Buddhism were transported to Hong Kong and the content of the books maintained a close relationship with Chinese traditions. Due to changing foreign trade trends, woodcut versions of these Buddhist books were delivered to the south part of Guangzhou

and then later to Hong Kong. Lee (1997) mentioned the perspective of the ancient economic development of Hong Kong. He pointed out that merchant ships travelling to Hong Kong would arrive at its main port and sail through the gates of Tuen Mun. The government had set up the town of Tuen Mun during this same period and sent troops to these gates. These troops frequently brought Chinese culture to Hong Kong. In the period of the South Han Dynasty, Hong Kong was rich in pearls. In addition to retaining specially purposed households in the Tai Po area, they also sent troops to the station. The collected typographic material created in Song Dynasty revealed the point of view from Lee. They reflected that the Central Plains region was often invaded by small groups from the north. Compared to the North, the South part of Hong Kong was much more stable, and a large amount of arable land was not yet claimed. The Central Plains people were attracted by this, which led to the settlement of, for example, Deng, Peng, Lin, and Tao. Family members like Hou moved to Hong Kong to make a living from farming, to places like Kam Tin, Tuen Mun, Tai Po and Lung Yeung Tau. The visual material collected about the typographic work created such as the almanack are believed to have been introduced to Hong Kong during this period. Hong Kong was also rich in sea salt at this time, prompting the imperial court to send troops to the station. Two pieces of collected topographic records reflected Hong Kong's social economy fared better in the Ming Dynasty. Alike the description of Lee (2002). Villagers earned a living through agriculture and fishing, or by trading salt, pearls and incense. The creation of an impressive Dapu bowl kiln also enhanced the technology of porcelain and was a considerable artistic achievement, too. The development of typography also took huge strides when masters of this art moved to Hong Kong. These artisans moved onto large pieces of land that had been occupied by earlier occupants, as typography thrives in unusual, remote places. Since earning a living was a struggle, most of the men had to go abroad to earn money in foreign currencies. During the process of the cultural exchange, the correspondence between Western and Chinese styles would also be brought to Hong Kong when relatives visited. Therefore, it was believed that communication and the communication of culture would spread. From another point of view, China’s vast territory and a plethora of ethnic groups and dialects made the text the paramount medium of communication. The roots of the text are far-reaching because Hong Kong’s ethnic group comes from a variety of places in China. As such, its development was more varied.

4.3.2 The early growth of Hong Kong Typography in the Colonial era (1900-1920)

Hong Kong's ethnic groups come from all parts of the Central Plains of China. After arriving in Hong Kong, they were engaged in activities such as farming, salt refining, fishing, pearl harvesting and planting incense trees. They also engaged in trade activities, so business trips were also frequent.

Moreover, the introduction of Buddhism led to increased demand for scriptures, books, papers, meditation, cards and advertisements. Local printing production was similarly promoted when these items were unable to meet the needs of business travellers in terms of quantity and content. The first use was also naturally printed in the prevailing edition at that time. Since trade inevitably brings advertisements, the text was the original primary advertising medium. As such, it was necessary to use distinctive art characters to attract attention, while woodcut versions could include engraving, but this was the only option at this time. This method has had a significant influence on the development as well as the popularity of typography. Since Hong Kong became a colony, there have been various political changes in the motherland. As a result, more of the mainland population has moved

to Hong Kong, while foreign printing also spread to Hong Kong during that period. In the long period of these important books, woodblock printing was an essential medium for the creation of texts. Because different printing techniques were only used in foreign languages, foreign missionaries used woodblock printing (Woodberry, 2012). This suggestion proposed that foreigners worked with Chinese people to carry out the necessary work for woodblock printing.

4.3.3 The development in the early 20th century (1920-1970)

Although Hong Kong is a small place, it has a long-standing and innate connection to the motherland and its lengthy cultural background. Therefore, the development of Hong Kong's art characters can be traced back to the culture of the motherland, which then merged with Chinese and Western cultures to gradually form a unique incarnation. Calligraphy was a kind of art, and the art characters derived from it form another typographic feature (Xiao, 2016; Lee, 1997). Complex, rich creative characteristics (Belk, 2007) significantly influence artistic value. Furthermore, the creation of these creative characters was changing. Thousands of characters were created, all extremely distinctive and varying in shape. The visual material collected about the reflected that art enriches the colour of life and subsequently enhances people's tastes, thus promoting the overall development of society (Tsien, 1985). This finding revealed the artistic characters of typography. They emphasise the typographic characteristics inherent in the structure of a text. Similar to the point of view from Zhang (2000), characteristics of Hong Kong typography, has freer and more possibilities to be changed, a quality that is unique to Hong Kong's unique blend of Chinese and Western culture.

The findings and discussions from scholars strengthened the uniqueness of Hong Kong typography (Zhang, 2000; Choi, To & Chiu, 2012). However, in one sense, Chinese calligraphy has a high degree of typographic composition. There is often a strong sense of difference. Inferior calligraphy also includes the problem of typos because people are inevitably humbled and ignored. The original idea, or the image after it was processed as an applied text element, can become removed from its original meaning or characteristics. This can be unintentional or because the original creator did not think it was worthwhile. The inclusion of emphasis, in the original typographic form, was based on unconscious encounters; that this was an idea to be exerted could go unnoticed. A combination of both these possibilities is highly likely. Either way, this model has increasingly become one of the methods used in the creation of Hong Kong typography. Because of so-called 'calligraphy', some aspects of this method were the effects of a combination of ideas, since there was no single prevailing technique (Xiao, 2016). Quality is based on the specific tastes of a specific era, and the writing can sometimes seem awkward to those who are unfamiliar with it. It was often disliked in the United States, for instance, because of the original typographic characteristics of Chinese characters. Despite this, there were still many admirable qualities. For example, text elements were often used in Chinese folk crafts (Choi, To & Chiu, 2012). Craftsmen who lacked basic calligraphy or typographic skills still wanted to express themselves through crafts, which often resulted in poorly written typography. Thus, as described by McLaren (2017), a less elaborate kind of Hong Kong typography was conceived through general cooperation. Although very simple in character, this has become an inspiring example of a textual element. The original high-quality Hong Kong typography combines this kind of model with appropriate descriptive techniques and the influences of foreign cultures.

4.3.4 The development in the late 20th century (1970-1990)

Until 1974, after the anti-colonial movement, Hong Kong culture met its peak of influence among other Asian countries such as South Korea, Japan, China, etc. during the 1970s-80s. In the same period, Japanese comics, music and drama alternatively brought the Japanese typographic design to Hong Kong. Japanese design firms, even design foundries such as Monotype facilitated the modification of Hong Kong's typographic design. It spread its influence through mass media platforms, such as movies, TV dramas, songs. This finding revealed Pan (1997)'s analysis. The Hong Kong design followed the mass media platforms to be explored. In the 1980s and 1990s, the change of signboard characters was even more significant. For example, round-faced characters and variety of Hong Kong typography have applications. These were modern design fonts.

Signboards were, on the one hand, diversified, while on the other hand, they continued to strictly adhere to with traditional rules strictly. The fonts used in Hong Kong typography were more diversified, even incorporating spray paint and visual elements favoured by young people. Most of those continuing to use traditional elements were more long-standing companies, old institutions, or new operators in the old industry. Most of them maintained the traditional model, which meant they still applied the script as a signboard. Due to the widespread use of prepress computers, the production of signboards also changed (Ip, 2008). Large-scale printers and large-scale canvas matching meant entire signboards could now be printed by computers and made into a canvas signboard. There were many choices in terms of fonts, but large-scale companies still used proprietary typographic designs and the traditional ideas and characteristics of typography (Wong, 2011). By the end of the 1990s, signboards had become accessible from their prototype or through an applied art analysis of their visual elements (Reed, 2007). Even examples of street art that used specific features as creative elements was applied to signboards in the workshop. Although this still involved some difficulties, like the inability to see the typography size, differences between workshop version and the original street art script were seen as negligible and unimportant. This shows how the development of signboard entered a new era; one which was often more beautiful.

4.3.5 The contemporary Hong Kong Typography (after 1990)

After 1997, Chinese people increased their influence on informational domains. The influence from Western cultures, at the same time, has resulted in the formation of unique visual elements. Their influence also greatly influenced the application of tools, materials as well as printing techniques. These range from the era of typography to the traditional plate-making of offset printing (Ip, 2008). According to the analysis in Ip's article, the art of movie advertisements also turned to more varied visual effects until the end of the 1990s due to the widespread application of computerised pre-press procedures. Shades or colour effects were often combined with the background. The use of computers also resulted in a higher level of integrity. However, it seems that in terms of innovation, it was not as revolutionary as it seems: individual titles for TV series, similar to movies in many ways, also used very distinctive art characters.

According to the above development, the findings provided design students understand the relationships between typography and the changes of Hong Kong culture all around the world. It is also an opportunity to let the world understand and how Hong Kong historical influence on its unique typography. Her unique typography style is the most substantial evidence to present how the culture was infinitely created and grown. The research results also provide an indicator to design participants to investigate the approaches for optimising

the design outcomes as well as promoting the values and culture of Hong Kong style. Hong Kong is characterised by a unique culture thanks to the interactions between East and West and its city lifestyle. This research study leads the general people, both foreigners and Hong Kong people to know the unique typography which is rooted in Chinese culture and influenced by the changing in the society. This study investigated the features of Hong Kong typographic design elements and explored a new way to introduce them to general people. It is also an excellent opportunity to let the world to understand our Hong Kong history and its influence on typography development. Local designers understand the unique Hong Kong culture and use it effectively among their designs through this study. The research results also indicated that local designers or design students to consider if they can include these unique Hong Kong styles in their creation. For typographic and graphic design participants, this study will also provide theoretical background and analysis to understand the relationships between typography and the influence of design concepts from Japan, Southern Korea and China (Sherif, 2017). It is aimed to compile a historical archive of Hong Kong typographic design for Asian academics in order to understand the design history of Hong Kong from another perspective. It is expected that the research result of this study would also examine the value of Hong Kong typographic design and language as a response to the resolution to adopt simplified Chinese.

5 Conclusion

This study demonstrated how cultural design research could be developed through visual content analysis. It has shown how to encode cultural design research topics involving complex issues connecting to the humanities and social sciences. The practical application of content analysis has investigated the development of Hong Kong typography. In recent years, more tourists have been coming to Hong Kong. Some visitors have begun working in Hong Kong, learning the Cantonese dialect and adopting the Hong Kong lifestyle (Chun, 1996). Some studies have explored how the Cantonese dialect has developed in Hong Kong; however, Hong Kong typographic design, which has developed in close connection to the Cantonese dialect, has not received much attention from scholars. Hong Kong was characterised by a unique culture, which has emerged thanks to the interactions between East and West and its city lifestyle. In 1842, Hong Kong was ceded to Britain as a colony; English has been an official language of Hong Kong since this time and could be easily be found in official government documents. After 1974, Hong Kong culture reached its peak of influence among other Asian countries, such as South Korea, Japan and China, during the 1970s–80s. In the same period, Japanese comics, music and drama brought Japanese typographic design to Hong Kong. Japanese design firms, even design foundries such as Monotype, influenced the further development of Hong Kong's typographic design. Its influence spread through mass media platforms, such as cinema, TV and music. All the development has shown the collected visual material revealed the timeline of Hong Kong typography as well as the previous theoretical studies about Hong Kong typographic design style.

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Establishing Trust through Storytelling: A Model for Co-Design

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Recent research has demonstrated that it is critical for designers to establish trust with collaborators in their ability, integrity and benevolence for successful co-design. It has also been acknowledged that in part, this trust is established through storytelling exchanges between designer and collaborator. This paper examines this finding across eight cases where stories have been exchanged between designer and collaborator at different stages in the design process. The cases are comprised of interviews with key stakeholders working in collaborative settings from: IDEO; the National Health Service; Glasgow School of Art; Northumbrian Water; Unilever; Royal Bank of Scotland; Tomato; Traffic Penalty Tribunal; and True North. The emerging themes suggest: stories based on real-life settings help to establish trust in ability and benevolence due to the compassion they can demonstrate; stories that employ novel modes of communication help to establish trust in integrity due to the fulfilment of an expectation to be 'cutting edge', and, stories that include elements of humour help to establish trust in benevolence due to the revealing of character. These findings are presented as a model for co-design, to help an ordinarily instinctive activity become strategic.

Keywords: storytelling; trust; co-design; collaboration

1 Introduction

The role of design is ever growing, and has been promoted as a vehicle for organisational change across private (Gloppen, 2011; Junginger, 2006; Junginger & Sangiorgi, 2009), public (Bevan, Robert, & Bate, 2007; Design Commission, 2013) and voluntary community sector settings (Author, 2015). As design has moved from its traditional field of making 'things' to creating change, the focus of research has initially been to track impact, in order to justify the presence of the discipline in fields normally linked to traditional management subject areas (Sangiorgi, 2011; Wetter Edman, 2011). More recently, focus has shifted to understanding the collaborative relationship between designer and organisation, as that too has altered as a result of this new focus on designing behaviour, rather than objects (Yee, Jefferies, & Michlewski, 2017; Yee, Jefferies, & Tan, 2014).

A recent research inquiry has established the importance of trust between designer and organisation, in order to co-design strategic level processes and enact radical change (Author, 2015). The designer's trustworthiness was more important to the collaborator than the trust vested in the methods being applied, as the collaborator had to believe in their ability to use the approach in the best way possible for the organisation (Author, 2015;

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Author, 2017). The research presented in this paper builds on this initial understanding by interrogating the role that storytelling plays in establishing this trust across three different cases, before proposing a new approach to using storytelling to enhance co-design in organisational contexts.

1.1 Important Types of Trust in Collaboration

The importance of the trust between designer and collaborator has not been widely discussed to date. Research conducted into this topic has predominantly focused on the different forms of empathy and their role in design projects (e.g. Goleman, 2007; Kimbell, 2013; Kouprie & Visser, 2009, Young , 2014). Goleman (2006, p. 101) builds on the idea of empathy by suggesting that people can display types of intelligence, such as 'emotional' and 'social', which can be linked to a designer's ability to elicit trust from a client or stakeholder. Recent research has also explored the role of the designer in projects that aim to bring about change (Tan, 2012; Yee, Jefferies, & Michlewski, 2017; Yee, Jefferies, & Tan, 2014), suggesting that personality traits, as well as design skill, are significant in achieving success. Amongst these texts, the importance of trust is often mentioned, but *how* it is elicited between a designer and collaborator is not explicitly explored.

The development of trust and its importance in relationships and activities has been studied across a variety of subjects, including social sciences, psychology, economics, and management. Based on the analysis of various literature, Rousseau et al., (1998) created the following definition:

"Trust is a psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions or behaviour of another". (Rousseau et al., 1998, p. 395).

Rousseau *et al.* (1998, p. 395) suggest that there are two conditions of trust, the first being risk. In this study, the collaborations with designers (introduced in the proceeding section) can be seen as carrying risk, as the organisations were engaging with an external consultancy or team to try and further an internal objective. In three instances, this risk was heightened as the engagement was with design students from UK universities, where the implied inexperience of the students created a sense of risk.

The second condition of trust is interdependence, where "the interests of one party cannot be achieved without reliance upon another" (Rousseau et al., 1998, p. 395). In all co-design projects, success cannot be achieved without engagement with key stakeholders to help the designers shape successful solutions. Therefore trust, by Rousseau's definition of both risk and interdependence, was present in all of these cases.

The varying theories of trust (Mayer, Davis, & Schoorman, 1995; Rousseau et al., 1998; Williamson, 1993) mean that there are also many models on how to view the outcomes, causes or prerequisites of trust. As there are no specific models on the development of trust in relation to design in social contexts, it is appropriate to draw on those proffered by organisational discourse to support the discussion of the development of trust in this case study. Mayer *et al.*'s (1995) model of trust is the most widely accepted in the relevant literature, and its three aspects of perceived trustworthiness; ability, integrity and benevolence, will be used to frame this study's findings.

Mayer *et al*., (1995) define the first of the factors in perceived trustworthiness as *ability*, described as the "group of skills, competencies, and characteristics that enable a party to have influence within some specific domain". Many other models have identified similar factors (e.g. Gabarro, 1978; Kee & Knox, 1970; Williamson, 1993), the terms often used imply an expertise or competence that is more generic. However, this model depicts a trustee's perceived ability as task and situation-specific; in one area they may be considered expert, and in another, be perceived to lack the necessary ability (Mayer et al., 1995; Schoorman, Mayer, & Davis, 2007).

Integrity in this model "involves the trustor's perception that the trustee adheres to a set of principles that the trustor finds acceptable." (Mayer et al., 1995, p. 719). Those 'principles' need to correspond with those held personally by the trustor (the person imparting the trust), but also the organisational principles. Mayer et al., (1995) cite other research projects on trust relationships, such as those conducted by Gabarro (1978), who defines integrity as character, and Hart et al., (1986), who describe it as openness or congruity, as further evidence of the importance of integrity in perceived trustworthiness.

Mayer *et al*.'s (1995) third and final component of trustworthiness is *benevolence*; "the extent to which a trustee is believed to want to do good to the trustor… that the trustee has some specific attachment to the trustor" (Mayer et al., 1995, p. 718). A trustee has to demonstrate that their relationship with the trustor, in this case, the client, is not purely about personal gain. A designer's benevolence would be judged in relation to their desire to achieve the best outcomes for the stakeholders or organisation i.e. putting organisational goals ahead of individual ones (Rosen & Jerdee, 1977). Previous research has found that the trust placed in the designer, was more important than that they placed in the approach, as the designer was the only proponent of the 'benevolent' trait, which was particularly important in a social context (Author, 2015).

Whilst researchers have considered the relationship between trust and the impact of design on an organisation (Author, 2015; Yee, Jefferies, & Michlewski, 2017; Yee, White, & Lennon, 2015), research into precisely *how* designers present the three features of trustworthiness is of particular value to those looking to co-design in contexts where risk and interdependence exist.

1.2 Establishing a Criteria for Storytelling in Collaboration

In the research inquiry related to this paper, storytelling was found to be one of the ways that the designer established trust in both the approach, and themselves as the proponent of the process. They used storytelling to share previous successful applications of design and service users' experiences across all project settings (Warwick, 2015).

Storytelling is a useful phenomenon to acknowledge when examining collaborative processes, as the universality of stories in sharing and conveying knowledge is well recognised (Collison & Mackenzie, 1999; Davenport & Prusak, 1998; McDonnell, Lloyd, & Valkenburg, 2004; Nonaka & Takeushi, 1995). Collaborative relationships such as those between designers and their clients provide a platform for storytelling to occur during the conveyance of knowledge from one party to another (Leonardi & Bailey, 2008). In these instances of storytelling, designers are able to exhibit the factors that elicit trust.

Storytelling can take many forms, including conversation, presentation and storybook. In relation to displaying factors of trustworthiness, both psychological and dialogic models of

storytelling are relevant. Psychologist Jerome Bruner (1990) developed a theory of the narrative construction of reality, in which he set the following criteria for an occurrence of storytelling:

- Action directed towards goal
- Order established between events and states
- Sensitivity towards what is canonical in human interaction
- The revealing of a narrator's perspective

Further to this, storytelling's specific relationship with design has been considered from a variety of viewpoints. Design researcher Peter Lloyd (2000) examines dialogue between members of design teams in order to extrapolate the stories that they tell during the process of designing. Of particular interest in his research is the criteria he establishes to identify an occurrence of storytelling:

- It can be interpreted or read
- Different narrative viewpoints can be included
- There is a sense of closure; a definite ending
- A name can be invented that references the complex of action

A verbal exchange between designers constitutes only one form of communication that designers may use during a collaborative design project. The first criterion suggests that a story is interpreted or read. With respect to other formats of communication that designers may use, such as imagery and film, it could be argued that a story can also be heard or watched, both of which also require interpretation.

Therefore, when adapting this criterion to the context of a collaborative design project, it should simply state that '*it can be interpreted'*. The third criterion suggests a sense of closure is required; however, a concept, which by all intentions may require further development, can be communicated using an open-ended story to stimulate further discussion. Therefore, it is not necessary to fulfil this criterion at all times during a collaborative design project. The second and the fourth criteria are wholly relevant. As a viewpoint or range of viewpoints can be represented through a concept or range of concepts. Also, when communicating a design concept, it is likely that a name will be invented to reference the story, which can then act as a recall for the design concept itself.

When comparing these criteria to Bruner's (1990), it can be seen that there are some similarities: both agree that a story must reveal a perspective or viewpoint; Bruner (1990) suggests that there must be an order of either events or states and Lloyd (2000) proposes that there must be a definite ending suggesting an order of events or states. However, in addition to Bruner's (1990) criteria, Lloyd (2000) also suggests that a story must be interpretable, meaning that an understanding of something can be gained from it and that a name can constitute a reference to the story. An adaptation of these criteria for an instance of storytelling in a collaborative design project is communicated below:

- There is action directed towards a goal
- It can be interpreted by the audience
- There is a sequence of events and/or states
- There is a sensitivity towards user interaction
- The designer's perspective is revealed in the communication

- A name can be invented to reference the complex of action

It is this combination of these theorists' models for storytelling, adapted to the context of a collaborative design project, which define the specific instances of storytelling that this research examines. The cases presented in this paper all refer to stories exchanged between designer and collaborator that fulfil this criteria. It discusses these projects in relation to the three factors of trustworthiness established in the previous section; *ability, integrity* and *benevolence,* in order to suggest how different types of storytelling can be used to exhibit each one.

2 Methodology

A case study research design was chosen to "define topics broadly not narrowly, cover contextual conditions and not just phenomenon of study, and rely on multiple and not just singular sources of evidence" (Yin, 2003, p. 33). This study is thought to be the first exploring the role of storytelling in eliciting trust in co-design projects, and as such, dictated an exploratory design (Yin, 2003, p. 3). An embedded, multiple-case design was chosen, exploring design projects that involved eight different organisations and designers, allowing the authors to draw more generalizable insights (Yin, 2003, p. 45).

Cases had to comprise of a situation where organisations worked collaboratively with designers who communicated using storytelling as defined in section 1.2. However, it should be noted that trust was not explicitly mentioned in any of the research material or interview questions, so as not to prejudice the research.

The research was qualitative by nature, in order to explore "well-grounded, rich descriptions and explanations of processes in identifiable local contexts" (Miles & Huberman, 1994, p. 3). The researcher conducted semi-structured interviews (Robson, 2011) with key stakeholders (both designers and organisational employees) involved in each collaborative setting. Interviewees were asked to speak about the storytelling that occurred and how this had impact. A thematic analysis of the interview transcripts was then conducted, in order to establish relationships between storytelling and trust. The cases were as follows:

2.1 IDEO

IDEO are a world-leading global design consultancy. They have over seven hundred employees in nine different locations across the world. They work collaboratively with many different types of organisations on complex challenges. Much of the communication that takes place between them and their collaborators involve examples of storytelling. An interview was conducted with an employee of IDEO about their collective experiences of co-design projects whilst working there.

2.2 National Health Service and Glasgow School of Arts

In 2012, designers from the Glasgow School of Art collaborated with the National Health Service in order to help them re-design the nutritional management and monitoring system for vulnerable, older hospital patients. There were several examples of storytelling during the co-design project. An interview was conducted with a designer from Glasgow School of Arts about their experiences during this project.

2.3 Northumbrian Water

Northumbrian Water are a utilities company based in the North East of England. In 2016, they worked collaboratively with Northumbria University Design School. They asked

industrial design students to co-design concepts that would stop the general public from flushing unsuitable things down the toilet. In total, five groups of three designers presented their work at interim and final stages, which were all examples of storytelling that met the aforementioned criteria. An interview was conducted with an employee from Northumbrian Water about their experiences during this project.

2.4 Unilever

Unilever's Research and Development Centre, UK, has a long-standing relationship with many universities and design consultancies. During these relationships they have collaborated on many projects for their Laundry and Household Care departments from 2004 until present day. Much of the communication that took place during these projects involved examples of storytelling. An interview was conducted with an employee from Unilever about their experiences, having been involved in many of these projects.

2.5 Royal Bank of Scotland and Glasgow School of Arts

In 2016/17, designers from Glasgow School of Art collaborated with the Royal Bank of Scotland to help them re-think their Security Assurance services. An interview with an employee from the Royal Bank of Scotland, and three interviews with designers from Glasgow School of Art, were conducted about their experiences during this project, in which they described several examples of storytelling.

2.6 Tomato

Tomato are a London-based design consultancy that specialise in brand, product and digital experiences. The majority of the communication that takes place between them and their collaborators involve examples of storytelling. An interview was conducted with an employee of Tomato about their collective experiences of co-design projects whilst working there.

2.7 Traffic Penalty Tribunal

The Traffic Penalty Tribunal are a Government department charged with managing the parking appeals system in the UK. The parking appeals system relates to the council's monitoring of illegally parked cars; if a member of the public is issued with a penalty for parking illegally they have a right to appeal this judgment. Since 2009, the Traffic Penalty Tribunal have worked with designers to co-design new concepts for parking appeals related systems. Much of the communication that took place during this work involved examples of storytelling. Two interviews were conducted about this experience, one with the Chief Adjudicator of the Traffic Penalty Tribunal and one with an in-house designer that worked for the Traffic Penalty Tribunal for a number of years.

2.8 True North

True North are a Manchester-based design consultancy that specialise in co-designing brand experience. Most of the communication that takes place between them and their collaborators involve examples of storytelling. An interview was conducted with an employee of True North about their collective experiences whilst working there.

3 Case Examples and Discussion

After conducting a thematic analysis of the transcribed interviews, several themes emerged in relation to how storytelling had contributed to establishing trust. However, there were three key themes present in multiple cases:

- Storytelling based on real-life experiences observed by the designer established trust in their ability.
- Novel modes of communication to tell stories established trust in the designer's integrity.
- Storytelling based on real-life experiences observed by the designer, delivered with an element of humour, established trust in their benevolence.

For illustrative purposes, the following sections will describe an example of how these themes existed in one of the cases. It should be noted that examples of the stories are not included in the discussion, as they are deemed commercially sensitive. Instead, the sense of the story has been described and the focus of the discussion is on the impact of the story in relation to perceived trustworthiness of the designer.

3.1 Northumbrian Water Case Example: establishing trust in ability

In this case, an employee from Northumbrian Water was interviewed about a collaborative design project that asked industrial design students from Northumbria University to create concepts that would stop the general public from flushing unsuitable items down the toilet. The Northumbrian Water employee focused a lot of their responses on the final concept pitches.

The employee from Northumbrian Water proclaimed unprompted that pitches delivered through storytelling *'worked better'*, and that when storytelling isn't used *'there's no context'* and the pitch therefore *'doesn't have the same level of meaning'*. When asked to explain why they believed this was the case, they began to recall the pitches and concluded that those using storytelling based those stories on real-life observations. It was these instances of real-life observations that demonstrated to the Northumbrian Water employee that these teams were more capable than the others. When probing further as to why they believed this to be the case, they stressed the importance of making stories *'as real as possible'*, because they believed that when *'research [becomes] the foundation of your story'*, you are simply demonstrating the ability you have to compile research into a meaningful insight. They proposed that an organisation can learn from the insight presented in a story of this type, whether or not it has led to a commercially viable concept.

The Northumbrian Water employee proclaimed that they were *'bowled over'* by the stories the industrial design students told. Further to this, they explained that it transpired that storytelling was the *'best way to sell the ideas'* and invigorate thinking around the problem that the design students used to inspire their concept generation (how to get people to stop flushing inappropriate items down the toilet). The change in thinking that this project stimulated has led to Northumbrian Water seeking future collaboration with designers to develop the students' concepts, and also to confront other problems that the organisation has with respect to the wider services they provide. The stories therefore simultaneously demonstrated the students' ability in this domain, but also the relevance of design to a non-design organisation. This experience correlates with those described in four other cases: National Health Service and Glasgow School of Arts; Unilever; Royal Bank of Scotland and Glasgow School of Arts; and Traffic Penalty Tribunal.

3.2 Unilever Case Example: establishing trust in integrity

In this case, an employee from Unilever's Research and Development Plant in Port Sunlight, UK, was interviewed about a series of collaborative co-design projects they had overseen

during their employment. Designers working collaboratively with Unilever included design students from various UK-based universities, and a number of professional UK-based design consultancies. During the interview, discussion was focused on the communications they were engaged in by designers, including project meetings, emails and concept presentations, and the impacts this had had on the organisation.

During the interview, again unprompted, the employee from Unilever proclaimed that communication following a storytelling format was always more engaging. When asked to explain this further, they stated that storytelling *'helps you focus your mind on what might actually work and what might not work or what would be really interesting if you could get it to work'*. When probed further as to how storytelling focuses your mind, they explained that the novelty of the communication demanded their full attention. They proposed that when experiencing stories delivered in modes such as film and animation, as opposed to *'the usual PowerPoint presentation*', you were much less likely to become distracted. An expectation that designers operated on the 'cutting edge' of technology, with respect to modes of storytelling, was implied. When thinking retrospectively about their collective experiences of novel storytelling, they surmised that this was a primary reason why Unilever had had such a long-standing relationship with design professionals. When asked to explain this further, they attributed engaging novel storytelling to *'authenticating basic ideas'*; bringing a level of integrity to their working relationships.

It is important to mention that when in a situation where the integrity of a working relationship is influenced by the capability of using what is perceived as a novel mode of storytelling, there are various implications. Firstly, you must understand what is perceived as novel by your audience, and secondly, you must understand how to stay on the vanguard of novel storytelling during a time when diverse communication styles become ever more mainstream.

When reflecting on the body of work that has happened collaboratively between designers and Unilever, the Unilever employee acknowledged that a cultural change had taken place in the organisation. Part of the responsibility of their role within Unilever was to *'find new ways of working'* and they firmly believe that design has helped to achieve this goal, in particular due to the stories they have told. This correlated with the impacts of storytelling described in the following cases: IDEO, Northumbrian Water, Tomato, and, True North.

3.3 Traffic Penalty Tribunal Case Example: establishing trust in benevolence

In this case, a designer and chief adjudicator (self-proclaimed storytellers) working for The Traffic Penalty Tribunal were interviewed about their experiences of pitching new concepts for dealing with parking appeals to various councils in the UK.

During the interview, both the designer and the chief adjudicator explained that it was crucial to *'win over'* their audiences as quite often they were *'dyed in the wool'* people. By this, they meant that the people in their audiences had only ever done things in a certain way and that because of this, they anticipated it might be difficult to change their mind about how to do these things. When asked how storytelling had helped them in these situations, they proposed that providing context through telling stories based on the *'real-life experiences'* of people parking illegally, and those enforcing the law, seemed effective. When asked to discuss this further, they described that when you create a story from the real-life experiences of many, you have to condense these people down into a single character. In thinking about this character, and their voice in the story, you have the possibility to inject

personality quirks that add a level of humour. They believed that doing this can *'make [a storytelling experience] fun'*, and appeal that it appeals to *'the lighter side'* of your audience. When reflecting on these instances of storytelling, they believed that a more positive experience had been achieved as the audience trusted in the benevolence of their ambitions.

The designer and chief adjudicator from the Traffic Penalty Tribunal collaborated with many councils throughout the UK, and also presented their work at an IFG conference event that included representation from Westminster. Evidence of the change that this work has stimulated in their collaborative partners is considerable; the Traffic Penalty Tribunal became the first body to develop an online parking appeals system in one particular council, and the stories they have told about the success of this project have stimulated similar work in other areas. For example, a UK court of justice also reformed their appeals service by providing an online system as a result of this work. The designer directly linked the impact to the relationship they developed in each setting, which highlights the importance of the stories told to persuade councils that they wanted to 'do good' for the organisation and its stakeholders. This experience correlates with experiences described in the Northumbrian Water and Unilever cases.

4 Establishing Trust through Storytelling: A Model for Co-Design

It is essential that trust is established between designers and organisations when working collaboratively; without trust, the success of co-design is limited (Warwick, 2015). As demonstrated by the research this paper discusses, storytelling has an intimate relationship with establishing trust in a number of ways.

Firstly, storytelling can establish trust in the ability of a designer. Before revealing their concept, a designer has an opportunity to tell a story that justifies the concept's existence. This might happen on an informal basis during discussion, or a more formal basis such as a design pitch. In this instance, stories told from the perspectives of real people have proven to give an organisation trust in the designer's ability. For example, before revealing a concept for a time-saving kitchen gadget, a designer might tell a story about a single parent family preparing a meal based on their observational research. These types of stories were identified as establishing trust in a designer's ability in five cases examined.

Secondly, storytelling can establish trust in the integrity of a designer. During collaboration between designer and organisation, there are a number of opportunities to share stories on an informal basis about previous work. This typically occurs during the early stages of project negotiation. In these instances, showing work that employed novel styles of communication reinforced trust in the designer's integrity. However, when comparing case studies, it became apparent that what is deemed as novel by an organisation is dependent on their experience. For example, using a movie to pitch a concept might seem novel to an organisation that has only ever used PowerPoint presentations, whereas an organisation that has seen many movie presentations might find an animation more novel. It transpired that there is an expectation from organisations that designers are 'cutting edge' with regards to the communication styles they use when storytelling. As such, novel communication styles were identified as giving confidence in designers' integrity in all cases examined.

Finally, storytelling can establish trust in the benevolence of a designer. The organisations in all cases examined identified that using the perspectives of real people in stories that discuss and pitch concepts can indicate benevolence. This was attributed to the fact that

showing an understanding of someone other than oneself is viewed as compassionate. Further to this, they also indicated that having humourous content in a story also established trust in benevolence. The rationale given for this was that these types of stories revealed the personality of the designer(s) to the organisations they were working with, making the collaboration feel more 'friendly'.

These conclusions are summarised in Figure 1 below:

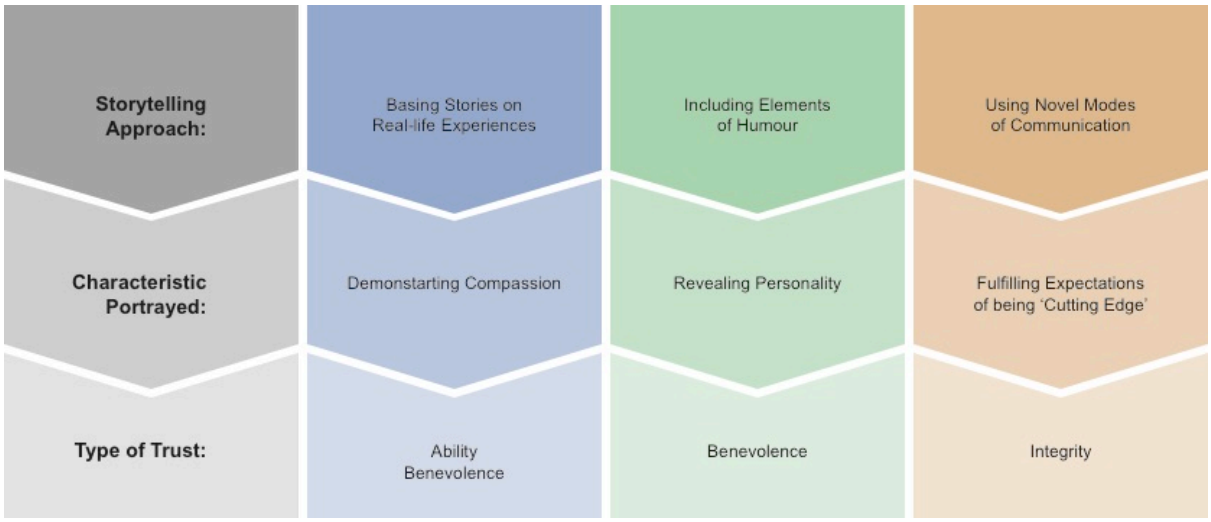


Figure 1: Establishing Trust through Storytelling: A Model for Co-Design

This co-design model offers valuable insight into the way designers can use storytelling to elicit the three factors of trustworthiness, in order to maximise the impact of co-design. It is of value to both practitioners and academics working in contexts where there is a perceived risk in the engagement, and interdependence between designer and client, that dictates the presence of trust. Designers have used stories intuitively to help forge relationships with clients, but this research provides detail as to the particular types of stories that can help to demonstrate particular factors of trustworthiness to add rigour to this otherwise instinctive activity.

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David Parkinson: Dr Parkinson's research is concerned with the role storytelling can play when pitching design concepts. It is his belief that a strategic approach to this stage of the design process can lead to more successful collaborations between designer and client.

Laura Warwick: Dr Warwick's research is concerned with the role service design can play within third sector organisations. As well as an academic role at Northumbria University, she also works part-time for various national charities including 'Mind'.

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Evaluating Crowdsourced Designs: How Community Shapes New Product Design

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Organisations increasingly initiate and develop crowdsourcing communities based on the needs for problem solving and innovation. The amount and diversity of designs generated on online communities pose new challenges in evaluating and selecting promising ones. This research aims to examine how crowdsourcing community evaluates crowdsources designs, especially what and how social and technical mechanisms in the community affect evaluating practices of designs. Drawing on prior work in design and creativity, and social evaluation, we uncover multiple criteria of defining and capturing value and conducting evaluating practices in crowdsourcing. More specifically, we argue that categorical assignment of a product design affects evaluators' endorsement and this relationship is moderated by designers' cognitive engagement The findings have theoretical implications for crowdsourcing research community and provide managerial insights for organisations engaged in design crowdsourcing practices.

Keywords: product design; crowdsourcing community; evaluation; design innovation

1 Introduction

The rise of the prosumers (To er 1980: 2) and the ad an ement o Internet te hnology result in vibrant crowdsourcing communities contributing new ideas especially through the web-based platforms (Amabile 1996; Konieczny 2009). Crowdsourcing, coined as a term by Howe (2006), refers to the process of calling for inputs from a large group of people particularly though web-based platforms, which is increasingly applied in generating new designs (Evans et al. 2015; Liu and Lu, 2016).

Design crowdsourcing allows organisations to access a wide and diverse knowledge (Füller et al. 2007) at a lower cost (Nambisan 2002), facilitate new product development and problem solving (Thomke and Von Hippel, 2002), and generate significant commercial benefits for business (Nishikawa et al. 2013; 2017). Whereas third-party design crowdsourcing services are available such as InnoCentive, DesignCrowd and DesignHill, many companies, including LEGO, Threadless and Tokyoflash, have established their own design crowdsourcing platforms (Liu et al. 2019). Yet, the amount and diversity of generated

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designs from crowdsourcing platforms pose a new challenge to evaluate and select promising ones and integrate them into organisations' strategies (Eling and Herstatt 2017).

Facing cognitive and attention limitations, organisations start to use the crowdsourcing evaluation to increase the processing ability and reduce costs (Schemmann et al. 2016). They develop communities of contributors and enthusiasts, mobilise them to rate designs, and provide recommendations for improvement, aiming at simplifying and supporting organisations' decision making (Alam and Perry 2002). Previous research is predominantly concerned with two perspectives: first, how crowdsourcing evaluations effectively assess designs' novelty, originality, and usefulness contributing to new product development (Onarheim and Christensen 2012) and second, how to innovate and optimise incentive systems to encourage the participation of the crowd (Dontcheva et al. 2011). While these studies offer significant insights of crowding's instrumental role in design generation and its service to organisations, very limited research focuses on the evaluation stage of crowdsourced designs. It remains unclear how community evaluates designs in a space characterised by shared identity and intimate social relations among design contributors and evaluators (Sukhov 2018). This is not a trivial question for several reasons: first, such communities, after creation, can form their own norms and values that shape external audiences' perception of organisational identity, and influence market receptions of products; second, internal dynamics among enthusiastic contributors can offer invaluable information for organisations to monitor changes of tastes and preferences of users; third, such communities can also provide inspiration and stimulation for organisations' internal procedures and practices of product design and development.

Our paper considers crowdsourcing communities as one type of navigating device that connects innovation with market through generating and evaluating ideas and designs (Araujo et al. 2010). On the one hand, crowd serves as a critical source of innovation with a strong linkage with consumption; on the other hand, it also provides an opportunity for users and enthusiasts to express their passion and engagement. Thus, crowdsourcing practices are instantiations of multiple definitions and orders of worth, including economic, cultural, social and technical values (Stark 2009). Crowdsourcing communities are venues of encounters and interactions between different actors involved in related practices (Collins 2004). We draw on literature from creativity and design research (West and Bogers 2014), and social evaluation (Lamont 2012) and define crowd evaluation is a social process that negotiates intersubjective understanding of designs and creativity in a relational manner. The aim of this study is to understand what makes product designs more attractive than others to community members.

The online community of enthusiastic members provides a unique opportunity to study crowdsourcing evaluation. Since both designers and evaluators are familiar with the firm and its products, and the spirit and lifestyles they present, their evaluations are situationally and culturally bounded. We argue that evaluators interpret product designs by looking for creativity cues (Cronin and Loewenstein 2018). First of all, category research (Hsu and Hannan 2005; Negro et al. 2010) suggests that evaluators use categorisation or classification to understand product designs' meanings and market identities and assess

their intrinsic and actual appeal. If a product design is assigned with many categories, it may confuse evaluators and demonstrate its limited efforts in each of the categories. Consequently, product designs with more categories assigned compared to less categories will receive penalties and worse evaluation (H1).

Product designs presented via online platform as cultural goods are talked about, discussed and communicated through language and pictures (Loewenstein et al. 2012). How both dimensions are presented in the design indicates the level of cognitive engagement of a submitter in the design, and her/his taste and sophistication in understanding the collectively shared identity around the firm (Loewenstein and Mueller 2016). By cognitive engagement we refer to actors' efforts invested in verbal and visual behaviours to present and promote their image publicly (Elsbach 2003). We expect to find textual and visual cues in design descriptions condition evaluators' perception and judgment based on categorical understanding. Thus, we propose that higher cognitive engagement (verbal and visual resonance) mitigates the negative relationship between the number of categories assigned to a product design and evaluations' assessment (H2). Figure 1 shows the conceptual framework of this research.

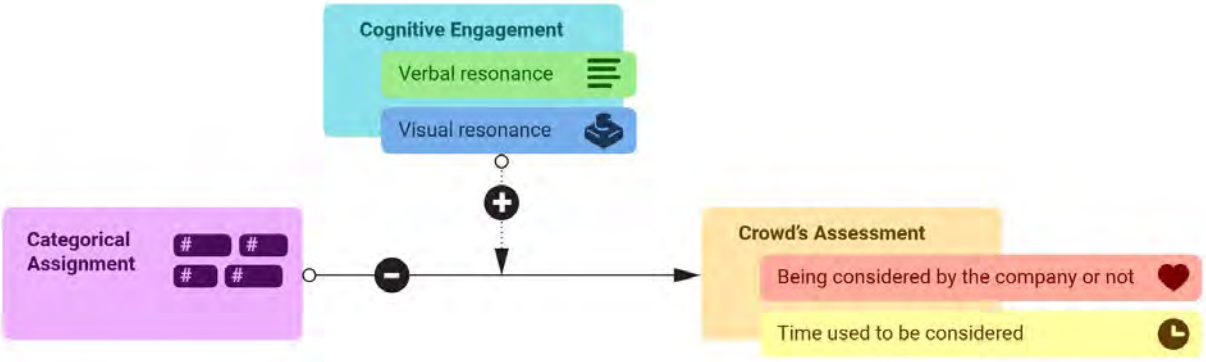


Figure 1. Conceptual framework of this research

2 Research methods

To address the research question, a crowdsourcing community developed and managed by a leading international company in the entertainment sector is investigated. This empirical setting is ideal for our research. First, the successful history of the company was based on providing innovative and creative products. However, a recent crisis has forced the company to rethink and redefine creativity. A crowdsourcing community was developed as part of the reposition attempt to better understand customers and market dynamics. Second, the company has a worldwide customer base that not only buys the products, but also constitutes a community of enthusiastic fans and players. Because of the interactive and experiential nature of the products, customers share the passion in developing new designs. Third, the crowdsourcing community provides a unique space for customers and enthusiasts to generate and play with, and evaluate product designs, and co-develop products with the company. The web-based platform offers a wide array of multimodal information, including

visual, physical, textual, and numerical for our analysis of evaluating dynamics within the community.

The crowdsourcing community provides naturally occurring data covering ideational, interpersonal and textual elements of idea generation and evaluation. We collected all existing product designs in this crowdsourcing platform until August 2018, which led to a data sample of around 2000 designs generated and evaluated by members of the community. This community is a web-based platform, where registered users can post their own product designs and evaluate others. Non-registered users can only browse ideas.

A product design typically consists of following information: the submitter's ID and design submission date, textual description of the design, visual presentation of the design, the update records of the design by the submitter, other users' comments and "likes", and the firm's official comments. To understand how community members evaluate product designs, we use different techniques to explore the rich information provided by the platform. First of all, we coded the textual description of a design by using computational textual analysis to capture linguistic styles and patterns as the text serves as an important communication component to evaluators (Carley 1997). Second, we also coded visual presentation of a design relying on expert raters to assess the content and quality of design components (Kreuzbauer and Malter 2005). In addition, we manually coded the success of each product design – how many supporters an idea gains in a certain time period, and if an idea is chosen by the company or not.

Dependent variable: we are interested in examining what leads to better evaluations. To measure evaluations, we take two different approaches. First of all, we coded whether a product design reached 10000 supporters (a requirement set by the case company). Reaching a certain number of supporters is an indicator of a design\s popularity and marketability. Product designs that surpass 10000 supporters will be chosen by the company for consideration of production. Second, we also counted how many days a product design needed to obtain 10000 supporters.

Independent variables: Categories research has demonstrated that assigning more categories may lead to social penalty because of increasing confusion (Hsu et al. 2009). In our case, a product design may be assigned with more or less tags or categories. For example, a classroom setting may refer to students, teachers, classes, biology, school, etc. We measured *categorical assignment* as the number of tags claimed by a submitter for a design. We coded *cognitive engagement* in two ways. To measure verbal resonance, we used the sociolinguistic – LIWC (Linguistic Inquiry and Words Count, see Tausczik and Pennebaker 2010) to capture words used in the description of each product design. This tool is based on sociopsychological evidence and grouped words in different categories. Percentages of words in cognitive categories are used as a measurement of the level of verbal cognitive engagement. Visual resonance are measured by expert raters' assessment of the quality of various design demonstrations, such as image quality and design details.

Moreover, a number of control variables at the project and submitter level are added in this research. Logit model and ordinary least squares (OLS) methods are applied separately for analysing two dependent variables.

3 Initial findings

We are currently in the process of fine-grained data analysis. Preliminary results provide support to our hypotheses: product designs assigned with more tags are less likely to reach 10000 supporters' threshold. If reached, they used more days to obtain evaluators' endorsement. The abovementioned relationships are moderated by cognitive engagement, so that the higher verbal/visual resonance, the less the negative effect of the number of tags assigned to a product design on evaluation.

4 Contributions to knowledge

This research is an interdisciplinary attempt to study a virtual online community aiming at fostering creativity through the power of social intimacy. This study has important theoretical implications. First of all, it contributes to open innovation literature by elucidating multiple criteria of defining and capturing value. The convergence and divergence in their grammars of worth will advance the understanding of how to organise and structure creativity more effectively. Second, this study advances the knowledge of design generation and evaluations by zooming in onto a small world where contributors and evaluators voluntarily engage in design activities that shape organisational identity. In particular, the multimodality of social evaluations of creative designs are uncovered. Third, this research contributes to interdisciplinary research by showing how design and creativity research and organisational theory research can complement and inform each other. This study also has practical implications. First, it can provide detailed observations of crowdsourcing communities for organisations to test and improve different mechanisms that safeguard and sustain creativity and design innovation. Second, it will showcase different dimensions of design generation processes and patterns, so organisations can learn from the crowd and develop new tools and frameworks to achieve innovative design.

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Exploring Intensity Factors and Patterns of Experience

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As information and media diversify, experiential value and emotion creation, which are required to construct deep experience, is increasingly important. After focusing on quality and function, the object that takes humanity, emotion, and value into consideration has become another medium that design communicates with the world. The type of individual experience is indicative of societal change, which is developing diversely. As emotional intervention and experience creation are intertwined with deep individual experience, this study will explore intensity factors and categories that have an impact on influencing the individual experience. The findings can be separated into two sections, including the intensity factors and patterns of Indi-Experience. The first section presents all the factors affecting the level of intensity in Indi-Experiences, which followed the structure of 'Category-Concept-Properties-Dimension'. The second section defines four distinct patterns of Indi-Experiences based on the analysis of cluster analysis and qualification method type III. The result takes in four patterns of deep Indi-Experience, including 'Good Old Times', 'Powerless', 'Empathy-joy' and 'Sudden Upbeat'. After comparing the eight categories of memorable and deep Indi-Experiences, two main patterns could be stretched out. Meaningful objects or unpleasant situations which raise an unchangeable or un-reproduced fact could seem like a pattern that forms one's deep experience. Secondly, 'Empathy-joy' and 'Sudden Upbeat' shows that unexpected experiences lead to positive emotions could be seen as the other pattern.

Keywords: Experience, Individual Experience (Indi-Experience), Intensity Factors, Activity, Kansei

1 Introduction

In the past, industrial design is focused on the functional aspect of products and is oriented toward system efficiency and enhancement. Human experience, emotion, habit, faith, and empathy are often ignored (Chien-Ta Huang & Rung-Huei Liang, 2009). The user-oriented design trend—close to how human operates and experiences and humanisation feelings, emphasises the importance of elevating the interactive process between user and product and creating better experiences (Jhang-Syong You, Pei-Hua Huang, and Yan-Ru Chen, 2009). Thus, creating extraordinary "Interactivity" is beneficial to creating meaningful shared values. Information Interaction Design (Shedroff, 1999) proposes Creating Values, Compelling, and Empowering thru communicating messages is an essential skill that everyone in the new era should possess.

As information and media diversify, experiential value and emotion creation, which are required to construct deep experience, is increasingly important. (Hsu, C. S., 2016) After

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focusing on quality and function, the object that takes humanity, emotion, and value into consideration has become another medium that design communicates with the world. The individual experience itself could not be explored thorough simplified model considering the elements in the real world, such as time, space, physics, contexts, and signs (Chien-Ta Huang & Rung-Huei Liang, 2009). Even though the concept of “Interactivity” has no clear definition and measurement method. (Rafaeli & Ariel, 2007, Ariel & Avidar, 2015) The depth and quality of interactivity (which constructed experiences) do not have a clear definition in the current stage, while the interactive design is also a new field that rarely defined and categorised (Shedroff, 1999).

The type of individual experience is indicative of societal change, which is developing diversely. As emotional intervention and experience creation are intertwined with deep Indi-Experience, this study will explore intensity factors and categories that have an impact on influencing the individual experience.

The research objective is to explore the intensity factors and patterns of Experiences.

1.1 Research Scope and Limitation

To acquire a holistic sampling of individual experience for analysis, the data points adopt in the research are not limited to specific scenario and sequence. This research focuses on the past experiences of interviewee instead of the Indi-Experience when conducting the experiment. The group interview is conducted in a way that interviewees could freely state their past experiences, and the researcher does not imply and intervene in the narration process. This stating personal memory is called Episodic memory in Psychology, which relates to the memory of human, event, time, place, and object. Since the research process is of sharing experiences based on interviewee’s willingness, the accuracy of memories is thus concerned. Nonetheless, the twist of memory as a result of implication is not in the discussion of this research.

2 Literature Review

Based on the relevant literature, theories, this chapter can be divided into three key parts. In this chapter, research on experiences, activities, statistics and analysis methods applied in this research would be discussed and following by a brief commentary in the end.

2.1 Experience

This section will discuss the correlation between "individual experience" (related to First-hand, personal experience) and "experience" (related to Mental structure, Schema), and its differences. The relevant literature is discussed below.

2.1.1 Individual Experience (Indi-Experience)

Kelly (1987) considers “Individualized Experience” is not merely simple or pure senses, but an explanatory sense toward behaviour. Schmitt (1999) points out that experiences are individual events that a single person reacts to specific stimulation, including the overall nature of life. Individual experience is derived from direct observation of or participation in events, whether the event is real, dreamlike, or simulated. Pine and Gilmore (2011) mention in the book of “The Experience Economy” that individual experience is a fantastic feeling generated when an individual’s conscience reaches specific emotional, physical, intellectual or even spiritual levels. Two different individuals would not go through the same individual

experiences even if they participate in identical events since individual experience is a process of individual associating “mind activities” and “events”.

2.1.2 Experience

The American philosopher and educator John Dewey define “Experience” as a “product” from the interaction between man and environment. As the interaction is an ongoing process and an activity that never ends, therefore man’s experience will reconstruct and rebuild continually. In an ordinary concept, experience includes the scope of “Knowledge” and “Skill”; it is an output from experiencing or observing a particular event and could be applied in later parts of work. The storage and application of experience could be associated using Schema Theory from a psychology standpoint.

2.1.3 Preliminary Summary

This section focuses on the literature review of individual experience (Indi-Experience) and experience, which indeed are two sides of a thing. Based on the extensive review of the psychological perspectives, the experience is the foundation to construct and shape knowledge, value, and belief, and further, affect the generation of behaviour. The experience is also the basis to justify Indi-Experience at the time being. Because of the differences in experiences, two different individuals would not have identical individual experiences even if they participate in identical events since Indi-Experience is the process of association between the personal experience and the event. In essence, experience affects the Indi-Experience, and Indi-Experience also further shapes Indi-Experience.

In order to understand the intensity factor and type of experiences, this research will focus on capturing the experience that is participated in person (self-explanatory). Through conducting a workshop (focus group interview), the research will use the single Indi-Experience as the unit of capturing the experiences and as the foundation for further studies.

2.2 Activity

The research will discuss “Activity” as the unit of analysis to examine the experience and apply activity theory as the main argument in this section. The activity referenced in the research is the overall perspective of an event, including the subject, object, and mediating artefacts.

2.2.1 Activity Theory (AT)

Activity theory (AT) originates from the research of linguistic and psychology by Russian psychologists Vygotsky and Rubinstein; it could be considered as a theoretical structure as well as a methodology. The meaning of the word is not merely activity, but also contains the connotation of events and activities that are meaningful. Vygotsky questions the contemporary well-received Stimulus-response Model as he points out that human activities are meant to have purposes, and activities would be completed using physical or psychological “Tools” (Hasan & Kazlauskas, 2014).

The core of the activity is formed by the relationship between subject and object (See Figure 1) under the development of activity theory structure, and the resulting outcome of activity could be produced either of intended or unintended.

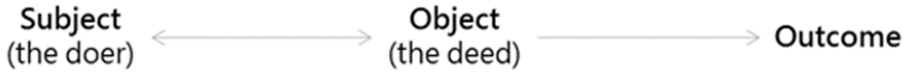


Figure 1 The Core of Activity

The object, which functions as the deed of the doer under this structure, is not limited to physical entities but also includes societal and cultural entities. Although our sensory module cannot proceed with these societal and cultural objects, we could nonetheless utilise them and sense the existence, and as a result, both physical and mental activities have its functioning deed.

2.2.2 Preliminary Summary

This study discovers the depth and type of experience using the activity as the unit of analysis, and through the literature review of activity theory, the research demonstrates that three components of activity are subject, object, and outcome. Involved meditation must be considered and evaluated in the interaction process between the subject and the object.

3 Experimental Methods and Procedure

This study was conducted by qualitative research technique for understanding the intensity factors and discover appropriate categories of experience. Following the last chapter, a preliminary theory model was built through the literature reviews. In this session, the experimental design and structure (3.1) will be discussed, including the method of data collection (3.2) and analysis (3.3).

3.1 Experimental Design and Structure

This experiment included two main phrases, data collection and analysis. In the phrases of data collection, the researcher held four experience sharing workshop (focus group interviews) for gathering the first-hand experience as preliminary data (See Figure 2). Each workshop contains steps of ‘experience collection’ and ‘experience sorting’ by order. Workshop participants will share and note their own experiences, which for the use of experience sorting.

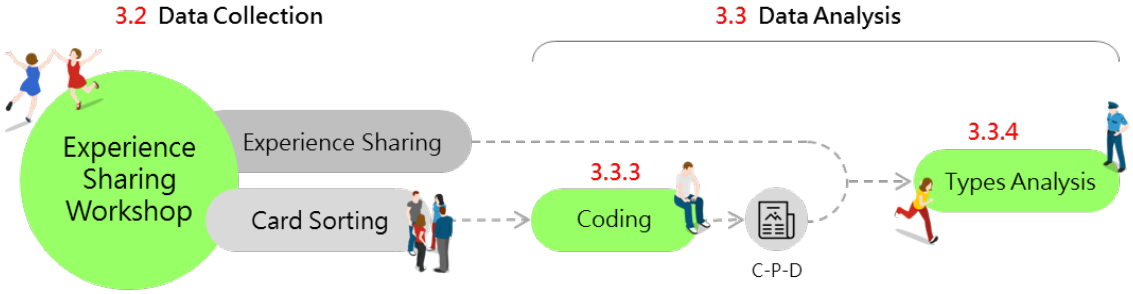


Figure 2 The procedure of Data Collection and Analysis

Moving down to the next part of the experiment, the phase of analysis is conducted by coding and type analysis. A code team is established at the beginning of this stage. There are five coders in the team consisted of 4 graduate students and the author. All the vocal data from the interview will be transferred into transcripts in order to be analysed by coders. C-P-D (Categories-Prosperities-dimensions) structure will be established by conceptualising raw data and re-categorising them in order to build a meaningful structure for understanding the intensity factors of experience. Types analysis will use the factors in C-P-D structure to categorise experiences and contextualise phenomenon.

3.2 Data Collection Procedure

In this section, data was collected from 'experience sharing workshop' (see 3.2.1) by adopting focus group interview techniques. There were two phrases of this workshop: (1) Experience Sharing and (2) Card Sorting.



Figure 3 Structure of Focus Group Interview

3.2.1 Focus Group Interview

Details of the workshop will be included in this section, including participants, environment and equipment, workshop procedure and collected data. In this study, a total of four experience sharing workshops were conducted, and a total of 31 participants were interviewed within the focus group. Ninety-six experiences were gathered within fore workshops, and four evaluated results were presented by the card sorting period.

1. Interviewee Sampling

   Participants' selection is a vital part of qualitative research. The design of the focus group interview follows the principal of high homogeneity in groups in order to create a good interaction within the group and encourage them to talk freely. In the other hand, to control and grasp fruitful opinions and experiences, a total of four experience sharing workshop was built. As consideration of the workload of each participant, each workshop invited approximately 7-9 participants, which slightly higher than traditional focus group interview.

   The composition of the workshop participants is shown in table 3-1. Participants' age ranges from 20 to 30, and most have a bachelor degree or above. More than 60% of the participants have formal working experience. Table 3.1 shows more details of the participants.

2. Environment and tools

   The workshop (interview) environment shown in Figure 3.3. Interview environment is an independent space which can effectively prevent external noise. Participants were seated around the table while the moderator (researcher) seated at the end of the table. The arrangement of the seat ensured that each participant could receive the guidance of the moderator for enhancing the efficiency of the interview and can see each other's facial expressions and body language for reducing the occurrence of semantic misunderstanding. Also, the temperature had been set around 25 degrees Celsius for making sure the workshop will be in a comfortable environment.



Figure 4 Environment of Focus Group Interview

In order to limit the error of transcripts during transferring from sound-recorded data, cameras were set up in both sides of the workshop space, taking video records of each workshop (focus group interview).

3. Interview Procedure

The workshop was run by the framework of the focus group interview and controlled within two hours. The experience sharing workshop is divided into three stages: (1) Introduction, (2) Experiences Sharing and (3) Card Sorting. See Figure 5 for the overview of the focus group procedure.

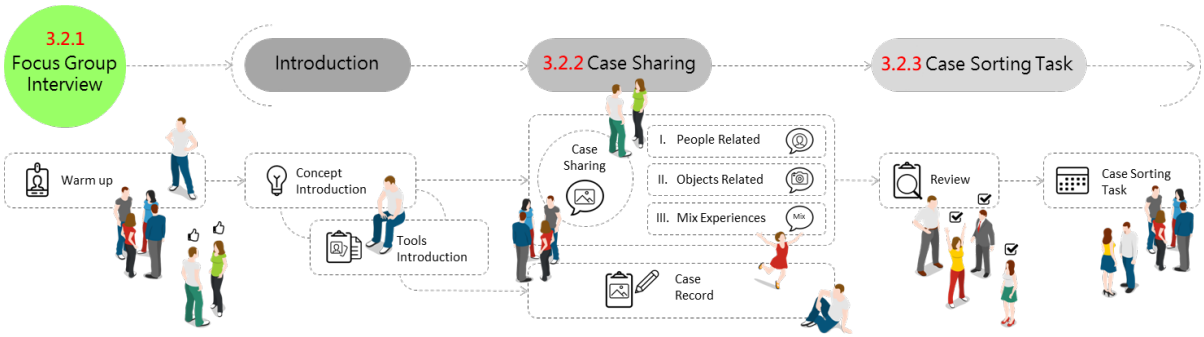


Figure 5 Focus Group Interview Procedure

4. Collected Data

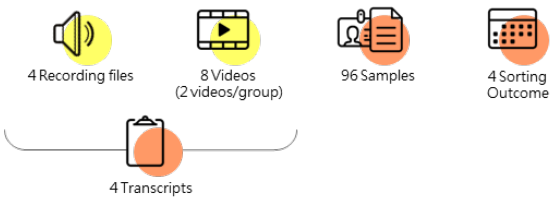


Figure 6 Data Collection

This study conducted a total of four workshops. The collected data included four recording files (sound recording only) and eight videos (2 videos per each workshop). Also, 96 experiences were gathered within four workshops, and four evaluated results were presented by the card sorting period. The video and sound recording data are only for research purposes. All vocal data from the interview will be transferred into transcripts by the researcher for further analysis. (See Figure 6)

3.2.2 Experience Sharing

The Experience sharing session of the workshop encourages our participants to deliver and share their own impressive experiences. After personal experience sharing, note cards were prepared for participants to record their own experience for the next phase of the workshop. In order to better capture 'impressive experiences' from participants and make the discussion more concrete, sharing stage was divided into three parts included (1) people related experience, (II) Object related experiences and (III) Mix experiences as Figure 7 presented.

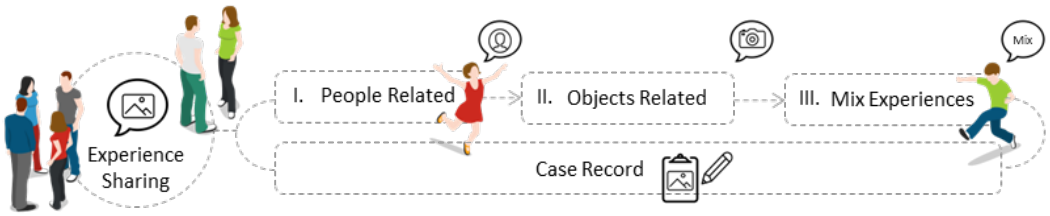


Figure 7 Procedure of Card Sharing Section

3.2.3 Card Sorting

The card sorting session aims to understand how participants define their own experience as deep or shallow. First, the moderator led participants to review and read over their own experiences, which had noted on the notes cards. After all the participants ran through their experiences, they were asked to do 15 minutes' card sorting task. In this session, participants need to cooperate and exchange their ideas of how to differentiate deep experience with shallow one (See Figure 8).



Figure 8 Procedure of Card Sorting Section

As Figure 9 shown, the example of note card has three filled-in space with three main questions, included ‘Object’, ‘Event’ and ‘Feeling’. The note card is designed to let participants record their own experience and can easily share with others.



Figure 9 Card Example (in Mandarin)

3.3 Data Analysis

This study adopts the technique of qualitative coding for data analysis. All the vocal data were transferred into transcripts for better analysis. In order to acquire robust and rich insights from first-hand data, this study takes on similar steps of open coding and axial coding process original from grounded theory. In the coding process, all the data and field notes were reviewed and coded line-by-line in order to capture all the possibilities during the focus group interview. After several discussions with the code team, all the labelled codes captured from transcripts will be put in the model transformed from activity model and multi-store model.

3.3.1 Code Team

For better reliability, a code team was established at the beginning of the coding session. All of the data, including transcripts and video recording, were reviewed separately by coders to avoid mutual interference.

There are five coders in the team consisted of four professionals and author. Merely all the coders have a different background, including psychology, literature and design. In order to acquire suitable coders for this study, all the coders had attended the experience sharing workshop held beforehand and know about the procedure of the workshop. All coders were received coding instruction and done a preliminary coding session before the formal coding session started. Code team was organised as table 3.2 presented.

Table 1 Code Team

No.	Gender	Education	Occupation
01	M	Bachelor of Design and Psychology MS student	Designer
02	F	Bachelor of Design	Production Manager Designer
03	F	Bachelor of Taiwanese Literature	Junior High School Teacher
04	F	Bachelor of Psychology	MS student
05	F	Master of Design	Designer / Secretary

3.3.2 Coding Procedure

The coding procedure used in this study can separate into two sections, (1) labelling section and (2) Categorizing section. (See Figure 10)

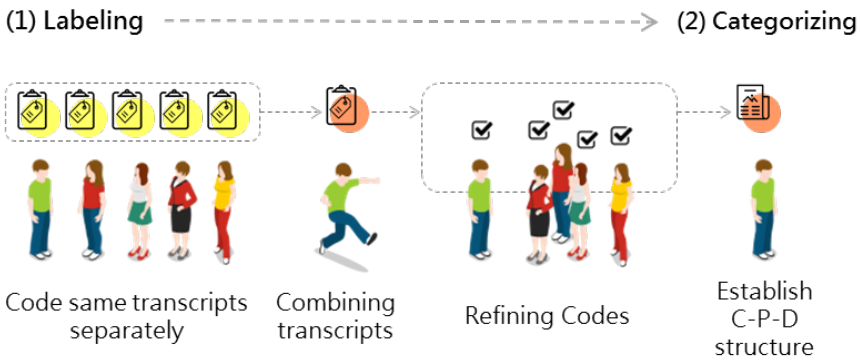


Figure 10 The Procedure of Open-Coding

In the labelling section, all the data was reviewed and coded line-by-line by each coder separately. In a total of four group interviews were coded by a code team in this section. The data was labelled as much as possible and open to all the viewpoints and different interpretation of the original conversation. After collecting all the labelled transcripts, the author generated a combined transcript that put all the labels together as appendix B shown. After, researcher and each coder met separately to refine codes and discuss all the codes (include other coders) on lists to get the prevailing consensus.

In the categorising section, the researcher has to structuralise labels and categories generated from the last section by the researcher's thoughts and ideas. This section followed the structure of 'Categories-Properties-Dimension' to relate all the labels and form a new structure of experience's intensity.

3.3.3 Type Analysis

After the coding session, this study looked further into the classification of experiences by applying the cluster method and quantification method (type III). By applying the outcome from the coding section, the researcher took intensity factors as a measurement to score participants' experiences gathered from the workshop. Types of experiences will be discussed in the next chapter. The score of each factor shown in Appendix A.

4 Findings

Following the study of intensity factors in the previous chapter, the result of the analysis will be discussed in three parts in this chapter. The first part is a basic understanding of how to experience depth is being defined based on the results of card sorting in experience review. The second part organises Categories-Properties-Dimensions (C-P-D) coding method and discusses the potential variables that affect the intensity factors. The third part provides the cluster analysis toward the deep and shallow cases and finds out how networks between intensity factors that affect experiences are formed.

4.1 Capturing Intensity Factors within Card Sorting

This study holds four groups of focus group interviews, and a 15 minute of card sorting phase that only focuses on the cases of each specific session is arranged at the end of each interview. The results of card sorting in the four sessions are analysed as follow.

Participants classify the experiences based on the level of depth in the card sorting phase in group 4. It could be inferred that the intensity factor is a continuous dimension, and an intensity spectrum could be constructed by comparing one to another. (See Figure 11)

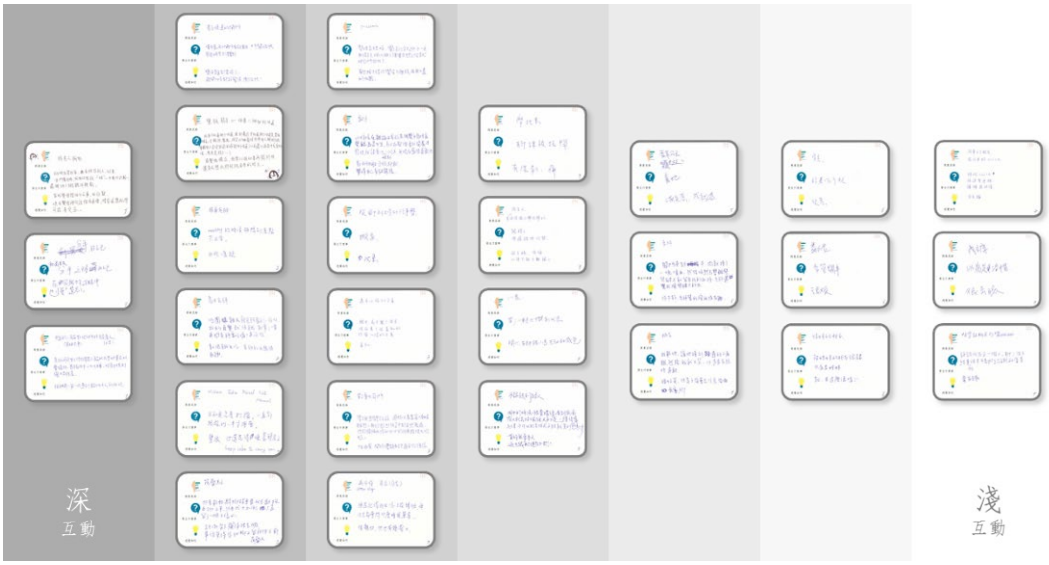


Figure 11 Card Sorting Result of Group 4

The classification structure of card sorting outcomes in group 1 and 3 (See Figure 12) are different from that of group 4 (Figure 11). There is a distinct binary classification between deep and shallow in group 1 and 3 in terms of the plot of event or emotion. Similar cases would be classified into the same group to review intensity and would become the basis for sorting.

Items appear between deep and shallow binary classification in sorting event of group 1. A “medium” item connects deep and shallow areas and constructs a continuation layer. Also, “unclassifiable” items imply that other variables exist in deep and shallow classification.



Figure 12 Card Sorting Result (above: Group 1; below: Group 3)

The participants use the x-y axis graph to review and classify each case by two-dimension – physical experience strength and psychological impact intensity. (Figure 4.3) Participants could, therefore, classify intensity factors clearly, and unclassifiable items do not appear in the group.

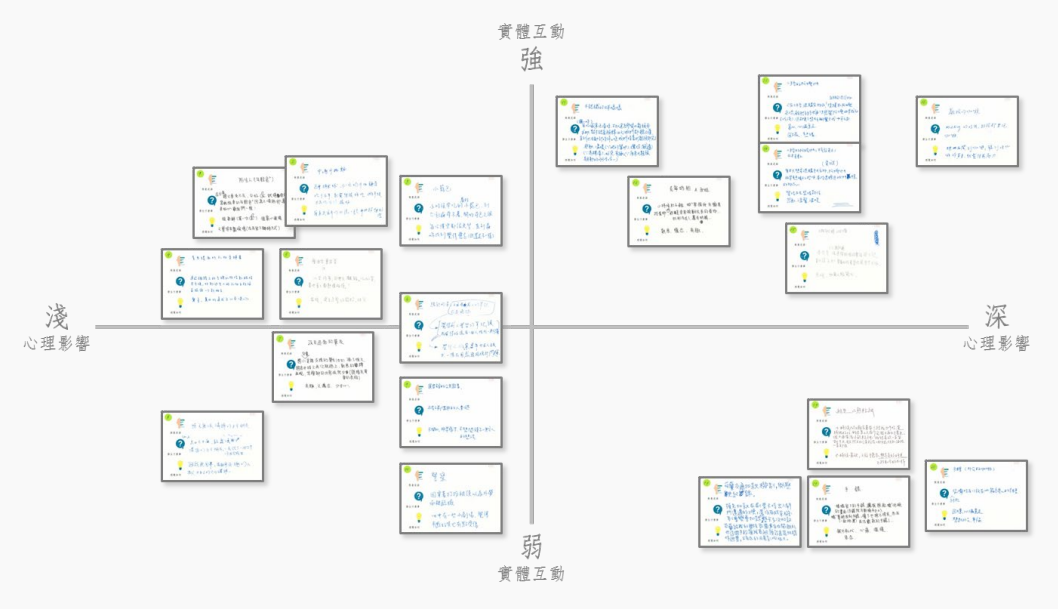


Figure 13 Card Sorting Result of Group 2

During the process of card sorting, it is observed that subject factors such as personal value and impact are relevant to intensity classification. The exchange of thoughts between groups will also have an impact on intensity classification. The card soring outcome could demonstrate points as below:

- The intensity in the Indi-Experience is distinguishable.
- Indi-Experience could be reviewed by sorting and layering.
- Using multi-dimensional classification method could reflect the intensity classification more accurately.

4.2 Intensity Factors of Experience

The multi-dimensional structure that is related to intensity factors is built step by step using the coding method, which could reconstruct the properties and dimensions through conceptualise phenomenon. The study extracts the relationship between subject and object in activity (event) and processes the analysis of each concept through physical and mental activity dimensions.

Table 2 Table of C-P-D Intensity Factors

Category		Sub-Category		Properties		Dimensions	
A	Physical Activity	A-1	Physical Mediation	A-1-1	Material Object	With	Without
		A-2	Duration	A-2-1	Duration	Extended	Brief
		A-3	Direction	A-3-1	Directionality	Two-way	Single
				A-3-2	Initial Direction	Initiative	Passive
		A-4	Condition	A-4-1	Distribution	Normal Event	Random Event
				A-4-2	Reproducibility	Reproducible	Irreproducible
B	Mental Activity	B-1	Perceived Control	B-1-1	Control	Can Control	Cannot Control
		B-2	Intention	B-2-1	Intention	Specific Intention	Without Intention
		B-3	Emotional Connection	B-3-1	Native Connection	Strong	Weak
		B-5	Engagement	B-5-1	Engagement	High	Low
		B-6	Emotion	B-6-1	Pleasantness	Pleasant	Unpleasant
				B-6-3	Emotional Arousal	Arousing	Sleeping
				B-6-4	Turning Point	With	Without
		B-7	Reference	B-7-1	Related Experience	Present	Absent

4.3 Four types of memorable Indi-Experience

All cases discovered in this research should be considered as relatively deep or memorable Indi-Experiences based on the criteria of the workshop. Before discussing the deep Indi-Experience, this study will first focus on discussing the feature of the memorable Indi-Experiences. According to cluster analysis and the rating scale of C-P-D table of intensity factors, deep Indi-Experience cases are categorised into four types (See Figure 14) and are described below.

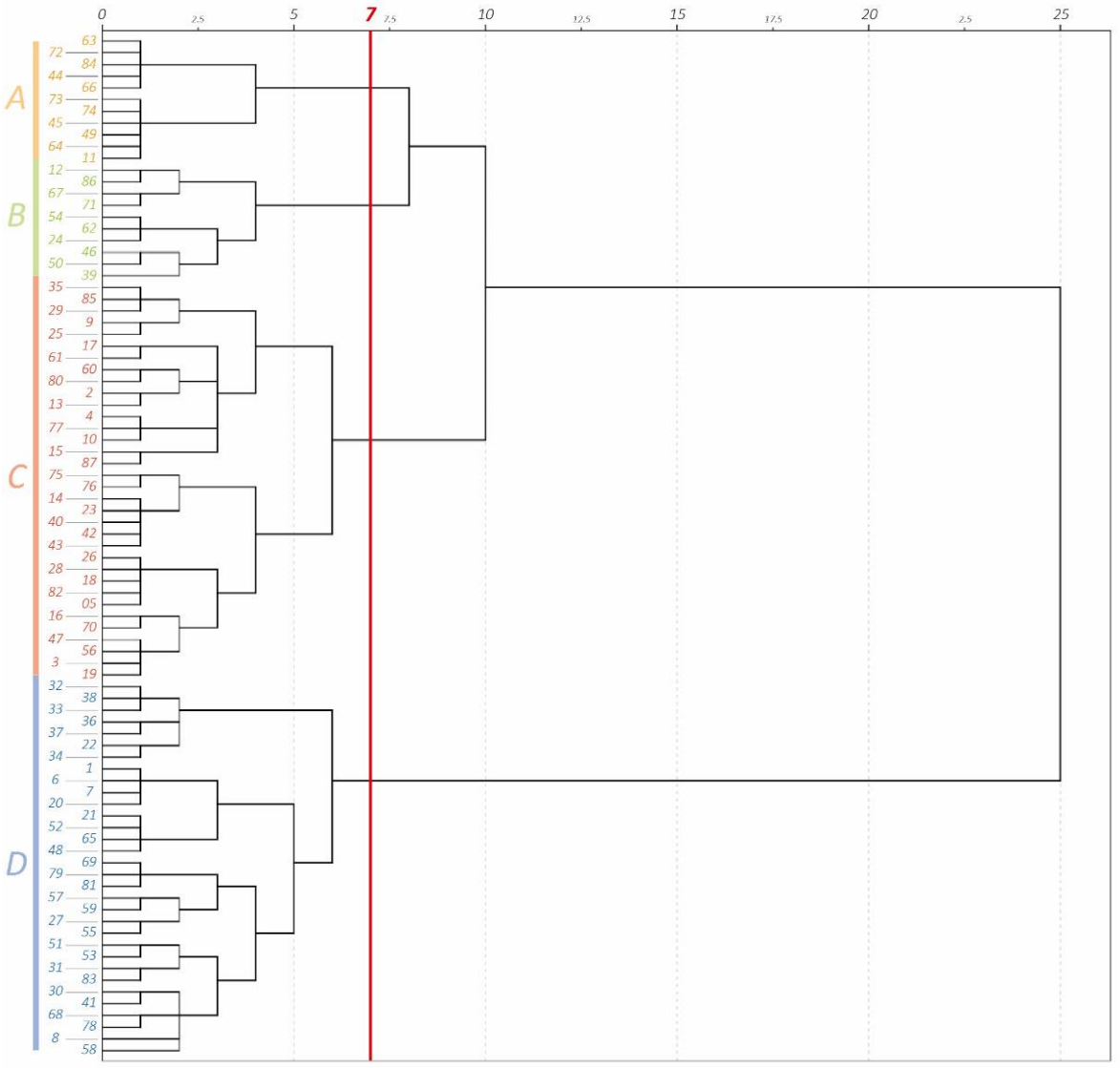


Figure 14 Clustering Tree of Indi-Experience based on Intensity Factors

Based on the cluster analysis of Indi-Experience samples and an overview of the content of the samples, four groups are named and defined, which are disintegrated (A), sensational (B), tangible (C), and unmanageable (D). Cases of four groups and the intensity factors are plotted in the graph below (Figure 15).

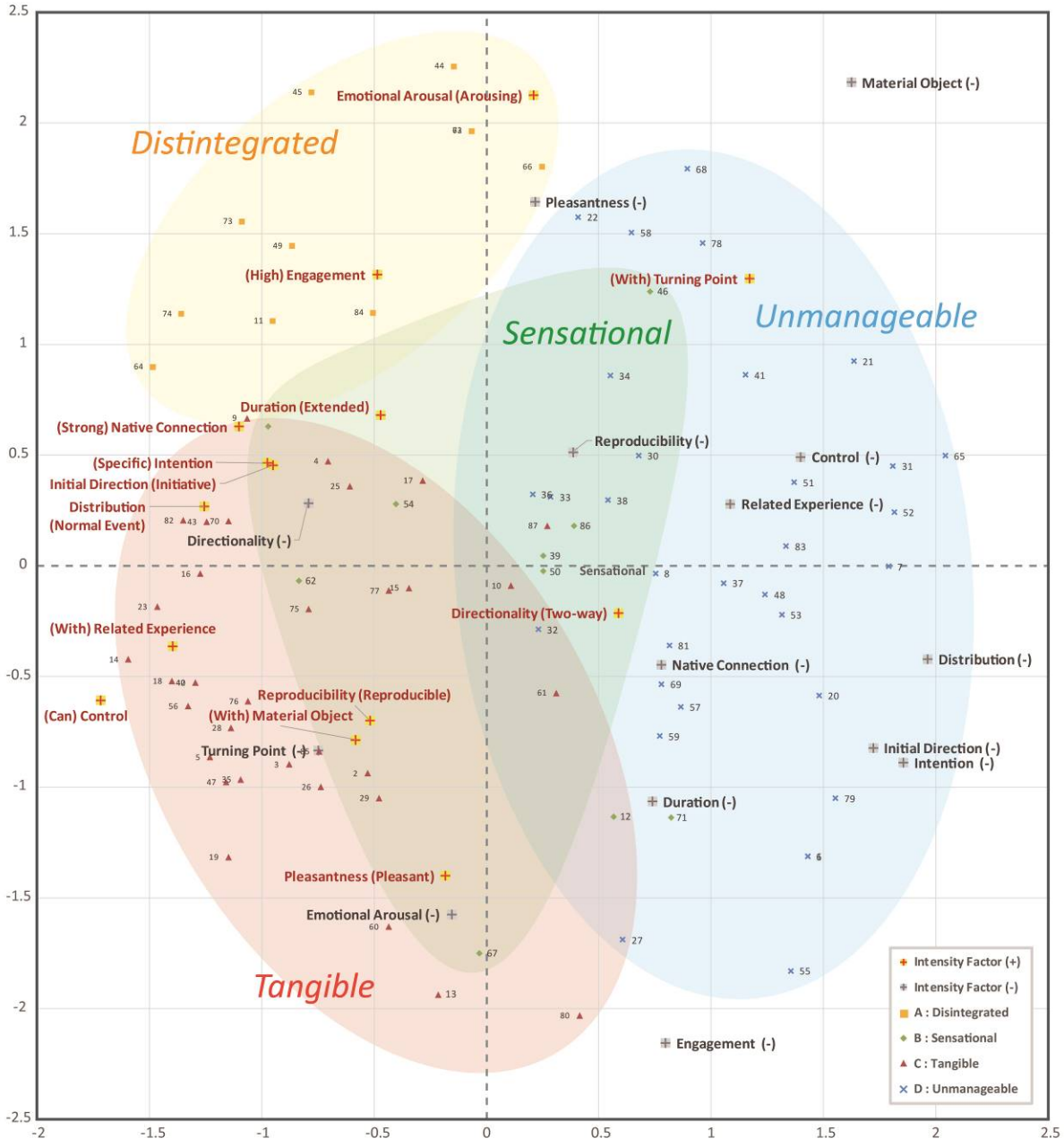


Figure 15 Four Types of Indi-Experiences

- A : Disintegrated

  This type of Indi-Experience often begins with an objective-oriented behaviour and often endure an extended period. However, the resulted is ended with strong negative emotion.

  The strong connection usually exists between object and subject such as an ex-boyfriend, important client, relatives, familiar location, blog posts written by the participant, etc., as observed in the samples. The type of activity usually lasts for an extended period, and the emotion invoked is usually negative and stimulating, for instance, intense emotional connection to the scene that prompts the sentiment, thoughts of passing the time and changed things, complaints of “Why does this always happen to me?”, frustration, self-doubt, and shameful feelings.

- B：Sensational

  “Sensational” type of context has a rich emotional connection, but the actual content could not be recalled precisely. This type of Indi-Experience usually starts from a memory triggered by the senses and resulted in heartwarming feelings subsequently. This type of deep Indi-Experience usually happened years ago and required a series of activities in the background to awake the memory, yet an individual has no control of the content in present days. The memory is often recalled through a strong connection to senses, for instance, the connection between the smell of coffee and pressure, the connection between the taste of soup dumplings and homesickness, and mysterious plant smell prompts the memory of riding a bicycle with father, etc.

- C：Tangible

  A tangible and physical medium that could be controlled must be featured in the event or activity of the “tangible” group. The event itself should usually happen and does not evoke any emotional responses.
  The correlation between these types of events is low. However, a tangible and physical medium or object must be present in the event, such as furniture as an object while assembling it or physical gifts in a gift exchange event.

- D：Unmanageable

  In “Unmanageable” type of experience, subject and object have a less emotional connection and have less relevant experience in between. Thus, this type of event is random, unreproducible, and uncontrollable.
  The object in the type of experience usually has traits of uncontrollable and weak emotional connection. For example, stranger, online acquaintance, someone being mistaken for, etc., are usually the object. It is often the first time that the subject has such experience as it happens randomly. The type of experiences includes receiving an unexpected gift, system error occurring abruptly, or getting injured accidentally.

The Indi-Experience cases of “sensational” memory are projected in between the other three axes; nonetheless, these experiences are still being clustered into one group. It could be seen as between intervention of senses and deep Indi-Experience; there should be rooms of discussion in the future.

4.4 Deep Individual Experience

After the analysis of the memorable Indi-Experience, this session will discuss in detail about the deep Indi-Experience which been identified after the four workshops by the code team. Cluster analysis is conducted for the deep Indi-Experience. The factors that compose deep Indi-Experience will be reviewed and defined.

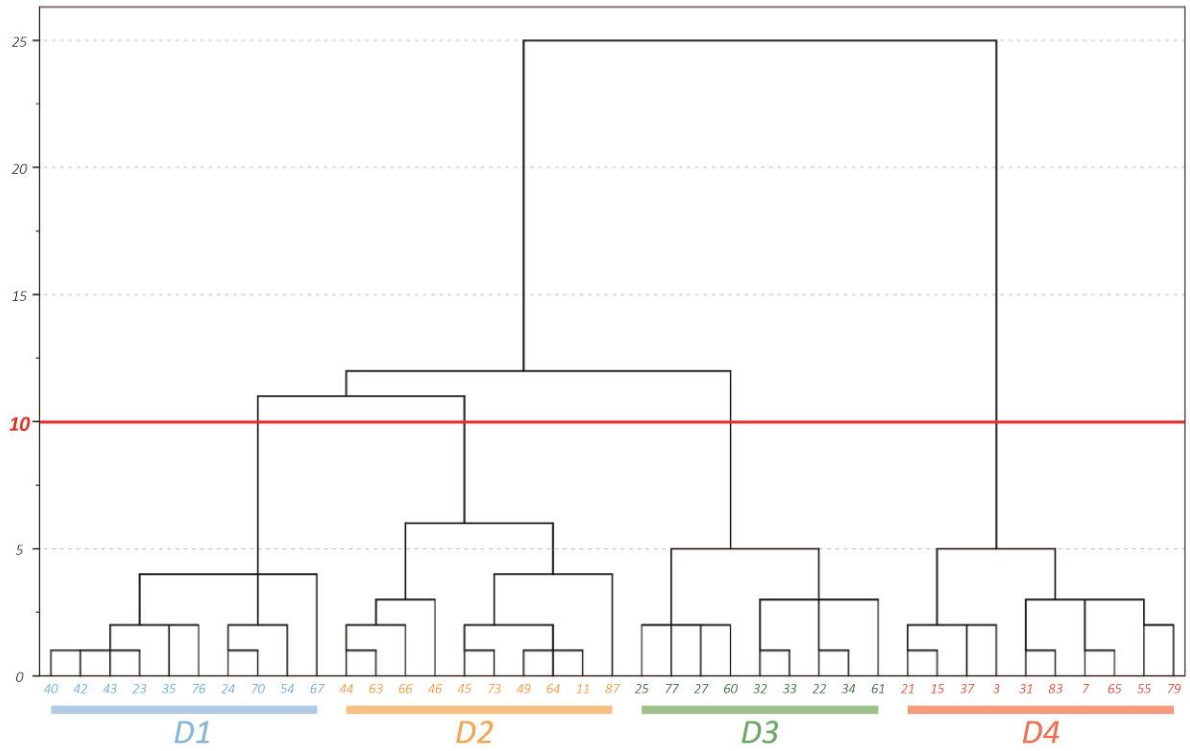


Figure 16 Dendrogram of Deep Experience

Four clusters of deep Indi-Experiences are founded using Ward's cluster analysis to group the cases. Based on the traits they are named as "D1: Good Old Times", "D2: Powerless", "D3: Stranger's Reciprocity", and "D4: Sudden Upbeat". Analyses of the four groups are provided below.

- D1：Good Old Times

  The subject invokes pleasant memories surrounded by an object which were gone for good. This type of Indi-Experience is firmly connected to a meaningful object; for example, like a toy from childhood, sugar can of a grandfather who passed away…etc. Because it is a past that could not be reproduced, the Indi-Experience is a process of reconstructing a period of the past which linked to a specific object.

- D2：Powerless

  The subject proactively invokes memories that are unpleasant and unreproducible. This type of Indi-Experience samples is almost entirely dedicated to the portrayal of "unreproducible memories" – Memory of taste evokes sickness of hometown, life scene with the former partner, amazing experiences shared by a group. Because it is a past that could not be rewind, the experience is a process of reconstructing the memory. The negative Indi-Experience triggered by the type of experience has different levels of significance, including hometown sickness, thoughts of passing the time and changed things, the sadness of unable to reproduce beautiful memory, and the loss results from missing the best times of life.

- D3：Empathy-joy

  The subject purposely reaches out to a stranger and in turn, have a pleasant experience.

This type of deep Indi-Experience focuses on the concept of “exchange” – the subject proactively interacts with an unfamiliar object and receives a genuine positive emotional feedback. The traits of this type are “not previous emotionally connected” and “bidirectional”. Sample descriptions include: Stranger promises hitchhiking request without reservation, retrieving a package from a neighbour who has never met before, and gift exchange with someone who is abroad and yet to meet.

- D4：Sudden Upbeat

  Pleasant mood as a result of receiving an unexpected message.
  This type of deep Indi-Experience focuses on “one-way recipient of information” and “unexpected emotional turn” of two objects that have no emotions attached previously. Some sample descriptions include unforeseen greetings from the bus driver results in a good mood for the rest of the day, an unexpected passionate treat from a stranger, and impacts as a result of memento from an unknown elder.

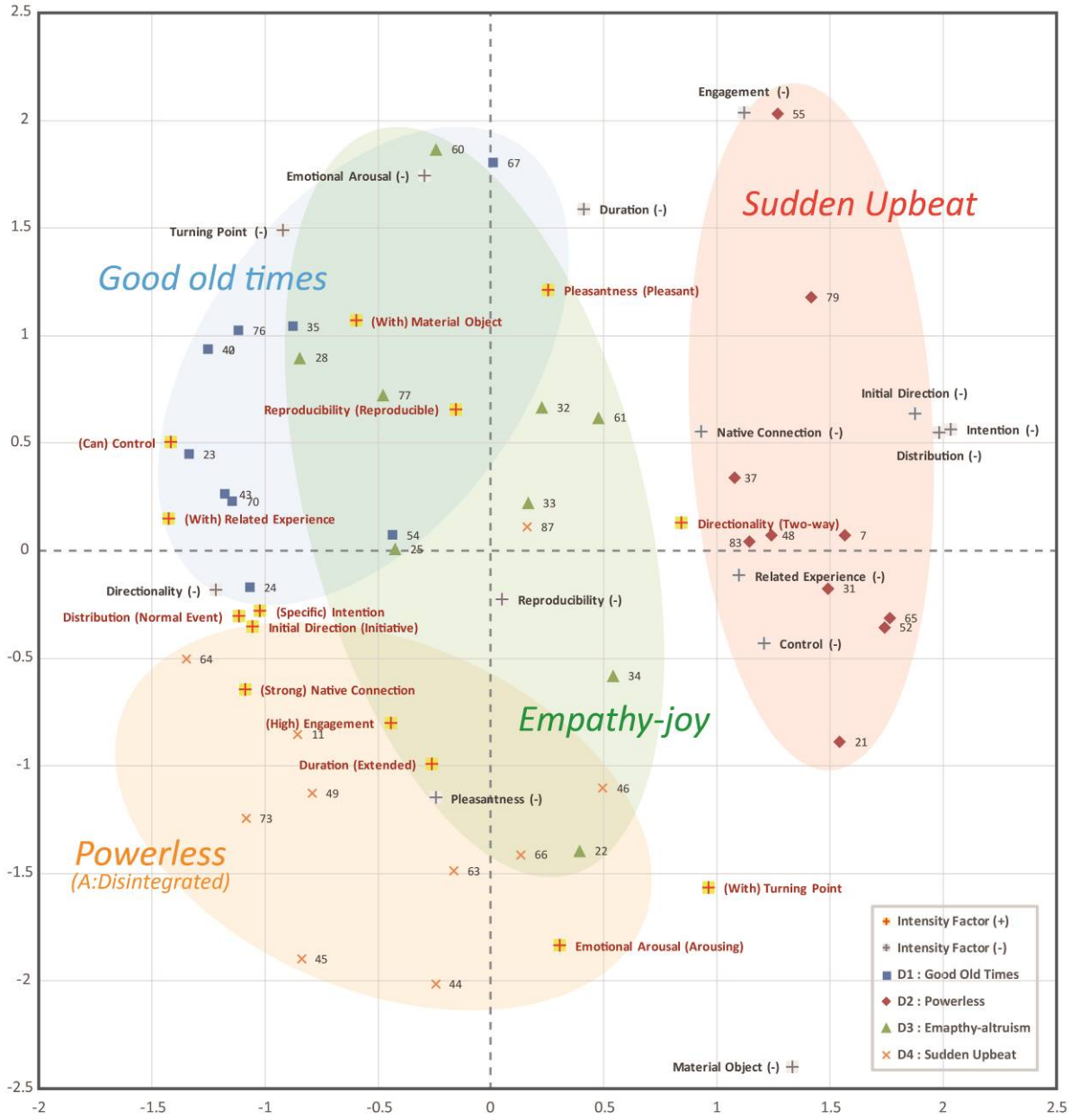


Figure 17 Four Types of Deep Indi-Experiences

5 Conclusion

The study finds that the intensity of experience has multi-dimensional properties and multi-factorial variables and using man as the subject to judge the intensity would inevitably unable to prevent the differences between interpretation and review from happening. Also, the study ensures there is an objective assessment standard to classify experiences. After using coding to reconstruct interview data, a table of C-P-D Intensity Factors is generated. The properties and dimensions of the sub-categories could be queried using the table (Table 2), and these attributes are the factors that affect the intensity level proposed by this study.

After intensity factors are being labelled and categorised, the study uses cluster analysis and Quantification Method Type III to review samples of experiences in all and by groups. The analysis result shows that memorable Indi-Experiences could be grouped into four categories – disintegrated, sensational, tangible, and unmanageable. (See Table 3)

Table 3 Four types of Indi-Experience

Type		Feature
A	**Disintegrated**	Subjects in this group are always highly involved in the activity with the specific intention for an extended period. The outcome usually arouses strong negative emotion, which results in mental breakdown.
B	**Sensational**	Subjects have a robust native connection with events which contain strong sensory cue for the subject, such as unique smell, weird taste, etc. The interaction always starts with external stimuli.
C	**Tangible**	Subjects need a tangible or physical object as the cue for evoking the impression of events.
D	**Unmanagable**	Subjects usually have no related experience to the events. Experiences in this group are uncontrollable and cannot be reproduced.

Compare the cases in the cluster of deep Indi-Experiences; the results demonstrate that deep Indi-Experiences have four patterns, which are *Good Old Times, Powerless, Stranger's Reciprocity, and Sudden Upbeat*. (see Table 4)

Table 4 Four types of Deep Indi-Experience

Type		Feature
D1	**Good Old Times**	Pleasant memories surrounded by the subject's physical objects which were gone for good.
D2	**Powerless**	Subjects feel slightly unpleasant and have no power or opportunity to change the past.
D3	**Empathy-joy**	Sense of pleasure is based on the subject's responses given by strangers.
D4	**Sudden Upbeat**	Subjects unexpectedly experience pleasantness through a sudden message delivered by strangers.

After comparing the eight categories of memorable and deep Indi-Experiences, the study finds that the group Powerless (D2) is well overlapped with the group Disintegrated (A). The unpleasant (negative emotion) situation which cannot be flipped could be seen as a way that forms one's deep experiences.

Take a closer look at four groups of deep Indi-Experience; two main patterns could be stretched out. Firstly, D1 (Good Old Times) and D2 (Powerless) can be seen as a similar situation. Meaningful objects or unpleasant situations which raise an unchangeable or un-reproduced fact could seem like a pattern that forms one's deep experience. Secondly, D3

(Empathy-joy) and D4 (Sudden Upbeat) shows that unexpected experiences lead to positive emotions could be seen as a pattern that also forms one's deep experience.

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Appendix A: The score of each intensity factor

Category	1-1	1-2	1-3		1-4		2-1	2-2	2-3	2-5	2-6			2-7
	Physical Mediations	Timing	Direction		Codition		Control capability	Goal	Emotional Involvement	Attention	Emotion			Reference
Properties	1-1-1	1-2-1	1-3-1	1-3-2	1-4-1	1-4-2	2-1-1	2-2-1	2-3-1	2-5-1	2-6-1	2-6-3	2-6-4	2-7-1
	Material Object	Duration	Directionality	Initial Direction	Distribution	Reproducibility	Control	Intention	Native Connection	Engagement	Pleasantness	Emotional Arousal	Turning Point	Related Experience
Dimensions	(With)	(Extended)	(Two-way)	(Initiative)	(Normal Event)	(Reproducible)	(Can)	(Specific)	(Strong)	(High)	(Pleasant)	(Arousing)	(With)	(With)
1	1	0	0	0	0	0	0	0	0	0	1	0	1	0
2	1	1	1	0	1	1	1	1	0	0	1	1	0	1
3	1	1	0	1	1	1	1	1	0	0	1	0	1	1
4	1	0	0	1	1	1	1	1	0	1	0	1	0	0
5	1	0	1	1	1	1	1	1	1	1	1	0	0	1
6	1	0	0	0	0	0	0	0	0	0	1	0	1	0
7	0	0	0	0	0	0	0	0	0	0	1	1	1	0
8	0	0	0	1	0	0	0	1	0	0	0	0	0	0
9	1	1	0	1	1	0	1	1	1	1	1	1	0	0
10	1	0	1	1	1	1	0	1	0	0	0	1	0	0
11	1	1	0	1	1	1	1	1	0	1	0	1	1	1
12	0	1	1	0	1	1	0	0	0	0	1	0	0	1
13	1	0	1	0	0	1	1	1	1	0	1	0	0	1
14	1	1	0	1	1	1	1	1	1	1	1	0	0	1
15	1	1	0	1	1	1	1	0	1	0	1	1	1	0
16	1	1	0	1	1	1	1	1	0	1	0	0	0	1
17	1	1	0	0	1	1	1	1	0	1	1	1	1	0
18	1	1	1	1	1	1	1	1	1	1	1	0	0	1
19	1	1	0	1	1	1	1	1	0	0	1	0	0	1
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24	1	1	0	1	1	0	0	1	1	1	0	0	0	1
25	1	1	1	1	1	0	1	1	0	1	1	1	0	0
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27	1	0	1	0	0	0	0	1	0	0	1	0	0	1
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29	1	1	1	1	1	0	1	1	0	0	1	0	0	0
30	1	0	1	0	0	1	0	1	0	1	0	1	1	1
31	0	0	1	0	0	0	0	0	0	1	0	0	1	0
32	1	1	1	1	0	0	0	1	0	1	1	0	0	0
33	1	1	1	1	0	0	0	1	0	1	0	0	0	0
34	1	1	1	1	0	0	0	1	0	1	1	1	1	0
35	1	1	1	1	1	0	1	1	1	0	1	0	0	1
36	1	1	1	0	1	0	0	1	0	1	1	1	0	0
37	1	1	1	0	0	0	0	0	0	1	1	1	0	0
38	0	1	1	1	0	0	0	1	0	1	1	0	0	0
39	1	1	0	0	1	1	0	0	1	0	0	1	0	0
40	1	0	0	1	1	0	1	1	1	1	1	0	0	1
41	1	0	1	0	0	0	0	1	0	1	0	1	1	0
42	1	0	0	1	1	0	1	1	1	1	1	0	0	1
43	1	0	0	1	1	0	1	1	1	1	1	1	0	1
44	0	1	1	1	1	0	0	1	1	1	0	1	1	1
45	0	1	0	1	1	0	1	1	1	1	0	1	1	1
46	0	1	0	0	1	0	0	0	1	1	0	0	1	0
47	1	0	0	1	1	1	1	1	0	1	1	0	0	1
48	1	1	1	0	0	0	0	0	1	0	1	1	1	0
49	1	1	0	1	1	1	1	1	1	1	0	1	1	0
50	1	1	0	0	0	0	0	0	1	1	0	0	0	1
51	0	1	1	0	0	0	0	0	0	1	0	0	0	0
52	0	1	1	0	0	0	0	0	0	0	1	1	1	0
53	0	1	1	0	0	0	0	0	0	1	1	0	0	0
54	1	1	1	0	1	0	0	1	1	1	0	0	0	1
55	1	0	1	0	0	0	0	0	0	0	1	0	0	0
56	1	1	0	1	1	1	1	1	0	1	1	0	0	1
57	1	1	1	1	0	0	0	0	0	0	0	0	0	0
58	0	1	0	1	0	1	0	0	0	1	0	1	1	1
59	1	0	1	1	0	0	0	0	1	0	0	0	0	0
60	1	0	1	1	1	1	1	1	0	0	1	0	0	0
61	1	1	1	0	0	1	1	1	0	1	1	0	1	0
62	1	1	1	1	1	0	0	1	1	1	1	0	0	1
63	0	1	1	1	1	0	0	1	1	1	0	1	0	0
64	1	1	0	1	1	1	1	1	1	1	0	1	0	1
65	0	0	1	0	0	0	0	0	0	0	0	1	1	0
66	0	0	1	1	1	1	0	1	1	1	0	1	1	0
67	1	0	0	0	1	1	0	0	1	0	1	0	0	1
68	0	0	0	1	0	0	0	1	0	1	0	1	1	0
69	1	0	1	1	0	1	0	1	0	0	0	0	1	0
70	1	1	0	1	1	0	1	1	0	1	0	0	0	1
71	0	0	1	0	1	1	0	0	1	0	1	0	0	0
72	0	1	1	1	1	0	0	1	1	1	0	1	0	0
73	1	1	0	1	1	0	1	1	1	1	0	1	1	1
74	1	1	0	1	1	0	1	1	1	1	0	1	0	1
75	1	0	0	1	1	0	1	1	1	0	0	0	1	1
76	1	0	0	1	1	0	1	1	1	0	0	0	0	1
77	1	0	1	1	1	0	1	1	0	1	0	0	0	0
78	0	0	1	1	0	1	0	1	0	1	0	1	1	0
79	1	0	1	0	0	1	0	0	0	0	0	0	1	0
80	1	0	1	1	0	1	1	0	0	0	1	0	0	0
81	1	1	0	1	0	1	0	0	0	0	0	0	1	0
82	1	1	1	1	1	1	1	1	1	1	1	1	0	1
83	0	0	1	0	0	1	0	0	0	1	0	0	1	1
84	1	1	1	1	1	1	0	1	1	1	0	1	0	0
85	1	1	1	1	1	0	1	1	1	0	1	0	0	0
86	0	1	1	0	1	1	0	0	1	1	1	0	1	1
87	1	0	0	1	1	0	1	0	0	0	0	1	1	0

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From Copenhagen to Gorton: Wellbeing, Democracy and the Role of Urban Design

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This paper explores how spatial structures – via urban design – can promote wellbeing by reducing spatial expressions of economic disparity and facilitating positive encounters between social groups. It starts by presenting a critical review of key literature exploring neighbourhood effects. A new conceptual framework is proposed to consider the processes that promote spatial injustice and their detrimental effect on individual wellbeing. The focus of this study is how the design of public space can moderate the effects of social processes. This paper examines best-practice examples in Copenhagen and their application to case studies in North Gorton, Manchester. Methods used include site surveys, observations and interviews with residents, key neighbourhood workers, urban designers and city officials. This paper proposes that some of the effects of spatial injustice in Gorton can be mitigated by enhancing the levels of democracy and contact within public space design and the process of its delivery.

Keywords: Urban Form, Wellbeing, Inequality, Spatial Injustice, Democratic Public Space

1 Introduction: The Spatial Challenges of Wellbeing

On a regular basis, policymakers are faced with making judgements about what resources to promote and whose wellbeing[1] to prioritise. Although average wellbeing scores have improved in the UK, inequality of wellbeing has also increased (NEF, 2015). One of the key issues that policymakers face is disrupting the self-reinforcing cycle of unequal economic geographies and low wellbeing outcomes.

From macro to micro levels, inequality and injustice can be spatially structured (Refer to Sabbagh Gomez, 2018). Individual wellbeing and life outcomes can be limited by exposure to this spatiality. Thus, urban form performs a critical role in the efforts to promote wellbeing.

These issues are explored by examining the pattern of disparities in wellbeing, and the physical settings where prominent spaces of injustice have formed. The role of urban form and the influence of space are investigated through two case studies in Copenhagen, Denmark and North Gorton, Manchester and discussed throughout the paper. A global

[1] For more information on the definition of wellbeing and how it is measured, please refer to *The Little Book of Wellbeing* (Boyko, Coulton, Sabbagh Gomez, & Cooper, 2017).

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perspective of spatial inequality is used as a macro view to understand how trends of uneven pockets of wellbeing are established within a larger urban context. The paper focusses on social processes of neighbourhood effects[2] to better understand how the relationship between different people living in these city neighbourhoods can be affected by the design and of public space.

2 Spatial Injustice

2.1 Defining Spatial Injustice

"The welfare of a nation can scarcely be inferred from a measurement of national income". (Simon Kuznets in report to the Congress, 1934)

The spatial organization of inequality is, in part, a manifestation of unequal distribution of resources, opportunities or outcomes occurring at the level of individuals, families, and groups that is mapped on geographical units. However, spatial injustice is defined as the intentional efforts to organize physical space in ways that maintain or reinforce that inequality. (Galster & Sharkey, 2017:2; See also Dreier, Mollenkopf, and Swanstrom 2001). Whereas spatial inequality is heavily accentuated by economic factors such as wealth or income, spatial injustice focuses on political aspects or devices of power and control (Soja, 2009, 2010).

2.2 Consequences of Spatial Injustice

From an economic perspective, spatial inequality may be beneficial or harmful (Kim, 2008). Concentration of trades and specialization can increase economic returns on the basis of proximity, scale and productivity. Optimal levels of inequalities have a fragile balance and if the economies are not internalised, beneficial effects can be disrupted. When inequality is persistent, spatial injustice can reduce wellbeing, limit life chances of specific sectors of society, and cause social instability and poverty traps, leading to a fragmented urban and social fabric.

Milanovic (2012, 2016) talks about "citizenship premiums". His research indicates that a place of residence has a higher impact on determining income, opportunities, and outcomes than social background. Health, education, social inclusion and mobility –both social and occupational- are some quality of life outcomes that can be distressed by spatial injustice and the prolonged occupation of a disadvantaged spatiality (Galster,2014; van Ham, 2012). This phenomenon is often referred to as area or neighbourhood effects.

2.3 Injustice and Wellbeing at Neighbourhood Level

The spatial effects of injustice on individual wellbeing reveal a conspicuous relationship at the neighbourhood level. According to an Office of the Deputy Prime Minister (ODPM) 2005 report, long-term exposure to spatial inequality can have a detrimental effect on individual wellbeing. That is, "living in a deprived area adversely affects individuals' life chances over and above what would be predicted by their personal circumstances and characteristics" (ODPM, 2005:6). Location appears to be a driving factor for the reproduction of inequality and the spatial manifestation of injustice.

[2] Refer to Sabbagh Gomez (2018) for wider discussion on social processes and neighbourhood effects.

In social sciences, the concept of the neighbourhood effect suggests that the social and economic status of a neighbourhood can directly or indirectly influence individual outcomes. Neighbourhood effects have preoccupied researchers as far back as 1925 (See Park, Burgess & McKenzie, 1925). However, it was Wilson's 1987 spatial and social associations, which sparked a renewed interest in this field (van Ham, 2011).

Wilson (1987) argues that, during the 1970s and 1980s, the exodus of manufacturing jobs and the middle class from urban centres caused the cities to shrink. by affecting individual outcomes, such as economic self-sufficiency, violence, drug use, low birthweight, and cognitive ability. Reflecting on Wilson's key proposal, Mayer and Jencks (1989) hypothesised that "poor children living in overwhelmingly poor neighbourhoods find it harder to escape poverty than poor children living in more affluent neighbourhoods." (Mayer & Jencks 1989:1441).

3 Towards a Spatial Injustice Framework

According to the literature, four mechanisms may explain how the spatial characteristics of a neighbourhood can impair wellbeing and life chances (Bauder, 2002; Galster, 2012, 2014; Johnston & Pattie, 2014):

- Geographical factors: Spatial mismatch (access to suitable jobs);
- Environmental factors: Exposure to neglected surroundings, violence, hazards and toxins;
- Social processes: Cohesion, control, networks and collective socialisation; and
- Institutional mechanism: Access to quality public services.

Based around these factors and associated literature, this paper presents a spatial injustice framework that places wellbeing at its core. It is intended for urban design projects or initiatives to target social progress through wellbeing. The framework measures wellbeing through key life outcomes -health, education, social exclusion and social/occupational mobility and it aims to ascertain how these outcomes are influenced by the four critical mechanisms outlined above (For further information see Sabbagh Gomez, 2018).

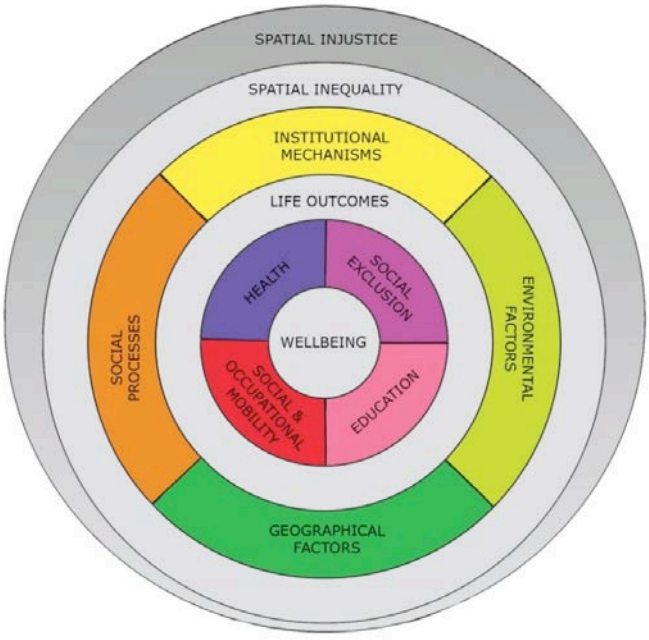


Figure 1. Spatial Injustice Framework

This framework can be used by policy makers and designers as an overarching conceptual model to ensure key issues are considered by focussing on the analysis of social progress in relation to the design of neighbourhoods. It can support different phases of local initiatives such as strategic definition, briefing, data collection, development, monitoring, design and social review. It can also be used as an infographic or template to stimulate a discussion that aims to mitigate effects of spatial injustice.

Focussing social process of social cohesion, the model has been recently applied to two case studies in North Gorton, Manchester and Copenhagen. Findings from this research will be used to develop design guidelines for decision-makers interested in improving the equity of wellbeing in their neighbourhoods.

4 From Copenhagen to Gorton: Initial Findings

4.1 Gorton and Copenhagen

This section highlights initial findings from field work in Copenhagen and North Gorton.

From being at the forefront of steam engine innovation at the turn of the century, Gorton has failed to recover from the decline of heavy industry. The traditional Victorian urban grid appears fragmented, and to a large extent replaced by an urban plan based on car-led zoning strategies. Gorton is earmarked as key growth area for housing and industry under current Manchester Strategy Plan, and there is new focus on wellbeing to prevent low health outcomes. Despite a higher than average proportion of people aged under 24 years, 31.4% of residents' day-to-day activities are limited due to health issues.

In contrast, Copenhagen was chosen due to its enduring high levels of wellbeing and social cohesion, regularly topping polls for most liveable city on the planet. This paper focuses on the current Integrated Urban Renewal Initiative. This programme focuses on districts that fail meet the high living standards of the city. The purpose is to address site specific challenges by promoting trust, participation and positive relationship through the design of public space.

In both cases, the methods used include site surveys, observations and semi-structured interviews with residents, key neighbourhood workers, urban designers and city officials. The initial findings of this qualitative analysis illustrate approaches to overcome spatial injustice and increase wellbeing.

4.2 Preliminary findings

4.2.1 Increasing Contact

Interviewees at Copenhagen stressed the importance of public space as a place to mitigate, and negotiate difference between social groups. The philosophy of the Copenhagen Urban Renewal Department is that "If there is no space to meet, then people won't meet". Literature review on the topics of lived diversity and contact theory also suggest that urban space may act as a catalyst for tolerant attitudes which can be enhanced through casual contact (Wessel, 2009:5). Tolerant attitudes can in turn increase wellbeing by promoting empathy, and reducing anxiety and group threat (Dixon et al., 2005).

Initial analysis of field research in Copenhagen, indicates that urban strategies aimed at increasing contact between groups, are often designed to feature spatial overlap between distinct functions. At the ByOasen Park in Norrebro, a petting zoo and farm have been

located at the heart of a nursing home. The project aims to increase intergenerational contact through community projects involving neighbouring nursing homes and local schools. The park also includes a recycling zone and community goods exchange hut to further the dimensions of contact between groups as homeless people can frequent these facilities.



Danish spatial strategies to promote cohesion and tolerance between groups can have an application to Gorton. Data collected from case studies in North Gorton highlighted challenges on relating to tolerance and contact between different groups. Initial findings suggest that social housing areas with diverse groups (age and background) often have high numbers of complaints to housing association and a high turnover of residents. Research from Gorton also suggests that even in areas of social housing where complaints are generally low, turnover is low and there is regular positive contact between neighbours (such as barbeques), dissimilar social characteristics are precluded from the main group activities.

Site observations in Gorton revealed that urban strategies are heavily weighted by the desire to minimise maintenance, increase security and reduce crime. As such the urban form appears fragmented, fostering segregation of functions and groups and minimising lingering. Public space appears neutral and unprogrammed: designed for everyone but addressing no-one. This spatial design strategy adversely affects the feeling of community and neglects deeper social issues such as low levels of trust, low aspirations, low engagement, fear of otherness and reduces opportunities for contact as long-term strategy to reduce anxiety and group threat.



Figure 3. Public space in Gorton appears neutral and unprogrammed.



Figure 4. Urban design in Gorton reinforces low levels of trust and aspirations

4.2.2 Democratic Space

A healthy city can embrace and make productive use of differences of class and ethnicity and lifestyles it contains, while a sick city cannot. (Richard Sennett, 2011. Cities, Health and Wellbeing Conference, Hong Kong)

For Sennett's (1998) vision of democratic urban public space, difference, is a key feature (Nielsen, 2019). Public space, as an everyday space that is safe and freely accessible, that attracts specific but diverse groups can offer the opportunity for people to become familiar with the complexity of 'otherness' that is characteristic of urban settings (Sennett, 1998, 1971).

The Danish cases explored for this paper relate to Sennett's concept. They are designed as transformation strategies that allow for concurrent use of diverse groups. As explained during recent interviews with urban designers in Copenhagen: "A way to be together without the need of invitation or full personal participation" by purposely addressing subgroups that "don't fit everyone, but someone" For example, at Mimersparken, the outdoor kitchens with barbeque facilities are used almost exclusively by residents of immigrant origins, allowing positive casual exposure between cultures. As described by a regular Danish resident "It always looks very nice. We don't bring our dinner here, it is not the Danish thing to do, but it is great seeing all the other families together".



Figure 5. Barbeque gatherings at Mimersparken. Source: Den bemandede legeplads i Mimersparken.

This kind of public space is often described in Danish terms as ‘democratic space’: “The contemporary practice of democratic public space design in Denmark is characterised by meeting the goal of mix and exchange through organising and catering for different uses and levels of attachments to the site.” (Nielsen, 2019:52)

Nielsen also highlights the importance of combining the everyday life of the neighbourhood as well as the universal elements that invite wider groups. The life of a democratic public space should not rely on commercial activity or even local agents, but should also enable a full spectrum of participation, from interaction and exchange to casual contact such as the informal gaze of commuters and transient users.

In Gorton’s ‘secure-by-design’ public space both the people are discouraged from lingering. This was evident from the lack of specific local elements (e.g., barbeques) as well as the more general amenities, such as benches, bins, trees, flowers, etc. The result is pervasive neutrality that dejects positive appropriation and enables incivilities such as fly-tipping. According to local neighbourhood workers, incivilities are also underlined by low economic means, low education, low aspirations, low engagement with the community and low levels of trust.



Figure 6. Incivilities at Gorton due lack of spatial definition: Approach to Gorton Railway Station (Above right and left) . War Memorial Square (below)

4.2.3 Public Engagement

In Copenhagen, public engagement is seen as critical for the success of urban renewal developments. All urban space projects must be supported by local neighbourhood social strategies as well as wider cultural events (e.g. festivals). All interviewees in Copenhagen agreed that, in their experience, public engagement was essential for the democratic performance of design. Key benefits highlighted include:

- Public engagement on public space projects expose residents to institutional processes, build relationships between public and institutions and increase levels of trust.
- Early public participation increases awareness of new spaces and promotes early activation of the site. One of the techniques used for early activation is temporary projects by local groups. These projects can also be strategic to start conversations between the disparate groups that may use the space on completion.
- Engaging children at local schools raises aspirations, educates future citizens, and promotes public participation.
- Participation throughout the design process (from inception to completion) increases feelings of ownership within the community, reducing overall maintenance costs.

5 Conclusion

Urban design can be instrumental in the enjoyment of democracy beyond the political arena. This paper argues that democracy in the design of urban space is understood in terms of equity of opportunities and its role as enabler of public engagement. For this to occur, democracy must be expressed both as an end product but and the design process. From a physical perspective, urban design must embrace socio-spatial elements that are creative, innovative and that promotes a variety of activity for a diverse public to enable positive contact between groups. From a design process dimension, public empowerment is key to the success of any urban regeneration strategy:

> The tolerance, the room for great differences amongst neighbours […] are possible and normal only when streets of great cities have built in equipment allowing strangers to dwell in peace together in civilized but essentially dignified and reserved terms. (Jacobs, 1961:72).

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Ignite, Share and Reflect: Design Tactics to Foster Social Interactions Between Migrants and Locals in Istanbul

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Design for social integration aims to provide support to foster societies that are inclusive and tolerant with a diverse array of people, regardless of whether they are locals or migrants. So far, in order to support migrants on their integration to a new society, a diverse range of tools have been developed which have been more focused on providing technical knowledge about migration (e.g., learning a language, legal orientation). However, developing positive interactions between locals and migrants is also a potential strategy for facilitating migrants' integration into a new society, as it helps to overcome prejudices and social exclusion which has been in rise recently. Since this strategy is underexplored, we conducted a study with the local and international community at a university in Istanbul to understand interactions between these communities and identify ways of encouraging positive interactions between culturally different groups. In this paper, we present four themes, three design tactics along with three design speculations derived from this study.

Keywords: *design for social integration, migration, interactions, urban spaces*

1 Introduction

The purpose of design for social integration is developing tools, methods and interventions to foster societies that are stable, safe, tolerant and integrative of diversity (Jeannotte, 2008). In this sense, it focuses on creating solutions to support diverse communities' development and participation in society (Bengs, Hägglund, Wiklund-engblom, Majors, & Ashfaq, 2018; Cipolla & Bartholo, 2014; Coleman, Lebbon, Clarkson, & Keates, 2003; Greater London Authority, 2018; Manzini, 2014), which is the approach used when developing solutions to support immigrants integration to a new society.

By 2015, there were 244 million international migrants (McAuliffe, & Ruhs, 2017), representing one of the biggest migration waves in history. At the same time, there has been a rise in radicalization expressed by discrimination and social exclusion (Bijl, & Verweij, 2012) which are triggered by prejudices (Amaral, Woldetsadik, & Armenta, 2018; International Crisis Group, 2018; McAuliffe, & Ruhs, 2017). Prejudices can be originated by perceived threats experienced by the local community regarding the possible disintegration of their existing values and beliefs, cultural dissonance, and/or the loss of their resources

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(Bizman & Yinon, 2001; Matusitz, 2012; Mähönen, Jasinskaja-lahti, & Liebkind, 2011; Paolini, Harwood, Hewstone, & Neumann, 2018; Stephan & Stephan, 1996; Stephan, Ybarra, & Rios Morrison, 2009). Even so, previous work indicates that prejudices and social exclusion can be reduced by increasing positive and meaningful contact between different social groups (Allport, 1954; Brown & Hewstone, 2005; Pettigrew, 1998; Pettigrew & Tropp, 2008; Tausch et al., 2010). These are understood as interactions that promote a positive attitude towards the other (Wessendorf, 2014), promoting a positive learning and shared understanding, (Allport, 1954; Arias, Eden, Fischer, Gorman, Schaarf, 2000; Pettigrew, 1998) and/or interactions on which people exchange more personal and deep information about the self (Great Britain, 2009).

Previous technological solutions addressing this issue have mainly focused on developing tools that provide technical knowledge related to the migration process (e.g., learning the language or making legal orientation accessible). To the best of our knowledge, there has been no study addressing prejudices directly, aiming to enable positive contacts among culturally different groups. In this paper, with the intention of exploring how design can facilitate positive and meaningful interactions between culturally different groups, we conducted two rows of semi-structured interviews with 14 students from the local and international community of a university in Istanbul. We identified four themes pertaining to interactions between local and international students. Additionally, we propose three design tactics that would enable positive interactions between culturally different groups and present three design speculations to illustrate how these tactics could be applied.

2 Design for Social Integration and Migration

Design for Social Integration has its origins on Social Design, which seeks to create solutions to solve complex social problems through design (Bengs et al., 2018; Cipolla & Bartholo, 2014; Coleman, Lebbon, Clarkson, & Keates, 2003; Lee, & Cassim, 2009; Manzini, 2014), becoming an activity related to society's development (Papanek, Fuller, 1972).

Social integration seeks to foster societies that are stable, safe and just, promoting non-discrimination, tolerance, respect for diversity, equality of opportunity, solidarity, security and participation of all people, including disadvantaged and vulnerable groups and persons (UN, 1995). Thus, the aim of social integration is for diverse social groups to interact with tolerance, respect and equality.

In the current context of migration, design for social integration has been providing different solutions to support migrants' integration to a new local community. We reviewed previous projects related to migrants' social integration and categorized them into two groups in regard of whether these projects involved technology or not, as this factor changed the medium of interaction with other people.

2.1 Technology-mediated solutions

Regarding information and communication technologies, and other technology-mediated projects (Abujarour, Krasnova, & Hoffmeier, 2018; Bacishoga, Hooper, & Johnston, 2016; Benton & Glennie, 2016; Gifford & Wilding, 2013) the following areas of social integration have been previously addressed:

- Language: these are solutions aimed at facilitating communication between people that do not speak the same language. Examples are translation applications, online language videos and connecting immigrants with translators in real time (Abujarour &

Krasnova, 2018; Bacishoga et al., 2016; Brown, 2015; Brown & Grinter, 2016; “Kiron”, 2014; Patil, 2019; “Tarjimly”, 2017).

- Legal orientation: these projects are aimed at helping migrants to get support and knowledge to conduct permit procedures and learning about their rights (Harney, 2013; “Signpost”, 2015)
- Mobility inside a city: these tools are aimed at giving immigrants information about where to go for specific procedures (e.g., hospitals, government offices) and how to reach there (Haus Leo & Welt Haus der Kulturen der, 2017; “Maseltov”, 2015; “nett.werkzeug”, 2016).
- Social network: these projects are aimed at supporting migrants with means to connect with their relatives and friends in other countries (Gifford & Wilding, 2013; Navarrete & Huerta, 2006), and informing them about recent news from their countries of origin via different social media channels.

These projects showed the importance of mobile phones on migrants’ lives (Bacishoga et al., 2016; Benton & Glennie, 2016; Harney, 2013; Patil, 2019), as most of the solutions were related to this artefact. As mobile phones are ubiquitous and affordable, they allow migrants to stay connected with the people that were a part of their lives before migrating, to their culture, and also facilitates their integration to a new country.

2.2 Non-technology-mediated solutions

These projects have focused on language barriers (e.g., language classes, developing understandable graphic signs) (Lanfer & Taylor, 2006; Stern & Seifert, 2010), community empowerment (“CoRE”, 2019), and legal orientation. Most of this work is developed under workshops and/or work sessions, which are mostly offered only for migrants unless these are integration-focused workshops on which people from a community develops activities together (e.g., painting, planting trees, crafting together, cleaning a park). These projects are often organized by municipalities, universities, and NGOs. A similar case is the Social Integration Design Lab in London which aims to create a space that congregates different stakeholders to embed social integration and design principles into public service delivery, projects and policies (GLA, 2018). Thus, this is a space to create social integration solutions for the city.

Overall, we observe that the existing solutions perceive language as the principal barrier for social interactions and they have a more technical approach (e.g. learning a language, legal orientation) to integration. Regarding technology-mediated projects, the lack of interaction between host communities and migrants has not yet been addressed. While on non-technology mediated projects, there has been efforts to conduct activities that gather people together. Even so, their scope is small in comparison to what technology can reach, besides mostly working with immigrants-only instead of integrating the local community too. Thus, we believe that, in terms of design for social integration, there is an opportunity to create technological interventions that enables and facilitates positive and meaningful interactions between local community and migrants. In this paper, we examine this opportunity based on a user study conducted with international and local students from Istanbul. In the following section, we explain this study in detail.

3 The Present User Study

3.1 Research Context

We conducted a user study at a university campus in Istanbul to get a broad picture of the student's experiences and opinions towards migration. To elaborate, we wanted to know their point of view regarding interaction with local/international communities from that university, what promotes interactions and what refrains them from interacting.

Turkey is on the list of top 20 destinations for international migrants and, at the same time, in the list of top 20 origins of international migrants (McAuliffe, & Ruhs, 2017). The latter means that Turkey represents both, a country from which its citizens migrate from and to which foreigners migrate to. Also, looking at Turkey's history, the country has experienced many migration waves from Balkans, Soviet Union, Iran and Iraq, as well as other developing nations (Kirisci, 2003). Even though Turkey has an important migrant population there has been a rise in violence and social exclusion towards immigrants in the last years (ICG, 2018). Due to all these reasons, we took Istanbul as a case for exploring interactions between locals and immigrants.

3.2 Participant's procedure

We conducted two sets of interviews with two different groups of participants to better understand their daily interactions with each other. In the first set of interviews, seven international students at Koç University participated. These participants consist of three undergraduate exchange students, three Ph. D., students, and one master's student. Their average age was around 26 years (Table 1), and they had an average of 35 months spent in Turkey. Their birth countries consisted of China, Germany, Iran, Kazakhstan, Kosovo, and the United States.

Table1 International community participant characteristics

	Age (M_{age}= 25,71)	Country of birth	Time spent in turkey	Level of education
P1	20	China	2 months	undergraduate (exchange)
P2	20	China	2 months	undergraduate (exchange)
P3	21	Germany	3 months	Undergraduate (exchange
P4	35	Iran	5 years	PhD student
P5	23	Kazakhstan	5 years	PhD student
P6	24	Kosovo	6 years	Master's student
P 7	37	United States	4 years	PhD student

We reached the international community and recruited them through the International Community Office of the university, which helped circulate an open recruitment e-mail. All the participants consisted of individuals volunteering to participate. Upon signing the consent form, we asked them 17 questions concerning the following topics:

- process of migration,

- the struggles they have experienced before and during this process,
- the frequency and quality of their interaction with the locals,
- their definitions of and opinions about integration in general and integration in Istanbul,
- and how they perceive cultural differences.

We conducted a second set of interviews with 7 undergraduate students who were born and who have lived in Turkey for their entire lives (Table 2). The average age of the Turkish participants was 22 years. Upon signing the consent form, we asked them 12 questions about the following topics:

- the frequency and quality of their interaction with the international community,
- their definitions of and opinions about integration in general and integration in Istanbul,
- and how they perceive cultural differences.

Table 2. Local Community Participant Characteristics

	Age (M_{age}= 22)	Country of birth	Level of education
P8	21	Turkey	undergraduate
P9	25	Turkey	undergraduate
P10	21	Turkey	undergraduate
P11	20	Turkey	undergraduate
P12	19	Turkey	undergraduate
P13	24	Turkey	undergraduate
P14	24	Turkey	undergraduate

We conducted all the interviews in the meeting room of the design research centre, and they lasted approximately an hour. In addition to recording the interviews, we took notes of important comments and points made by the interviewees. We transcribed and coded the 14 interviews and notes separately. We used the thematic analysis method to analyse our data (Braun, & Clarke, 2006), the process of analysis started by identifying the key points (e.g., integration, the process of migration, interaction, prejudices). Then, we integrated relevant quotes of the interviews to these the aforementioned key points. Finally, we created clusters of themes with regards to topic's affinity, which we organized several times. At the end of the analysis, we had identified four different themes that elaborated on the topic of design for social integration.

4 Findings

Several themes reoccurred frequently during our interviews. Firstly, we identified language as a barrier that gets in the way for the initial interaction, which is a point we previously came across on the literature (Spencer-Rodgers & McGovern, 2002). However, we also discovered that overcoming this language barrier does not ensure that meaningful

interactions will be established, as there might be a lack of motivation or even a lack of occasions for interaction. Additionally, the interviewees perceive integration as a joint action, not depending solely on immigrants' efforts. Finally, interviewees find intercultural contact as beneficial for bringing new perspectives for both parties and even for inducing self-reflection.

4.1 Language as a barrier

The participants perceived language differences as a barrier which impedes the interaction between the international community and locals. The primary reason was that not many Turkish people knew and spoke English. Although only one of the participants was native english speaker, they all agreed that it would make it easier for them to communicate in public if more Turkish people knew English, particularly because it would facilitate how they navigate in the city and carry out daily tasks. As an example, Participant 3 from the international community mentioned how the difficulty of using public transportation in Istanbul is amplified by language barriers:

> "I was amazed with and at the same time horrified by how much time it takes and how complicated it might get to go from one place to another in Istanbul. In touristic areas like Sultanahmet or Taksim, you can find your way through since the majority, especially the vendors, speak foreign languages and are willing to help you. However, when you leave these areas, it gets incredibly hard to find someone that can help you even you can't find which bus you will have to take."

However, it has been brought to light by 10 of the participants that although speaking the same language would considerably facilitate the interaction between two groups, it does not ensure that an interaction will be established in the first place. Even though in the university setting almost all of the Turkish students and staff speak enough English to be able to engage in a conversation, this alone did not automatically lead to the initiation of interaction.

4.2 Integration as a joint effort

9 interviewees defined the term integration as "*being a part of a group, belonging to a group, not feeling like a stranger*". We observed a commonality in terms of how the participants viewed integration as a bidirectional process. According to the interviewees, the process of integration should not solely concern immigrants or be dependent on the minority's willingness and efforts to be part of the social or economic spheres of the hosting society. Likewise, this process should not be completely dependent on the host society's ability and eagerness to accommodate. The interviewees repeatedly emphasized the necessity for integration to be a process relying on a joint effort. On one hand, immigrants should be willing to adopt some essential practices of the accommodating culture, and on the other hand, the members of the host society should be understanding of the differences and be helpful in guiding their process of adaptation and integration.

Nevertheless, neither participants from the international community nor the Turkish participants thought of Istanbul (or Turkey in general) as a place where integration easily takes place. This judgment was essentially based on the opinion that Turkish people put a distance between them and the people they perceive to be "*culturally different",* even in a multicultural city like Istanbul. The participants identified religion, ethnicity, rituals, food, dynamics of interpersonal relationships and home life as the areas that would reflect cultural differences the most. In between these, the participants perceived the first three topics as especially sensitive for Turkish people.

This attitude towards differences has been regarded by both, the international and local interviewees, as one of the primary reasons for the exclusion of immigrants. Hereof, the interviewees agreed upon the idea that to make an environment easy to integrate into, its habitants should first acknowledge that there might be cultural differences among themselves, and then try to get to know and become aware about these differences, since most of the conflicts arise from unawareness, or uncertainty about another person's culture.

4.3 Benefits of cultural differences

When asked if they thought interacting with people having different cultural backgrounds had any impact on them, all of the interviewees agreed that this interaction was valuable for them in one way or another. First and foremost, they stated that this interaction exposed them to perspectives that they were not necessarily familiar with, also helping them correct the misjudgments they had towards certain cultures. Importantly, 11 interviewees out of 14 indicated that having interactions with people from different cultures allowed them to engage in introspection and to get to know themselves better. Participant 9 who belongs to the local community said:

> "By interacting with people who are culturally different, I also feel like holding a mirror to myself. I can understand my culture better, even my personality, by comparing the differences and finding out the similarities among those differences. When I reach that level of understanding, it doesn't only affect my interactions with people who are culturally different or people in general. I become even more understanding and tolerant in other aspects of life."

4.4 From superficial to meaningful interactions

Although the interviewees underlined that even an initial exchange of information during this interaction could bring about benefits, both the international and the local interviewees agreed that most of the time, the interaction cannot be easily initiated due to a lack of motivation to interact, linguistic problems, prejudices, or simply because there is no occasion where these groups can interact. Participant 8 from the local community said:

> "I don't necessarily avoid interacting with foreigners at the campus, but to be honest, I don't try to interact with them unless there is an occasion where we come together. I feel like at the campus, they mostly choose to hang out with other international students, and we mostly hang out with other Turkish students. I think this is because, at least on our side, that communication is easier and smoother with people you already know or share a similar culture with. This might be why I am not going out of the way to try to communicate with the internationals."

Even if the interaction is initiated successfully, the early and more superficial interaction is not perpetuated for a longer time for it to become more meaningful. To elaborate, the interviewees defined a meaningful interaction as being able to share topics that are more personally relevant, importantly including negative life experiences, in addition to daily experiences.

One reason provided by the interviewees regarding the interaction not being continuous is that locals have an already existing entourage, as well as settled dynamics within that entourage that carry cultural influences to an extent, which makes it harder for foreigners to find their place within those established dynamics. This situation sometimes results in locals refraining from participating in the activities organized by the international community. To exemplify this situation, Participant 7 from the international community said:

> “I have been hosting Thanksgiving dinners at home with 15-30 people since the year I came to Turkey. I have always tried to reach out to and invite Turkish people to these dinners, but none of them has come even if they initially accepted the invitation. Sometimes they don’t even bother to respond, which makes me question why I am even making the effort.”

5 Design tactics to support interactions between culturally different groups

Engaging in a positive and meaningful contact with culturally different groups has the potential of preventing prejudice against each other (Allport, 1954; Brown & Hewstone, 2005; Pettigrew, 1998; Pettigrew & Tropp, 2008; Tausch et al., 2010), facilitating the integration of migrants to the local community. As stated before, the strategy of enabling positive interactions between these groups in order to reduce prejudices has been underexplored. We addressed this gap by exploring ways in which design could support positive and meaningful everyday interaction between locals and migrants. We did this by conducting interviews with the international and local community of a university in Istanbul. We have identified these tactics based on an analysis of interview results. Then, we shared these tactics with a group of designers and psychologists working in our research lab to generate speculations that can illustrate these tactics. We created design speculations for public settings (e.g., bus stops, parks, bus tips, metro lines), since in these places different communities co-exist at the same time and hence, these places can provide an opportunity to create everyday interactions. In the next section, we present the design tactics and related speculations.

5.1 Igniting curiosity

In our interviews, participants emphasized that Turkish society is not highly accommodating to cultural differences currently, but that these cultural differences could actually benefit both parties if the local society was curious for learning them in the first place. In this regard, the first tactic we propose is to ignite an interaction by triggering one’s curiosity about the other. Asking questions regarding cultural differences that can potentially be interesting for people or learning about a different group might be viable options. The overall goal in this stage is to move from culturally different groups avoiding each other to foster some kind of curiosity and then, to identify and emphasize similarities between these groups.

5.1.1 Design speculation 1: Station Connections

Exploring how interactions between strangers can be initiated by making use of the feeling of curiosity towards the “unknown”, we have speculated about placing interactive screens in different buses or subway stations. Two individuals can be situated in different stations and engage in a game in real time, even a game as simple as Tic-Tac-Toe. The players can join an activity together without having prior information about each other’s identity, which might actually make them curious about who they are playing with. At the end of their game, the screen will ask the players if they want to know the identity of the other as well as if they want to share their own identity, possibly initiating an interaction that is no longer anonymous.

Besides games, we could also pose trivia-like questions so that people in the bus stop can learn something (e.g., food, music, history) regarding the culture of a different country and then think about whether there are any similarities with their own culture, trying to create connections.

A different alternative is asking people about their interests and suggesting a route of the city they can follow using public transportation, igniting curiosity in regard to the person's interest. When two people having a shared interest join from different parts of the city, they will be matched on their routes so they can share this experience together. The different activities will be in the form of "missions" that one has complete to master that route. For example, if the individual is interested in traditional foods, s/he will receive a route of the city in which s/he can try different dishes and learn something new, accompanied by other people.

These interventions could initiate two different kinds of interactions: first, virtual interactions with the unknown player in the other station and also, with other people on the bus stop at that moment, which might encourage them to continue interacting during the bus trip. We think that anonymity is needed in the first instance so that people do not start with a prejudice regarding who is on the other side, and also so that they feel less shy about starting an interaction.



Figure 1. Representation of design speculation in a bus station.

5.2 Supporting shared experiences

We discovered in our interviews that it is difficult for the participants to start interactions with a member from the other community, and it is definitely more difficult to make these interactions long-lasting and meaningful. However, these meaningful contacts could make the integration process easier for immigrants. We think that after helping individuals acquire some knowledge regarding a culturally different group, design solutions should lead people to engage in a deeper understanding of the other's experiences. In this sense, we can focus on similarities and shared human experiences between people (Adida, Lo, & Platas, 2018). Losing people, loving people, frustrations, happiness, successes, and failures can be experiences that connect people, and sharing these experiences can turn a superficial interaction into a more meaningful one, even through virtual interactions.

5.2.1 Design speculation 2: Share the Park

We thought about giving individuals the opportunity to share their stories in a public space while learning about the stories of others. In a predefined public space like a park, an

interactive bench can be set. It will sense when an individual sits on the bench and will send a notification through its surface, asking the individual to share his or her own story, or anything that s/he might want to share about himself or herself. The individual will also have the chance to look at or hear other people's stories shared at that spot. These "stories" might be in the form of writings, drawings, or even sounds. This way, although not in real time, an interaction will be developed among people who are complete strangers, in the form of a shared experience.

Another option is to benefit from augmented reality and mobile phones, in the sense that people will have the chance to "attach" their stories or experiences virtually to certain items within a public place (e.g., a tree in a park). The recipient of the stories will be able to perceive these stories by holding his or her phone to the item in which the stories are attached and kept and leave his/her own. This way, people can digitally tag experiences, reflections or thoughts to a place or an item in the city, which will be shared with other people that normally inhabit that place too. For example, if someone is in a park and he or she feels like sharing an experience, they can upload that story which the next person that sits on the same bench will receive, and so on. With this proposal, we think that people who do not normally interact with each other but go to the same places in a city can start a virtual interaction and even develop some level of understanding of the other by collecting their experiences on those places. Later on, people can get in touch and further proceed to an interaction in person.

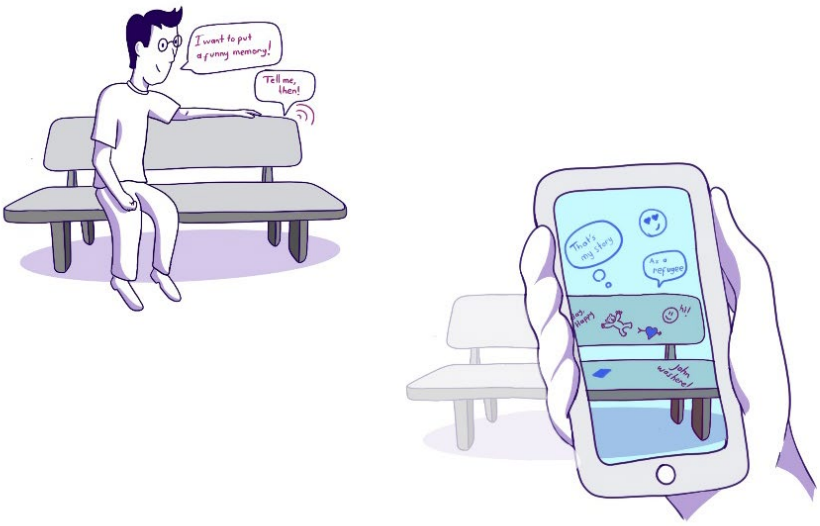


Figure 2. Representation of design speculation in a park

5.3 Triggering self-reflection

The third tactic is a key element for overcoming prejudices, as it is necessary for people to reflect on their own prejudices first in order to reappraise them (Pettigrew, 1998). The participants underlined the fact that interacting with individuals from different cultures encourage them to reflect on their own culture as well as their opinions on other cultures, which is crucial for the realization of their misunderstandings or prejudices. Self-reflection can simply be triggered by providing powerful questions as part of the design that will encourage the individual to interrogate his or her experience with the other, and to see himself or herself in the shoes of the other.

5.3.1 Design speculation 3: Mirror, Mirror

An effective way of encouraging self-reflection in individuals would be asking questions that can trigger introspection. A machine, similar to a tickets kiosk in subway stations, will be used to display tweets or newspaper headlines which contain an element of discrimination towards the migrants and ask individuals what they think about that tweet or headline. Through artificial intelligence, the machine will analyse the keywords provided by the entry of the individual, to evaluate whether there is some kind of bias towards these groups. Then, the machine will transform this prejudice into something positive, in the form of immersive videos, images or sounds, to finalize by asking a question to the individual that would induce self-reflection so they can examine their internal thoughts and feelings. For example, if someone's comment has a prejudice component about a migrant community, then the machine can display a short 360 VR video showing the experiences of this community, from their point of view, to correct the initial prejudice and end by posing a self-reflective question, for example "*What are you scared of?*" or "*What if this was your reality?*" . With this idea, we think that we could add some perspective about the life of different communities and even induce curiosity for these people to interact.

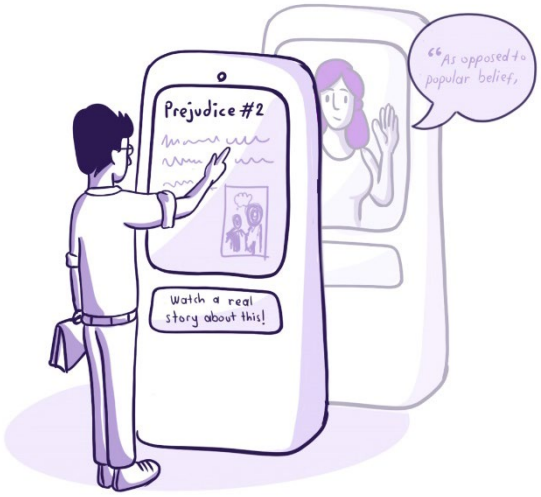


Figure 3. Representation of design speculation for a subway station

6 Conclusion and future work

In this study, we identified a gap within the domain of Design for Social Integration, since current work has not explored enabling positive interactions between culturally different groups as a strategy to overcome prejudices and foster social integration. We conducted interviews to understand how we can, from a design perspective, foster these interactions between the international and the local community on a university setting in Istanbul. We identified four themes related to how these communities interacted. Based on the findings, we proposed three design tactics that could start interactions along with design speculations that exhibit how these tactics could be applied in real contexts.

With these design proposals, we expect to provide a space for design and technology to be applied within the context of the integration of migrants, giving people more opportunities to interact as well as tools that support this interaction. Additionally, we think that our design tactics can be applied to other instances of exclusion concerning undermined groups, as

they can be adapted to target prejudices towards any these groups. For example, we could use the bus station games to have elderly people and young people come together to share their experiences on a route.

Regarding social integration, there is never a single solution. We do not posit these tactics as the only way to proceed, but instead, as possibilities for designers working on the same subject. Also, we understand these tactics as complementary with each other instead of different paths.

As for the limitations of this study, the first limitation is its scope. Our participants represent a small population of the aforementioned communities since they included a group of international students and the local community of a university in Istanbul. Thus, findings might not be generalized to all migrants in different countries and different conditions, nor to other kinds of undermined communities. Second, the speculations were not developed with the communities that are involved in the problem, which we will do in our future work. Our future work will focus on co-creating solutions with the communities of interest and further developing our proposed design tactics to enable positive and meaningful interactions for culturally different communities exploring how can we, by design, overcome prejudices between these communities and foster social integration.

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Improving User's Well-being Through Leveraging Attachment to Interactive Products

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As smart technologies are advanced, interactive products are being more and more developed like person to person interaction than person to product interaction. More attention has to be paid to product attachment because interactive products are designed as human agent. However, few studies have been conducted to address the interaction between user and product based on interpersonal relationship. Therefore, this study attempts to figure out what user's attachment to interactive products can be formed and how the findings could help design practitioners increase user's well-being. As a first step of the study, literature review was conducted. According to that, studies on product attachment have focused on the determinants of product attachment. However, there are four different attachment types in psychology. It was also found that attachment is a contributor of people's well-being. Based on the findings from literature, this study discusses the contributions of the study and follow-up studies.

Keywords: attachment, product attachment, attachment type, interactive products, sustainability, AI speakers

1 Introduction

As technology develops and society diversifies, manufacturers are increasingly producing a variety of products. Companies are also trying to investigate how to increase consumer's attachment, defined as "the strength of the emotional bond experienced with a specific product" (Mugge, Schoormans and Schifferstein, 2005), to their products. It is because consumers value a product more when they are attached to the product. This allows users to use the product more carefully, care better, and use it for longer (Mugge, Schoormans and Schifferstein, 2005). It also prevents their products from being replaced with other products and indirectly increases brand loyalty (Pedeliento, Andreini, Bergamaschi and Salo, 2016). In this phenomenon, consumer's attachment to product is largely one way to help not only enhance the user-product relationship, but also increase sustainability by extending the product lifecycle (Hemel and Brezet, 1997). In other words, it helps for sustainability by increasing product longevity (Page, 2014).

Since product attachment is considered to be an important factor for society and company, much attentions have been paid to product attachment in design research. The focus was mainly on how attachment to a product is formed and how it can be measured. The studies have also identified determinants that affect product attachment and have provided design

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strategies for design practitioners. In addition, studies in the field of HCI have also taken product attachments into consideration as a means of enhancing user experience with interactive products. However, an understanding of product attachment from the studies is limited to the degree to which it is strong or weak only (Klein and Baker, 2004; Schultz, Klein, and Kernan, 1989).

Unlike the product attachment, there are several different types of attachment (also called 'attachment style') in interpersonal relationships: attachment is originally derived from psychology. According to Bartholomew's adult attachment model (1990), attachment types are classified into four categories: secure attachment, preoccupied attachment, fearful attachment and dismissing attachment, depending on the positive or negative model of interpersonal relationships.

If the classification of attachment in psychology can be applied to product attachment, an in-depth understanding of the attachment between user and interactive products would be possible. In addition to that, attachment in person to person relationship can be a contributor to human well-being. For example, secure attachment is more likely to lead to well-being of a person while fearful attachment is transformed to secure attachment by providing proper treatments. Therefore, if analogy is identified between person-product attachment and attachment in interpersonal relationship, we could contribute to user's well-being by providing an in-depth understanding of attachment with design practitioners.

In order to apply bilateral relations like the attachment of human relations, this research focuses on interactive products that are more associated with person-to-person-like interaction. In other words, if no interaction is made between a product and the user, we cannot expect an analogy like person to person relationship. That is, a best target type of product is interactive products that act like a person. Considering smart technologies are rapidly emerging and the demand for products that can interact like human more and more increases, the study would deserve to pursue. In order to achieve the goal of the study, research questions are formulated: first, we will examine whether the attachment type classification in psychology can be applied to product attachment. Second, we will examine the correlation between types of product attachment and types of attachment in human relationships. If two correlations are significant, we will, lastly, investigate how designing interactive products could relieve the deficiencies of attachment in interpersonal relationships.

2 Literature review

In order to gain an understanding of product attachment, an in-depth literature review was conducted addressing what product attachment is, how it is formed, how it is measured, and design implications and limitations. Regarding attachment in interpersonal relationship, we also carried out the same study but in the field of psychology with questioning how attachment has been classified in psychology, how to transform a fixed type of attachment, and how they affect human well-being.

2.1 Attachment in the user-product interaction

2.1.1 Product attachment

Although the definition of product attachment is slightly different between studies, product attachment is commonly defined as the strength of emotional bonding that a user experiences with a product (Schifferstein, Mugge and Hekkert, 2004; Schifferstein and

Pelgrim, 2008). It means that product attachment is represented as a degree of difference (Klein and Baker, 2004; Schultz, Kleine and Kernan, 1989).

2.1.2 The determinants and measurement of product attachment

Many studies have examined how people get attached to things (Ball and Tasaki, 1992; Klein and Ellen, 1995; Schifferstein, Mugge and Hekkert, 2004; Schultz, Klein and Kernan, 1989; Wallendorf and Arnould, 1988). One of the studies revealed four determinants of product attachment pleasure, self-expression, group affiliation and memories (Mugge, Schoormans and Schifferstein, 2008). Another study, done in the field of consumer behavior, suggested that the reason why we attach to products is because it helps us to define, maintain and enhance ourselves. As a result of the study the authors presented four facets of consumer self: diffuse self, private self, public self, and collective self (Schifferstein and Pelgrim, 2008). They also explored the seven possible determinants that can predict product attachment: enjoyment, memories, self-identity, life vision, utility, reliability, and market value. Through experiments they identified only enjoyment and memories as significant factors that contribute to product attachment.

So how can we measure the attachment to a product? According to the article 'Consumer-Product Attachment: Measurement and Design Implications (Schifferstein and Pelgrim, 2008)', they developed a scale that can measure product attachment based on the components of product attachment such as irreplaceability, indispensability, and self-extension. More specifically, irreplaceability means to have symbolic meaning such as feeling differently even though it is physically same product. Indispensability tells you if the product cannot be missed. Self-extension refers to whether the product feels like part of the user.

2.1.3 Design implications and limitations of the research

As we can see above, in design research of product attachment, the focus has been on exploring ways to 'strengthen' emotional bonding between users and their products through design. To do so, they identified determinants that affect attachment and also suggested design strategies that increase those determinants (Mugge, Schoormans and Schifferstein, 2008; Schifferstein and Pelgrim, 2008). For example, designers can incorporate elements of surprise into their products as a design strategy in order to inspire enjoyment (Schifferstein and Pelgrim, 2008). However, such suggestions are still unclear about how to better design if product attachment is the case. For instance, memory as one of the determinants is hard to control by the designer and also pleasure disappears over time (Schifferstein and Pelgrim, 2008).

There are also several studies in the HCI research whose focus is on product attachment. One of the studies has analyzed the people's attached digital products in the home (Odom, Pierce, Stolterman, Blevis; 2009). To strengthen an attachment using personal inventories, the study discovered the four relationship clusters of human-product relationship: engagement, histories, augmentation, and perceived durability. Another study also used personal inventories used in Odom's framework of attachment categories (Gegenbauer, Huang; 2012). In the study, they investigated the approach to longer the usage of technological interactive product.

2.2 Attachment in the interpersonal relationship

2.2.1 Attachment type

Attachment theory was developed by the psychologist John Bowlby (1969). In psychology, a typical definition of an attachment is “an emotional bond where a person seeks proximity to the attachment object and uses them as a safe haven during times of distress and as a secure base from which to explore the world” (Fraley, 2019). In interpersonal relationship, several types of attachment have been defined, which is called ‘attachment style’ in psychology: however, we use ‘type’ instead of ‘style’ because ‘style’ contains aesthetical meaning in the field of design. Attachment type is influenced by the relationship with caregivers when they are infants (Ainsworth, Blehar, Water and Wall, 1978). This type of attachment thus formed affects their relationships with others who they associate with until they become adults.

If so, how different have attachment types been between studies? Typically, there are two representative methods of classification. First, Ainsworth and her colleagues (1978) experimented with attachment types by creating a situation called “strange situation”. In this situation, the child experiences a situation where he separated with the caregiver and then reunited. Through this experiment, secure attachment, avoidance attachment, and anxiety-resistant attachment are classified according to the child’s reaction and stress level when they are separated from each other and when they meet again. Second, according to Bartholomew’s adult attachment model (1991), attachment types are classified as secure attachment, preoccupied attachment, fearful attachment, and dismissing attachment, depending on the positive or negative model of self and others (Bartholomew and Shaver, 1998) (see Figure 1).

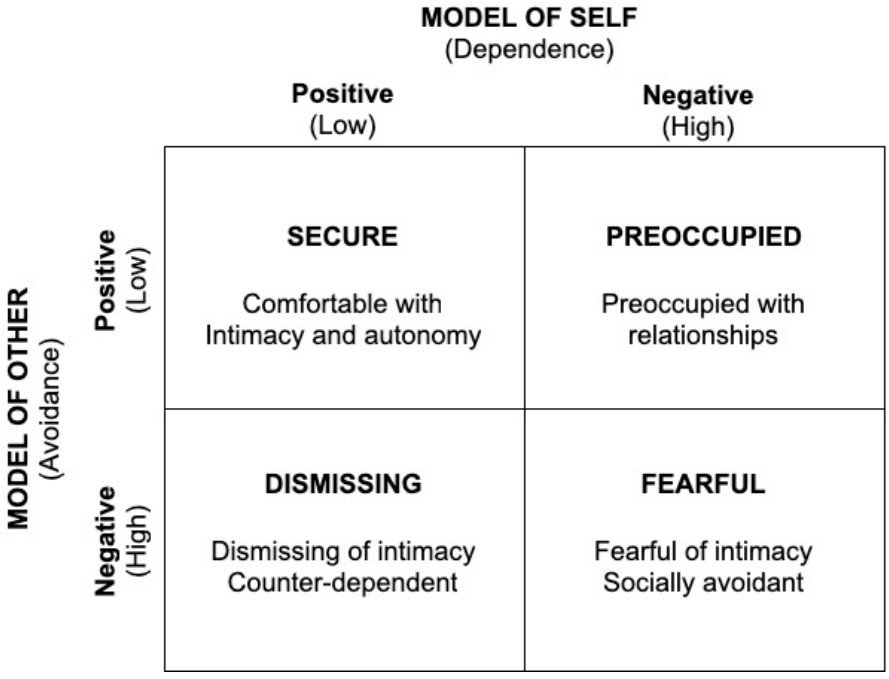


Figure 1. Bartholomew’s four-category model of adult attachment types in terms of model of self and other (1991).

2.2.2 Attachment and human well-being

Exploring the correlations between attachment types and people’s lives, studies of adult attachment types have proven that having a secure attachment is important for people’s well-being (La Guardia, Ryan, Couchman and Deci, 2000). For example, those classified as

secure attachment showed little emotional distress and negative affect (Simpson, 1990), fewer physical symptoms (Hazan and Shaver, 1990), and less fear of death (Mikulincer, Florian and Tolmacz, 1990). In addition, some studies have found that secure attachment is a predictor of well-being. One study found that an attachment style predicts an adult's romantic relationship and that attachment is correlated with self-esteem (Feeney and Noller, 1990). Furthermore, other studies include the attachment style and the vulnerability of depression (Murphy and Bates, 1997) and the intimacy of friend (Grabill and Kerns, 2000). For example, those with secure attachment tend to be less depressed and more intimate with their friend than those who did not.

2.2.3 Transformation of fixed attachment

Attachment types can change over time. For example, it can be changed by specific events such as relationship breakups (Sbarra and Hazan, 2008; Kirkpatrick and Hazan, 1994). Since stable attachment has a good effect in human well-being, it is required to change the unsecure attachment securely. Various solutions have been suggested to stabilize attachment. The most promising solution for this is the attachment security enhancement model (ASEM) (Arriaga, 2017). According to ASEM, it is necessary to promote secure model of self for people with high anxiety to revise insecurities and to promote secure model of others for people with high avoidance. In order to stabilize the self-model, situations to promote self-confidence can be enhanced by raising self-worth or increasing independence. In order to stabilize the other-model, promoting positive aspects of dependence through situations that feel intimacy or rewarding when they receive support will reduce distrust and distance to others. Thus, continuous and frequent interaction in a therapeutic direction is important for stabilizing attachment (Fraley, 2019).

3 Discussion and follow-up study

To sum up, product attachment is catching more and more attention as something that companies and designers should pursue. In addition to that, products are getting smarter and smarter like human thanks to advanced technologies. In this trend, many design studies have been exploring attachment, but this attachment is defined only as a 'degree of difference'. Thus, this study attempts to provide a holistic picture of attachment between user and interactive product by adopting attachment in interpersonal relationship. As the first step of the study, literature review was conducted to see how attachment in interpersonal can be used for designing interactive products in order to contribute to human well-being.

When we looked at product attachment, we were able to discover the limitations of current research. The limitations are that they define attachment as a single meaning and that they use only the determinants of attachment as a way to enhance attachment. To overcome these limitations, it is necessary to diversify the attachment rather than merely one-dimensionally understand it. As a way to do that, we will further diversify product attachment using attachment in interpersonal relationships, which is the origin of the word attachment.

From the literature review on interpersonal relationships to be application to product attachment, we have found the following possibilities. Firstly, human attachment has a great influence on our lives. We have seen many studies that attachments make a significant impact to human well-being, particularly secure attachment. Secondly, the attachment in psychology can change and therapies exist to change it stably. Therefore, if we can steadily change the attachment of a person, it could contribute to increase human well-being.

Through the literature review of attachment in design, HCI research, and psychology, two possibilities were identified. First, unlike human to product attachment, there are several types of attachment in human to human attachment. If the product attachment can be typified by diversifying it as in the interpersonal relationship, a more detailed understanding of user-product relationship will be provided. Second, if we put the therapies that stabilize the attachment of human relationships into user experience with products or services, we will be able to contribute not only strengthening the product attachment but also increasing human well-being.

To explore these possibilities, further studies are designed as below (see Figure 2):

First, we will examine whether product attachment can be typified, such as attachment in human relationships. To do this, we will apply the method of classifying the attachment type used in psychology to the product. Second, if so, we will see how the attachment of a person to a product and the attachment to a human being have a correlation. To explore this, we will measure both human attachment and product attachment and then compare the two. Third, we will also see how these findings can help a person's attachment. In order to do this, we will apply the treatment of human attachment to product design to make the attachment stable for the well-being of the people.

The more specific methods are: First, a questionnaire and an interview will be conducted by modifying the attachment measurement method used in psychology for product attachment. In particular, it would be appropriate to use four adult attachment models of Bartholomew. This is because it will target adults who use the product, and unlike other methods of attachment categorizations, it is composed of two dimension which enables us to understand more detail way. Next, a designer workshop will allow design practitioners to apply attachment therapy to product design.

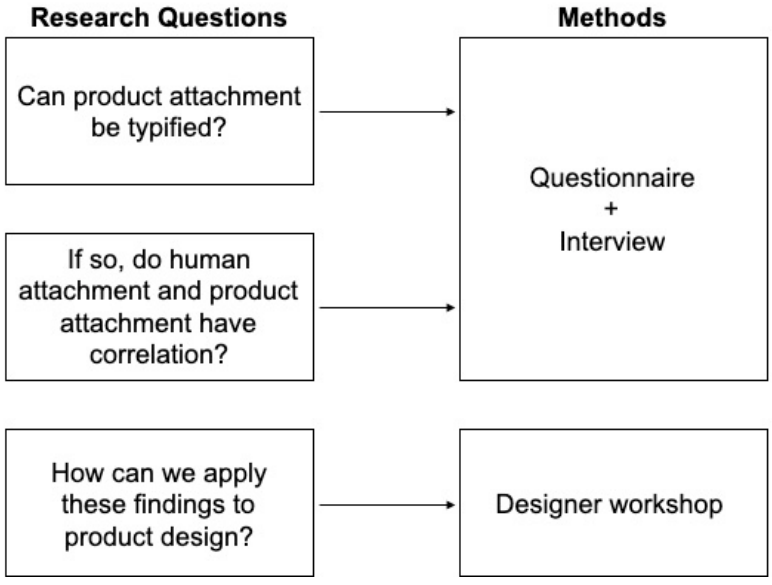


Figure 2. Experiment design adopted in the main study

For the study, an interactive product should be selected. This is because the attachment to human relationships comes from the 'relationship' with the other party, so targeting an interactive product that creates "bilateral relations" through more active, two-way communication with products is suitable for this study. Specifically, it will be artificial

intelligence speakers, which are a relevant example of emerging interactive technologies. Since they give the impression that users are communicating with person, this would be appropriate for the user to personify the product and evaluate it by applying the interpersonal relationship. To this end, subsequent studies will explore deeply about interactive products covered by HCI domain, especially AI. Also, considering artificial intelligence products are becoming increasingly popular in the market, this study will provide useful insights about better designing products or services with artificial intelligence.

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In-Progress Reporting: Development of China's Creative Economy Through Participatory Design Research in Post-Industrial Regeneration

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This paper reports on work-in-progress as part of a project funded in October 2018 by the U.K. Arts and Humanities Research Council and Newton Fund. It details the project's early activities following the establishment of a multi-disciplinary research network of British and Chinese academics pursuing research through engaging with cultural organisations, commercial stakeholders and other constituent groups in Europe and China. The investigation focuses on generating alternative strategies for sustainable urban renewal of China's post-industrial areas. In the search for new drivers of growth, China is moving from a model of expansion, to one of revitalising its urban areas. This is as a result of the Chinese government's recognition of the increasing importance of the creative industries in China in stimulating the country's future economic growth. Since October 2018 the UK-China research team have worked on preliminary research activities that will become the foundation for the later stages of the project. The research has focused on the three Chinese cities of Shenyang, Dalian, and Wushan. each of these areas offers particular histories, social demographics, economic characteristics, and cultural identities that afford different opportunities for regeneration though a diversity of creative economy activities. Post-industrial sites within each area have been identified for potential re-generation and provide a focus for the investigations in each location. Although the project is still in its early stages, this paper defines the context for the project and documents the initial findings.

Keywords: China; Post-Industrial; Regeneration; Creative Economy; Participatory Design Research

1 Introduction

Post-industrial sites in Chinese cities are being redeveloped as catalysts for the regeneration of urban areas, as the Chinese economy moves to an innovation-driven, and wealth-creation phase of its development. Examples such as Beijing's 798 Art Zone and 751 Design-Park are exemplars of this (see figures 1&2). However the success of these projects in driving the development of China's creative economy has led to a number of copy-cat redevelopment projects, duplicating the format of industrial zones and cultural parks in cities around the country. While these urban renewal projects are ambitious in seeking to foster China's next stage of economic growth, they often fail to respond to the different contexts of each location. Understanding that regeneration is beyond bricks and mortar, and pertains to an

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area's physical, social, and economic well-being (Office of the Deputy Prime Minister, 2003), is particularly pertinent for the sustained development of local creative economies, where an understanding of local skills, trading histories, cultural heritage, and the social narratives that bind community identity, can help to deliver effective regeneration strategies.





Figure 1 and 2; Beijing's 798 Art Zone and 751 Design-Park, Source: Jon Spruce

In responding to these issues, a multi-disciplinary partnership of UK & Chinese academics and practitioners was established. The partner institutions include: The Public Art Centre of China National Academy of Paint (CNAP); Luxun Academy of Fine Arts (LAFA); Dalian Polytechnic University (DPU); Liverpool John Moores University (JLMU) and Manchester Metropolitan University (MMU). Funding was gained for a three year research project through the UK Arts and Humanities Research Council (AHRC) & Newton Fund in October 2018 entitled 'Developing the Creative Economy in China.' (Arts and Humanities Research Council, 2019) Specifically, this project aims to investigate alternative strategies for sustainable urban renewal of China's in post-industrial areas, pursuing research activities through engagement with cultural organisations, commercial stakeholders, and other constituent groups in both Europe and China. In the search for new drivers of growth, China is moving from a model of expansion, to one of revitalising its urban areas. As western economies have expanded from manufacturing-based to service-orientated sectors, so the creative industries in China become increasing important in stimulating its future economic growth.

The research project focuses attention on the three Chinese cities of Shenyang, Dalian, and Wushan. Each of the areas offers particular histories, social demographics, economic characteristics, and cultural identities, affording different opportunities for regeneration though a diversity of creative economy activities. Post-industrial sites within each city, currently earmarked for potential re-generation have been identified by the research partners, providing a focus for the investigations in each location. The project will enable the joint research team to obtain a broad and diverse understanding of urbanisation and spatial regeneration issues, representing different forms of urban structure, industry and culture, due to geographical location, local economies and regional institutional support.

The three locations of Shenyang, Dalian and Wushan are replete with decommissioned and abandoned factories and warehouses due to the changing contexts in which they operate. Various political, ideological and conceptual factors have led to these changing contexts, such as: the changes in China as it has moved from a Maoist regime towards participation in the free market economy; the growing focus on developing digital technologies rather than

more traditional ‘hard industries’ has altered the needs of industry; greater global concern for the environment, and for fostering individual consciousness and creativity.

A key innovation in the project is the use of the participatory approaches and methodologies to generate new knowledge and insight. Through identifying local cultures and social narratives that prevail in the three locations within the cities of Dalian, Shenyang and Wushan, a programme of participatory activities that incorporate novel, context-rich research methods, for example, 'walking interviews', are being conducted. These, along with a series of inclusive stakeholder workshops, will generate strategies in response to the needs and ambitions of particular sites. For example, a case study with complex needs is the regeneration of the huge decommissioned cement factory in Wushan (see figure 3). The workshops and interviews will inform urban renewal strategies at a local level, through the development of spatial concepts that target the regeneration of such specific sites.



Figure 3: Wushan’s Decommissioned Cement Factory Site, Source: Jon Spruce

This project does not just propose solutions for future designs but it analyses how extant sites should be remodelled and repurposed for the needs of current society. The project applies design research to generate socially inclusive insights, informing the critical

understandings of identity and culture within urban regeneration strategies, deepening understanding of the social and cultural capital of a region, city or place, affording the opportunity for future interventions to enhance existing notions of social value.

2 Research Context

The Chinese economy is slowing down after years of rapid development. Since 2011, more than half of the Chinese population have been living in cities. Urbanisation is making China wealthy, however is it sustainable? (The Atlantic, 2013). Porter's (1998) theory, that China was shifting from a factor-driven and investment-driven phase to the innovation-driven and wealth-creation phases of economic development is now being realised. Problems such as imbalance between urbanization of land and urbanization of population have arisen (Di, 2013), with the layout of the urban development and regional infrastructures demonstrating a shortage of comprehensive coordination (Zhang, 2012). This provides an opportunity for the development of creative ecologies that can both drive economic growth and respond to the increasing social welfare issues arising from mass-urbanisation of many Chinese cities over the past three and a half decades. In this new context of innovation driven wealth-creation, creative problem solving approaches such as 'design thinking' will have an increasingly significant role in informing economic development, in both the creative and non-creative industry sectors. In the search for new drivers of growth, China now moves from a model of expansion, to one of revitalising its urban areas.

Post-industrial sites in Chinese cities are being redeveloped as catalysts for the regeneration of urban areas. Examples such as the aforementioned Beijing's 798 Art Zone and 751 D-Park are exemplars of this strategy, tuning into the creative cultures of these cities to provide platforms for creative enterprises to flourish. (Jenkins, 2008) The success of these projects in driving the development of China's creative economy has led to a number of imitative redevelopment projects, creating a blueprint for the format of industrial zones and cultural parks in cities around the country. These newer projects are not always successful or adhere to the moral urges behind the predecessors. As Wang and Li state (2009): "Once the link between artists and archaic industrial buildings is underscored and legitimized, the resulting space becomes commercialized and, to an extent, discriminatory. The transformation of a place may generate economic returns, but in the process it results in gentrification and social exclusion." (Wang and Li, 2009, p.884) Indeed, while many urban renewal projects are ambitious in seeking to foster economic growth, they often fail to respond to the different contexts of each location within the design and planning. So, although performing well commercially through providing retail and entertainment facilities, they perform poorly in providing other opportunities for developing local enterprise, or addressing social welfare needs, focusing on models of consumption to drive growth rather than creation to build local economic prosperity.

The locations of Shenyang, Dalian and Wushan, selected for this project proposal represent very different industrial and cultural heritages. They represent heavy industrial zones, towns famous for cultural heritage and coastal or port cities. From imperial legacy and industrial power, to social upheaval and conservation of natural beauty, each location presents particular opportunities and challenges for how its cultural heritage may be best understood and interpreted, and how collective cultural memory may be positively activated to inspire and promote appropriate responses to urban renewal and economic redevelopment.

3 Methodology

The post-industrial sites within each city that are currently earmarked for potential regeneration have been identified by the research partners, providing a focus for the research investigations in each location. An evidence-based research methodology will be employed through each stage of the project, including case study analysis, ethnographic studies, and participatory design-led workshops. Promoting inclusion and critical analysis will be highly important in balancing potentially competing agendas such as social welfare, commercial enterprise, and centric urban renewal strategies.

As part of an initial visit to each of the site locations a series of qualitative, ethnographic studies have been and will continue to be conducted in Shenyang, Dalian and Wushan. These include observational and participatory methods that seek to gain insights from a range of local stakeholders such as residents, community leaders, municipal service providers, civic and educational leaders. The research seeks to engage core constituents that collectively embody China's current, and future, consumers and creators of a sustainable, relevant, fit for purpose creative economy. Location-based, semi-structured interviews have formed and will continue to be the basis of these studies, along with 'walking' interviews conducted over an extended period that capture a range of personal narratives of people's experience of living and working in the locations of Shenyang, Dalian, and Wushan. This approach is highly visceral and provides researchers with a deeper understanding of culturally held values, social histories, attitudes towards regeneration, and insights into urban characteristics that inform how an understanding of place and identity may unlock potential opportunities for culturally coherent regeneration strategies.

The research team anticipate that this level of critical enquiry will continue to uncover many particularities of the selected regional sites and their associated cultural narratives. It is also recognised that such socially inclusive, qualitative approaches as human centred ethnographic studies, will generate a quantity of interrelated subjective and objective data, which will need to be carefully disaggregated as part of the research team's analysis and evaluation processes. However, the opportunity to apply these methods, and the insights they will reveal, maximises the level of support and local access our Chinese partners are affording this project to an unprecedented degree. The subsequent results of the research study will potentially carry a high level of impact in regional and national policy making, due to its relevance at a socio-cultural level, and its resonance with constituent values and sense of identity. The project team Chinese partners are highly respected; for example, The China National Painting Academy is China's top art school, and so the Chinese government and aspirational universities and organisations across the country will monitor the activities closely. Analysis and discussion resulting from the site visits and ethnographic case studies will enable the planning and construction of a series of locally focused research activities that explore the generation of potential design-led solutions via the delivery of participatory creative workshops.

4 Interviews with Chinese Stakeholders

This work-in-progress paper reports on responses from the initial series of interviews conducted with artists and creative practitioners, and with local government officials. Specifically, the interviews have been conducted at the sites of: the decommissioned Wushan Cement Factory; 1905 Cultural and Creative Park, Shenyang; Heshe Art Zone, Dalian; No. 15 Warehouse, Dalian and International Yacht Harbour and Eastern Water Town, Dalian. Interview templates with questions for the initial stakeholder groups were generated to provide a consistency in questioning but which also recognised the difference in context for each. The semi-structured interview questions focused on (1) stakeholder

context (2) current practices (3) development strategies (4) key challenges. These themes provided a basis for each interview to follow, but did not seek to constrain the interviewees' responses, as gaining personal perspectives was an important part of the interview process.

4.1 Artist/Practitioner Interviews

Wang Xueli, owner of Dalian Jungle Cultural and Creative Limited in Heshe Art Zone, is a carpenter who creates bespoke luxury wooden objects such as rocking chairs and sideboards (see figure 4). In an interview with the project team, Wang (Guo; Roberts; Spruce 2018a) explained that his business has been very successful since moving to Heshe Art Zone: "People place an order a long time in advance and then wait for me to complete the work… I am unable to keep up with the demand for my products. Everything takes a long time to make and I have many people who wish to buy from me." Interestingly, he did not value particularly the fact that Heshe Art Zone could be considered part of a new cultural wave or urban regeneration- or even that he was surrounded by other artists and craftspeople. It is apparent that he has a true vocation and valued Heshe Art Zone for its low cost rent and convenient location. His goal is not to pursue fame or wealth but it is to continue to make beautiful hand-made objects which provide him with a sense of fulfilment: "I do not make a large amount of money but am making enough for quite a decent living. It does not matter to me that I am not making more because happiness and fulfilment in my work is more important to me. I hope to continue in this way with this business." (Guo; Roberts; Spruce 2018a). It is evident that commitment to his bespoke crafted objects, and personal satisfaction at work, are key motivators for Wang Xueli. He is not swayed by proximity to other creatives or by the desire to be part of the fashionable post-industrial regeneration projects in China.



Figure 4; Wang Xueli (right), owner of Dalian Jungle Cultural and Creative Limited, with his Assistant, (left). Source: Emma Roberts

Similarly, artist Zhao Lin, who has a studio and creative arts business in Shenyang's 1905 Cultural and Creative Park, states that making art is her vocation and that she too does not seek great financial rewards when making her work: "I am not making any money. I am only

breaking even and so it is not a good financial living. However, making art is my vocation and I am not particularly motivated by making money. It is more important to me to spend each day in making art and having a good quality of life- even if I do not have enough money. I will keep going as long as possible in this way until I run out of money."(Guo; Roberts; Spruce 2018b). Zhao Lin rents a portion of a room that is shared with other artists and designers; however her own space is defined. She works and shows her work inside an extant copper tank belonging to the previously industrial site which has a section of the vertical wall removed so that it acts like a window for displaying her work (see figure 5) The top of the tank is also removed and this allows her to see up to the original glass panes of the former factory roof. Zhao Lin gains inspiration for her creativity as a result of this setting and commented: "I particularly wanted to rent this specific space- inside an old industrial tank inside the room. It is quite cosy inside here and it is easier to stay warm. I can look up and see nature- the rain, clouds, sun etc. and so although I am inside an old tank and inside a room in an old factory, I still feel connected to nature every day and this is very inspirational to me. I enjoy looking up and knowing that it is raining or if it is sunny. It is like being outside even though I am inside." (Guo; Roberts; Spruce 2018b).



Figure 5; Zhao Lin, Studio Artist at Shenyang's 1905 Cultural and Creative Park. Source: Emma Roberts

4.2 Local Government Interviews

Interestingly, there seems to be a disconnect between the foci of users of the space compared to the concerns of local government officials who are responsible for implementing these new urban redevelopments according to government edicts. The users of the spaces- the creatives- demonstrate their passion for making individual bespoke objects and see this as the product of and holistic lifestyle. They live for their work and thereby pursue personal fulfilment and creative joy- rather in the manner advocated by the British nineteenth-century Arts and Crafts Movement proponents. In contrast, it seems that representatives from local government have observed the cachet that arises from recent urban regeneration projects and perhaps believe that releasing a new former industrial site will guarantee creativity and economic revival.

For example, in Shenyang, Mr. Kui, a Shenyang local government official, explained that prescient goals for the city are “1) to establish Shenyang as the National Centre City; 2) to have a centre in technology creation; 3) to create an area for advanced equipment for manufacturing (smart manufacturing); 4) to create a high quality living centre.” (Guo; Roberts; Spruce 2018c). So, technology and smart manufacturing were key goals for him and other city leaders, in contrast to artist Zhao Lin’s emphasis on hand-made, individual objects such as painted ceramic cups or flower pots. Kui does believe that it is vital to preserve the features that remain from heavy industry uses (such as winches, cogs, turbines etc.), but this seems to be because these features are believed to provide stimulating visual cues which indicate that ‘creativity’ is present and possible. He commented that Shenyang’s “old urban plan had heavy industry especially in one city region- very concentrated. When developers remove this to another area it provides an opportunity to develop a new creative and cultural area based on old heritage… The elements left over from the old uses become the key to start a new creative industry. Without these old elements nothing is possible.”(Guo; Roberts; Spruce 2018c). He also believes that former industrial workers, such as factory employees, can transfer easily to new roles within the creative industries that replace the functions of their previous workplaces: “A worker who had a role in a very large traditional factory can easily transfer to a small role within a much smaller creative-focussed industrial factory.” (Guo; Roberts; Spruce 2018c). However, this perspective perhaps assumes that creativity itself is easily generated and easily accessible to all workers. It also suggests that financial rewards are almost guaranteed following the process of urban renewal.

An interview with Mr Yang, a local government official in Wushan, revealed that national government environmental policies are also important drivers in considering the redevelopment of post-industrial sites.” (Guo; Roberts; Spruce, J. 2018d). Plans for the redevelopment of the local cement factory that was decommissioned in 2015 following such changes in national government policy, are being considered with the ambition to convert the site into a media and film studio hub for the region to be called ‘The 175 Three Gorges Creative Industry Park’. According to Mr Yang this redevelopment is highly important to the town’s future, as the majority of employment within the town is already related to the tourist industry, due to its position at the Three Gorges of the Yangtze River (see figure 5). The tourist industry currently accounts for approximately 70% of the town’s workforce, with the remaining 30% being involved in agriculture. Therefore the development tourism was identified as the primary focus in continuing to grow and fuel much of the local economy. Though great in ambition for the site’s redevelopment, and the economic benefits it may bring to the local economy, recognising the need for redevelopment to comply with national government guidance on environmental protection was also an imperative. Mr Yang suggested that “If the plans to develop the factory site into a media and film centre are delivered, then there may be the need for additional capacity in hotels, and other tourist and visitor type facilities to be developed in Wushan itself” (Guo; Roberts; Spruce, J. 2018d) and that, in this way, introducing creative industries to the area would benefit local people and the economy.



Figure 5; Three Gorges of the Yangtze River at Wushan, Source: Jon Spruce

A further interview with a local guide employed by Wushan town authorities, a resident of the area all his life, revealed that there was recognition by the authorities of the previous environmental damage caused by industrialisation. Specifically in Wushan, following the construction of the Three Gorges Hydroelectric Dam in 2012, raising the local river level by 175 metres and submerging Wushan's old town. The local authority were therefore very keen to pursue the cement factory site redevelopment as the film and media centre proposals relate to an existing film festival that takes place in Wushan, drawing in people from across the region. Historically the area is very important to China, both in terms of the development of the country's culture and because of its status as an area of natural beauty. It is hoped that combining these things together will bring more tourists and develop the areas creative cultural importance.



Figure 6; Wushan's decommissioned cement factory and local official, Source: Jon Spruce and Emma Roberts

Indeed, officials interviewed so far are very receptive to receiving the information generated from the project. Jiang Kun, a designer of two creative cultural parks in Dalian states: "We need the help of such a research team so much. As a group of self-employed developers of cultural parks, we can't compete with those state-owned cultural parks, which have powerful support. To avoid the unnecessary problems, we would like to get a modular design deriving from this project's research results to test the feasibility of our planning. I really hope to see the application of the research results of this project in China." (Guo; Roberts; Spruce, J. 2018e) and such a modular design, based on the cumulative research conducted during this upcoming two and a half year period, is certainly part of the projection.

5 Concluding Remarks

As the project is still at a very early stage, only launching in October 2018, it is not yet possible to draw any robust conclusions. However, following the initial site visits and early stakeholder interviews at the locations in China, some emerging themes have been identified, including: the vocational train of mind apparent in creative practitioners; the value placed on bespoke works by practitioners and their clients; the linkage between urban regeneration zones and local universities, and the potential for a disconnect between the practitioners that inhabit the creative park sites and those driving urban redevelopment.

So far, the project researchers have observed that one criterion for success of repurposed industrial sites, seems to be strong links with local universities. For example, various walls in Heshe Art Zone in Dalian are painted with street art made by students of Luxun Academy of Fine Art and the studios are populated to a large extent by graduates of the art school and by staff who also teach there or who were former teachers. Similarly, the 1905 Creative and Cultural Park in Shenyang hosts exhibitions by current students of Luxun Academy of Fine Art and provides rented studio space for many ex-students. Additional sites that are primed for redevelopment, and which could benefit from this project's recommendations, are also being studied by researchers at nearby universities. For example, the former light bulb factory- 'Wisdom Park' - in Dalian is being assessed by researchers from Dalian Polytechnic University and local art students are again tagging the area and painting street art murals on the walls (see figure 7).

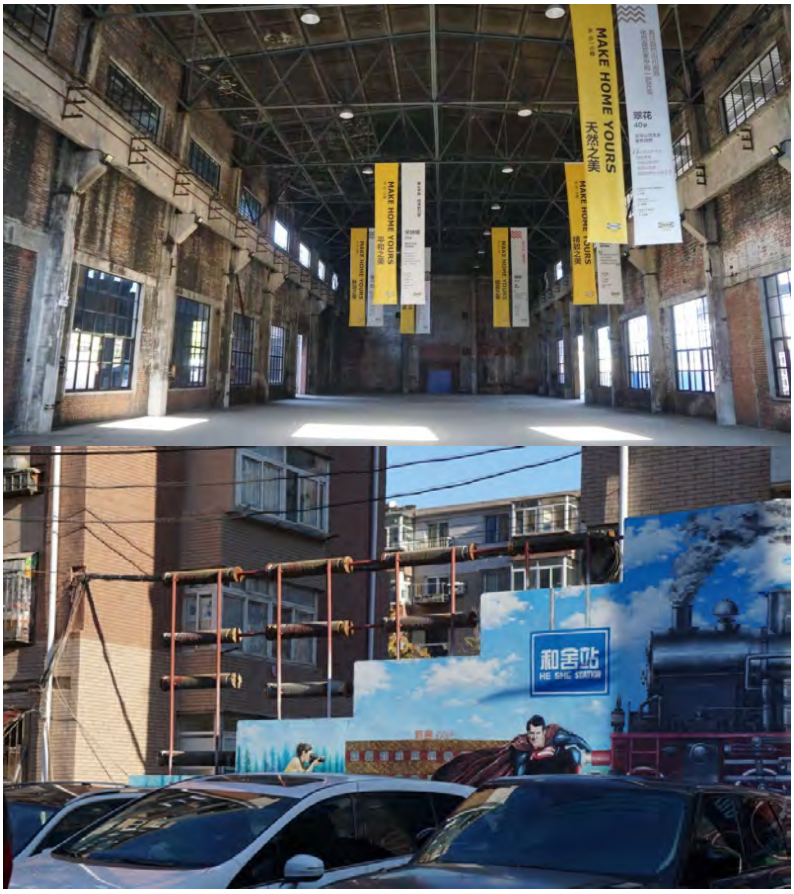


Figure 7; Wisdom Park, Dalian and local LUXAN art school student street art. (Source: Emma Roberts and Fang Bin Guo)

The potential for a disconnection between the values of creative practitioners who inhabit the redeveloped sites and creative parks, and those driving some urban renewal projects, such as local authorities and private developers is clearly evident in the initial interviews conducted. As Wang and Li are noted to have observed earlier, the gentrification of sites resulting from economic success may threaten true validity and potential. This is something that for some at least may threaten the authenticity and sustainability of renewal projects aimed at stimulating local creative economies. Wang and Li (2009) highlight previous instances of this tension early in the redevelopment of Beijing's 798 Art Zone: "As early as 2004, the very pioneer Sui Jianguo removed his studio from 798. Three years later, the other leading personality, Huang Rui, left as well. By March 2009, the number of artists among the pioneer group was lower than 30. Aside from the complaint that the district became "more about a show rather than serious art," another fundamental factor that drove the artists out was the rise in rent, which ranged from 2 to 7 RMB per sq. meters per day, more than doubled that in 2002. The frequent interruptions by increasing amount of tourists are complained as annoying. Artists, who used to actively seek public attention during the battle against demolishment, now see it a burden". (Wang and Li, 2009, p.884)

As the project continues to generate further findings over the coming two and a half years, the research conclusions and conceptual ideas for regeneration of the sites may further highlight their potential roles as cultural hubs for creative practitioners, students, tourists and interested locals. Such hubs may become ideal locations for exhibitions of artists' and designers' work, with these relationships stimulated by the academic project partners located within regional arts institutions promoting the inclusion of small businesses to produce culturally relevant products, or works of art and craft. These are likely to support the preservation of Chinese cultural heritage and ensure that traditional crafts and techniques are not dismissed as a result of the desire to advance in applying contemporary creative technologies. Third sector and community based organisations may benefit from the research, as its methods highlight the value of developing a deeper understanding of cultural identity, and the role this can play in fostering social wellbeing, harnessed positively through sensitive urban regeneration. This is also valuable for the general public, as the repurposing of industrial sites will potentially provide better prospects in areas which are now experiencing post-industrial decline and unemployment.

More broadly, the future results of this study will benefit other researchers in the field by providing a comparison of existing western and Chinese urban renewal projects within one study, generating a combined series of results that evaluate the effectiveness of these schemes in promoting economic growth, creative enterprise, social welfare and cultural engagement. The results will inform future urban renewal strategies, and be of relevance across both Europe and China. The results of the case studies and ethnographic research activities will further inform constituency-driven spatial concepts as proposals for regeneration of industrial sites, promoting an inclusive model of co-creation that is still uncommon across Europe and China, but is quickly becoming a recognised approach to enabling local authority and constituency agreement that is required for large-scale renewal projects.

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‘Invisible Minorities’: Exploring Improvement Strategies for Social Care Services aimed at Elderly Immigrants in the UK using Co-Design Methods

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This paper forms part of a larger study on how co-design principles can be used in social care service design to mitigate challenges around service use for non-native (immigrant) elders in the UK. Research shows that conventional care for immigrant elders remains fairly inaccessible. Cultural and language barriers ensue a lack of self-confidence, where users would avoid dealing with the state altogether. Often, this user group end up relying heavily on word of mouth and informal family care. This significant absence of independency supports lessened citizen agency, which can negatively impact on the construction of our personal identities. The research aims to use co-design to help foster representation and learning through professional discourse. This method has been proven successful in public projects by encouraging empowerment and belonging within the wider community. A preliminary literature review builds an overview of UK’s current social care service structure and a window of insight into the service experience of non-native peoples. Additionally, by dismantling global social care service structures we begin to understand social care best practices, whereas expert interviews reveal the dynamic of organisational culture at local government level and the way in which bureaucratic processes often stump development. By exploring a varied perspective (service designer, user, sociologist), the discussion uncovers opportunity for the development of future service co-design strategies aimed at service providers, that are more culturally sensitive and situation appropriate.

Keywords: elderly; social care; co-design; service design; minority ethnic groups

1 Introduction

The older ethnic population in the UK (those aged 50+) is set to double between 2007 and 2026, from 1.7 million to 3.8 million people (Lievesley, 2010). These comparable changes in demographic and the overall growing number of elderly people in our global societies are expected to be just some of the main social challenges we will face in the coming decades (Zeeb, Rothgang, & Darmann-Finck, 2018). The UK is currently host to the most diverse older populations in the EU. London is home to some of the most varied and largest concentrations, with over 1 million people aged 65+, 22% of which are from ethnic backgrounds and a total of 37% born outside the UK. By 2051 there will be 7.3 million ethnic minority residents in England and Wales aged 50+ (Lievesley, 2010). With this significant increase, we will care for more people living with multimorbidity and long-term conditions

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(Ahaddour, van den Branden, & Broeckaert, 2016). As a result, demand on care is predicted to dramatically increase, yet a predicted 26% fewer residents will be in receival of council support (King's Fund Home Truths, 2016). Despite small changes that have recently been developed to consolidate care services around the elderly immigrant user group, almost 70% of them still feel they do not know enough about current care system changes and opportunities (Healthwatch UK, 2018). Among other challenges, a lack of understanding and agency within a service context heightens feelings of anxiety and vulnerability (Anderson et al., 2013). Consequently, due to the limited use of care services by migrant populations, it has been said that institutions are not stimulated enough to offer services tailored to their needs (Ahaddour et al., 2016). As reasons for limited service use are later discussed in this paper, Ebrahim (1996) notes that even when elderly immigrants may make little use of existing services, it must not be taken as an indication of a lack of need. By taking these considerations into account, co-design works by providing a knowledge of existing structures of care, access channels and a sense of working together towards a common goal (Miller & Hamilton, 2008). Overall, this type of community participation strengthens the role of the citizens, which is identity-establishing and is seen as a part of positive community development (Mueller, Lu, Chirkin, Klein, & Schmitt, 2018).

The primary purpose of this paper is to explore how social care services for elderly immigrants are administered, designed and delivered in the UK. Leading to a discussion on some of the challenges within the public service design system and how co-design methods can help improve future development. The nature of this exploratory research requires a qualitative approach using extensive literature review, case studies and expert interviews. This is to form the initial stages of a much larger study, where a framework of co-design principles would be established in order to optimise social care services for this user group.

2 Literature Review

The key areas explored in this literature review are the history and current state of UK social care, as well as ways in which ethnicity impacts service use. Predominantly, this section aims to provide an understanding of how service structures impact access to care.

2.1 Social Care Services in the UK

After the initiation of the 'Welfare State' in 1942, the Beveridge report was the first comprehensive system of social insurance designed to help support the general population out of poverty. Today, the workings of health and social care services in the UK still remain deeply influenced by this post-war welfare state legislation (Glasby, 2012). In recent years however, attempts have been made to lead the care structure into new ways of service provision. Social care and social policy are broad terms covering a whole range of private and public activity. By definition, social care refers to a range of services provided by the state often in support of vulnerable people of all ages with physical and mental disability and illnesses. These services generally include adult care, personal care, home adaptations and social support. The National Framework for NHS Continuing Healthcare provides the following definition of social care in the UK: 'providing assistance with activities of daily living, maintaining independence, social interaction, enabling the individual to play a fuller part in society, protecting them in vulnerable situations, helping them to manage complex relationships and (in some circumstances) accessing a care home or other supported accommodation'.

2.2 Impact of Ethnicity on the User Journey

In this discussion, it's important to outline that the project focuses on the experience of people deemed as 'invisible minorities', whose facet of invisibility is presented as part of a description for the social markers of this user group. 'Invisible minorities' is a term coined in reference to people who are not always seen as part of a minority in the obvious way with which ethnicity is observable in the western world, i.e. skin colour. Social markers (the aspects of our identity that differentiate us), of invisible minorities, are often blurred or not at all present, which adds a certain degree of indistinctness. Too often, unrealistic assumptions that needs are met through this user group's own family and community are made by people and institutions put in place to support them (Schoenmakers, Lamkaddem, & Suurmond, 2017).

Some research has been conducted in the way different aspects of ethnicity impact access to health and care services. Even though research in the field of social care is scarce, an assumption can be made that similar barriers are present for immigrant elders in accessing state social care services. Discussed below, are three Scandinavian studies that depict a comparable difference in health and well-being as well as care service utilisation between native and non-native health and social care users (Verhagen, Ros, Steunenberg, & de Wit, 2014), (Verhagen, Ros, Steunenberg, Laan, & de Wit, 2014). The research shows a significant lack of health literacy and support in making sense of health and care support, all noted as just some of the qualities that foster disengagement with state health and social care services. Additionally, a lack of culturally sensitive care leads to the importance of specialised training and staff selection programs for improving cultural sensitivity. However, it is important to note that health and care workers are often required to initially possess strong ties within the local migrant community, in order for them to produce effective change and implement positive care and support methods (Verhagen, Ros, Steunenberg, & de Wit, 2013).

A study conducted on Black Ethnic Minority Elders (BME) in London by the King's Fund in 2002, showed that often, practical and logistical issues come into play and can seriously inhibit individuals, thus affecting well-being formats. The report referred to a lack of adequate care service advertising, poor service access, lack of interpretation services and lack of liaison with external independent sector service provider seriously harm BME care involvement (Kapasi, Silvera, & Consultants, 2002). Ultimately, a response and an appropriate action plan is required on behalf of the user from policy makers, service planners and practitioners, on influencing action, and developing ideas to facilitate change ("Experiencing ethnicity," 2004). Other research suggests we must place large importance on the feature of identity, specifically in co-design processes. Aspects of representation and identity formation, play a large role in understanding how to transform relations of power and encourage civic engagement (Renedo & Marston, 2011). In understanding the experience of immigration on a person's social and mental capacity, the diagram below depicts the different stages and impact.

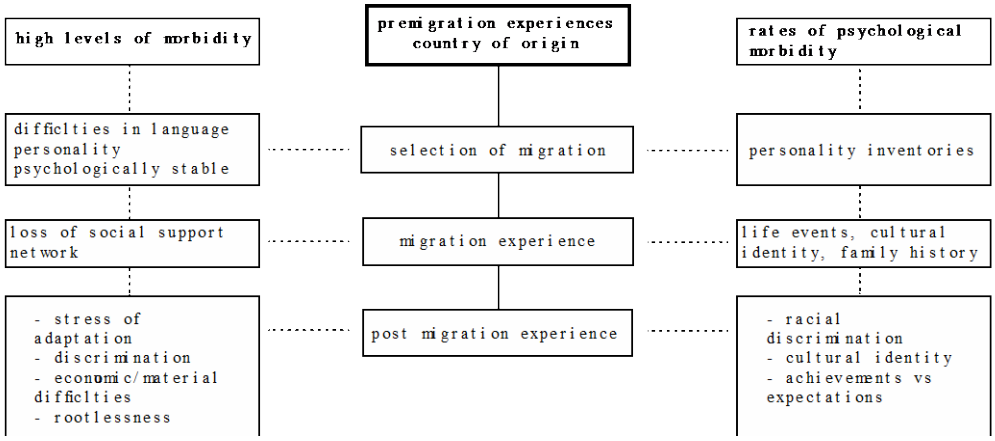


Figure 1. Stages of Migration and Psychopathology (adapted from (Ríos, 2008).

Psychopathology specifically references collective mental health features of a particular demographic, in this case, that of elderly immigrants and refugees as they experience similar psycho-social events in resettlement. The figure, with stages of immigration and the psychological impact each on personal experience and relationships shows a loss of social network from uprootal, stress of adaptation and rootlessness pointed out as being just some of the results of immigration. All people facing aspects of migration also experience the heightened need for cultural integration within their new environments. The older we are when resettling, the more amplified are risks related to cultural shock and anxiety from the experience. It has been described that these psycho-social intricacies place a large burden on the way people experience special services (Ekşi, 2002).

3 Case Studies

Purposeful case sampling was used for the selection of four countries in order to provide information-rich cases, studied in-depth (Patton, 2002). This sampling technique allows control over the search for specific cases to fit specific criteria (Bernard, 2000). The following countries were chosen to form part of this research due to their high GDP spend on health and social care, large proportion of elderly people and access to care. The purpose is to explore key features of well-established social care systems from economically developed countries. An important aspect to define was mandatory long-term care insurance, which meant that many of the country residents have free or subsidised access to state-run social care services. This criterion impacts access to state-run social care services for all citizens.

Country selection is based on following criteria:

Table 1 Case Study Criteria.

Country	Percentage of GDP Spent on Care for the Elderly	Percentage of People Aged 65+	Mandatory Long-term Care Insurance
Germany	10.1%	21%	1995
Denmark	10.9%	20	N/A
France	11.6%	20	2002
Belgium	10.7%	19	N/A
United Kingdom	9.4%	19	N/A

Source: World Bank, 2017 & The Organisation for Economic Co-operation & Development.

3.1 Germany

Following a major reform of Germany's care system in 1995, the country created a new model of service provision and funding, which allowed equal distribution of resources between central and local government, funded out of pay deductions. This offered universal and more appropriate care where and when it was needed, it helped relieve local councils from commissioning responsibilities by providing overall better quality care and releasing pressure from other parts of the system (Chazan, Lewis, & Neville, 2017). Over the next couple of decades, Germany saw a significant increase in demand on publicly funded care. By the end of 2011, almost 2.5 million people were dependent on state services ('The Local', 2014). Germany's social care is now effectively transferred and run by central government with overall GDP (gross domestic product) spend on overall social care of about 25.1% ('England's Social Care Crisis', 2018). The scheme is needs assessed and has been expanded to cover a variety of disabilities. It provides all residents with a reliable system of care, no matter what the circumstances. In addition to being 'inter-generationally equitable' (only workers pay to sustain it) it is also politically sustainable, with a growing reserve. However, since the model only covers basic needs, it has been argued that poorer people usually rely on other social benefits to meet their care necessities, whereas wealthier citizens account with their own savings. Thus, making the private care sector a distinct 'go-to' for some, expanding the field where generally, users cover the difference in cost. A key prediction for the German social care system is that over the course of the next few years, cost pressures may have a significant effect on operation. According to the Federal Statistical Office, Germany had a total of 767,841 non-German over-65s in 2013. Where most foreign seniors come from EU member states with Italy, Greece and Croatia ('How good is Germany for the elderly?', 2014). Over the past few years, funding for integration of migrants in the country has dramatically increased, with the bulk going to language courses (Konle-Seidl, 2017).

3.2 Denmark

Registered residents are usually automatically entitled to publicly financed care services. Operating on a regional basis, Denmark's social care provision is covered by its 'Health Law', which in turn assigns responsibility to regions and municipalities for delivering state services to vulnerable people (European Migration Network, n.d.). Principles include ensuring the delivery of high-quality care, access to information, service integration and transparency in activity. The national government sets the framework for elected councils to adhere to for specialised services and social care coordination. It has been noted that organised patient groups actually engage in policymaking at national, regional and municipal levels and are involved especially with care services. The country spends 2.2% of its GDP on care for the elderly, second only to Sweden, and Danes over the age of 65 receive a basic pension of about 8,000 krone (£811) a month, before tax. The rights of the elderly are championed by senior citizen councils in each municipality, and leaders from Denmark's five geographical regions meet with local authorities and practitioners to plan improvements to services every three years (Russell, 2016). The Danish model revolves around the idea of choice and prevention, with up to 24-hour home care available, free, for people aged 67 or older. Once people in Denmark hit 75, they receive two check-ups a year from a public health nurse to see if they need home care or other help. The nurse checks to make sure the fridge and medicine cabinet are stocked, whether the clients see friends and family, and whether they seem to be in sharp mental and physical health. Many people remain independent but sometimes people need help a lot earlier than they recognise - that's why there are

‘supervised freedom’ care homes available to them (Social and health care policy in Denmark).

3.3 France

The French social care system is partially funded by obligatory social security contributions, where premiums are automatically deducted from employee salaries (The Norwegian Health Care System, 1998). Three of the main central state services ensure the coordination and planning of social policy. A recently reformed concept introduced regional health agencies, which meant that several institutions were merged in order to manage the overall delivery of care services (Somme & de Stampa, 2011). These major regional and local state services for social affairs implement national policies and define and coordinate action at their levels (‘France in London | A Comparison between the French and British Health systems’, 2015). The key responsibility for elderly people with chronic conditions on the other hand, lay with two ministries and two insurance systems (ministry of health and ministry of solidarity, health and retirement pension insurance bodies). Additionally, social aspects of long-term care are managed mainly by the general councils at the department level following France’s decentralisation policy (Somme & de Stampa, 2011). Care for the elderly (criteria for application is 60+ years old) is available via public monetary benefits and is means assessed using a national scale (‘Alzheimer Europe - Policy in Practice’, 2007). In regard to migrant users on the other hand, eligibility rests on two bases: lawful residence and occupational status. This is usually established by the provision of evidence regarding identity, residence and resources (Da Lomba, 2010). A large measure of access to care for North-African elders is granted via ‘The Law of the Adaptation of the Society to Ageing’ (Mandrin, 2017). This aspect of French policy permits a form of transition via a simple declaration, whereabouts North-African migrant elders are granted their French social rights whilst assisted long-term stay is provided within their home countries This provides access that many other ethnicities simply do not have. Another example of French government initiatives in support of elderly migrant comes in the form of semi-public organisation ADOMA, which includes improvement and adaptation of housing that meets the needs of this segment of the older population and providing healthy ageing personalised and targeted support (Mandrin, 2017).

3.4 Belgium

Providing a range of services, Belgium’s long-term care system is financed by social security and general taxation contributions. Organised at the federal, regional and municipal levels, separate regions are generally responsible for economic migration and support in care. In 2012, 11% of the Belgian population held a foreign nationality and some research estimates found that around 19% of the population was foreign born. The main foreign nationalities in Belgium include Italian, French and Dutch. However, the most represented of the groups are those of Moroccan and Turkish descent, where ethnic elderly are among 1/3 of 65+, suffering from at least 2 serious chronic conditions. In order to help support this part of society, local authorities, municipalities and the Public Centres for Social Welfare provide cultural aid to minority people by covering the implementation of different integration initiatives set by government, such as housing and social assistance (Willemé, 2010). In recent years, the Walloon government initiated a program called ‘The decree of 28 April 2016’ which introduced compulsory integration schemes in local areas. The program included 120 hours of free French lessons for migrant communities among other new citizen orientation programs. With no major developments for social and healthcare access for

migrant citizens, access is currently the same as that of Belgian nationals (assuming residence has been granted) (Mussche et al., 2013). Overall, in spite of equal accessibility and integration programs, there are still groups of migrant communities who have less access to care, especially preventative care, as found by a study conducted to compare five EU countries (Rosano et al., 2017). Research concludes that aspects of 'diversity-oriented, migrant-sensitive prevention' are still highly required. Policies are also needed in order to mitigate barriers to care for immigrants, especially in areas where intersectional discrimination is still present. In order to reduce disparity, Belgium has been cited as one of the major European countries that fits regular public administration reforms into their model of authority. This empowers citizens and employees, increasing the quality of service provision; this model has been described as an 'overlap of their traditional administrative systems with more citizen orientation' (Torres, Pina, & Acerete, 2005). The key issues surrounding elderly immigrant care in Belgium, specifically labour migrants, as one report suggests are that of lower social and financial position, less knowledge of available care, all maintained by having little knowledge of the local language (Casal-Sanchez, 2018).

4 Expert Interviews

Hour-long, semi-structured exploratory interviews were conducted with specialists in co-design, service design and social identity. The purpose was to explore challenges within the public sector in co-design and service design, as well as to better understand ethnic and migrant experience with regard to public services. Grounded theory was used for the analysis method of the interview results, as the problem themes emerged out of the raw data. The following experts were queried:

Table 2 Expert Interviews Role & Field of Expertise.

Respondent	Role	Field of Practice
1	Freelance Service Designer, User Researcher & User Experience Designer	Local government, Service and Experience Design
2	Professor, Participatory Design Public Project Specialist	Community orientated participatory design, Local government
3	Professor of Social Policy, Social Citizenship & Migration	Social Exclusion-Inclusion, Migration & Social Policy
4	Researcher	Psychological & Behavioural Science, Social Identity & Representation
5	Co-design expert, ex-civil servant	Community projects, Refugees and Migrant experience
6	Professor, Service Designer	Service Design, Nomadic Experience

4.1 Service Administration: Disjointed associations

Experts agree that, as marketed private services become more readily available to the public, social care services fail to be more universal and often do not converge with the overall system of care. This severely impacts on the way elderly people use services as increasingly, not enough is being done to manage recovery when users become a part of a disjointed system of care. Policy on the other hand, gives a 'backdrop to hostility' with assumptions often made that immigrant elderly are being taken care of by their family members on an informal basis. This becomes a part of the generational stream & expectation, with what is

seen as the burden of care being moved elsewhere. A way to manage some of these challenges, experts agree, is to ensure thorough citizen-state involvement, where the user becomes expert by experience, allowing for family members who are also carers to participate in the research dialogue. Most importantly, within these processes, service users can be taught about the care service structure and availability. It is important also to note that specific discussion was formed along the themes of social identity and prejudice against marginalised groups of people within the system of care. It was suggested that a way to mitigate this issue is to ensure compassionate forms of training and care amongst service representatives on all levels of practice.

4.2 Service Design: Lack of user research and user testing

Respondents outline two major issues in service administration, design and delivery in the public sector. Most discussed is the lack of 'discovery phase', described on the UK Government website as a means of 'learning about your users and their context' (UK Gov, "Agile Delivery".), a process that helps to reduce uncertainty and assumptions made about consumer needs. Despite the UK Government Digital Service, which formed in 2010 to help improve and consolidate digital public services within central government, it seems much less has been done about the spread of the same user-centred values outside of central government. Another key issue discussed is a significant lack of user testing. Once projects near their service roll-out stage, designers would often administer technical testing to check for any interface instability without conducting in-depth usability checks. At this stage of the process, it is already too late to make any significant changes. Public services would often go through major transformations such as a channel shift from a physical to a digital representation, without acknowledging user requirements. Described as taking a passive view, institutions would assume the view of simply knowing what's best for the service user, and often unwittingly excluding elderly citizens and digitally illiterate service users.

When prompted about the cause of these major discrepancies, respondents listed issues of management, lack of resources and time restraints. In order to comply to these limitations, both designers and project management staff are said to 'cut corners' in order to roll out more projects in a shorter time-frame. One way to overcome these issues, experts agree, is to apply incentives that focus on quality and process management during the service design process. This motivates service designers and providers to adhere to the whole process of user testing and permit usability measurement. As suggested, a 'mandate discovery phase', could be the answer to fostering a better designer-citizen synergy.

4.3 Conditions for participation: The designer and wider community

Here experts speculate the changing role of the designer, especially within the co-design service session. The designer is referred to as sense-maker, one that establishes collective communication. They foster familiarisation by helping find a concept catalyst and common ground, in order to 'bring everyone to the same level', disintegrating feelings of fear often felt in dealing with the state. As part of the collective community building process, experts agree that it is up to the designer to build personal and collective awareness of cultural nuance and help the wider community adapt themselves, in order to create better conditions for participation. When often met with resistance, the only way to overcome it is through establishing community keyholders and establishing a panel reference group.

The final element of this process is expectation management. From the beginning of the co-design research process, it is important for the designer to clearly relay an understanding of

project outcomes and how findings will later be relayed to the wider community, actively closing the feedback loop. This important step establishes a reciprocal relationship.

5 Use, Emergence & Impact of Co-Design

The term co-design has long been used in both academia and practice, unconstrained by the borders of the design field. It is important to note that in the history of its development, the better known components of co-design emerged from aspects in the business and marketing fields, as opposed to design practice (Sanders & Stappers, 2008). Parallel to its growth in design, where it slowly began to emerge in 1970s Scandinavia, Michigan Business School Professors Prahalad and Ramaswamy popularised the concept of co-design as user involvement for 'co-creating value with the firm' (Prahalad & Ramaswamy, 2004). The key idea here, was to generate a sustained system of gain.

The value of co-design, could be argued, lays predominantly in its objective – 'not only involving users in service development, but also involving service developers in the realities their services are contributing to' (Holmlid, 2009). In other words, aside from the aspect of mitigating knowledge asymmetry from the perspective of the participant, co-design can tackle the issue of the all too known 'we simply know better'.

'To everyone according to their needs, from everyone according to their ability'

- Karl Marx, 1875

Co-design is a democratic method, a mindset, a way to meaningfully engage "hard to reach" users, support change and build social capital, often requiring a diverse range of participants in exploring, developing and testing responses to shared challenges (Blomkamp, 2017). Co-design in healthcare innovation, for example, has strongly drawn on this premise of using design tools for improving varies aspects of the care quality service (Carr et al., 2009), here the concept of value changes form. Between 2005-2013, the former National Health Service Institute for Innovation and Improvement (NHS III), then in support of all NHS funded organisations, developed an experienced based co-design toolkit in order to involve non-design users into the service development process ("EBCD," n.d.). This was the beginning of tipping the scales of power in public service development, it emphasised the value of patient involvement and primary data collection to the overall process of service development.

5.1 Co-Design and the Dynamics of Power

Exploring use and opportunity and the Challenges of Co-Design: In discussing challenges surrounding implementation of the co-design process, we must address the proverbial elephant in the room. Issues surrounding citizen engagement and distribution of power within the process of service development are often discussed and could be addressed via Arnstein's 'Ladder of Participation' (1969). After her work in urban planning, Sheery Arnstein notes, there is a 'critical difference between going through the empty ritual of participation and having the real power needed to affect the outcome of the process' (Arnstein, 1969). Thus, it could be argued that fostering an environment where the shift of power is considered more of a fluid activity is key to truly engaging with a wider audience and optimising co-design processes. The figure below illustrates the notion of different sets of power held by participating citizens.

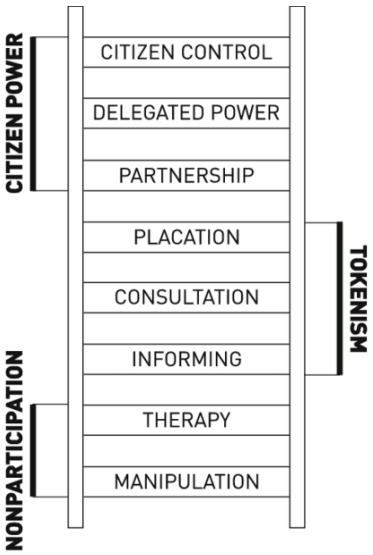


Figure 2. Arnstein's Ladder of Participation.

Types of participation and 'non-participation'

As rates of participant across different segments of society are found to be highly contrasting, especially amongst marginalised groups, it is important to illustrate that Arnstein's ladder of citizen participation specifically highlights some of the ways that empowerment takes place in any citizen-state partnership. The different rungs of the ladder represent different categories of 'power'. In order to nurture truly powerful community participation programs, we must first become aware of bias and power dynamics in order to prevent negative impact. The following descriptions take into account power processes within co-design:

Manipulation: This is the initial level at which all citizen-state relations begin. It is considered non-participative and achieves public support through simple public relations.

Therapy: This subsequent level aims to educate or 'cure' participants. It could be considered that in co-design for social care, participants become informed about public care structures and access to care. Very early stages of this process act as a form of engagement with the elderly immigrant user group.

Informing: This level is considered to foster a one-way flow of information during the process of co-design with the user group or stakeholders, no feedback is taken into account in order to improve processes for the future.

Consultation: This level begins to take into account power dynamics. Even by applying various ways of consulting the user group and stakeholders thorough public enquiry, this stage of the ladder is still considered a "window dressing ritual", as the final decision is usually still made by those consulting.

Placation: Stakeholders have more of an impact through opinions, ideas and outcomes. Here, two-way communication lays at the core. Hand-picked participants are requested into committees; however, final say remains with power holders in order to judge legitimacy of the feedback collected.

Partnership: At this level, power is redistributed amongst citizens and power holders. Planning and decision-making responsibilities are better shared amongst those involved in the process of co-design or project.

Delegated Power: Citizens have hold much more power on this level, this strictly ensures accountability and discussion on improving service appropriateness is strongly considered. Impact on this level is much more secure.

Citizen Control: This level does not account for intermediaries; all program and project processes are accounted for by the people.

6 Conclusion & Opportunity Identification

The current state of social care services in the UK shows a general necessity for improvement in the way services are run, disseminated and experienced by users. From this preliminary discussion we have found that too often user research isn't placed high on the agenda of UK municipalities. With strict time and funding constraints within authority often adding to the lack of sustainable models of governance and allowing assumptions to inhibit appropriate development. In light of this preliminary study, we can conclude that there is a need for more holistic commitment to the design research phase in UK government. Expert interviews reveal that the way to mitigate current issues of social care service design, administration and delivery, lay in effectively in administering mandate design and user testing processes. With a better understanding by all stakeholders of long-term value and impact of user research and co-design, we can ensure the development and improvement of state services for elderly immigrants. It is important to frame co-design as a useful approach for encouraging collaboration between practitioners and vulnerable or marginalised users, family members and staff, especially in complex environments. Therefore, the study lays out the potential for improved social care services, engagement and integration of elderly immigrants in the UK through principles of co-design. On one hand, working collaboratively with small communities of displaced elders will fundamentally help empower and instil active citizenship, allowing them to become a more integral part of the general population. On the other hand, it will improve efficiency in user research processes and arm service providers with knowledge of exactly what their users' requirements are.

The next stage of this research study will be to provide a better understanding of the UK social care service system. Further in-depth expert interviews are required in order to establish service design and delivery issues. Finally, co-design sessions with experts and elderly immigrants will help build guidelines for future development.

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Layout Preference for Korean Movie Posters: Contextual Background or Character Dominance

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This study uses three surveys to investigate whether movie posters are required to be redesigned when importing and releasing foreign movies for a Korean audience or vice versa. Survey I included the four major attributes of poster design: character, background, title text, and colour contrast. This was carried out with Koreans (N = 30) and Americans (N = 30). Using conjoint analysis, both groups considered background to be the most important attribute, as they both perceived the background as needing to contain contextual information about the movie. In Survey II (N = 32), which was performed with existing posters, the Korean participants showed a preference for background-rich layouts, thereby confirming the results of Survey I. Different from Survey I and II, in which the majority of participants were in design-related domains, Survey III was included participants of much wider age groups and various occupations (N = 133). The younger participants in Survey III have the same tendency as the design-conscious groups from the two previous surveys. On the contrary, the older participants in Survey III were indifferent to the poster's layout; instead, the older participants showed slightly positive responses to character dominance. Given that the preferences of the two different age groups do not merge, Survey III concluded that the targeted age range of the audience is an important factor that should be considered while approaching various movie poster layout styles. In future studies, more variables are expected to be explored to provide empirical evidence for design practitioners to create design outcomes more efficiently.

Keywords: layout preference, movie poster, visual localisation

1 Introduction

One of the most controversial and frequently debated issues in international marketing and advertising literature focus on whether international marketing strategies should be standardised across national markets or localised to individual national markets (Duncan & Ramaprasad, 1995; Szymanski, Bharadwaj, & Varadarajan, 1993). These debates are actively carried out in the intangible content industry, including industries for movies, games, and music, which are simultaneously released to multiple countries. In particular, due to the development of the Internet and mobile devices, media are globally disseminated in real time (Küng, Picard, & Towse, 2008).

Although localisation and globalisation are crucial issues nowadays, not many studies have empirically tested whether people have actual visual preferences depending on their cultural and geographical backgrounds. In specific, many movie posters are often visually localised

to demonstrate the distinct difference of visual components between the Western and Asian markets.

Based on this circumstance, this study intends to investigate whether localised marketing visuals reflect the preference of the target audience, specifically in regard to movie posters. To examine whether preference varies depending on viewers' cultural context, we compared Koreans' and Americans' preferences for the visual components of movie posters, considering each Asian and Western ethnic group, respectively. Three surveys were performed, which asked about participants' preferences regarding the posters' layouts. The quantitative data are expected to offer empirical evidence to which design practitioners may refer.

2 Related Works

2.1 The globalisation and localisation of movie posters

Although great attention has been paid to comparative studies on globalisation and localisation to properly serve consumers' demand in various locations, the compared effectiveness between the two methods still remains controversial. Globalisation has become a trend in general, but localisation has also shown its effectiveness in some cases. For example, De Mooij (2018) asserted that there might be global products or brands but there are not global people. Recently, some studies attempted to reconcile both methods to synergise the positive aspects of each method (Karpati, Freedman, Castro, Kallio-Tavin, & Heijnen, 2017; You, Kim, & Lim, 2016). In this context, a global release of media contents needs to consider which approach is better fitted between the two. Movie posters are redesigned mostly when the movie is locally disseminated while lacking of objective evidence.

2.2 The graphic design characteristics of movie posters

Movie posters generally have an analogous format since they usually contain similar contents, such as a title, the characters, and a tagline. Considering that, the graphic attributes also can be summarised based on the contents.

2.2.1 Characters (actors)

The characters who drive the story are a core element of any movie. Also, characters are a major element to bear in mind when designing a movie poster. The number of actors, their body posture, the portion of actors on the poster, and so forth can be adjusted to effectively deliver the movie's context. However, how actors are visually displayed is different between Western and Asian countries. When a movie is released to the Korean audience, the poster is redesigned using a conventional method. According to previous studies, it was observed that main objects or characters were positioned in the centre and dominated the layout (Kang & Kim, 2014; Roh, 2017). More specifically, their faces or upper body parts are zoomed in on. Thus, the Korean audience readily focuses on actors who appear in a given movie.

2.2.2 Background image

The background image of a movie poster can illustrate more detailed information about the movie. The image can imply the historical background, where the story takes place, and the main plot in the story (Kang & Kim, 2014). Western movie posters comparatively have more space to illustrate this information than Korean posters, since the actor's photo is smaller in

Western posters. As a result, Koreanised movie posters contain fewer contextual visual sources, whereas Westernised ones focus on and easily convey the contextual information.

2.2.3 Colour

A movie poster's colour concept illustrates the movie's mood. In general, colour is utilised as a symbolic attribute to deliver message of contents and inspire sentiments (Suk & Irtel, 2009; Taft, 1997). Also, the meaning that the colours imply can be similar or dissimilar across cultures (Madden, Hewett, & Roth, 2000). As seen in Figure 1, the colour of a poster implies the tone and story that the movie tells across a country or region. For example, the combination of orange and greenish blue in *Blade Runner 2049* describe future city setting. Dark blue dominated in the *Sherlock Holmes* poster and created an atmosphere of mystery. While the usage of colour is similar across countries, the adjustment of the colour contrast in Korean movie posters is usually stronger than that in Western ones (C. Y. Lee & Paik, 2007) to help posters stand out from others and attract people's attention. Korean posters are considered to be marketing materials.

2.2.4 Text

The text attributes, such as the title and taglines, help audiences understand the story and characteristics of a movie more directly (Mahlknecht, 2015). The text is not very emphasised in Western movie posters, aside from the title, but it is considered to be an important element in Korea when promoting a movie. Specifically, the image of the main actor tends to be predominantly positioned on the movie poster, and thus the image elements cannot deliver enough information about a given movie due to the lack of space in the poster's layout. Consequently, supplementary explanation text is added in Korean posters to describe the film's story in more detail (Kang & Kim, 2014). The posters also have more superlative expressions or exclamations to amplify their content (G. H. Kim & Kim, 2007).

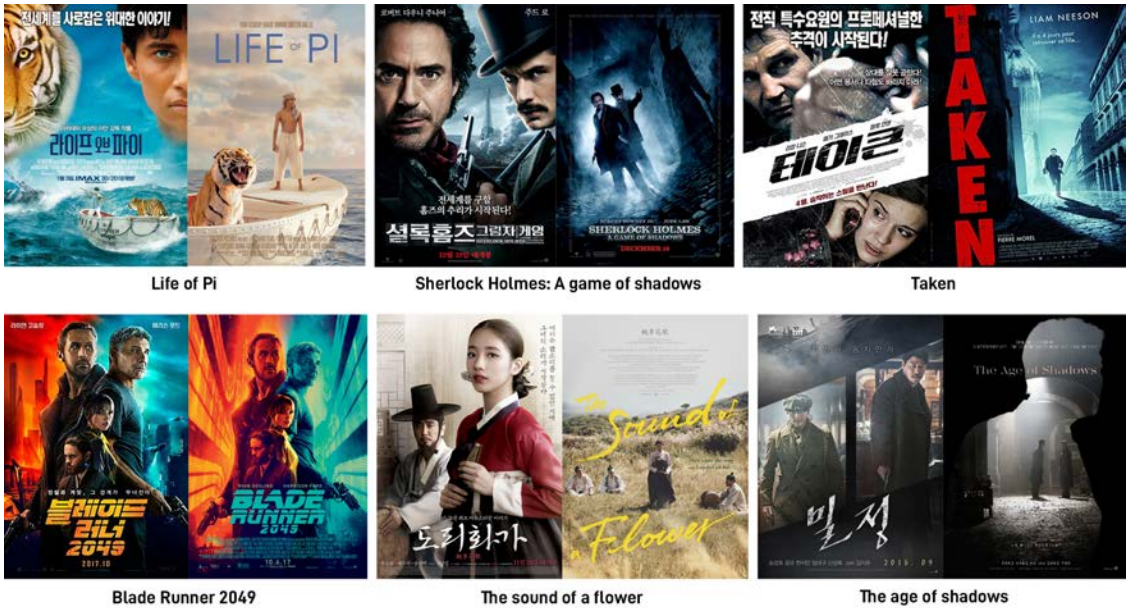


Figure 1. Korean market targeted movie posters (left) and Western market targeted movie posters (right).

2.2.5 Localised movie posters in Korea

Concerning this distinctive difference in movie poster styles, designers claimed that the investors request poster designs with a high exposure of famous actors/actresses, award records, or names of famous directors (E. S. Lee, 2017) because they believe it can lead to

commercial success and easily attract people's attention (D. B. Kim & Choi, 2017). The movie poster pairs in Figure 1 demonstrate a clear distinction between Koreanised and Westernised layouts and designs. For example, the Korean versions have close-ups of the main actors, specifically those who are popular in Korea. Interestingly, in its overseas version, the actors are further away. Instead, the movie poster illustrates the background and actions of the actress. Also, explanatory taglines were added in the Korean version of *Life of Pi*, *Sherlock Homes*, and *Taken*.

2.3 Process of study

Despite the observations in the previous studies, it is not yet clear that the Koreanised movie poster layout is preferred by a Korean audience. We planned surveys to examine the preference for movie poster layout designs to determine what kinds of visual elements play the dominant roles that appeal a given audience. The survey targeted both Koreans and Americans to compare any preference caused by a difference in cultural backgrounds. In the following, the survey method and results are described, including a comparative study between Koreans and Americans, followed by a confirmatory study with Koreans regarding the results of the comparative study. We compared the answers of the designer group with those of the non-designer group among Koreans to more clearly identify of what the general audience favours.

3 Survey I: The impact of poster layout attributes on preference

3.1 Outline of Survey I

In Survey I, we attempted to analyse what factors influence the audience more heavily regarding judging the visual appeal of poster design. Based on the literature review, we focused on the four types of visual attributes: the actor composition, background, text, and colour contrast. We assumed that, depending how these attributes are integrated, people might find different posters attractive to different degrees. We used a conjoint analysis, a survey-based statistical technique that is used in a wide variety of problems in consumer research. It helps researchers estimate the impact of selected product characteristics on customer preferences for products (Cattin & Wittink, 1982; Green & Srinivasan, 1978). Then a t test was used to compare the assessments between Koreans and Americans.

3.2 Survey participants

We recruited 30 Koreans and 30 Americans for the survey. The Koreans were university students majoring in design and were paid for their participation. The average age was 27.50 (SD = 4.47) years, and 14 men and 16 women were recruited. The American participants joined the survey through an online survey system and were paid for their participation. Among the 30 recruited Americans, 21 were men and 9 were women. Their average age was 31.53 (SD = 6.24) years, and their professional fields were not limited to design. All participants had normal colour vision and fluency in English.

3.3 Survey stimuli

As mentioned earlier, we articulated the four attributes of movie posters: dominance of actors/actresses, backgrounds, text, and colour contrast. To generate alternative movie poster designs in a systemised way, we planned several levels within each attribute. The dominance of actor composition had three levels: one actor, various actors, or no actors (or non-human objects). Regarding the background, we considered two levels: illustrative or minimal. An illustrative background often explicitly demonstrated the story of the movie,

while a minimal background did not give much information. Then, the text had four levels: title only, title with a supplementary phrase, title with the actors' names, or title with both a supplementary phrase and actors' names. Lastly, the colour contrast has two levels, which are simply high contrast or low contrast. Therefore, we had a total of 48 combinations possible for comparison.



	1	2	3	4	5
Actor	None	Various Actor	None	One Actor	One Actor
Background	Landscape	Landscape	Solid Color	Landscape	Solid Color
Text	Title & Actors' Name	Title & Copy	Title & Copy	Title & Actors' Name	Title & Copy
Color Contrast	High	Low	High	High	High

6	7	8	9	10	11
One Actor	One Actor	Various Actor	Various Actor	One Actor	One Actor
Solid Color	Solid Color	Solid Color	Solid Color	Landscape	Landscape
Title & Actors' Name	Title	Title & Actors' Name	Title	Title & Copy	Title
Low	High	Low	High	Low	Low

12	13	14	15	16
None	One Actor	One Actor	Various Actor	None
Solid Color	Landscape	Solid Color	Landscape	Landscape
Title & Copy & Name	Title & Copy & Name	Title & Copy & Name	Title & Copy & Name	Title
Low	High	Low	High	Low

Figure 2. 16 Movie posters were created to serve as stimuli. The graphic profile of each poster fits the 16 profiles generated by an orthogonal design method.

To reduce the number of combinations while minimising the loss of information, we applied an orthogonal design method offered in the SPSS 24 software package. We obtained 16 necessary combinations, namely profiles, in the context of a conjoint analysis. As shown in Figure 2, the 16 profiles show 16 ways of combining the four attributes, and the survey participants were presented them instead of all 48 combinations. In Figure 2, movie poster design alternatives are displayed, and they show how the four attributes were combined. When making the movie poster stimuli, we adopted the title and story of the well-known movie *Les Misérables*. To avoid any influence from the participants' previous exposure to the *Les Misérables* posters, we intentionally composited the movie poster images with different American film actors.

3.4 Survey procedure

We handed each Korean participant printed copies of the movie posters presented in Figure 3 (left). We asked the participants to rank the printed stimuli in order of their preference, from the most preferred to the least preferred. The most preferred movie poster should attract the most people and lead them to watch the movie. Also, to ease their decision-making process, we previously guided them to sort the 16 movie posters into three ranked groups: poor, fine, and good. Then the participants were asked rank a much smaller number of posters within each group. By doing so all participants easily made a rank order of the 16 movie posters within 10 minutes, as shown in Figure 3 (right).



Figure 3. Face-to-face survey. One participant arranged the 16 movie poster images in order of his preference.

We launched a Google Forms survey and recruited American participants through Amazon Mechanical Turk. As in the survey with the Korean participants, we asked them to rank the 16 movie poster images in order of their preference. Also, we guided them to sort the 16 posters into three groups first and then asked them to finalise the rank to simplify the procedure before starting the survey. After screening out some participants whose answers were incomplete, we collected assessments from 30 Americans.

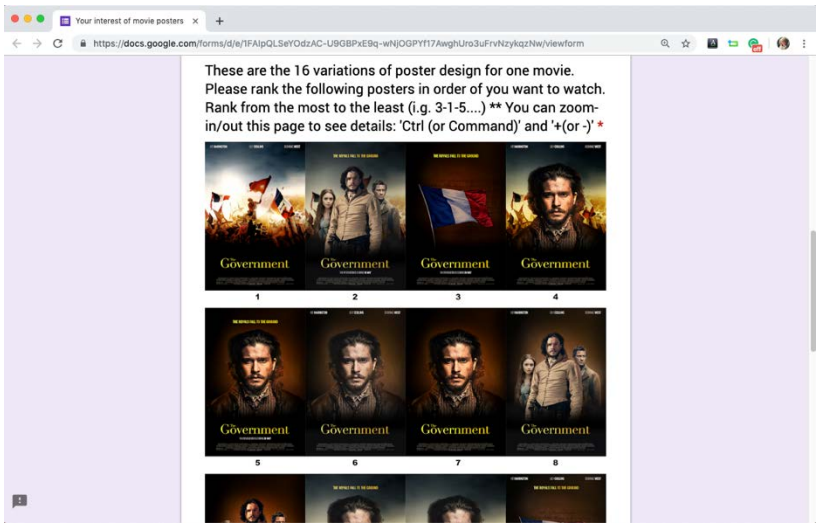


Figure 4. An online survey advertised through Amazon Mechanical Turk. Online participant also arrayed the 16 movie poster images in order of his preference.

3.5 Results and analyses

Based on the ranked data from each cultural group, we performed a conjoint analysis for Korean and American groups separately to determine what factors drive Koreans' or Americans' preference of movie posters. The conjoint analysis yielded values of relative importance regarding the four factors and the utility scores regarding the levels of each factor.

3.5.1 Comparing the impact size among the four factors

We obtained 30 sets of relative importance for each cultural group. The bar chart in Figure 5 presents the averaged relative importance of the four factors while comparing the results between Korean and American participants. The orange and blue bars indicate Korean and American results, respectively. The chart illustrates a strong consistency between the two groups, explaining that both groups considered the background to be the most relevant attribute, followed by actor, colour contrast, and text. In particular, the averaged relative importance values of the backgrounds were 52.44 by Koreans and 52.45 by Americans, suggesting that the background factor played a dominant role when the survey participants from both groups were made their decision regarding preference. On the contrary, the text was the least influential attribute for them when deciding their preferences from among the movie posters.

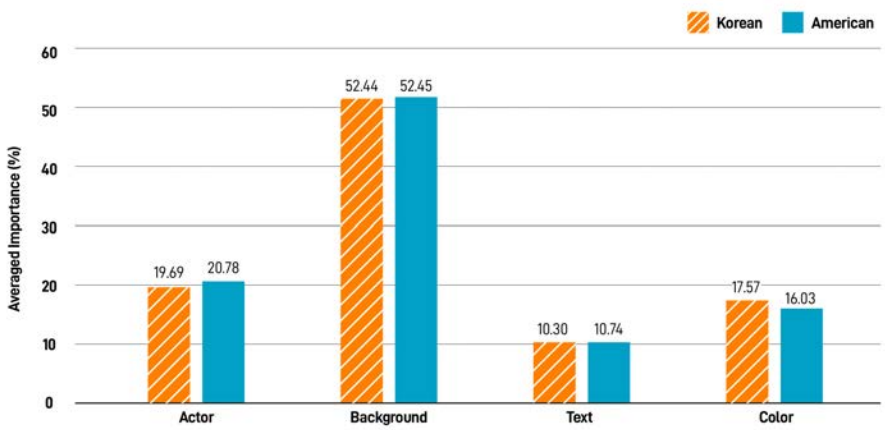


Figure 5. Relative importance score of each attribute. Koreans (N = 30) versus Americans (N = 30).

As discussed when Figure 1 was introduced, our initial assumption was that there would be a cultural difference in preference. However, the survey results provided coherency, implying that the Koreanised layout design is not necessarily successful, especially when the design targets the design-sensitive younger generation in Korea.

3.5.2 How to design the four attributes

Then we analysed the utility scores of each factor to learn what combination is more appealing. For example, the actor's presence showed the second biggest impact on the audience's preference. As we looked into the utility scores of levels of "actor" attributes, both the Korean and American groups preferred one actor much more than multiple actors. In particular, the survey participants disliked posters with multiple actors more than posters without actors. Then, as presented in Table 1, the averaged utility scores of each level were compared between Koreans and Americans. To test the mean difference between the two groups, an independent sample t test was performed for each comparison. The analysis yielded no statistical difference at all, and the significance values were rather close to 1.00.

Table 1. Comparison of utility scores of the factor levels between Koreans and Americans. The mean comparison between the two groups did not yield any statistical differences, indicating that the two cultural groups made similar assessments.

		Korean		American		Mean difference	
		Avg. Utility Estimate	std.Error	Avg. Utility Estimate	std.Error	T value of Independent samples t-test.	Sig. (2-tailed)
Actor	One Actor	+0.49	0.23	+0.41	0.24	0.24	0.81
	Various Actors	-0.57	0.27	-0.71	0.28	0.35	0.73
	None	+0.08	0.27	+0.30	0.28	-0.56	0.58
Background	Landscape	+1.41	0.17	+1.40	0.18	0.01	099
	Solid Color	-1.41	0.17	-1.40	0.18	-0.01	0.99
Text	Title	-0.28	0.30	-0.21	0.31	-0.15	0.88
	Title + Copy	+0.04	0.30	-0.19	0.31	0.53	0.60
	Title + Name	-0.04	0.30	+0.03	0.31	-0.17	0.87
	Title + Copy + Name	+0.28	0.30	+0.37	0.31	-0.21	0.83
Color	Low	-0.47	0.17	-0.43	0.18	-0.17	0.87
	High	+0.47	0.17	+0.43	0.18	0.17	0.87

Based on the utility scores, we then generated a sum of utility scores of each profile of the movie poster designs. In Figure 6, the 16 movie posters are arrayed in the order of their sum of utility. Among the 16 designs, both Koreans and Americans appeared to prefer combination no. 13 the most, as its sum of utility was the greatest calculated by the Koreans (2.64) and by Americans (2.61) who participated.

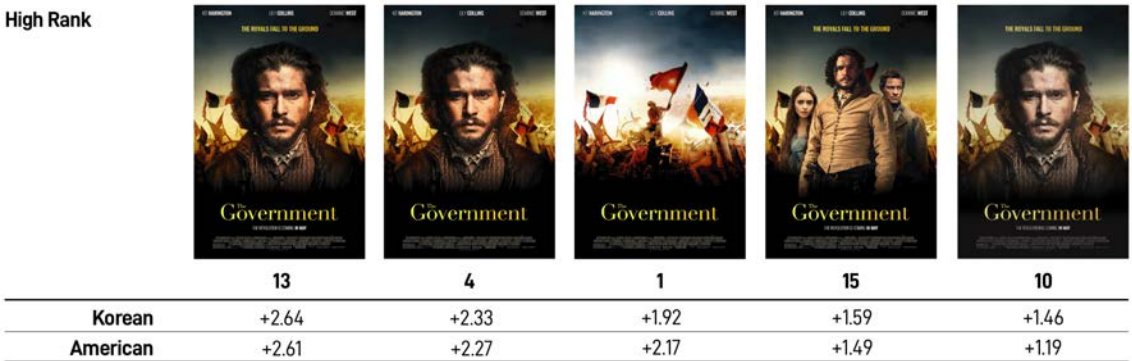




Figure 6. The highest and lowest five combinations based on the sum of utility scores.

Therefore, we discovered a strong common tendency between Koreans' and Americans' preferences. According to the survey results, the background is an essential factor that appeals to the audience. In Survey II, we tried to validate the survey findings. To be specific, we tested whether the rich expression of a movie poster's background appeals to Koreans more than the current conventional layout dominated by an actor or an actress.

4 Survey II: Is there no more need to localise movie poster design in Korea?

4.1 Outline of Survey II

In Survey I, we learned that both Koreans and Americans consider background contents to be quite important. This violates how movie posters have been redesigned for Korean domestic market in general. Often, when a new movie is released in Korea, distributors highlight the outstanding profile of the movie during its promotion by emphasising famous actors or any awards the film has won more than the actual content of the movie. In Survey II, we tried to examine whether a background-rich movie poster layout appeals to Korean viewers more successfully than a conventional character-dominated poster layout. In particular, we employed 12 real movies, including eight that have already been released and four that are upcoming.

4.2 Survey participants

As in Survey I, we recruited students majoring in design or design professionals. A total of 32 people participated in Survey II, and 21 were women. The average age was 30.38 years with a standard deviation of 5.30 years.

4.3 Stimuli and procedure

In Survey II, 12 pairs of movie poster layouts were presented on a display in a random order. One of each pair was from when the film was initially distributed. Then, using the Adobe Photoshop, we created either one background-rich or character-dominated movie poster to make every pair styled in both ways. Consequently, every pair consisted of one background-rich layout and a character-dominated layout. When creating the layout alternatives, we replaced all English titles with Korean titles to avoid any bias caused by language except the poster of *Lizzie* which was not written in Korean in the real Korean localised poster. When a pair of poster layouts was presented, we randomised the left and right positions. While viewing a pair of poster layouts, the participants selected the poster that appealed to them more and encouraged them to watch the movie more than the alternative layout. Survey II was conducted through online participation and took less than 10 minutes.

4.4 Results and analyses of Survey II

As anticipated, the background-rich layout was overall more often preferred than the character-dominated layout. We performed the goodness-of-fit test to statistically confirm whether the frequency of pairwise choices showed a specific tendency. As a result, among the 12 pairs, only two pairs showed that the character-dominated layout was preferred, and they are shaded in orange in Figure 7. One of them was the poster for the movie "Lizzie". The background-rich version of "Lizzie" did not contain much content in the background. In this regard, Survey II confirmed that Koreans seem to prefer background-rich movie posters. However, Survey I and II were limited to a narrow demographic, thereby resulting in a tendency for a biased opinion. Before deriving the final conclusion, we carried out another survey to check the previous findings.

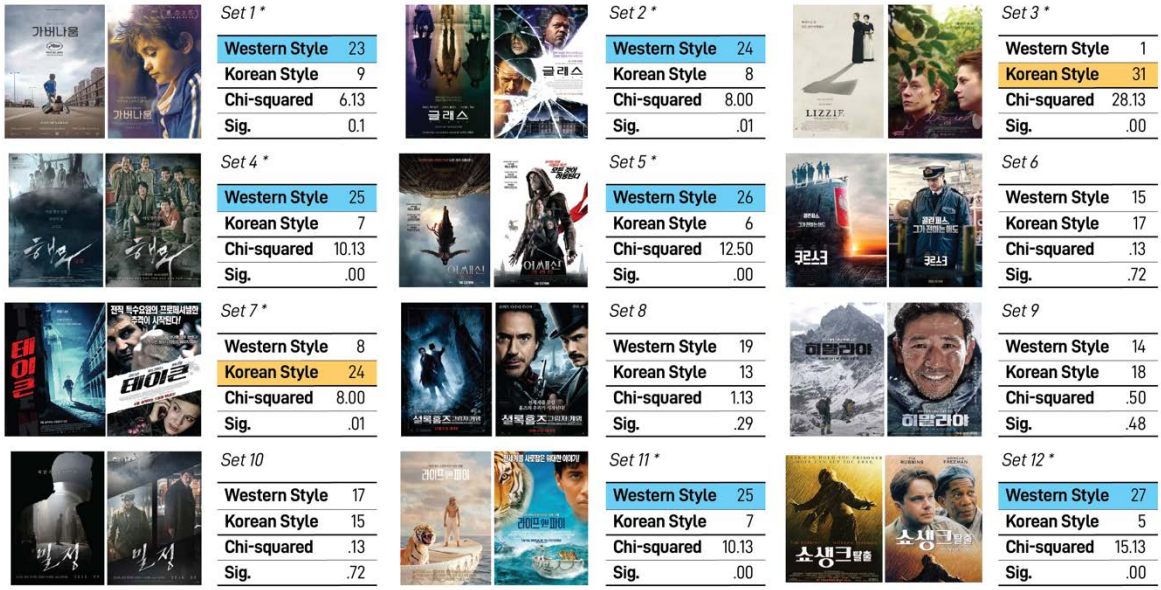


Figure 7. Background-rich (left, i.e. Western) versus character-dominated (right, i.e. Korean) movie poster styles. The survey participants were asked to choose which one they preferred. Orange: When a character-dominated layout is preferred; blue: When a background-rich layout is preferred (N = 32), Survey II.

5 Survey III: Preference survey along the generational line

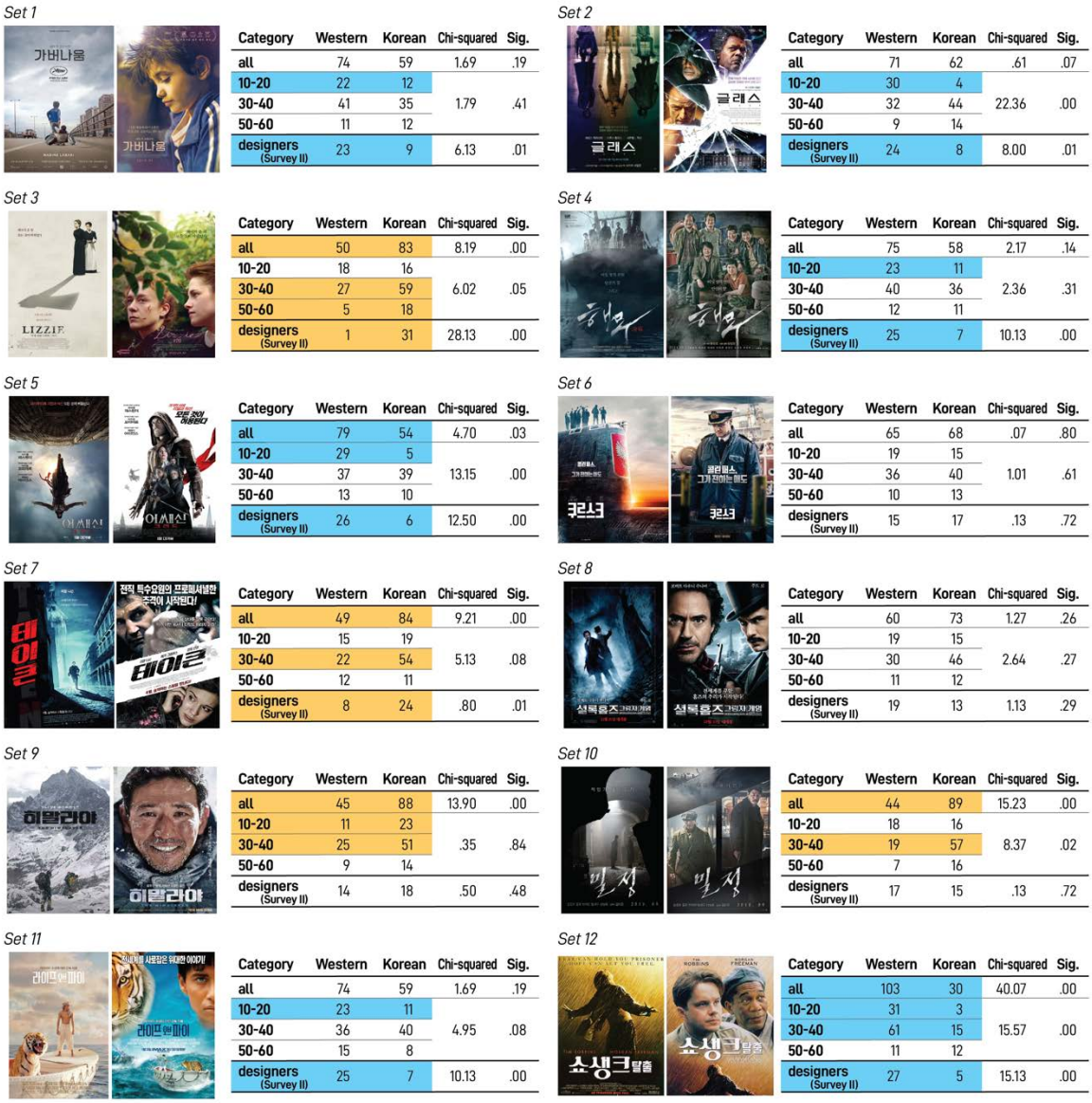
5.1 Outline of Survey III

In Survey III, we tried to diversify the participants in terms of age and field of expertise. We recruited a total of 137 people, and their occupations were not limited to educators, housewives, students, office workers, scientists, retirees, and so forth. We allowed anyone to participate in the survey as long as he or she likes to watch movies often. After removing four incomplete answers, we collected 133 answers from 59 men and 74 women. Their ages ranged between 15 and 68 years, and the average age was 38.29 years. The survey method, including movie poster stimuli and pairwise comparisons, was identical to that used in Survey II.

5.2 Results and analyses of Survey III

Because such a wide age range has participated in Survey III, we examined the data based on each age group. We also compared the results of Survey II and III to determine whether the group of Korean designers might have a particular tendency. Figure 8 displays the frequency of preference for either a background-rich layout (i.e. Westernised style) or a character-dominated layout (i.e. Koreanised style) among the three age groups. At the same time, the frequency data were also examined based on designers versus non-designers. In Figure 8, when the frequency yielded statistically significant differences based on a chi-square test, we shaded the data either in orange or blue ($p < .05$). The data shaded in orange indicate when the participants preferred character-dominated layout. The blue-shaded data mean the participants preferred a background-rich layout. For example, in set 1, 2, 4, 5, 11, and 12, both the younger generation and the group of designers preferred the background-rich layout. The average age of the group of designers was 30.38 years, as described in section 4.2. Interestingly, among all 12 pairs, the preference tendency of

younger participants (teens~20s) is mostly aligned with that of the designers. Other than that, one style cannot be confirmed as being more preferred than the other one in general. Instead, both styles were selected evenly in many cases.



Set 1

Category	Western	Korean	Chi-squared	Sig.
all	74	59	1.69	.19
10-20	22	12		
30-40	41	35	1.79	.41
50-60	11	12		
designers (Survey II)	23	9	6.13	.01

Set 2

Category	Western	Korean	Chi-squared	Sig.
all	71	62	.61	.07
10-20	30	4		
30-40	32	44	22.36	.00
50-60	9	14		
designers (Survey II)	24	8	8.00	.01

Set 3

Category	Western	Korean	Chi-squared	Sig.
all	50	83	8.19	.00
10-20	18	16		
30-40	27	59	6.02	.05
50-60	5	18		
designers (Survey II)	1	31	28.13	.00

Set 4

Category	Western	Korean	Chi-squared	Sig.
all	75	58	2.17	.14
10-20	23	11		
30-40	40	36	2.36	.31
50-60	12	11		
designers (Survey II)	25	7	10.13	.00

Set 5

Category	Western	Korean	Chi-squared	Sig.
all	79	54	4.70	.03
10-20	29	5		
30-40	37	39	13.15	.00
50-60	13	10		
designers (Survey II)	26	6	12.50	.00

Set 6

Category	Western	Korean	Chi-squared	Sig.
all	65	68	.07	.80
10-20	19	15		
30-40	36	40	1.01	.61
50-60	10	13		
designers (Survey II)	15	17	.13	.72

Set 7

Category	Western	Korean	Chi-squared	Sig.
all	49	84	9.21	.00
10-20	15	19		
30-40	22	54	5.13	.08
50-60	12	11		
designers (Survey II)	8	24	.80	.01

Set 8

Category	Western	Korean	Chi-squared	Sig.
all	60	73	1.27	.26
10-20	19	15		
30-40	30	46	2.64	.27
50-60	11	12		
designers (Survey II)	19	13	1.13	.29

Set 9

Category	Western	Korean	Chi-squared	Sig.
all	45	88	13.90	.00
10-20	11	23		
30-40	25	51	.35	.84
50-60	9	14		
designers (Survey II)	14	18	.50	.48

Set 10

Category	Western	Korean	Chi-squared	Sig.
all	44	89	15.23	.00
10-20	18	16		
30-40	19	57	8.37	.02
50-60	7	16		
designers (Survey II)	17	15	.13	.72

Set 11

Category	Western	Korean	Chi-squared	Sig.
all	74	59	1.69	.19
10-20	23	11		
30-40	36	40	4.95	.08
50-60	15	8		
designers (Survey II)	25	7	10.13	.00

Set 12

Category	Western	Korean	Chi-squared	Sig.
all	103	30	40.07	.00
10-20	31	3		
30-40	61	15	15.57	.00
50-60	11	12		
designers (Survey II)	27	5	15.13	.00

Figure 8. Preference by age group; shaded comparisons indicate statistically significant differences between layout styles. Cells shaded in orange are when a character-dominated style (i.e. Korean) was preferred. Cells in blue are when a background-rich style (i.e. Western) was preferred. When cells are not coloured, the preference was not distinctive. N = 133, Survey III. Designers' (Survey II) cells are added for comparison.

6 Discussion

When a movie is released, the poster delivers diverse messages in an extremely compact form. This study was initially motivated by movie posters being redesigned for local audiences in Korea or global audiences abroad. Without considering whether such redesigning reflects the different preferences of people, it is known that movie distributors prefer to highlight well-known actors and award-winning records more than a film's contextual information. By convention, when a foreign movie is distributed in a domestic

market, the movie poster is redesigned by making the face of a well-known actor or actress more dominant in the centre. On the contrary, when a Korean movie is exported abroad, the poster's layout changes by making the actor or actress much smaller while including more background content. This triggered us to try to investigate whether there is a difference in preference based on which layout is aligned with the methods that designers use when editing movie posters for domestic or overseas distribution.

First, we conducted a survey to figure out which attribute of a movie poster's layout design plays a more dominant role in influencing people's preferences. The survey was simultaneously carried out with Korean and American participants. Based on the survey, we determined that people were highly biased as a result of the movie poster's background. Specifically, the more the movie posters contained rich backgrounds that illustrate the movie's content, the more people preferred the posters. The results show that both Koreans and Americans have a very similar tendency; this result was not expected. In particular, the Korean participants considered the background to be quite important, which is the opposite of the cliché Koreanised movie poster layout. Based on this finding, we conducted the second survey by manipulating actual movie posters. We presented a pair of movie posters to Koreans and asked them to choose which they preferred. As anticipated, the background-rich versions were more appealing in general. However, we admit that both surveys were carried out mainly with participants who are designers or people in design-related fields. In Survey III, therefore, we expanded our study to reach non-designers and covered a much wider range of age groups.

Compared to what we have found in two previous surveys, Survey III shows that the layout style is rather dependent on personal taste. Only members of the younger generation expressed a similar tendency to that of the designer group, and their preference was more toward the background-rich layout or the so-called "Western style". We assume that the actor or actress is not as influential to young audiences as it is to older audiences. Also, the contextual information of the movie is more important to a young audience.

In this study, although we managed to conduct three survey sessions by recruiting two cultural and various age groups, the empirical findings are still limited to controlled visual stimuli. For instance, we articulated the four attributes in defining the profile of movie poster layout designs. However, in design practice, there are a lot more details that designers should tackle. Hence, the findings of the study are confined to a limited number of visual attributes among many potential elements of graphic design.

Nonetheless, this study investigated people's preferences when viewing graphic design in an analytical manner, based on which a future study may easily replicate the method used. Also, the empirical findings provide evidence that design practitioners can refer to when they make a decision. In this study, we examined mainly Korean participants compared with a group of American participants, focusing on posters that were redesigned for the local population in Korea. For any designers in any field, localisation is crucial, and designers should optimise or should not compromise when making choices. It is expected that preference studies on localisation are actively conducted and that, eventually, they offer designers guidance to achieving a more successful design.

7 Conclusion

In this study, we conducted three surveys to investigate whether movie posters need to be redesigned when an imported movie is released for Korean audiences or vice versa. By convention, movie posters are redesigned by zooming in on the main characters while minimising the background. On the contrary, when a Korean movie is exported, the posters highlight the background more and contains more contextual information. In this circumstance, the first survey was planned with four major attributes of movie poster design in mind: character, background, text, and colour contrast. We used a conjoint analysis to determine what attributes greatly impact people's movie poster preferences. In Survey I, both Korean and American participants considered the background to be the most important aspect; when the background contains contextual information about the movie, the preference rose greatly. This result was confirmed in Survey II when we conducted a test using real movie posters. In Survey II, we asked Korean participants to choose which poster they preferred more between a background-rich layout and a character-dominated layout. We confirm that Korean audiences appreciate movie posters when they include the stories or mood of the movie in an explicit manner in the background. However, the tendency was somewhat different in Survey III, when we expanded the participant pool to include a much wider range of ages and various occupations. In previous surveys, most of the participants were either majoring or working in design-related domains. In Survey III, younger people in their teens or 20s followed the same tendency as the design-conscious group from the previous surveys. On the contrary, the rest of the participants in Survey III did not present any strong tendency toward the movie poster layouts. Instead, they showed a slightly positive responses to the character-dominated layouts, resulting in room for designers to approach various layout styles depending on the target audience. In future studies, more variables are expected to be explored to provide empirical evidence for design practitioners to more efficiently create successful design outcomes.

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Methods for researching and building capacity in co-design among non-experts

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The paper presents two case studies of methods that were used in practice with non-expert co-design groups. The methods draw on asset-based community development principles to fulfil a two-fold objective: first, to study co-design (derive knowledge *about* co-design), and second, to support co-design practice by building the capacity of those groups to carry out design tasks. The paper discusses how the two objectives are met in each case, and derives some general observations about co-design practice in the context of non-expert groups and the capabilities that need to be supported or nurtured. The paper contributes to the development of design research methods that have an impact on societal change.

Keywords: co-design, asset based community development, design capacity

1 Introduction

Designers and design researchers have been developing new approaches and practices seeking to involve a wide range of people in design and design research as a means of affecting positive changes at a human, social, political, and environmental level. Under the rubric of co-design lay a broad spectrum of practices where people work together or connect their knowledge, skills and resources in order to carry out a design task. In such practices, designers and other partners (users or stakeholders) come together, ideally at all stages of a design process: to explore and make sense of their situation (their needs, resources and objectives), to creatively generate and develop ideas and, increasingly, to also 'produce' design solutions in order to realise an imagined better future. As Brandt et al (2013) discuss, such activities are often supported by design tools and techniques which must be developed and used with respect to their particular context and by adopting a particular mindset to make them valuable to participants and accommodate multiple voices.

This paper is focussed on a particular species of tools and methods, which are both tools for research about design, as well as tools for building participants' capacity to co-design. For the purposes of this paper, co-design capacity is defined as the capacity of a group of people to carry out a design task: that is, as posited above, to make sense of their current situation, imagine a better future and take steps to realise it. To make the focus of this paper and its contribution clear, it is important to clarify two elements: a) what we mean by tools for research about design and b) what we mean by participants.

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Since the first efforts to establish design research as a distinct type of intellectual enquiry in the 1960s, there has been a realisation that 'research' and 'design' interact at multiple levels (e.g. Rogers and Yee, 2015). Cross (2001) for example, discussed different ways in which 'science' (scientific research) interacts with design (i.e. scientific design, design science and science of design) and proposed (Cross, 1999) that design research can fall into three categories based on whether the focus is placed on the study of people, processes, or products (design epistemology, design praxeology, and design phenomenology). Jonas (2013) built on Frayling's (1993) categorisation of design research to introduce four modes of design research: research *for* design (research aimed at improving design), research *about* design (research aimed at understanding different aspects of design), research *through* design (research conducted through active participation in design) and research *as* design (research performed in the medium of design, abductively). Research as design is intrinsically about design as a distinct knowledge production activity, and can be embedded or interact with other types of research.

The majority of tools and techniques used by designers focus on involving people in research *for* and research *through* design. Research for design aims to help better understand and cater for their needs, values and preferences (as is typical in user research or ergonomics). Research *through* design has different facets. One type of research through design focusses on using design tools and processes in order to explore wider questions about society, technology and the environment (e.g. Dunne and Raby, 2013). In co-design, which is the field of relevance here, the focus is often on engaging people (users, stakeholders) more meaningfully in the design process, to elicit their complementary knowledge and expertise and utilise their creative capacity (e.g. Sanders and Stappers, 2012). In such studies we have an overlap between research *through* and research *for* design, as active participation in design has the ultimate aim or output to create innovative design products or services.

However, there is much less research in co-design which seeks to derive knowledge *about* design. The present paper focusses on studies that seek to derive knowledge about co-design. However these studies incorporate research *for* and *through* design as well, as they aim to support co-design practice through the medium of design (through design tools).

The second defining characteristic of this paper is that it focusses on cases where design is carried out by people who are *not trained in design* (for simplicity we will call them non-experts, although they may hold valuable expertise related to the design task at hand). By this we do not mean design students, but self-defined groups of people who wish to undertake design projects (e.g. communities of place or interest, civil society groups or activists). Those non-experts are the co-design participants we talk about in the paper. Note that in the studies that will be presented, the academic researchers (and authors of this paper) acted as facilitators or enablers of the design process, and the co-design participants were also participants in the research.

Having clarified these terms, it is now possible to specify the aim of the paper. The aim is to present and discuss a set of tools and methods used in practice with non-expert design groups with the two-fold objective to first, facilitate co-design and build the capacity of these groups to carry out design tasks, and second, to study co-design practices. We discuss advantages and limitations of those tools and outline key insights about co-design activity in

this context. We hope that sharing our learning about the particular tools and how they can be used in different settings can help inform future practice.

2 Context

2.1 Understanding co-design practices of non-expert groups

Co-design practices have their roots in ground breaking initiatives in the 1960s and 1970s associated with a quest for more equitable, democratic, and sustainable design solutions (Wates and Knevitt, 1997; Sanoff, 1999; Gregory, 2003; Ehn et al, 2014). Research in co-design entails a variety of practices adhering to different principles and traditions (see Zamenopoulos and Alexiou, 2018 for a comprehensive review). Progressively over the years, the engagement of everyday people in creative and design practices has become more direct: design activism, Do-it-Yourself practices and social entrepreneurship have emerged as important practices associated with the broader term 'social design' and 'creative citizenship' (see e.g. Manzini, 2015; Hargreaves and Hartley, 2016). Such practices are thought to disrupt existing norms and values, offer new ways of inhabiting and experiencing reality and provide innovative solutions that at the same time meet social needs and create new or stronger social relations. While a lot of research has focussed either on practices led by professional designers or projects initiated through research, the focus of this paper is on pre-existing groups who already work or have a design project in the making. Typical examples include groups who self-organise to design and provide a new local service, neighbourhood forums and neighbourhood planning groups, or groups that take over the development of an existing building or open space. The present paper is part of a research programme that aims to better understand how those practices are born and operate, and the conditions (human, economic, social) that make them possible.

2.2 Developing design capacity

Support for creative citizen or self-organised co-design groups that comes from regional and national government (at least in the UK), often focusses on funding/fundraising advice, business development and project management, while design capacity is customarily injected in the form of expert advice. Additionally, while changes in legislation may fundamentally provide rights for citizens to engage in design activities, legislations and laws on their own cannot guarantee a capacity to do so.

Here we take inspiration from community development (particularly asset-based community development) practices to focus on unearthing the intrinsic resources and capacities that people have and that can be mobilised and nurtured to carry out projects.

Rather than focusing on deficits or things that are missing, asset-based approaches suggest that community groups will be better equipped to develop their projects if they can identify and mobilise the assets they already have (Kretzmann et al, 2005). The term assets includes tangible resources such as spaces, services and infrastructures, but also intangible resources such as creative talents, skills, knowledge, emotions, values and social relationships. O'Leary et al (2011) categorise assets under seven categories ('Seven capitals'), three tangible: Financial, Built and Natural, and four intangible: Human, Social, Cultural and Political. They emphasise the importance of intangible assets and their role in helping to strengthen and better use other types of assets, such as buildings or financial capital. In contrast to tangible assets, which are more easily recognised and more likely to be already utilised effectively by communities, intangible assets often remain unrecognised

and unrepresented. Thus they can be identified as the main carriers of untapped potential and value.

The case studies presented in this paper examine the development and use of tools/approaches that can help elicit and mobilise assets as a means of developing the capacity of groups to carry out their design task.

2.3 Tools and techniques for design research

As discussed, the paper is concerned with tools and methods used to conduct research *through,* research *for* but also research *about* design. The use of creative and engaging objects, techniques and toolkits is becoming an integral part of any type of design research, so in order to clarify the focus of this paper, it is useful to briefly examine some existing categories of tools and terms used and discern similarities and differences.

Sanders and Stappers (2012) presents a number of different tools and mechanisms which support engagement in design research. These tools and mechanisms are thought to facilitate broadly the acts of making, telling and enacting (Brandt et al, 2013). Sanders and Stappers (2014) identify and discuss three key approaches: probes, toolkits and prototypes. Cultural probes were introduced by Gaver et al (1999) as a way to provoke inspirational responses from users and usually consist in a collection of objects such as maps, instant cameras, or postcards. The original articulation of probes aimed to realise an alternative 'designerly' mode of conducting research (research as design) that values uncertainty and provokes subjective interpretation (Gaver et al, 2014). Later realisations of probes include empathy probes, value probes and technological probes (see Mattelmäki, 2005; Madden et al, 2014;). Based on a review of the literature and exploration of the different ways probes have been used, Mattelmäki (2005) suggests that probes can be used for four reasons: inspiration, information, participation and dialogue. Beyond inspiration, probes can help elicit user perspectives, and they can support dialogue and collaboration, empowering users to participate in innovation. Comparing probes to generative toolkits Sanders and Stappers (2014, pp 8) purport that a main difference is that generative toolkits are used as part of 'a more deliberate and steered process of facilitation, participation, reflection, delving for deeper layers in the past, making understanding explicit, discussing these, and bridging visions, ideas and concepts [scenarios] for the future.' Additionally, while probes tend to be used individually by users on their own, toolkits tend to be used as part of a facilitated collaborative process (where users participate either individually or in small groups). Prototypes are quite different from probes and toolkits as they are used to physically represent ideas or concepts, to communicate those ideas and to explore their 'technical and social feasibility'. Between probes, toolkits and prototypes, exist other approaches. Examples include games (Brandt, 2006) which engage participants in a playful way by using a set of rules and tangible objects, and which are thought to be useful in staging participation and aiding exploration of relevant issues to feed into design work; and provotypes (provocative prototypes) (Mogensen, 1994; Boer and Donovan, 2012) which focus on revealing conflicts between different stakeholders in a participatory innovation process, and may be used at the beginning of the process to stimulate generation and exploration of ideas.

In this paper we focus on approaches that, similarly to toolkits, are used to support co-design (particularly at the early phases, helping to delve into the past, identify current issues of concern and explore ideas for the future). However, they are also specifically designed so as to collect information not (only) about the task in hand, but also about the very process of co-

design and the things that enable or inhibit it. Reflecting on the information collected can help progress design in the particular context, but analyzing information collected through multiple applications of the approach in different contexts, can help generate knowledge about design more generally.

As the terminology used to discuss different approaches (e.g. tools, techniques) is often confusing it is useful to consider some definitions proposed by Sanders et al (2010). According to their proposal, tools are the material components used in activities, whereas toolkits are collections of tools used together. A technique is how the tools and toolkits are put into action (e.g. classification, collaging) and a method is a combination of tools, toolkits and techniques that are strategically put together to address defined goals with a research plan. An approach is a more encompassing term, that describes the overall mindset of a research plan. The paper focusses on methods (and associated toolkits and techniques) that adopt an asset-based approach to co-design. These methods however are not rigid; they can and have been adapted for application in different contexts (and for specific purposes).

3 Case studies

The paper presents two case studies of methods that were developed and used with a number of different co-design groups. The first, called Asset Mapping was developed (in collaboration with colleagues at the Helen Hamlyn Centre) as part of a project called Creative Citizens which aimed to explore the potential of media (particularly social media) to support creative citizens across various domains of practice. The method was applied across all three strands of work of the project in the UK, led by different community-academic partnerships: among hyperlocal journalists; creative network participants; and community groups involved in place-making projects (nine groups in total). All groups who undertook the asset mapping exercise in this case went on to design and produce media interventions to suit their purposes. Examples include a ‘printervention’, a digital storytelling site, a graphic novel and online planning consultation sites. The second method, called Challenges-Assets-Opportunities was developed as a part of a project called Empowering Design Practices which aimed to explore how community-led design can be enabled among groups who look after historic places of worship. The approach in this case was used with groups thinking about changes to their building in order to ensure its sustainability and widen its role as a community resource. The results discussed here focus primarily on the application of the method with eight groups looking after churches in England, UK who took part in a workshop using the approach for the first time.

3.1 Asset Mapping

The asset mapping method was developed by building upon a number of existing approaches (Guintoli et al, 2012; Kretzmann et al, 2005; O’Leary et al, 2011; Mathie and Cunningham, 2002; Rowson et al, 2010), and by consulting with different practitioners and experts. This was followed by a period of experimentation where various versions were piloted and tested with different groups. Amendments took into consideration the need for flexibility (so that the approach can be used in a variety of community settings), practicality (taking into consideration the needs and the time limitations of community participants), and observability (the need to be able to document observations and outcomes for further detailed analysis).

As discussed, the approach was based on asset-based community development (ABCD) principles however is distinctive in that it has a dual purpose (to support research and co-design). This meant both a focus on helping capture tangible and intangible assets that could be used to achieve the objectives of each group, as well as their perceptions of these assets as narrated and negotiated between participants. To support co-design among non-experts the method was also intentionally developed similar to a game so that they can engage creatively and in an intuitive or playful way.

The method uses the following tools: a map with circles drawn around a central point and six stacks of objects (props), each representing a different category of assets. The six asset categories were: spaces (built or open), people (including roles, skills or capabilities), infrastructures (such as transportation), groups and businesses (public, private and civil society organisations operating at local and national level, clubs, networks etc), media (online and offline) and other (for anything that doesn't fit into the other categories, such as cultural events, values, emotions etc).

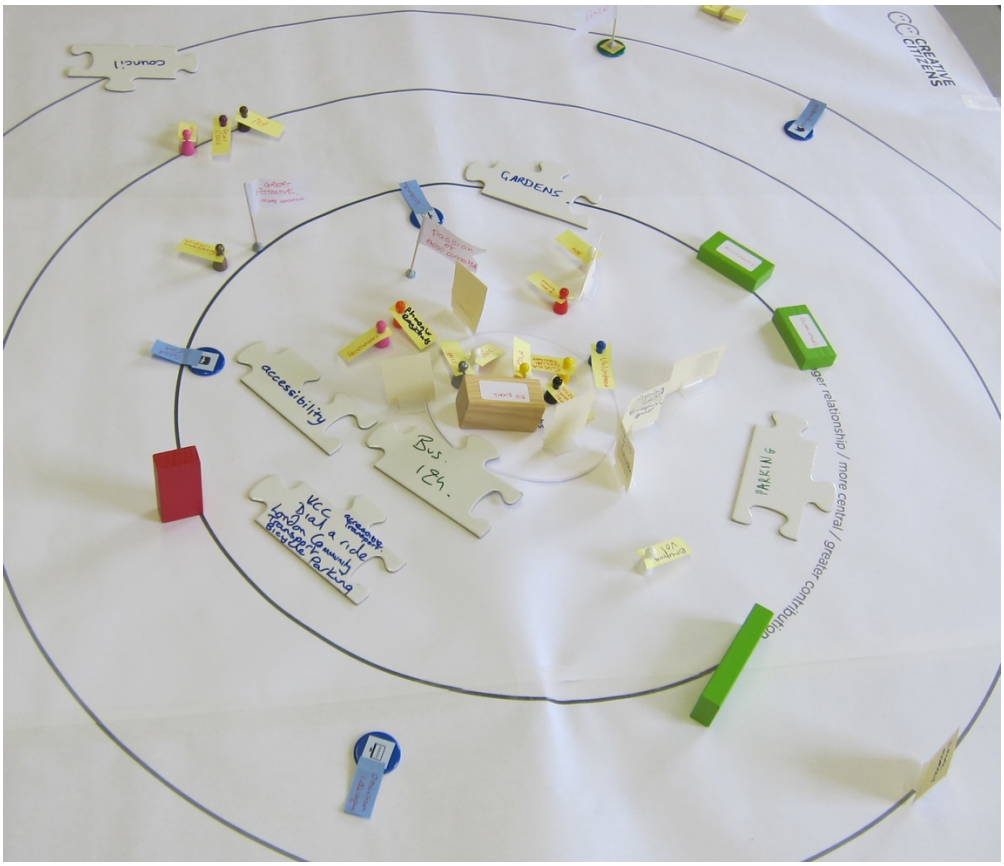


Figure 1: an example asset map

Asset mapping is delivered through a facilitated workshop were the participating group is invited to imagine that their project is at the centre of the map and to prioritise different assets at their disposal, according to how central/important they are to the project, or how easily they can be mobilised. Assets at the centre are more active or important; assets at the periphery can be seen as untapped or potential assets. The facilitator helps the group identify, explain and negotiate their assets, their importance, and their relationship to one another.

The method includes different techniques that may be used in combination with one another at different stages. Participants may create a *collective map of current assets* by negotiating the value of each asset, its position and its relationship to other assets. *Individual maps* can also be created to capture personal values and individual connections to different assets. Individual asset mapping asks participants to place themselves (rather than the project) at the centre of the map and consider their own roles and connections with assets on the collective map. Finally, a *potential assets map* can be constructed collectively to identify missing or underused resources, and to kick-start the generation of a common vision and ideas for new projects and potential solutions. While group maps are representations of consensual ideas about a community's assets, a personal asset map helps to explore individual perceptions of assets, which may or may not be shared among the whole group and which may help reveal conflicts and multiplicity of perspectives. It also provides a personal thinking space for individuals to understand their own role and potential contributions.

The use of physical props that can be moved around, redefined and repositioned was found to be important for facilitating active, playful and creative engagement. Assets become more tangible as they are externalised and become literally graspable, while at the same time they become more negotiable, as they can be renamed, repositioned, combined and even discarded.

Relationships among assets are captured in different ways. Assets in the same circle are loosely related in terms of their importance, but participants were also encouraged to consider explicit relationships between assets by clustering them together, combining them, or moving them further apart. Relationships might include conceptual and geographical links, business or working relationships, personal connections and social bonds. Relationships are also captured through personal asset maps, where individuals reflect on their connections with assets identified on the collective map and the strength of those connections. Implicit relationships are also identified by aggregating information on the individual maps (where for example a person is found to be connected to an asset through another person). For a more detailed exposition of the method Alexiou et al (2016).

3.1.1 How this method builds people's capacity to co-design

Observations recorded by the research during the asset mapping exercise, combined with participants' self-reflections and feedback provided through conversations and evaluation questionnaires after the event, helped identify different ways in which the exercise supported participants in their co-design tasks.

Used at the beginning of the co-design process, the asset mapping exercise helped participants make sense of their situation collectively and to establish a vision and a common understanding of this vision. More specifically, by identifying and negotiating assets and their significance participants developed a shared coherent understanding of their current situation and objectives by taking into consideration a variety of parameters. Ideas for activities to help promote their objectives also formed, through a consideration of potential and existing assets and relationships between them. Prioritising assets also played a strategic role in design decisions, helping participants to articulate a vision about what is important for future action and start establishing a plan of next steps.

Additionally, it was revealed that the approach had a role in facilitating collaboration and creativity. Giving everyone an equal opportunity to add an asset and rationalise it before opening it up to discussion was useful for establishing a level playing field, avoiding dominance from those most central to the project or too much focus on the 'correct' or 'established' view, thus making innovative insights and connections more likely to emerge.

Most importantly, asset mapping proved to be an important reflection vehicle: it provided the environment for participants to not only examine their project, but also to contemplate about and build on their own values, aspirations and capabilities.

For example, one of the participating place-making communities is an activist group opposing the demolition of a local market which houses a large Latin-American community. The asset mapping exercise was catalytic in shifting attention from opposition to productive acts. Rather than focussing on their usual activity of opposing the existing plan, they focussed on their own alternative community plan, on the process of visualising, communicating it in more detail and drawing further support for it. By mobilising and developing their own creative capacities two people from the group were able to construct a 3D virtual tour of their place in Stickyworld Inc and take it to their community for feedback. At the time, their proposal received enthusiastic support and 222 comments on the Stickyworld fed into the consultation process which saw their plan approved by the local council in 2014.

Co-design capability is however to be considered as something that goes beyond technical aspects of design. While the activist group mentioned above was able to draw on existing technical 'design' knowledge (3D visualisation, technical drawing), in other cases, technical design expertise was necessary to be injected into projects. For example, technical making and software design expertise was brought in another case, to support the creation of a 'story booth' within a community centre, however, this was seen as an input to a collaborative process where different stakeholders or experts come together to make things happen and to achieve something that they wouldn't be able to achieve without each other (see Greene et al, 2016). We came to understand that co-design capability relies heavily on the capability of connecting knowledge, skills and resources to carry out a design.

3.1.2 What have we learned about co-design

By collecting information about the assets and relationships among assets as those were recorded by the nine different groups, it was possible to draw some more general conclusions about the types of assets that are important for co-design.

For example, from a total of 360 assets identified in the asset maps of the nine groups who undertook the exercise, 53% were found to fall under two of the seven asset categories: people and groups and businesses (i.e. relationships and connections to other individuals, and formal and informal groups and organisations). These two types of assets were also predominantly at the centre of the maps. This signifies the importance of such intangible assets both as motivators and as vehicles for carrying out co-design projects. Mobilising these assets however, often came through engagement with other types of assets – particularly media (both social media and more traditional avenues such as printed media) and local places who play a catalytic role in generating and nurturing social relationships and a sense of identity and belonging.

Beyond looking at the maps themselves, recording, transcribing and analysing people's arguments and narratives was important for understanding group dynamics as well as

people's perceptions, motivations and practices that influence co-design. The maps and discussions helped uncover different organisational/governance structures, and different values and principles driving citizen led co-design practice. For instance, the activist group mentioned above had a strong social capital built on numerous connections with other groups and organisations which were distributed among its members, while another of the groups that took part in the project, a creative youth network focussed on music and video storytelling, was more reliant on personal connections and a growing 'gift economy' developed between friends. People's narratives around assets and the things they value, also revealed that some practices seemed to emerge from a sense of threat and an orientation or commitment towards democracy, such as in the case of the activist group, while other practices seemed to emerge from a sense of opportunity and an orientation or commitment towards innovation, such as in the case of the hyperlocal journalists and the creative network (Zamenopoulos et al, 2016).

3.2 Challenges-Assets-Opportunities

The challenges-assets-opportunities method built on the experience of the asset mapping method (and in accordance with ABCD theory and principles) but was developed with a different research question in mind and for a different co-design context. While the objective of combining research and action was the same, the method was used exploratively to help explore barriers and opportunities for design in the context of historic places of worship. The participants were groups who look after historic places of worship and have the need or aspiration to make changes in the building to better serve the needs of their local communities. The method was developed through mock exercises with research project team advisors and different aspects of the method were trialled with places of worship in conjunction with other activities.

The purpose of the method was to unearth challenges and assets that participants had, with a focus on helping them switch their frame of mind from the problems they face, to the opportunities that exist to overcome them through the mobilisation of existing assets.

The method uses the New IDEAS Hexagon tool developed by Imagination Lancaster, which consists of different coloured hexagon cards that can be connected at their corners to make associations and relationships in multiple directions. The different colours are used to represent each of the three themes of challenges, assets and opportunities. In addition to the hexagon cards, the toolkit includes a set of stickers that helps participants think about different types of assets (or lack of them) and make them visually explicit. Rather than the longer list of assets used in the asset mapping method, assets are grouped under three headings: people & connections (which includes skills and knowledge as well as relationships with other groups and organisations), resources & tools (which includes spaces, infrastructures, natural and financial resources), and values & emotions. Values & emotions was a category formulated in order to specifically help draw attention to and investigate people's motivations and underlying principles and perceptions of themselves and their community. This was particularly important for these projects as they encompass a complex entanglement of faith, heritage and community values and purposes.



Figure 2: an example map of challenges, assets and opportunities

The method is delivered as a workshop that brings together members from different groups in conversation with one another. Each team is first asked to consider their challenges and place them on the table discussing the roots to these challenges and making connections between them. Participants are then asked to add their connected assets onto this tapestry, before moving into imagining new opportunities that exist to utilise certain assets to address their challenges. Key to this exchange is having another team act as critical friend, helping their peers to externalise and clarify their thoughts and visions, often providing advice, creative input and inspiration. Besides the critical friends, each table has an academic facilitator and a (heritage) professional sharing their knowledge and experiences. The exercise has two rounds, and people rotate around the tables so that every team has the opportunity to share their project as well as act as critical friend to another.

3.2.1 How this method builds people's capacity to co-design

Feedback collected from 10 participants after the session point to a number of key outcomes. Participants found that the session helped them to look at a familiar situation in a different light or consider it from a broader viewpoint. They found that the ability to compare their own project and experience with others was valuable in many respects: on one hand they were able to understand they are not alone in their ventures and that the problems they face are surmountable, and on the other hand, they were able to reflect on their own individual identity and unique purpose and objectives. They also valued the structured approach that geared participants towards solutions and specific steps they need to take. The feedback established that the approach also built the participants' collaborative awareness, not only about the value of learning from other examples and projects, but also the value of engaging more people in understanding their situation and formulating a vision for their place.

Of the eight groups that took part in the workshop, three came back to the research team with further requests for support during their design process, particularly to learn how to engage the wider community (beyond their congregation) in decisions about the future of their place. At the time of writing one of them (a church near Stoke on Trent) has secured a grant from Heritage Lottery Fund which allowed them to complete a project to repair the building (and move it out of the heritage at risk register) and to convert part of the interior into a heated space that can serve both as a community hub as well as a worshiping space. An interview conducted with the vicar who led the project revealed that the workshop was instrumental in switching their perspective about what is possible and adopt a constructive attitude towards the building (see Brockwell, 2018).

3.2.2 What have we learned about co-design

The method helped collect information about the kinds of challenges these groups face in their co-design endeavours and the kinds of assets they have in their disposal. This is useful knowledge *for* the design process. However, crucial knowledge *about* design was uncovered through the process of switching from thinking about challenges to thinking about assets.

Participants found it easier to talk about problems (351 challenges were recorded across tables, as opposed to 235 assets) however the move from challenges to assets deeply transformed the perception of the task at hand. Some of the elements previously recognised as challenges, were re-interpreted as assets: for example, historic and other architectural characteristics of buildings which were previously discussed as challenges, now were seen as positive elements, associated with beauty and a sense of identity and attachment. Additionally, while some cultural and social challenges were originally identified (such as difficulty communicating the faith and social mission of those places and dealing with statutory bodies), these were overshadowed by the abundance of cultural and social assets available to the groups, such as a sense of community, and relationships and partnerships with other organisations (such as schools, charities and local businesses).

Finally, the method was very useful in creating a picture on how people think when identifying opportunities for future design work. The eight places of worship identified a spectrum of different opportunities but predominantly opportunities related to the development of cultural and social events and connections. 56% of these opportunities were ideas for actions (e.g. the organisation of events, local exhibitions, heritage trails, educational activities) and 44% of these opportunities were general objectives or principles (e.g. make the space a safe place, be the centre of community life).

Despite this switch from problem-based thinking to constructive thinking, analysis of the tapestries created and the discussions around them, showed that there were far more challenges than assets, and the opportunities created, although clearly built on assets available, were rather generic and did not eventually seem to address some key challenges. This along with the significant relative number of objectives and principles generated revealed to us that groups required more time dedicated to sharing, reflecting and agreeing on underlying principles to drive a project forward.

4 Summary and discussion

We discussed two different methods that have been employed with community groups to both build their capacity to carry out design tasks and to help investigate their co-design practice. These two objectives are obviously related, as better understanding of what makes

those non-expert groups capable to design, can in turn feed into the development of methods to support co-design.

Both methods were based on the principles of asset-based development which focusses on unearthing and mobilising the intrinsic capabilities and resources of people as a means for engendering change. Taking both methods together we can make some overarching observations *about* co-design in this context. We saw for example that there are different reasons and ways in which those groups come together to carry out a project, but in any case, human, cultural and social assets are crucial motivators and also vehicles of co-design. In particular, the sense of community and belonging, and the ability to build relationships and partnerships with a wide range of other groups and organisations were key. We saw that the methods were useful when they supported people not only to understand their situation and generate design ideas and actions, but also when they were supported to work together in those tasks.

In light of these observations, it is perhaps useful to view co-design capacity as consisting in three key interrelated capabilities or dimensions: creativity, collaboration and reflexivity. Here we take a distinct broad view of creativity - rather than focussing on originality or innovation, we associate creativity with the capability ‘to create’, to bring something into existence, but also with ‘resourcefulness’, the capability to find clever, apt ways to overcome difficulties. We also take a broad view of collaboration, which may include working together on a common goal, working together on separate goals, or just connecting knowledge and expertise to pursue a set of objectives. The key capability is to recognise the knowledge, skills and resources that others can bring and find ways to draw them together to achieve something that no-one alone can achieve. Finally, reflexivity is obviously the capability to take stock of one’s own situation, as an individual and as a group, and re-evaluate and re-formulate individual and shared principles, objectives and understanding.

When talking about co-design and design capacity more generally, it is important to consider the role of domain design knowledge, specialist knowledge and skills that allow things to get done in practical terms. In the cases we discussed, this included for example software design knowledge, knowledge of 3D modelling, or knowledge about architectural preservation, as well knowledge about the building design/planning process. In some cases, this knowledge was present or needed to be developed within the community, in other cases, it was brought in the project in the form of specialist advice. While the development of such domain design knowledge is important, its importance should be seen in the context of the three capabilities or dimensions, as an asset fuelling or facilitating creativity, collaboration and reflexivity.

We would like to conclude this paper with one final note about the methods presented, which constitute a particular species of design research. While we argued about their usefulness in understanding co-design practice and building co-design capacity, our aim is not to suggest that this species of design research is more advantageous than others or that it should be the norm. We see that these methods are part of the ‘arsenal’ of design research that can contribute to enriching design research and its impact on civil society and creative citizenship.

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Narrative dimensions for the design of contemporary visual identities

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At the end of the 20th century, the so-called new media allowed a large quantity of information to move around within innumerable interconnected nodes. Non-conventional narratives and hyper-novels emerge, in which the story unfolding possibilities are virtually infinite and where the reader becomes an interactive participant. Contemporary brands also embrace a level of flexibility that allows them to develop and closely accompany a constantly evolving and participatory world. Following the assumption that a brand is a live construction (Neumeier, 2006), the objective of this ongoing research is to identify how contemporary brands approach narrative through their logos. The method consisted of a qualitative hermeneutical content analysis of dozens of contemporary visual identities. The structural/discourse elements were grouped, a code book was created and an organising matrix was created to allow the emergence of six main dimensions of visual identity narrative, with the extended benefit of increasing brand engagement and meaningful brand experiences by designing the most structurally appropriate visual storytelling. If in the past brands' main goal was to be recognised by their audiences, currently brands are mostly focused on creating meaningful experiences through the active involvement of their audiences.

Keywords: Narrative dimensions, brand design, visual identity, contemporary brands

1 Introduction

Mieke Bal argues on how narrative is "the most wide-spread semiotic mode of expression" (2016, p. 101), commending its social relevance, as it is pervasive to most human communication techniques. For that reason, the author states that looking at narrative in the different sorts of media can contribute to our understanding both of culture and cultural differences. In fact, narratives are essential for humans to learn about the world and about themselves and to exchange all sorts of information and knowledge:

Narrative is the primary way through which humans organise their experiences into temporally meaningful episodes (...) narrative is both a mode of reasoning and a mode of representation (Richardson, 1990, p. 118).

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Given its human centrality and applicability, narrative has long been associated to design. Design Thinking approaches heavily rely on the power of narratives and storytelling for empathising purposes (Kankainen *et al.,* 2005; Hellström, 2007) and it is acknowledged that narrative has greater potential if it is to be used "beyond the experiential aspect of briefing" (Fritsch *et al.,* 2007, p. 6). For example, interior designers and architects use spatial narratives to tell a story about a place, including a predefined point of departure, a specific route, and a previsible end point, to "reflect the practices that make a place" (Ridge, Lafreniere & Nesbit, 2013, 178). Tools such as walkthroughs, storyboards, scenarios, user diaries, archetypes, personas, customer journeys, user stories and epics all lean on narratives for creatives, planners, developers and production teams to organise, systematise and represent insights, but also to anticipate future needs and contexts (Wright & McCarthy, 2010, p. 178).

> The ability of narratives to communicate ideas and to stimulate imagination allows design to go beyond functional purposes and opens new perspectives to imagine, discuss and propose scenarios for the future (Grimaldi, Fokkinga & Ocnarescu, 2013, p. 201).

In fact, traditionally, designers use narratives to start telling a story about a design artifact way before the artifact reaches the audience/user (Ocnarescu, 2012). Likewise, brand designers anticipate a great deal of storytelling, many of which can be experienced by the audiences in every interaction these have with the brands, from adverts to packaging. Hence the undiscussable importance of narrative for brands, mostly when in every interaction human beings have with brands, some small elements that one may think do not tell a story, are, in fact, telling more than one can expect. That shall be the case of logos in contemporary visual identities, where a set of multiple variations is designed/created, expanding the limits of the story being told.

The main objective of this ongoing research is to identify how contemporary brands approach narrative through their logos, and to what extent they renunciate the traditionally consistent and immutable storytelling. Following the assumption that a brand is a live construction (Neumeier, 2006), and grounded on Zadeh's (1996) idea that natural language is not easily translated into the absolute and dichotomic terms of True or False, or 0 and 1, in this research we assume that contemporary brands' narratives include the various states in between each of the binary options.

Thus, the research question guiding this research is: *What are the narrative dimensions structuring the design of brands' visual identities?*

2 Defining narrative

The first considerations on narrative (structure, creation, its effect on audiences) go back to the times of Aristotle (1987) and have been more recently developed by European structuralists (such as Seymour Chatman, Gérard de Genette) and Russian formalists (Roman Jakobson), but also by the futurist works advanced in

many different domains of human sciences (fine arts, literary studies, narratology, film studies, architecture) and by contemporary psychology research and practice. Thus, narrative, as a concept, is (and will be) open to diverse interpretations, mainly because it is so relevant in everyday practice and, therefore, impactful in both many different disciplines and in personal and professional approaches. It is, therefore, rather difficult to find a single definition but, according to Berger's (1997) review, narrative includes the description of a sequence of events, throughout a time period and, for Murray (1998), action is the vital element because it introduces change. Chatman (1978) explains that a narrative has two components: a *story*, that encompasses the content related to actions, happenings, characters and items of setting, and a *discourse*, which defines the means by which the content is communicated to the audiences. The story comprises the WHAT in a narrative (i.e. the substance), whilst the discourse comprehends the HOW (i.e. the form). Hence, the minimum WHAT-related elements are the existence of characters, their depiction/details, the action taking place, the location and spatiality, and the story resolution and elicitation of emotions (Abbott, 2008), whilst other frequent aspects to consider as part of a narrative are HOW-related elements such as the duration of the sequence of events that constitutes a plot, the order and frequency of the events (Genette, 1980), the role of the narrator, and the narrative genre (Berger, 1997). Chatman (1978) also distinguishes narrative events in terms of their hierarchy, explaining that classical narrative uses mostly major events (*kernels*) that, working as structure nodes, advance the plot by raising and answering questions and cannot be deleted without damaging the narrative logic. On the other hand, minor events (*satellites*) are created to add details to kernels and some can be eliminated (or not even created) without affecting the plot.

The sequential aspect attached to action seems to be of utmost relevance and, alongside the story resolution being reached, it is what distinguishes narratives from non-narratives (Berger, 1997). With an illustrated book the reader is given the narrative's representational details in the textual resources, which are accompanied by images that depict only one (or part of an) action, usually capturing a single moment in time. Hence, traditionally, with the exception of comic strips made up of frames capturing different moments in time, drawings, paintings, photos and all sorts of stand-alone static imagery are not understood as having narrative content (idem), seemingly contradicting what others define as visual narratives.

2.1 Visual narratives

Few authors have been dedicating their efforts and research to the definition of visual narrative (VN). Murray (1995) defines narrative illustration as the pictorial representation of one or more events that, taking place through a period of time, cause some sort of change in one or more characters. Neil Cohn (2013) has been developing the theory of Visual Narrative Grammar, but very much focused on comic strips, hence a sequence of images defined by panel borders simultaneously displayed in the same medium and concerned with a navigational component that

explicitly tells the audience where to start and how to progress through the sequence.
Pimenta and Poovaiah (2010) summarise VN as a visual that essentially and explicitly tells a story. The authors organise VN into three major types:

- *Static Visual Narratives*, in which the visual is fixed on the surface of the medium and the spectator, who has prior knowledge of the story (usually due to the support of other kinds of narrative, such as text) can decide the speed and sequence of viewing (precisely what Berger calls non-narratives), providing as examples of this category comics strips, picture books, narrative scrolls, infographics, among others.
- *Dynamic Visual Narratives*, in which visuals are replaced and succeed at the same pace, being both the speed of viewing and the sequence of visuals predetermined by the author/creator and where the audience does not need to know the story prior to viewing. Examples of these are animation, movies and puppet shows.
- *Interactive Visual Narratives*, in which visuals appear to be fixed but can be replaced by other visuals through a triggering feature, where the audience may need or not prior knowledge of the story, as in some cases the viewer decides how the narrative evolves, hence with the possibility of manipulating both the story contents and its sequence and form. Examples would be interactive e-books and interactive games, where AI and augmented reality can play a part.

Hence, visual narratives do not differ much from text-based ones: they tell a story through other sorts of graphic elements, which replace the written (or spoken) word, still providing the audience with the idea of continuity.

3 Postmodern times

Postmodernism recognises that human perception and interaction are necessarily subjective and that constant change, ubiquity and mobility are the *status quo*. At the end of the 20th century, the so-called *new media* allowed a large quantity of information to move around within innumerable interconnected nodes. Hypertextuality emerges in its open-ended and ever-developing fashion (Riffaterre, 1994). By the end of last century, some authors propose non-conventional narratives, hyper-novels in which the story unfolding possibilities are virtually infinite and where the reader becomes an interactive participant with increased ability to take part in the narrative, which becomes, as life, “a complex, heterogeneous assemblage” (Cotrupi, 1991, p. 280).
Transmedia storytelling and hybrid narratives emerge with the new century. Scolari (2013) argues that, besides allowing the expansion and distribution of contents throughout different platforms, they also facilitate the real-time participation and involvement of audiences in the construction of the narrative itself. Design and use/fruition time fuse into a single simultaneous moment, as described by Fischer and Herrmann (2015), following a meta-design approach which aims at encouraging designers to support users/audiences as active and creative contributors. With such configuration, narratives evolve and expand, allowing different meanings, creation times, media and authors, becoming more and more distant from its traditional linearity and loyalty to the original plot, clearly embracing a more fluid and organic

philosophy, giving room to the development of cognitive features and meaningful/emotional experiences.

3.1 Postmodern brands

According to Dubberly (2008, p. 2), current design practice has been adopting and replicating such postmodern “organic-systems ethos” and similar changes have been taking place within the domain of brand design. From a modernism perspective, brands have been known to ease recognition due to the implementation of consistent communication and design strategies. By the end of last century, the brand was commonly defined through rational statements: classic authors used to define a brand by grounding it on its products/services, and with the main function of differentiating these from their competitors’ (Kotler, 1981; Aaker, 1991; Al Ries, 1993). However, contributions to the neurosciences – namely with Damásio’s work (1995) on the relevance of emotions in decision-making processes – changed the way we perceive and conceive the world of brands. In fact, contemporary authors such as Lindstrom (2007), Gobé (2010), Batey (2016), Troiano (2017), among others, consider the brand as an emotional asset, a “gut feeling” (Neumeier, 2006, p. 2), that facilitates the involvement of audiences and, through that, build their preferences systems.

3.2 Brand storytelling

A brand can only be memorised when it becomes part of its audiences’ lives and stories. For that reason, brands and their associated “experiences, that are memorable or engaging, are mentally structured in narrative form by the user (Grimaldi, Fokkinga & Ocnarescu, 2013, p. 201). Brand storytelling has been extensively explored by brand practitioners and academics. It consists of a communication strategy aiming at sharing knowledge and creating bonds, using either a factual or fictitious narrative to connect the brand to its audiences, linking the brand’s values to the ones it shares with its customers. Accordingly, Fog, Budtz and Baris agree that "storytelling becomes an effective tool for creating an entire brand concept: one that stays with us, because it touches our emotions” (2003, p. 47). When it comes to traditional popular stories circulating at a global scale, brands tend to create adapted versions by assimilating local idiosyncrasies that define the different cultures and communities (Rogojinaru, 2011). Brand storytelling is, therefore, subject to flexible localisation strategies. As a consequence, when the audiences are personally involved in the storytelling process, they get to better understand the values embedded in the narratives, incorporating them due to the increased and eased identification (Batey, 2016).

In contemporary brands, the storytelling hero is decreasingly the brand itself (which used to push its attributes) and is increasingly being embodied by the brands’ audiences (who are pulled by the brand that merely guides them). Therefore, brands that adapt to the context in which they operate and where they know their audiences will be, embrace a level of flexibility that allows them to develop and closely accompany a constantly evolving world, hence disregarding the need of a strictly consistent approach (Lelis, 2019).

3.3 Brands in mutation

In the early 2000s, Kreutz (2001, 2005) identified two main visual brand identity systems: one where she would group brands labelled as *Conventional*, which main characteristics are standardisation, linear progress and fixedness, and another one that the author categorised as *Non-Conventional* or *Mutant*, where brands would present as multimodal, plural, fragmented and heterogeneous – postmodern. This very approach has also been researched by other authors, although recurring to different labels: *flexible* (Campos, 2007; Hewitt, 2008), *variable* (Kopp, 2002), *fluid* (Lapetino, 2011); *dynamic* (Felsing, 2010; Nascimento & Kosminsky, 2012; van Nes, 2012), *liquid* (Elali, Keiser & Odag, 2012), *elastic* (Muscianisi, 2017).

Nevertheless, Kreutz (2018) explains her preference towards the adjective "Mutant": it was due to the clash between 21st Century living generations, with emerging technologies and distinct systems of perception and sense making. The world was changing, but the word mutation was still associated to aberration and anomaly, when in fact, all the evolution in Earth has been intimately linked to biological mutations and ecosystem adaptations. Humans are naturally mutant beings in their capacity to self-reinvent and self-manage, as described by Maturana and Varela (1997) when they introduced the concept of *autopoiesis*. Interestingly, for Dubberly (2008) design shares with biology a focus on information flow, on networks of actors operating at many levels, and exchanging the information needed to balance and develop communities and systems. Design promotes mutation.

Within the Mutant group Kreutz found that these could be split into two visual identity categories: *Programmed*, where brands would respond to pre-established, scheduled or fixed in time variations (Figure 1), and *Poetic*, where brands can, potentially, be completely free of rules, only following the designer's creative and imaginative intent, in close communion with the audiences, constantly interacting with the brand (Kreutz, 2005) (Figure 2).



Figure 1. Battersea, a London-based animal rescue centre, uses a collection of ten hand-drawn watercolour dogs and cats (designed by Pentagram).



Figure 2. Perion invested in a "living P", an ever-changing symbol, open to infinite visual possibilities (designed by Ro&Co).

3.4 On brand poetics

Kreutz and Heck (2016) mention that Jakobson's poetic function of language, frequently used by brands in advertising, is a way of enticing the audience. Intensifying emotions as the authentic source of aesthetic experience is at the very nature of poetry. Shelley (2012) defines poetry as "the expression of the Imagination" and, according to Richard Rorty, a contemporary American pragmatist, for the romantics it is the poet (broadly speaking, the imaginative genius), who prevents humans to fall into communication finitude. The author states that:

> We should try to think of imagination not as a faculty that generates mental images but as the ability to change social practices by proposing advantageous new uses of marks and noises. To be imaginative, as opposed to being merely fantastical, one must both do something new and be lucky enough to have that novelty adopted by one's fellows – incorporated into their ways of doing things. […] On the pragmatist view I am putting forward, what we call "increased knowledge" should not be thought of as increased access to the Real, but as increased ability to do things – to take part in social practices that make possible richer and fuller human lives (Rorty, 2007, pp. 107-108).

Such openness to new communication opportunities would expectedly have more or less impact on postmodern brands' narratives and corresponding visual discourse. In fact, this rising ability to poetically do things is increasingly being embraced by contemporary visual identities, mostly through the diversification of visual-based expression, or via the combination of visuals with other sensorial modes. Therefore, it seems appropriate to understand visual identity narrative (VIN) in the context of these more or less poetic orientations in branding.

4 A tentative model for Visual Identity Narrative

The working framework is grounded on Lotfi Zadeh's Fuzzy Logic (1996), which supports approximate modes of thinking rather than exact ones, acknowledging the virtues of imprecision, very much common in human life complexities. Therefore, with a focus on narrative discourse and form, HOW-related elements explained through discrete labelling units – such as the type of narrator and the narrative genre – will not be considered.

Hence, as a frame of reference underpinning the definition of VIN, this research proposes the following, as depicted in Figure 3:

- *Static visual narrative* (or non-narrative) does not fully apply to Poetic VI, where logo variations and potential hypertextuality are allowed and welcome. This sort of visual narrative would easily apply to Conventional brands, in some cases being adopted by Programmed brands.
- The cases in which each logo variation can be replaced by a succeeding one at a regular/irregular pace would fall within the scope of *dynamic visual narratives*,
- Cases relying in a triggering feature, which can be predetermined and mechanical or unforeseen and poetic, allow the active participation of those that are no longer mere spectators – but mostly expectant audiences, now empowered with the capacity to co-design the logo and its VI – follow the characteristics of *interactive visual narratives*.

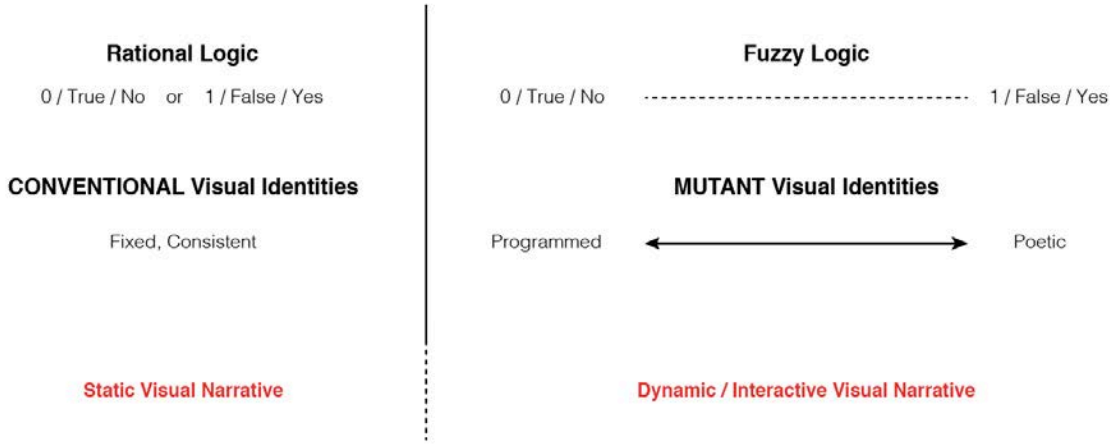


Figure 3. Proposed framing model of Visual Identity Narrative.

5 Method

This research followed an inductive reasoning, within the interpretive paradigm, aiming at adopting a post-structuralist perspective in order to deal with puzzling facts that emerged in the recent years, while both researchers had encounters with empirical phenomena that were not being explained by the existing range of theories, typically structuralist by nature. Therefore, the 'best' explanation among many other possibilities was chosen with the purpose of organising the complexity of the topic, or finding clarity in the identified problematic.

The method consisted of a qualitative hermeneutical content analysis. Because the discursive dimensions defining narrative in the context of visual identity (VI) have not been identified, the utmost goal was the definition of such dimensions within the context of contemporary brands, following the overall definitions of narrative and visual narrative found in the literature presented above, but also insights from previous works in this subject (Leitão, Lelis & Mealha, 2014a, 2014b).
Although this approach had no intention to generate a precise labelling or classification system and moves beyond the self-sufficient ideals of structuralism, each dimension is explained through the use of binary oppositions, as in a semantic differential. This allows the conceptualisation of a mapping tool where VIN can be conceived somewhere (anywhere) between two polar positions.
The starting point was grounded on the analysis of a wide range of brands (80+) conducted by the researchers throughout the years (Kreutz, 2001, 2005, 2009, 2018; Kreutz & Arévalo, 2013; Leitão, Lelis & Mealha, 2014a, 2014b; Leitão, Lelis & Mealha, 2015; Kreutz & Heck, 2016; Lelis 2019).
From these, 10 brands were shortlisted for analysis, all of them widely acknowledged as having dynamic visual identities (or allowing dynamic graphic ventures) and that were collected from the most up-to-date informal online resources of specialist knowledge (Underconsideration and The Branding Source websites) or from the online public and published portfolios of major communication agencies (e.g. Pentagram, Wolff Olins, among others). This guaranteed a minimum of credibility in both the strategic aspects and the design concerns of such brands. The 10 brands were Apple, City of Melbourne, Google, Melissa, MTV, NYC, OCAD University, Oi, Rio 450 and Russia, hence representing a wide range of sectors (ICT, Tourism, Fashion, Entertainment/Culture, Education and Telecommunications).
Then, by elaborating on the work of Leitão, Lelis and Mealha (2014a, 2014b) and using the reviewed literature on literary narrative and visual narrative, the minimum structural requirements for logos to be considered a narrative (or narrative containers) were identified, originating a preliminary code book with a large number of descriptors of structural/discourse elements (Figure 4). These were polished (in the sense in which related/similar categories were grouped and, whenever possible, reduced to one), and an organising matrix was created (Table 1), showcasing the emergence of six dimensions, their bi-polarities and their corresponding (and opposing) descriptions.

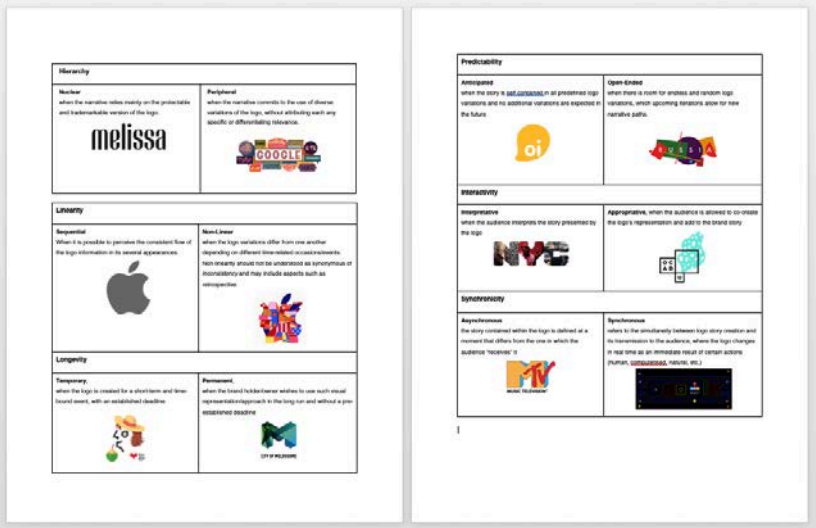


Figure 4. The 10 shortlisted used in the code book

Table 1. Conceptual organising matrix

Discourse elements of narrative	Dimensions of VIN	Analysis-led Semantic Differential		
Hierarchy of events	Hierarchy	Nuclear The narrative relies mainly/repeatedly on the protectable and trademarkable version of the logo.	|||	Peripheral The narrative commits to the use of diverse variations of the logo, without attributing each any specific or differentiating relevance.
Sequence and order of events	Linearity	Sequential It is possible to perceive the consistent flow of the logo's information in its several appearances.	|||	Non-linear The logo variations differ from one another depending on different occasions/events.
Duration and frequency of events	Longevity	Permanent The brand wishes to use such visual representation or approach in the long run and without a pre-established deadline.	|||	Transitory The brand's logo is created for a short-term and time-bound event, with an established deadline.
Plot strategy	Predictability	Anticipated The narrative is self contained in all predefined logo variations and no additional variations are expected in the future	|||	Open-ended The narrative is explored through endless and random logo variations, which upcoming iterations allow for new paths.
Hypertextuality	Interactivity	Interpretative The audience interprets the story presented by the logo	|||	Appropriative The audience co-creates the logo's representation and adds to the brand story.
Creativity time	Synchronicity	Asynchronous The narrative contained within the logo is created at a moment that differs from the one in which the audience "receives" it	|||	Synchronous The narrative contained within the logo is co-created or changed in real time as an immediate result of audiences' interventions

6 Narrative dimensions in contemporary visual identities

The presented dimensions were created to simplify the immense corpus on narrative theory, combining it with the scarce literature on visual narratives and intersecting it with the notions of brand storytelling and the current practice of visual identity design. The main objective was the proposal of the pivotal discursive dimensions of VIN.

6.1 Hierarchy

Ranging from *Nuclear* to *Peripheral*, this dimension describes the dependency relation between the trademarkable version of a logo and its possible variations. Nuclear cases are those where the narrative relies mainly (or uniquely) on the protectable version, such as IBM. Peripheral are the ones where the narrative commits to the use of diverse variations of the logo, without attributing each any specific or differentiating relevance, like Google, with its thousands of Doodles. However, it is expected that all brands will have a nuclear version, for trademarking purposes.

6.2 Linearity

Intimately related to Hierarchy, Linearity refers to the perception of sequence the logo usage and application provides the audiences with, ranging from *Sequential* to *Non-Linear*. Sequential cases are those where it is possible to perceive the consistent flow of the logo's information in its several appearances. Usually, nuclear approaches tend to follow a sequential or programmed VIN. Non-Linear cases occur when the logo variations differ from one another depending on different occasions or events (time-related or not), again, being Google a good example. However, non-linearity should not be understood as synonymous of inconsistency and it may include aspects such as retrospective, *analepsis*, *prolepsis*.

6.3 Longevity

This dimension ranges from *Permanent* to *Temporary*. Permanent refers to the time duration of the narrative associated to a specific visual identity; in others words, for how long will the logo be telling its story. These cases are those when the brand's visual representation lasts for a long period, without having a pre-established deadline. As an example, we could point to IBM, which basic design has remained unchanged since 1972. Temporary cases are those of a brand's logo created for a short-term and time-bound event, with an established deadline, such as the case of Apple, with its Special Event in October 2018, which, for the first time, used dozens of different Apple logos featuring unique artwork, exclusively to promote the event.

6.4 Predictability

As in a script-based plot, visual identities play with archetypes and narrative structures that can be more or less expectable, mostly when it comes to their story resolution, allowing both finite and incalculable versions, hence ranging from *Anticipated* to *Open-Ended*. Anticipated cases occur when the story is self-contained in all predefined logo variations and no additional variations are foreseeable in the future; this would be the case of MIT Media Lab, which dynamic visual identity, designed by Michael Bierut (Pentagram), presents its 23 research groups with their own logos deriving from the MIT Media Lab one. Open-Ended involve visual identities that acknowledge room for endless and random logo variations, which upcoming iterations allow for new organic narrative paths. Google is, in this case, the best example, where each one of its Doodles bring a great level of unpredictability, namely when it comes to the Doodle4Google contest, in which students from nursery to last grades of secondary/high school can submit their Google logo versions.

6.5 Interactivity

Grounded on hypertextuality potential of creating a network of several narrative pathways, this dimension spreads from *Interpretative* to *Appropriative*, referring to different possible levels of interaction between the brand's logo and the audiences. Interpretative visual identities are the ones in which the audience interprets the narrative presented by the logo without intervening in it, as in IBM, MIT Media Lab and in most brands' logos. Appropriative cases are those in which the audience co-creates the logo's representation or adds visual elements to it. This can happen both by invitation, strategically defined by the brand that welcomes this sort of collaboration, or as both a positive or negative manifestation that comes from the public and in which cases the brand has little will or control. The former can be exemplified by OCAD University (Ontario College of Art and Design) whose visual identity, created by Bruce Mau Design, is based on black-and-white modular frames to hold examples of actual student art and design work, being the students responsible for the integration of their own materials in the logo. The latter can range from passionate appropriations (such as the unofficial screen wallpapers using Apple's logo in complementary ways), or anti-branding appropriations, as in the case of BP's logo.

6.6 Synchronicity

This dimension refers to the alignment between the time of creation of the narrative (design time) and the time of reception of the narrative (use time) that can be misaligned or *Asynchronous*, or totally aligned, hence *Synchronous*. Therefore, Asynchronous cases are those in which the narrative contained within the logo is defined at a moment that differs (because it is previous) from the one in which the audience "receives" it. Most nuclear cases fall within this approach. Synchronous refers to the simultaneity between the logo's story creation and its transmission to the audience, where the logo changes in real time as an immediate result of certain actions (human – by intervention of both designer and/or audiences – computerised, natural, etc.). An example (of approximate synchronicity) is Nordkyn's visual identity, created by Neue Design Studio. Nordkyn is an arctic cold peninsula in Norway, where its extreme weather conditions play a huge role on the region's attractiveness from a touristic point of view. To represent such essence, the studio combined nature-based information with technology, developing a logo generator that allows the region's website to update the logo every five minutes, accurately representing the exact weather conditions of that particular moment according to the data constantly received from the Norwegian Meteorological Institute. Other synchronous examples include gamified logos, such as the Google Doodle created to celebrate Pacman's 30th anniversary.

7 The six dimensions within the fuzzy logic of Dynamic/Interactive VN

In order to better visualise how the six dimensions of VIN could be used to analyse and benchmark a brand's visual identity against, for example, its competitors, the authors created a representative visual map of contemporary dynamic place/destination brands considering their narrative choices and their position within

the fuzzy-logic spectrum of Mutant Visual Identities. For this exercise, official sources of brand application were consulted (brand/company website, brand manuals and standards and published/available social practices).
It was observed that the polar characteristics of the six dimensions that occupy the left-hand side of Table 1 are strongly related with Programmed VIs. In fact, adjectives such as *nuclear, sequential, permanent, anticipated, interpretative* and *asynchronous* are associated to the very idea of organisation, prediction and consistency, whereas qualifiers such as *peripheral, non-linear, transitory, open-ended, appropriative* and *synchronous* transport the reader to a context of instantaneous and multi-directional complexity, which is the extreme definition of a Poetic VIs (Figure 5).



Figure 5. Using the six Dimensions of VIN to map place/destination brands

Therefore, this research suggests as well that the six dimensions of VIN can be used to create and explore new dynamic VIs, and explain existing ones, either by informing or by being grounded on the Mutant Visual Identities framework (Figure 6) as per the proposed framing model of Visual Identity Narrative (Figure 3).

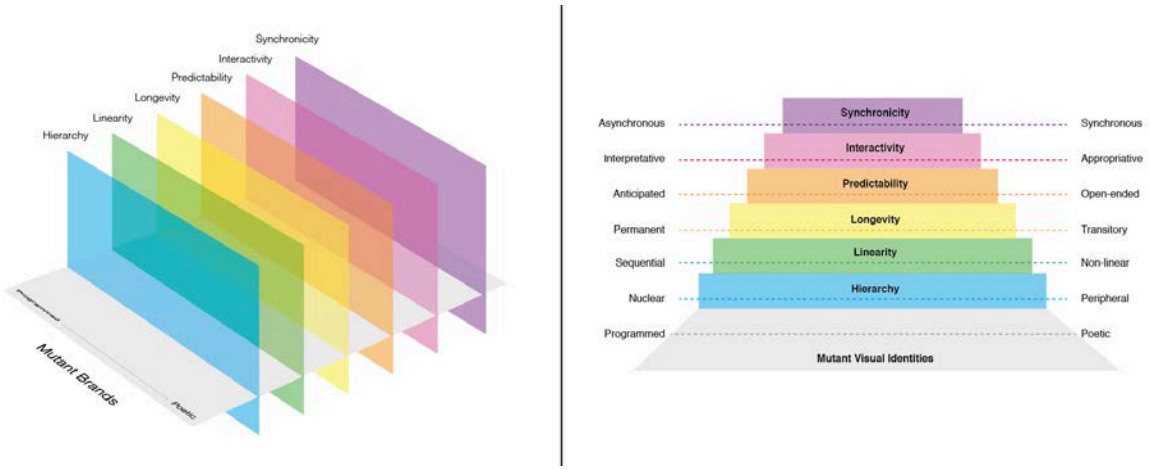


Figure 6. The six Dimensions of VIN and the Mutant Visual Identities framework

8 Discussion

It is important to emphasise that, within this framework, no pole or side of the semantic differential is meant to be understood as a better or preferable narrative approach as opposed to the other. Starting from each dimension and their qualitative elements of analysis, designers will be equipped to better assess and plan (or replan) a brand's visual identity according to its specific context. Notwithstanding, the poles on the same side of a poetic visual identity approach seem to rely on a democratised use of peripheral visual elements, varying in sequence according to their needs, following a swift and short-term kind of exposure hence increasingly unpredictable, especially if the audiences are given the opportunity to intervene, in real-time, on the spot.

As per the fuzzy logic framework, each VIN should be analysed and represented in terms of fuzzy sets, where each pole is always the crispiest possibility, but in between them one will find unclear sets, for which designers will try to find a nominal category – such as, for dimension Longevity, Less Permanent, Almost Permanent, Not Permanent or Transitory, Somehow Transitory, Very Transitory – and even micro fuzzy sets in between those categories, for the cases in which objective classification can be detrimental.

While it is clear that mobility and mutability is part of the way humans currently live it is not a good idea to adjust a brand's VIN every time a new trend emerges, without a contextual critical analysis. Surely design possibilities evolve thanks to the constant development of technology, and brand design is likely to become even more exciting in the years ahead. Throughout the history of design, many different trends were brought to scene, and yet they were not all necessarily good. An absolutely poetic approach may not suit all brands and all audiences.

9 Concluding remarks

By looking into the form/discourse of VIN, the answer to the proposed research question *What are the narrative dimensions structuring the design of brands' visual*

identities? is achieved with the identification of six VIN dimensions: Hierarchy, Linearity, Longevity, Predictability, Interactivity and Synchronicity, all structural and vital elements in a contemporary visual identity narrative. Therefore, this research provides insights for designers to look at how visual identities can be used to successfully support the brand storytelling, establishing or maintaining customer loyalty via synchronous or asynchronous practices, linear or non-linear stories, interpretative or appropriative approaches that last for longer or shorter periods and that can surprise more or less their audiences.

If in the past brands' main goal was to be recognised by their audiences, currently brands are mostly focused on creating meaningful experiences through the active involvement of their audiences, imaginative geniuses with an increased ability to do things. In a time where younger generations are becoming increasingly aware of and sensible toward societal issues, brands that augment their audience's ability to do things with their logos (which used to be a finished, untouchable and proprietary resource, and is becoming an always open-to-creativity canvas) may well be the ones that most successfully establish stronger emotional bonds with the public, by making possible richer and fuller human lives. A brand logo can hopefully be admitted as an element that can serve many other purposes than the mere and traditional identification one: it can, in fact, with a well thought structural discourse, be a gold mine of semantic and relational opportunities.

This paper is, therefore, a contribution to the knowledge of how just one of the many elements that form a brand (its visual identity, namely its logo), can still be conceived as a useful resource with so many other possibilities beyond the conventionally functional ones. And whilst some significant research in brand storytelling has already been done, most of it looks at the brand in its whole or uses one of the brand's intangible elements as frame of analysis (its culture or personality, for example, great assets for the development of representational and informational components of narrative), but no studies have considered the tangible and highly interactive element that the logo is, and how relevant it can be as a contributor and container of narratives itself.

So far, the value of this research resides in the identification and definition of the six main narrative dimensions of logos in contemporary brands, with the potential to allow future developments on a heuristic mapping and benchmark-led tool for a) better aligning the creative brief with the client's needs, and b) the extended benefit of increasing brand engagement and meaningful brand experiences by designing the most structurally appropriate visual storytelling strategy.

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Opportunities to design for the wellbeing of children undergoing cancer treatment at a Brazilian Hospital

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This research aimed at identifying design opportunities to contribute to the wellbeing of children undergoing cancer treatment, focusing on laboratory and imaging exams. Subjective wellbeing is stimulated by increasing positive affect and minimizing negative affect. Participatory observations were developed with children admitted for oncology treatment at a Brazilian hospital. Researchers interacted with six children from 4 to 8 years of age multiple times for three times every week during their recreational play time. From the results, four design guidelines were drawn: design for personalization (and against depersonalization); use of technology to allow immersive experiences in learning about the treatment and medical condition; gamify experiences to allow positive reinforcement; and design for focus redirection (distraction or refocus on less aversive experiences).

Keywords: Design for wellbeing; positive affect; negative affect; Healthcare; Brazilian context

1 Introduction

The Brazilian healthcare system is organized into three sectors: public (services provided by the Union), private (financed with public and/or private resources), and supplementary care (through private healthcare plans) (Paim et al., 2011). Healthcare system's public and private components are different but interconnected, and users may access all services, depending on their availability to pay. With a population of more than 207,700,000 Brazilians, only 27.9% have private healthcare plans (IBGE, 2017).

Brazil's public healthcare system, called Unified Health System (*Sistema Único de Saúde* - SUS), "relies on the concept of citizenship by establishing universal and integral access to healthcare as a guideline." (Silva et al., 2011, p.3813). Created in 1988, its purpose is to guarantee healthcare to all Brazilians (IBGE, 2017).

SUS has been facing some challenges, namely: the reform of its financing structure, the renegotiation of public and private roles, the adaptation of the model of care to meet the Country's rapid demographic and epidemiological changes, and the improvement of quality

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of care and safety (Paim et al., 2011). It is also challenging providing preventive care and improving patients' wellbeing, especially in public hospitals.

For children undergoing cancer treatment, SUS focuses on clinical issues. Direct care is already challenging, due to the Country´s lack of resources to provide qualified and safe services. With basic needs to be fulfilled, the effect of product, services, and hospital environments on children´s wellbeing are neglected. Therefore, this research explored design opportunities to enhance children's subjective wellbeing, focusing on laboratory tests and image exams – user journey.

Subjective wellbeing is not related to objective and material issues (e.g. having adequate and sufficient food and a safe place to live in). It focuses on the experience of positive affect, minimization of negative affect, and life satisfaction (Lyubomirsky & Dickerhoof, 2005) as predictors of wellbeing. By maximizing positive experiences and minimizing negative affect, children's wellbeing may be improved (Desmet & Pohlmeyer, 2013).

This research was developed at a Brazilian public hospital – *Hospital de Clínicas de Porto Alegre*. Children´s experiences with products, services, and environments were represented and observed through play, and design guidelines were drawn from it. This is part of a research project that will apply these guidelines to various prototypes focused on improving the wellbeing of children undergoing cancer treatment.

2 Research method

We used participant observation method, interacting with children admitted for oncology treatment to better understand their context (as recommended by Tonetto, 2016). A team of six researchers collected data for 2.5 months, interacting with six children (ages 4 - 8) three times per week, during their recreational play time. The hospital has rooms dedicated to Child Life for inpatient care, which include elements designed to support patients during their stay. In a large room with 4 desks (with 4 chairs each), computers and toys, children and adolescents play with other oncology patients and Child Life specialists through free play, arts and crafts.



Figure 1. Recreation room. Source: The authors.

The goal was to identify, from a designer's perspective, characteristics of hospital services that could contribute to the subjective well-being of children during their stay for treatment. We used Playmobil's hospital toys to represent each scenario (admission, room care, medical assistance, laboratory exams and scans) and invited the children to share their experience and/or the experience of a friend in those situations. Researchers worked in

pairs to facilitate video and audio recording of the interactions. To preserve the children's anonymity, they are presented as C1, C2, C3, C4, C5 and C6 (C standing for Child).



Figure 2. Toys used for data collection. Source: The authors.

The analyses took place at a tertiary referral, teaching hospital in southern Brazil with 845 beds, distributed as follows: intensive care unit (44), emergency department (47), inpatient unit (652) and other services (102). The paediatric oncology unit is a multidisciplinary service with 25 beds that cares for children from 0 to 18 years of age. Every year about 100 new patients receive treatment at this unit coming from all over Brazil. The study was approved by the hospital's Institutional Review Board (CAAE # 94028918.5.0000.5327).

3 Results

Figure 3 synthesizes the research results. We investigated laboratory tests and image exams – user journey (Column 1). Several influences on the children's wellbeing emerged from the observations (categories – Column 2) and were related to wellbeing theme(s) (Column 3). It's also presented the type of affect connected to them: positive, negative or neutral (Column 4), and a description of design guidelines (Column 5), discussed in the following section.

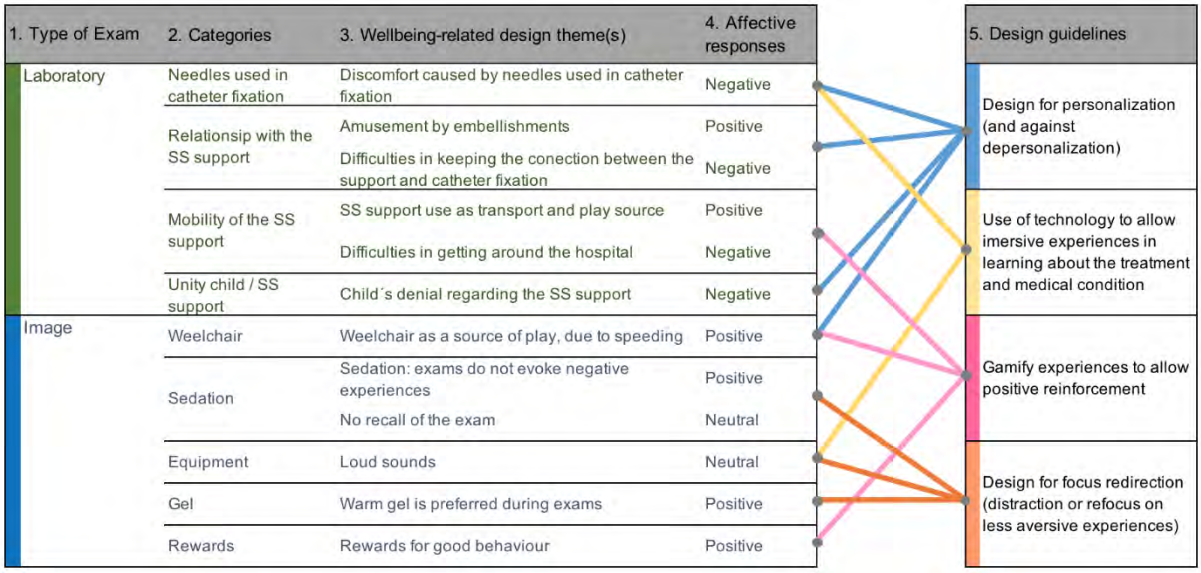


Figure 3. Results. Source: The authors.

When representing "laboratory tests" through play, children spontaneously simulated the collection of blood samples, realized through an intravenous access device (catheter). Catheters also allow medication, chemotherapeutics and parenteral nutrition to be administered (Vasques et al., 2009).

The first category was denominated “needles used in catheter fixation”. Children expressed negative affect in their relationship with the catheter, mentioning the needle as the main discomfort source. Some children had to implant catheters more than once, due to its obstruction, or to its removal (accidental or intentionally). Plays with C1 are examples of this category. When seeing the doll (a patient) without the serum wire (the connection to the catheter), he said: "He plucked the wire! Put the thread in it!". When the researcher asked if the wire couldn’t be pulled out, C1 replied: "No. You have to put the needle back, and it hurts”.



Figure 4. Patient demonstrating that the doll should remain connected to the wires. Source: the authors.

Children also associate the catheter with serum and equipment support, and this connection is made through tubes connecting these components to the catheter. Because of this perceived relationship, the support of serum and equipment were addressed in this paper as

“laboratory tests.” Three categories were identified: “relationship with the SS support”, “mobility of the SS support” and “unity child/ SS support”.

“Relationship with the SS support” concerns how the child appraises the support and the types of affect involved. Some children used adornments on their brackets, (e.g. superheroes, dolls, and balloons), while some parents made ornaments to hang on the stand. Positive affect was experienced towards these embellishments. In contrast, children see the support as an extension of the catheter and express negative affect towards the use of a needle to attach catheters to serum, supports, and equipment as a whole.

In “mobility of the SS support”, some children tried to use the support to move, climbing on it and using the wheels to drive it, experiencing positive affect. On the other hand, the lack of mobility generated by the tubes, connections, and support was associated with negative affect. Since the support always accompanies them, they expressed that they feel like one (“unity child/SS support”). There is also limited autonomy in handling tubes and wires when playing and moving, as well as in their understanding of how these devices work. Figure 5 shows C2 explaining how the medication is handled by the nurses through their connection with the catheter. Whenever it was possible, children ignored the support, avoiding talking about it (evidencing the experience of negative affect).



Figure 5. C2 shows the medication application. Source: The authors.

The exam described as “image – user journey” refers to the different types of imaging exams and the child's journey to do them. The first category (“wheelchair”) corresponds to how they are transported to the exams. During play, children indicated a preference for using the wheelchair to take patients (dolls) to the exams. It is possible to identify the positive affect involved in one of the situations, in which C3 said the wheelchair amuses her because it moves fast.

Positive or neutral affect was evidenced in the analysis of the second category (“sedation”). C4 expressed she liked to be sedated because the exam did not hurt. Neutral affect was the most common reaction, since children did not know how to talk about sedation or did not recall these situations.

The category “equipment” grouped reactions to sounds of the equipment used in imaging exams. Some children (C1, C4, C5) explained exams using camera sounds ("tic, tic, tic"). Many parents and professionals explain to children that these exams are like "taking

pictures". Neutral affect was noticed, being an opportunity for design to evoke positive responses.



Figure 6. Image exams explained by children. Transport the patient to the exam using a wheelchair (left) and child on the stretcher (right). Source: The authors.

The “gel” used during some imaging tests (e.g. ultrasound) may be a source of positive affect. Its temperature (preferably warm) may be an amusing factor, the same way as toys and stickers obtained for good behavior in the exams (“Rewards”), demonstrating another opportunity to evoke positive affect.

4 Discussion and conclusions

To promote subjective well-being, design guidelines (see Figure 3) were proposed to minimize negative affect, maximize positive affect, and stimulate positive affect, when it is currently neutral. The design guidelines were based on the analysis of the observations. They were developed by the authors during group meetings, in which applications of the results were discussed. This is a work in progress, with projects and prototypes being developed. Examples of current design as references to these guidelines are shown in the Figures.

The guideline "Design personalization (and against depersonalization)" refers to the design of possibilities that allow customization. This can be applied in different contexts, as shown in Figure 7.

Guideline: Design for personalization (and against depersonalization)	
Categories and Application	Example
Needles used in catheter fixation: Minimizing negative affect through embellishments with playful design. Relationship with the SS support: Promoting positive affect through customization for serum support. Unity child/SS support: Connecting children positively to the support, promoting its customization. Wheelchair: Designing customizable accessories for wheelchairs, allowing the design of the patient's journey to the exams.	"Super formula" was developed by the JWT agency for Pediatric Oncology of the hospital A.C. Camargo Câncer Center (São Paulo, Brazil), to improve the performance of chemotherapy applied to children and motivate them throughout treatment. Superhero adhesives were used in the chemotherapy room, as well as a capsule to wrap medication. JWT, Warner Bros., Vetor Zero, and pediatricians also developed comic books featuring superheroes recovering through Super Formula. The project was widely accepted and proved effective in motivating children in the fight against cancer. 

Figure 7. Guideline, its applications, and example. Source: Silva, (2014).

The guideline "Use of technology to allow immersive experiences in learning about treatment and medical condition" uses technology to inform children about the treatment, minimizing the negative affect generated by unknown contents and uncertainty. Technology can also be used to create narratives that contribute to the generation of a more playful treatment context (Figure 8).

Guideline: Use of technology to allow immersive experiences in learning about the treatment and medical condition	
Categories and Application	Example
Needles used in catheter fixation: Use of technologies (e.g. videos, virtual reality glasses, and augmented reality) to help understand the disease and the treatment, to minimize negative affect of the unknown, pain and discomfort. Equipment: Using technological possibilities to resignify the procedures of imaging, telling stories and creating experiences.	A study conducted in three pediatric hospitals in Sweden (2012 – 2015), evaluated children's responses to the psychological preparation before radiotherapy procedures, which generally cause fear due to the unknown. HUGO, a preparatory kit, was created, containing information available on tablets, equipped with headphones, a stuffed animal, a booklet for parents, and models of the tomography and radiotherapy machines. HUGO explained the procedure to the family and the children and was made available 5 days before the examination. The children experienced the intervention as positive, and HUGO's strength came from the interaction it provided between the patients and their families. 

Figure 8. Guideline, its applications, and example. Source: Engvall et al., (2018).

The guideline "Gamify experiences to allow positive reinforcement", shown in Figure 9, suggests the gamification of treatment to motivate and encourage children, as well as promote positive reinforcement in different stages of the healing process. It is also possible to design artefacts to accompany the child throughout the treatment.

Guideline: Gamify experiences to allow positive reinforcement	
Categories and Application	Example
Mobility of the SS support: resignify the relationship and the children's mobility with the support through design, turning it into an amicable partner during treatment Wheelchair: The journey to the examination rooms may be redefined based on the phases that make up the gamified experience. Rewards: Offer medals of courage, awards and prizes at each successful stage.	"Huggable" is an interactive teddy bear-shaped robot with an integrated system running through an Android application. It was developed by the MIT Media Lab, promoting the approach of children with their relatives and the medical team. The child interacts with the teddy bear through an application, which controls the actions of the robot, promoting a more welcoming interaction. 

Figure 9. Guideline, its applications and example. Source: Fluture, (2015).

The guideline "Design for focus redirection (distraction or refocus on less aversive experiences)" concerns the design of artefacts that redirect the child's focus during procedures that may be perceived as negative or invasive (Figure 10).

Guideline: Design for focus redirection (distraction or refocus on less aversive experiences)	
Categories and Application	Example
Sedation: Designing environmental and informational data on what occurs throughout the procedure to minimize negative affect before, during and after sedation, or making the experience more positive. Equipment: Designing playful interventions in environments and devices to evoke positive and minimize negative affect. Gel: Create distracting elements during procedures or make playful interventions with the gel.	"Aquarius Carioca" was created by the Desiderata Institute (Rio de Janeiro) to establish a more inviting space for children. Playful interventions were designed in the environment and on devices. These impacted on the minimization of pain during the procedures, the perception of time (seeming to pass faster), and the reduction of anxiety. 

Figure 10. Guideline, its applications and example. Source: Rouvenat, (2015).

Our aim was to identify opportunities to design for the wellbeing of children undergoing cancer treatment, by stimulating positive and minimizing negative affect, with emphasis on processes that occur during laboratory and imaging exams.

When comparing the Brazilian context to the other countries' examples, we can see that there is still a long way to go, which can be a result of the challenges SUS has been facing

(e.g. lack of funding and problems regarding changes in the system). Research shows that although SUS delivers healthcare to Brazilian citizens, it neglects subjective needs and the affects experienced by the patients. Thus, even though it already receives money donations, we suggest that SUS would greatly benefit from more funding opportunities, directed to upgrading the healthcare system. More specifically, investing in ways of engaging with patients' affects, consequently making their experiences better and improving their wellbeing.

Next steps of this research are the actual design, prototype, and testing of artefacts, to observe their potential to contribute to children's wellbeing. An important limitation of this research is that it is context-dependent. Therefore, it may be developed in other hospitals, to understand if and how these guidelines can be applied more comprehensively.

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Exploring Parental Experience at Children's Hospital: Design Recommendations for Their Needs and Wishes

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This study discusses the needs and wishes in relation to parental care experience at children's hospital. Interviews were conducted with 15 parents and nurses based on observation and emotion diary at a children's hospital. Parents of child patients not only care for child patients, but also act as medical communication and information providers. Many of the uninterrupted roles have caused parents to experience physical and emotional difficulties. The findings indicate that three considerations need to be taken in designing product or service for parents in order to deliver better user experience while taking care of child inpatients: comfort, knowing, and emotional experience. Design implications, limitations and further study were discussed as well.

Keywords: children hospital, child inpatient, parent, emotion, healthcare

1. Introduction

Hospital is an environment where both patients and health professionals exist for certain amount of time. Hospital is a healing space for patients while a working place for health professionals. Thus, it is important for patients and health professionals to coexist harmoniously in the hospital since they are the main users of the hospital (Alsos and Svanæs, 2011). However, it is unique that in children's hospital, parents of child patients also take care of the patients along with the health professionals, and they even intervene between the patients and health professionals. Because patients who are minors are vulnerable in social, physical, and cognitive ways, parents take a role as supporters.

The study of supporting parents of the patients were limited even though the parents were recognized as important people in the children's hospital. Most studies focus on usage of technology to help treating the patients. Design studies focus on caregiving parents' role as caregivers who takes care of the patients, messengers who report the status of the patients to health professionals, and decision makers as guardians of the patients. Past studies show that the health professionals rely on the parents' opinion about child patients' symptoms and experience (Najman et al., 2001; Shin and White-Traut, 2005; Vehviläinen-Julkunen, 1992). However, the parents and the child patients' evaluation of the healthcare professionals' function, behavior and experience may be different(Theunissen et al., 1998). The parents

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and the child patients may recognize various importance according to their symptoms (Tates and Meeuwesen, 2001), and it makes the healthcare professionals difficult to obtain the exact information about the child patients as well as affecting treatment (Suominen et al., 1995). The caregiving parents have a great influence on the child patients since they stay with each other for twenty-four hours a day. We are trying to understand the influence of the parents on the child patients and the health professionals. The purpose of this study is to understand the process of caregiving in the child patients' rooms, and to present means of settling the difficulties for the parents not only to give care, but also to be efficient for themselves.

A previous study illustrated the influence of the parents on treatment of child patients as assistants. According to the study, caregiving parents take efforts in physically, emotionally, and financially, and they are under a lot of pressure (Lu and Cheng, 2013). Montgomery(Montgomery et al., 1985) explains the pressure by categorizing into two groups; objective pressure and subjective pressure. The objective pressure includes physical and financial difficulties through caregiving process while subjective pressure includes emotional response of the caregivers. He determined that the caregivers may be tensed and depressed because of sudden changes of their everyday lives. Products such as monitoring technologies and hearing aids, which are mentioned in treatment of chronic disease, help the caregivers to be aware of the patients and reduce the stress. However, it is hard to find studies to relieve the stress of the caregiving parents. We hope that this study will give positive influence on caregiving parents' health along with child patients and healthcare professionals by decreasing caregiving parents' burden.

Faced with these challenges, our research question becomes;

- How do parents care for children in a children's hospital?
- Who does the parent interact with in hospital life?
- What are the difficulties and wishes of parents in their hospital life?

2. Method

In order to explore needs and wishes of parents as caregiver of their child in the children's hospital, observations and interviews were conducted.

2.1 Interview material

To understand caregiving activities of the parents and the nurses, we asked to write emotion diaries. Emotion diaries include emotion scores, activities, places, needs and wishes (Figure 1). We asked to keep emotion diaries in advance of the interviews, and the interviews were conducted based on the emotion diaries.

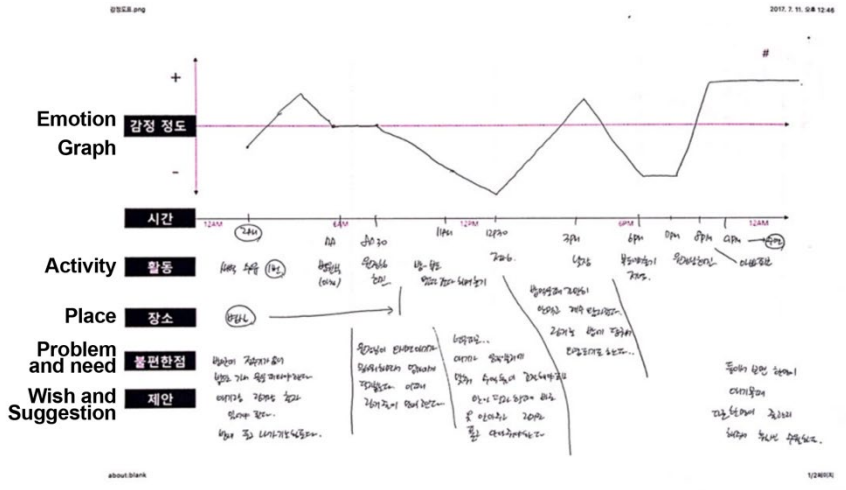


Figure 1. An example of an emotional diary written by the mother of a child inpatient

2.2 Data collection

The observations and interviews were conducted in three children's hospitals, and three researchers inspected and documented behavioural patterns of parents, their child patients, and the nurses under the hospitals' permission.

- Observation: Two researchers conducted observations in a common space with accompanying hospital personnel for 4 hours in the morning and afternoon. One person was able to observe one child patient the same as the parent assistant for 16 consecutive hours. Observations were carried out to understand children's hospitals from the viewpoint of the researcher, not the participants. The main focus of observation was the relationship between parents' interaction objects. The most common observation was nursing for children (Figure 2).

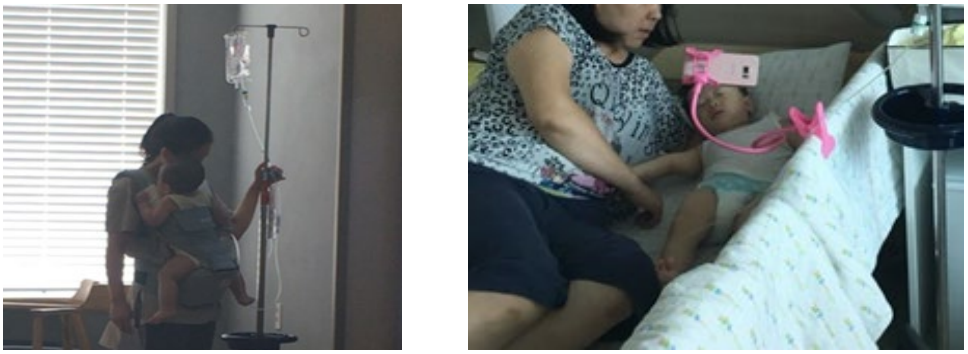


Figure 2. Scenes of daily life of a parent and a child inpatient in the ward

- Interview: The interviewees are recruited from three hospitals, and they are fifteen parents whose children are hospitalized at the time and fifteen pediatric nurses. All of the caregivers are the mothers of the children, and the ages of the children vary from nine months to five years old. The ages of the mothers are from in their late twenties to early thirties. The nurses work in pediatrics department, and the positions vary from new nurses who have three months working experience to chief nurses. Also, the ages of nurses are from mid-twenties to late-forties. Interviews took place inside of the patients' rooms or nurses' station, and it took between thirty minutes and one hour. All of the interviews are based on the

parents' emotion diaries and mostly about how their everyday lives have changed since the children were hospitalized, what they do in the patients' rooms, problems and what could be improved (Figure 3).



Figure 3. Scenes of interview with parents and nurses.

2.3 Data analysis

All of the recorded interviews were transcribed. We identified the problems from early data analysis among three researchers based on field notes and interview transcripts using Atlas.ti. The early data analysis is about emotion levels of activities which take place in the patients' rooms and when they carry out their tasks. Later on, we discussed about reasons of emotional changes of the parents and the nurses and how it affects their behaviors based on the collected data. Lastly, we created persona of the parents and the nurses based on the analysis to discovered concept of being caregivers as parents and nurses. We also investigated how parents can look out for their personal lives while taking care of their sick children based on the analysis.

3 Results

3.1 Child patients room environment

A child ward is a space where health professionals, child patients, and their families meet and is a space where patients and their families stay. Unlike home, the ward focuses on the efficiency of hospital life and the accessibility of health professionals. For example, the door of a child room has a small window, so nurses can check the situation in the room without opening the door. In the case of the room for one patient, the bed is located in a position visible from the door. Also, in the case of a room for patients, the door has a window. Each patient bed can be divided into curtains, and there is room for a bed next to the patient bed. There is no device provided for the privacy of the protector. Compared with a single room, in the room for children and parents, we can see quiet conversations and children watch videos quietly with their tablet. Because the spacing between beds is narrow and is not soundproof, side patients and parents can easily hear the sickness of child patients and the crying during the treatment process. This seemed to frighten the child patient, and their parents quietly explained the reason to the child patient and comforted him.

Narrow bed space did not cover the activity of child patients (Figure 2). Child patients wanted to get out of the room, and the parents used the IV pole to go around in hospital. In the restroom, child patients play, and child parents contact each other. Nurses have

separated few child patients with a certain virus and educated their parents for fear of cross infection. Child patients and parents who were not separated by the nurses took time to interact and seemed to share the overall story about the children. They shared not only current illnesses, but also past illnesses, treatment processes, etc. Also, they shared insurance treatment methods. They talked about their children's educational problems. The hallway and restroom were also space for child patients and parents of the multi-room to escape from the noise in the room. Parents also went out with a baby to sleep and out of treatment time from other patients in the room. The nurses' room was mainly located in the centre of the ward, and generally, more than one nurse was in the nurses' room. Parents usually visit when they need clothe of child patients, when the IV treatment is over, or when they have additional questions, such as medicine and medical care. There are a telephone and a button connected to the nursing room in the ward, but the parents mainly visited the nurses' room directly.

3.2 Parents' role and emotions in the hospital

Parents continued to care for the child patient by staying near the patient. Parents were close to the child patient for 24hours. The break time for the parents was the nap time of the child and the visit of other family members. Parental activity is to help the child's daily life and supporting therapeutic activities. It is an example of daily activities to help child patient to have a meal and to have a sleep. An example of helping with treatment is medication and communication with health professionals. The parent's responses to emotions were classified as positive and negative (Table 1). Parents played and exercised with children, and visits from other families evoked positive emotions. Classified as positive and negative (Table 1). Parents played and exercised with children, and visited from other families evoked positive emotions. On the other hand, helping to have a meal, go to the bathroom and helping with the healing process evoked negative feelings. Helping a have a meal and going to the bathroom is physically exhausting, the condition of the child patients is not good, and this condition expanded the role of the parents. Parents said it was difficult to control negative emotional expressions of child patients with child patient care. Therapeutic activities are said to be difficult because it is hard for parents to see child illness. Also, parents were not positive about communicating with health professionals. Parents thought the dialogue with the health professionals was formal. Particularly, parents thought that they would take part in the role of the nurses. Parents supported and comforted the emotional difficulties of child patients in the treatment of child patients. Parents said that seeing the pain and suffering of child patients is very hard, although not expressing them to the children.

Table 1 Emotions derived from parents' activities in the children's hospital

Activities with Positive emotion	Activities with Negative emotion
• Playing • Exercise such as walking • Family visit	• Taking body temperature • Changing diapers, going to the toilet. • Taking meals • Treatment (surgery) • Round visit by doctors • Changing clothes

4 Discussion

We categorized the results focusing on how the parents took care of their children, and how it affected the parents physically and emotionally. The parents were out of their ordinary lives and gave sensitive care to their children while they communicated with the nurses about treating their children. These activities may make the parents feel difficult physically as well as emotionally.

4.1 Comfort

The parents of child patient stayed at the patient's room day and night caring the child patients which includes cleaning up, feeding the patients, giving baths, giving medicines. The persona demonstrated that patients' everyday life happens in the patients' rooms, and they met with doctors for treatment in addition (Figure 4). P3 said that it is more difficult to care a child patient in the patient's room than at home.

"I do the overall job. My child checks the IV drip, I go to the bathroom together, I help him eat, sleep, I do all about daily life. I cannot help my child live alone. Because playing could not active, so we watch TV or play a board game."(P3)

"I check if fluid drop is fine, and I change diapers. I mostly take care of my kid." (P1)

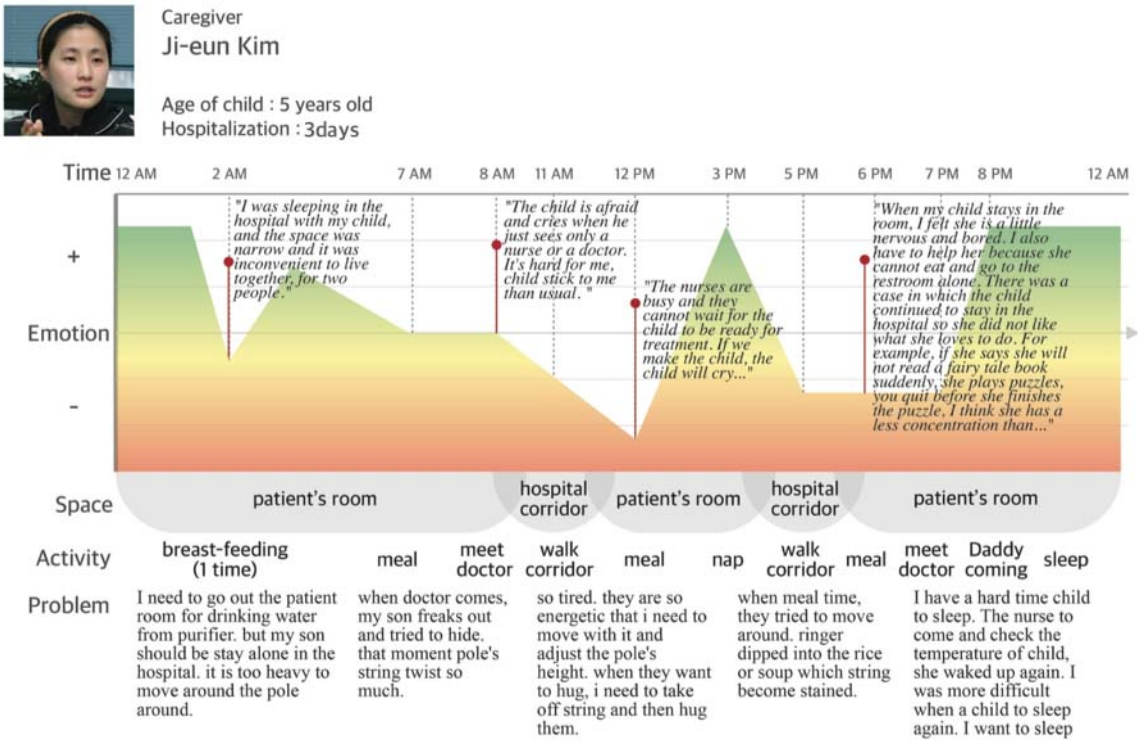


Figure 4. A persona of the mother of a child inpatient

Child patients had hard time adjusting their lives in patients' rooms since they were mostly preschoolers. They were irritated easily and refused food. The parents soothed the child patients to feed them and tried to comfort them emotionally. The parents brought the child patients' favorite toys to comfort and entertain them. Despite of the parents' efforts, the child patients were not themselves. The parents appealed physical fatigue from more energy expenditure than usual, and it may lead to inappropriate parenting. Taking the parents being

the primary interactive people into account, negative interaction of the parents may negatively affect the health of the child patients (Dunning and Giallo, 2012). Also, the parents feel guilty about the inappropriate parenting, and it becomes another stressful factor.

Situation: Check the temperature of the child with the ear thermometer

Nurse: I'll try it. It's not scary. Hello? Hello (Nurse put a thermometer on the child's ear)

Child patient: Stay calm while frowning.

Parent: hello (she speaks together), the child is unable to move suddenly by a parent.

Situation: Put an injection on a child patient

Parent: Holding a child and showing a child's favorite video on her mobile phone.

Nurse: Pororo, do you like Eddie? Do you like Pororo? (While talking, looking for blood vessels)

Child patient: he sometimes gave answer but focuses on videos.

"When my child stays in the room, I felt she is a little nervous and bored. I also have to help her because she cannot eat and go to the restroom alone. There was a case in which the child continued to stay in the hospital, so she did not like what she loves to do. For example, if she says she will not read a fairy tale book suddenly, she plays puzzles, you quit before she finishes the puzzle, I think she has a less concentration than..." (P6)

4.2 Knowing

The parents executed two major roles as bridges between the nurses and the child patients: They helped to carry out treatment and report the proceedings to the nurses. First, the parents helped to carry out treatment. Since young child patients were afraid of the treatment, they tended to cry when stethoscope is on their chest, or when taking their temperature. They even refused the nurses to come near by them. In these cases, the parents helped comforting the child patients and hold the child patients to complete the treatment or made a diagnosis

"The child did not like the doctor or the nurse coming. So the child does not like nurses coming to measure the heat, and the child keeps following me ...When the child hides his face, the child often cries." (P7)

The nurses assumed these behaviors are their obligation. However, the parents hoped the nurses to explain the reasons of the treatment before they carried on. They considered that the nurses cared about the patients by heart when the nurses confronted the child patients in person.

"Because patients often have difficulty talking about their condition, parents should be able to observe and tell the story to me, and some parents often do not." (N11)

Secondly, the parents were data collectors of the child patients' experience. They report the pain scale and the interval to nurses when child patients express pain. Even though the child

patients could communicate with language, they mostly revealed their pain with crying, irritation, and uncomfortable gestures. Therefore, the parents knew that their child is in pain, but it was hard to know the exact reason. Most parents assumed the reasons by their instinct. On the contrary, the nurses concluded the reasons by focusing on the patients' biological signs such as frequency and interval of the pain. The different style of accepting the patient' discomfort caused major conflict between the parents and the nurses. The nurses repeatedly mentioned the conflicts.

"Because the children cannot speak, it is difficult for the nurse to determine through the child's crying where the child is uncomfortable, or whether it is just grizzling or hungry. Parents can talk. They can say where is uncomfortable... " (N10)

"I take my child to the restroom, feed him, play with him and put him to bed… I tell the nurse or the doctor how my kid is doing, I take him outside when he wants to play, and I basically do all the work." (P7)

4.3 Emotional experience

The parents went through sudden changes besides the child patients. Since the parents could not overlook other family members who were still at home, they were burdened with more physical chores than usual and financial strain due to leave of absence from their work. However, they said that watching their children suffer is the most difficult thing.

"Adults can express their pain with language, but kids express with crying. So it's hard to know what is wrong. The parents are always anxious. That's why the parents also need consolation." (N2)

The parents plead physical and emotional difficulties. The emotion graph increased temporarily when the parents could take emotional break and then decreased back. It was interesting that the parents relieve their stress by communicating with other parents while walking back and forth the hospital corridor or in the service room.

"When I walk in the hallway or wait for the treatment, I talk to other patients' parents. Why they are hospitalized, or who their doctors are, or if the patients are getting better. I don't have many people to talk to in the patient's room, and I get so much information while talking to them." (P12)

The parents of child patients who were diagnosed with same disease share information and opinion about the process of the treatment. Not only that, they also shared information about medical insurance and other family members. They shared their difficulties, sympathize with each other and control their feelings.

5 Conclusion

This study demonstrates that the parents of the child patients need to take care of their own physical and emotional health in addition to take care of the child patients. Caregiving the child patients require them to take pause from their everyday life. We would like to discuss the ways to decrease the level of physical labor and support emotional well-being.

5.1 Improve management: Collaborating with healthcare professionals for physical response awareness and supervision

It is important for the parents of the child patients to be aware of the physical responses throughout the treatment process. The child patients have hard time delivering their physical

responses. It is also hard for the parents to interpret the child patients' status from their physical responses. Even though it has been indicated that reporting on symptoms is not objective, it is common for the parents to report the symptoms of the child patients(Theunissen et al., 1998). Severance of communication between the doctors and the patients lower the standard of medical care. We argue to suggest the parents to present evidences of the patients' symptoms to healthcare professionals rather than interpreting the symptoms subjectively. According to the result of this study, the perception of healthcare professionals differed as frequency and expansion of the symptoms varied even with small symptoms. Therefore, the parents should provide sufficient amount of data to the health professionals to help the doctors to make a correct diagnosis. Data can be collected by using real time tracking device(Patel et al., 2012) on the patients, or data collecting interface(Cheng et al., 2012; Weibel et al., 2013).

The conflict between the healthcare professionals and the parents begin from the approach of the symptoms of the child patients. Providing symptom-centered information assist the conflict between the healthcare professionals and the parents (Ammentorp et al., 2005). Even though the healthcare professionals understand the difficulty of the parents in the process of caregiving to their children, it was hard for them to understand emotional difficulties. To diminish the misunderstandings due to asymmetry of information, the healthcare professionals should provide clear information to comfort the parents of the child patients. For example, the healthcare professionals need to provide guidelines when documenting the symptoms. If some kind of templet is given to the parents to categorize types of symptoms such as common symptoms and the symptoms related to the child patients' illness, the communication between the healthcare professionals and the parents would be much easier. Also, the templet would provide the parents what to do when caregiving to ease the parents' anxious minds.

5.2 Sharing: Sharing knowledge and emotion, and dividing tasks

Generally, the parents who take care of the patients in the hospital are easily isolated. It is not considered that the parents gave up their everyday life to take care of their children. The result of this study show that the parents suffer from the labor which is 24 hours. Observing the child patients' symptoms is day and night job.

Physical labor levels were high due to the many roles of the child's mothers, friends, teachers, and therapists in the small house-like room. Sharing the degree of labor in these many roles with other families is a prerequisite for sharing voluntary work with sympathy. You can find opportunities for services at outside of hospital as a variety of activities in child care. Through the expansion of home care services such as cleaning and washing without direct interaction with child patients, sharing work is needed.

Parents should coordinate various aspects of their lives with their personal needs(Strauss et al., 1985). Caring by parents for the child patient is not visible, and the results of the effort are hard to reveal directly to the treatment. Therefore, it is difficult for other families to understand their parents' difficulties. On the other hand, rather than telling difficulties to other families, parents share their feelings with the parents of other children with the same difficulty and discuss stressful situations. Some parents shared information and difficulties through their internet blogs; there are many mother's forum about caring children. Parents were using blogs as a good activity to manage their emotions just by sharing their emotions and empathizing with them(Consolvo et al., 2004; Liu et al., 2011). In this case, we propose that we can expand the cases more easily and make it easier to frequently share the

difficulties of care for child patients and the treatment process by building a system that supports the emotional management of caregiving parents.

It should address the needs of caregiving parents, who play an important role in children hospitals. Parents are especially important because they have a significant impact on the physical condition and psychological condition of the child patient(Homer et al., 1999). Nevertheless, the difficulty of caring child patient by parents is overlooked. We suggest the opportunity to develop management and sharing methods for parents themselves in the study of parental activities in the children hospital. Nevertheless, our research has limitations. As with many qualitative studies, a relatively small number of participants were included, and children patients were excluded because of the difficulty of verbal communication. In the future, we will expand our research results not only to the ward but also to the outpatient children through the study of interaction with children.

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Pottery Workshop Design for Medical Settings "Pressed into a pot": Investigation of Mood and Expression in Specific Pottery Tasks

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The emotional evaluation was used widely in the field of design to explore client requirements. Keeping with the conference theme of the ‘people track’, this study presents an alternative way to integrate art and design with the emotional evaluation to support mental treatment in hospitals. The primary objective is to devise a pottery workshop which is appropriate to medical settings and explore healthy Japanese attendees’ mood and expressions about workshops. "Pressed into a Pot" experiments were then designed to provide therapeutic potential without workshop attendees having to touch clay directly. A pressed-mold technique was selected to limit technique in the workshop that focuses on the psychological effect of a pottery workshop in specific tasks. Experiments were conducted to examine the effect of the form and mediators that were later evaluated by a shortened version of the POMS, a written description, and art element consideration. The finding suggests "Pressed into a Pot" can develop participants' emotion and expression in positive directions even when the participants did not touch the clay directly. The form that needs physical tension tends to involve emotional expression potential. Unsuitable protectors and mediators in experiment workshops limit hand and finger movement. In this study, nitrile gloves are an appropriate protector as opposed to tongs and food wrap because of their capability to support free hand movement. Furthermore, hand pressing technique allows hands to contact clay effortlessly surpassing stamping technique. Pottery provides a non-verbal expression avenue that leaves clues of emotion. Therefore, consideration of participants' mood in multi-perspective help a provider to elicit emotions which are often concealed.

Keywords: pottery; workshop design; medical settings; emotional evaluation

1 Introduction

In the pinnacle pharmaceutical treatment technology era, depression continues to increase. Supposing that main pharmaceutical does not have a sustainable treatment for mental health, an alternative treatment might be the choice (Lambert, 2008). Pottery is recognized by the mental health community for its therapeutic potential for mental illness treatment. Despite this advantage, few studies advocate it over other kinds of clayworks in art therapy (Kvarnstrom, 2016; Sholt, 2006). Evidently, the research in this area is rather scarce. Clay products are multi-dimensional objects that have the qualities of weight, depth, and texture which convey a sense of reality and substance. Tactile contact is the first mode of

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communication for humans. During the early stages of life, babies are limited to oral and skin-contact communication (Sholt, 2006). Several studies have established the positive effects of using clay in art therapy as a versatile medium with practicability from children to adults. The therapeutic use can be limited to smearing mud on the surface or creating aesthetically pleasing sculptures or functional products, especially when utilized in a tactile-perception program (Moon, 2010). However, therapeutic qualities depend on the direction of therapy programs and the type of clays.

In this study, pottery is an object that is made out of clay by hand to communicate or express its creator's feelings and is complete when fired in the ceramic process. Potters' clay is a natural clay base and natural clay activities are inevitably dirty. Also, most ceramic decorating materials are known as toxic and difficult to manipulate. For these reasons, ceramic work seems inappropriate to be used in medical settings. The main obstacle for ceramic art programs in hospitals is infection control. Moon (2010) suggests that the material and tools used are cleaned to minimize the passage of infections. In fact, materials might not be an obstacle if creators do not cling to the traditional studio techniques. The main purpose of this study is to design a pottery workshop focusing on participants' expression which is as appropriate to the medical setting as possible. The experiment was designed to provide therapeutic potential without workshop attendees having to touch clay directly. The efficiency of the workshops was verified by investigating attendees' mood and expressions in particular trials called "Pressed into a Pot." The findings suggest alternative pottery workshop are a potentially viable treatment for mental health in hospital settings

2 Literature review

2.1 Therapeutic potential of pottery: The distinction from claywork

There are three main features unique to pottery as opposed to claywork. First, clay in ceramic processing is a natural clay base that was developed into a functional body knows as potter's clay. It is a versatile, natural material that awakens an earthly sense (Henley, 2002) and evokes in the creator more visceral, sensual, and physical investment than other media (Moon, 2010). Therefore, it is widely used in education and art therapy. Moreover, several studies categorize pottery as a kind of craft because it requires attention to a procedure (Moon, 2010). Pottery is unique from another claywork by its process, even when excluding the various forming and decorating techniques. In order for ceramic objects to be successful when fired, clay works must be hollowed entirely with the wall no thicker than approximately 12-15 millimeters (mm.). Pieces thicker than 12 mm. often blow apart during the firing process. Also, pieces thinner than 3 millimeters have a risk of breaking during the process especially when they need to move (Henley, 2002). Furthermore, only ceramics allow its creator to see the complete piece after firing. Other types of claywork do not require any firing process as its creator can see the finished work immediately following the action.

Previous studies have suggested being cautious when using crafts in therapeutic art because it may limit self-exploration and self-expression when creating artwork. However, it is not implied that crafts do not have any therapeutic potential at all. Despite this limitation, Moon (2010) posits that craft is yet a useful medium for those with limited mental and physical abilities or those experiencing reduced vitality. Several articles related to pottery making mention Girija Kaimal's research into topics of self-expression to explain that pottery can reliably relieve stress (Kvarnstorm, 2015, 2016). The study indicated artistic production

and crafting impact on self-expression at biological levels. The results indicate that cortisol levels lowered in about 75% of the sample after engaging in the process of making art, including modeling clay. According to the lead author, art serves purposes of deep expression that words cannot describe and helps to communicate in the inner state. However, the relationship between media choice and change in cortisol results were no significant differences (Girija, 2016). With the limited understanding of the self-expression and mood change which is encouraged by pottery making, these gaps persuade researchers to elicit what contributes to self-expression in pottery.

2.2 Clayworks, hand movement, and self-expression

Physical activity, especially hand movement, contributes to mental health. In fact, physical actions are linked with emotional thought processes including problem-solving, planning, and decision making. Particularly, moving one's hands activates parts of the brain that involve motor function more than moving other large body parts. Kvarnstorm (2016) mentioned Kelly Lambert (2008), a neuroscientist who delineated effort-driven reward circuit theory that emphasizes the benefits of manual labor to the theory focusing on the biological impact of self-expression. Lambert suggested that as people have more comfortable lives, this might contribute to a decline in our hard-earned rewards and its effect on the brain at the neurological level. In this pinnacle era of discovery and innovation , there are several options of pharmaceutical treatment to combat an increasing rate of depression. In addition, Martin Seligman (as cited in Lambert, 2008), the pioneer of the positive psychology movement, discusses bouts of depression in different generations in the United States of America. He indicates that the older generation who lived through the two World Wars and suffered from the past occurrences should be much more depressed than a younger generation. In fact, it is the opposite. Seligman reported that those born in the middle third of the 20th century were ten times more likely to suffer from depression than their earlier generations. The critical point is that the earlier generation's brain was trained to cope with mental anguish by their hard physical work. Significantly, human brains are programmed to feel a sense of satisfaction and pleasure when physical effort produces something tangible, visible, and associated with gaining something deemed necessary survival. Lambert coined this emotional payoff as "effort-driven rewards" that activate a sense of well-being as a neurogenesis stimulation. Thus, the brain areas that control movement, emotion, and thinking are interconnected. In the same vein, Garcia (2016) investigated the secret of how the Japanese citizens in the Okinawan village of Ogimi can live long and happy, and found that the Japanese centenarians were happily engaged in several tasks and activities involving their hands. They emphasized that as a key to longevity.

Kvarnstorm (2015, 2016) presented the reasons why her institute integrates pottery in depression treatment. In addition to the effort-driven rewards, she suggests that humans have utilized art as a medium of expression and communication even before the beginning of ancient history. Non-verbal language is a solution when words cannot define all forms of expression. Thus, it can be too complicated or overwhelming for words to hold. Henley (2002) also posits that clayworks can provide alternative avenues of communication to release multiple inner voices through sculptural forms. Besides, non-verbal expression processes may lead to the discovery of something previously unrecognized in verbal language. After that, it leads to the ease to communicate with verbal language.

In summary, physical activities are beneficial for mental health. While the present generation requires more intellectual workers than physical labors, activities that involve the use of

physical functions can revive skills and help the brain to fulfill experiences and prepare for life challenges.

2.3 The significance of pottery workshop design

2.3.1 Natural clay workshop in medical settings

In recent decades the medical community recognized the transformative potential of art. Therapeutic arts were increasingly integrated into mental health programs. According to previous studies, natural clays were used for psychiatric patients or were provided for occupational therapy programs and stress-reliever programs for hospital staff (Morais AH, 2014; White, 2013). In a condition of another kind of patient or medical settings, several studies used alternative clay such as polymer clays or self-hardening clays whereas some studies did not indicate the type of clay. Therefore, the information about the therapeutic potential of natural clays workshops in hospitals is insufficient.

Technically, natural clay is preferable from a natural source; for instance, clay which was discovered beside a lake or clay in damp rice field. Clay in ceramic processing is a natural clay base that was developed for a functional clay body known as potters' clay. Compared with other alternative clays, natural clay is troublesome to sterilize and store because sedimentary clay is composed of organic compounds which are prone to evaporation. For these reasons, it has a risk to contaminate and requires special knowledge. Potters' clay's body requires plasticity abilities that enable sculpting and firing. To rectify abilities of plasticity in natural clay, the levels of stone, excess sand, organic material or other impurities should be reduced. An efficient clay body for use in a therapeutic setting should be able to coil and bend into a loop without cracks or breaks along the process (Henley, 2002). As mentioned previously, potters' clay could be categorized as a kind of natural clay thus the foundation of material.

2.3.2 Professional skill requirement

The knowledge of the fundamental ceramic process is essential for workshop providers. Those providers with professional skills can choose the proper clay type and techniques to reach the workshop goals. Generally, inexperienced clients may lack skill or awareness of sculpting at a refined level; it is up to workshop providers to prepare workshop procedures to avoid allowing concern over the materials or processes to hinder creative outcomes (Henley, 2002). As mentioned above, in the case of non-verbal expression, a provider who can visually interpret what the participant articulated is likely to support other health care providers to explore problems of the patient which were overlooked or conceptualized (Bathje, 2014). With respect to the workshop design that aims for the therapeutic outcome, the ability of art criticism seems to be essential to comprehension to supporting the diagnosis.

It is unfortunate to limit the treatment options and leave out natural clay workshops particularly for medical settings because of its hygiene and management difficulties. Overlooking the sterilization and providing process, the moist stage of natural clays allows appreciating the reality. The earthly, fluid stage becomes fragile when it dries, awakening a cognition of naturalness.

Aforementioned, the pottery workshop design requires two pieces of knowledge: the ceramic process and art criticism. The mentioned knowledge to be able to guide providers to select the direction to utilize media to reach the therapeutic outcome without being too concerned

with the ceramic processes. This study presents an attempt to devise a pottery workshop which is appropriate to the medical setting and explore attendees' mood and expressions about the therapeutic potential of the workshop.

3 Methodology

3.1 Participants

3.1.1 Phase one

Participants were eight Japanese students of the Design Department, Fukui University of Technology, Japan, with ages ranging between 20-23 years old. The details of the participants are shown in Table 1.

Table 1 Participants data of phase one of the experiment

	Occupation	Gender	Age	Ceramic Art Making Experience
1	Design Student	Female	21	O
2	Design Student	Female	21	X
3	Design Student	Female	21	X
4	Design Student	Male	21	X
5	Design Student	Male	23	O
6	Design Student	Female	20	X
7	Design Student	Male	21	X
8	Design Student	Male	23	X

3.1.2 Phase two

Participants were Japanese members of Fukui University of Technology, Japan. Their ages were between 21-48 years old. They were five male and six female university students, one female instructor, and one male and three female officers. The details of the participants are in Table 2. All students and instructors were members of the Design Department. Three had some experience in pottery making at an intermediate level, and two students had beginning-level experience from primary school.

Table 2 Participants data of phase two of the experiment

	Occupation	Gender	Age	Ceramic Art Making Experience	Workshop Attendance					
					1st	Press A	Press B	Press C	Press D	Stamp A
01	Design Student	Female	21	O	O	O	O	O	O	O
02	Design Student	Female	21	X	O	O	O	O	O	O
03	Design Student	Female	21	X		O	O	O	O	O
04	Design Student	Female	21	X	O		O			
05	Design Student	Male	21	X	O				O	
06	Design Student	Male	21	X						
07	Design Student	Male	23	O	O	O	O	O	O	O
08	Officer	Female	38	X		O				
09	Officer	Female	28	X		O	O	O	O	O
10	Officer	Male	29	OO			O			
11	Officer	Female	31	X			O			
12	Instructor, Design Department	Female	48	OO		O	O	O	O	O
13	Design Student	Male	26	X		O				O
14	Design Student	Male	22	X		O				O
15	Design Student	Female	22	X		O				
16	Design Student	Female	41	OO		O				O

*** OO = a participant with ceramic art making experience at an intermediate level.*

3.2 Research instrument

With an aim to examine the participants' emotions before and after the therapeutic art program, the study employed a qualitative descriptive methodology supported by a quantitative evaluation. First, the qualitative evaluation observed participants' expression through a descriptive interview (a brief written description in Japanese) and art element consideration. With respect to quantitative data, the shortened version of the Profile of Mood States (POMS) in Japanese, which is a highly reliable psychological evaluation approach to measure temporary mood and emotional stages (Yoshioka, 2015), was utilized. The results of the POMS T-scores from 30 evaluation items were obtained according to gender and age group from the gross rating based on six scales, i.e., 'Tension-Anxiety,' 'Depression-Dejection,' Anger-Hostility,' 'Vigor,' 'Fatigue,' and 'Confusion' (Yokoyama, 2005).

Moreover, participants' emotions were also investigated after they cogitated their fired works. This situation is unique, making it distinct from other art and craft techniques such as painting and unfired clay work. However, this study did not include the comparison of mood change between bare-hand pressing and using a protector.

Participants' mood and expression were examined three times: before and after each workshop, and after cogitating their fired work, based on their write-up examinations and the shortened version of the POMS. Finished works were returned to each participant the following week or the next time they attended the workshop. This was also the time the write-up examination and the POMS were conducted. Regarding the expression element, this study also investigated the art element of pottery as non-verbal expression.

3.3 Workshop design

This study conducted a workshop called "Pressed into a Pot" that was comprised of two phases. The first author provided the structure of workshops, materials, and was available to give any assistance followed the lead of attendees while making pottery. Experiments employed the press mold technique following the design concept for medical settings. Workshops were designed for the attendees to avoid touching the clay directly while making pottery. In addition to avoiding infection, Henley (2002) states that oxide colorants such as iron in a red stoneware clay body might stain hands or clothing and influence clients to become adverse to the workshop.

Since pottery is categorized as a craft, sometimes clay work is criticized for being a craft technique which gives priority to material more than images. To determine the creative results, providers should beware of ceramics-centricity that contributes to the material becoming a disturbance of expression potential. With respect to the press mold, clients can manipulate and form clay into shapes using a plaster mold. Even a disabled person should be able to handle this task and enjoy expressing their emotions through clay work. Press molding furnishes to individual expression by putting a lump of clay into the mold freely rather than slip casting (Henley, 2002).

Given the possible technical difficulties, this study utilized the press mold technique in workshops to minimize problematic issues associated with forming skills. Meanwhile, it seems possible to decrease anxiety arising from forming skill by using a press mold technique compared with other ceramics technique.

After selected the forming technique, the second phase workshops continued after the first phase results were considered and some workshop detailed were modified. The results from the second phase workshops were compared focusing on two factors, mold shape and pressing technique, contributing to expression outcomes and mood change.

3.4 Experiments details

3.4.1 Phase one

The first phase was conducted one time on March 27, 2018, at the student space laboratory to investigate the abilities of expression and mood change in the controlled trials. Plastic food wrap and tongs were selected to be used as protectors. Hand pressing technique was used with the form of 130x130x13 millimeters square tile plaster mold. Four types of Japanese potters' clay of different color and texture (white stoneware, rough stoneware, red stoneware, and black pottery clay) were prepared in approximately 15 mm. diameter clay balls. The task required participants to pick up the clay balls using tongs and then put them in a plaster mold freely creation of their choice. After that, they had to cover the clay with plastic wrap and press them firmly (Figure 1).

The workshop was designed to follow the concept of 'beware touching clay directly'. At the same time, it should contain the sensibility of touching as much as possible. Cling film was selected because it is extremely thin, flexible, and durable. Furthermore, the selected clays have a shrinkage range of approximately 13 percent. Therefore, technically, they should not crack, even when used to create a workpiece.



Figure 1. Images sequential left to right showing an assignment of the experiment workshop. Clay balls(left), a participant putting clay balls on a plaster mold (middle), and a participant pressing clays balls through food wrap cover (right).

Decorating tools were also provided. They were daily life objects including chopsticks, plastic spoon-forks, plastic straws, bamboo skewers, and paper clips (Figure 2). Participants could choose the way to manipulate their work after the instructions were given.



Figure 2. Decorating tools.

3.4.2 Phase two

The second phase experiments were conducted to examine expression and mood change as a result of different forms of mold and pressing techniques. A stamping technique was selected to compare with the hand pressing technique. Workshop were separated into two sections as hand pressing stamping. Nitrile gloves were selected to be used as protector substitutes for the cling film and tongs. The four forms of plaster molds in this workshop included circle plates (Type A), circle bowls (Type B), square plates (Type C), and square bowls (Type D), as presented in Figure 3.

The experiment was conducted from June 8 to July 25, 2018, at the design studio. Participants had an opportunity to play with four kinds of Japanese potters' clay and decorating tools, similar to the first experiment. To avoid putting participants under pressure, a flexible schedule was made available for them. Every week, there were two three-hour workshops from 12.40-3.40 pm. available. The attendees could attend one or both workshops that best suited their schedules for however long they desired. In other words, they did not have to attend from the beginning to the end. Furthermore, it is important to note that attendance was completely voluntary. The participants could also decide not to attend any of the workshops as well.



Figure 3. Images sequential left to right showing the four types of plaster mold: A, B, C, and D.

1. Hand Pressing

The hand pressing section assigned participants to select one different type of mold each time and press clay in a mold freely by hand while wearing nitrile gloves (Figure 4).



Figure 4. Images sequential left to right showing participants wearing nitrile glove during a hand pressing workshop.

2. Stamping

The stamping section used stamping tools as substitutes for hand pressing (Figure 5). Participants were assigned to put clays in the mold and push them firmly by stamping tools.

The program provided stamping tools in various natural forms such as flowers and leaves, lines and dots were included as shown in Figure 6. The participants were also asked to wear nitrile gloves.



Figure 5. Images sequential left to right showing participants using stamping tools.



Figure 6. Stamping tools.

4 Results

4.1 Experience and decision to attend

The findings suggest that the attendees' prior pottery experience is not indicative of their following attendance.That is, whether the attendees would continue from the first workshop to the next could not be determined by their previous experience. It was found that one of experienced attendees joined only one workshop while others who finished the hand pressing program were mostly inexperienced.

Five students continued from the first experiment program to the second one. Six participants finished the hand pressing program of the second phase experiment and continued to the stamping program at least for the Type A mold. On the other hand, three students quit during the first phase of the experiment program. For the second phase, seven participants joined just one workshop and three participants performed hand pressing on the Type A mold and then skipped to the stamping technique using the same kind of plaster mold (see Table 2).

4.2 The first phase experiment results

The workshop noticed that participants had problems with the food wrap. It sometimes stuck to fingers and often did so to clay. Attendees who did not have any experience in ceramics-making might not realize the stage of clay moisture that made clay stick to food wrap when it became too moist. On the other hand, the clay surface would crack if it became too dry. Although, the average POMS T-scores did not change negatively, the scores of 'Tension-

Anxiety', 'Depression-Dejection', 'Fatigue', and 'Confusion' increased in participants who mentioned troubles in their written description.

Several words indicating troubles appeared in the written description. For example, "難しい-Muzukashii" means difficult; troublesome; unpleasant; uncomfortable. Sentences related to obstruction also appeared a number of times such as "I need to get used to manipulating," or "I have anxiety when I cannot succeed in my intention." To reconsider the participants' workpieces, the reflection of confusion and failure were presented in the works of participants who discussed troubles in the workshop. Also, the flow of making the pieces was observed by considering the continuity of clay arrangement. Several hints of confusion were evident in participants' works through the incontinuity of color, pattern, and form structures on both sides. Moreover, broken pieces due to a lack of sculpture skills were found in the group of participants who appeared to have trouble (Figure 7).

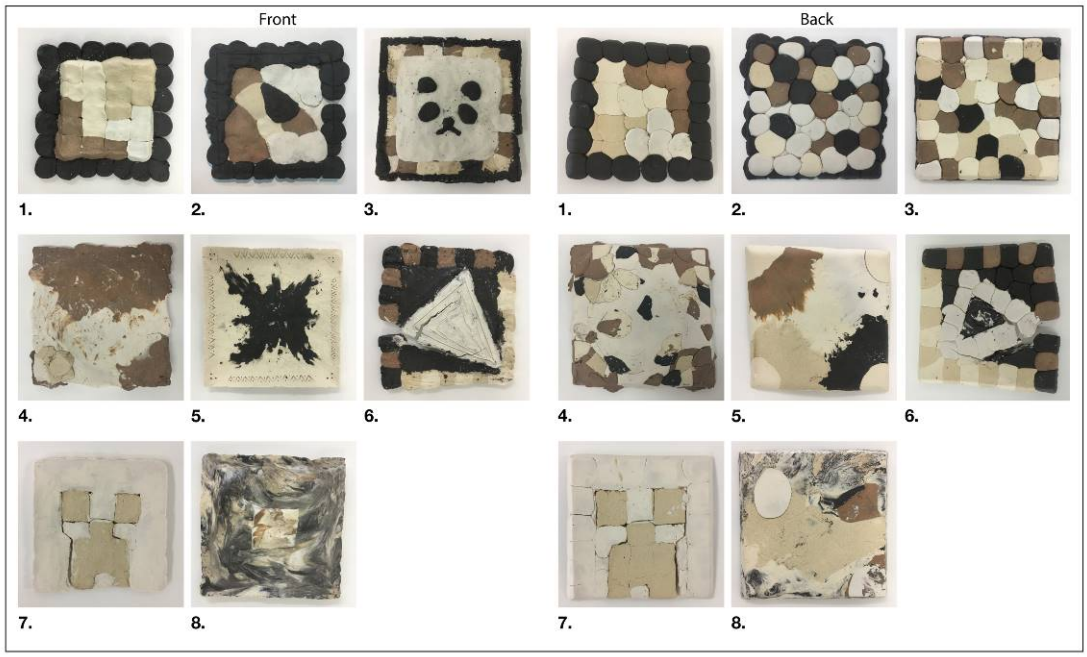


Figure 7. Complete works from the first experiment of Participants No. 2, 4, 5, and 7, who described troubles in their write-up examination.

The transition of the POMS T-scores average showed that 'Vigor' score increased while 'Tension-Anxiety,' 'Fatigue,' and 'Confusion' decreased. The score of 'Depression-Dejection' and 'Anger-Hostility' were contained while operating the workshop (Figure 8).

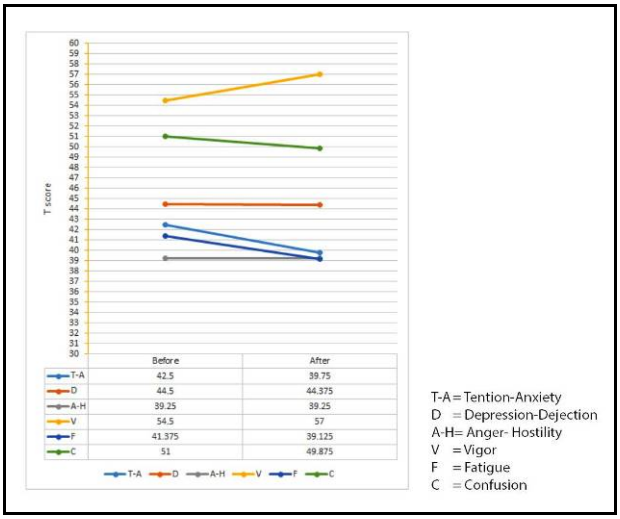


Figure 8. The transition of the POMS T-scores before and after operating the first experiment workshop.

The results from the mood stage observation after the complete works were returned to the attendees indicated that their moods were mostly lower than the mean (50 scores) except for that of the ‘Vigor’ scores. Additionally, when considering individual participants, some had an opposite mood transition from others. Three participants who had low ‘Vigor’ scores also described their negative feelings in the written description such as “If I had performed well, it would have been better” or some words that reflected their broken work (Figure 9).



Figure 9. The transition of the POMS T-scores before and after the first experiment workshop compared with that after the participants cogitated their work.

4.3 Comparison of mood stage and expression of four types of mold

From the first phase of the experiment program, it was found that food wrap was an obstacle. Therefore, in the second phase of the experiment program, nitrile gloves were used as a protector instead of food wrap. Two participants mentioned in their written description that nitrile gloves allowed them to manipulate clay in a much easier manner. In addition, the written description and the POMS results did not suggest any effects of different kinds of mold. Also, even though an obvious distinction of mood change did not appear in the results statistically, the chart shows that the decrease in ‘Tension-Anxiety,’ ‘Depression-Dejection,’ ‘Fatigue,’ and ‘Confusion’ of the type A mold were biggest. Also, according to the observation during the workshop, the use of deeper molds encouraged participants to twist their wrists in an uncomfortable angle and move parts of their bodies more than when they used a shallow mold (Figure 10).



Figure 10. Images sequential left to right showing participants is making their work with deep mold. Mold type D (left), Mold type B. (middle-right).

The transition of the POMS T-scores before and after the programs from the four types was observed in the same positive direction. The ‘Vigor’ score increased while scores in ‘Tension-Anxiety,’ ‘Depression-Dejection,’ ‘Anger-Hostility,’ ‘Fatigue,’ and ‘Confusion’ decreased after conducting the hand pressing section of “Pressed into a pot” (Figure 11).



Figure 11. The transition of the POMS T-scores before and after conducting hand pressing workshops, comparing four types of mold.

4.4 Comparison of the hand pressing technique and the stamping technique

Following the intention to decrease trouble related to crafting skill, this study hypothesized that tools might help participants to manipulate the clay more easily. Interestingly, the results suggested the opposite. Considering the art elements and write-up examinations, some premise is related to tools. About art elements that appeared in work, tools could be an obstacle of expression. Technically, stamping tools can encourage inexperienced participants to create nice-looking work. On the other hand, attendees who wanted to

express their feelings or creativity clung to ways in which they could manipulate the stamping tools.

Related to the previous results, Type A plaster molds were selected to compare the transition of mood and expression between hand pressing and stamping. Nine participants who completed both techniques of mold type A were selected for analyzing as shown in Table 3.

Table 3 Participant data of the second phase of the experiment

	Occupation	Gender	Age	Ceramic Art Making Experience	Workshop Attendance					
					1st	Press A	Press B	Press C	Press D	Stamp A
01	Design Student	Female	21	O	O	O	O	O	O	O
02	Design Student	Female	21	X	O	O	O	O	O	O
03	Design Student	Female	21	X		O	O	O	O	O
04	Design Student	Female	21	X	O		O			
05	Design Student	Male	21	X	O				O	
06	Design Student	Male	21	X						
07	Design Student	Male	23	O	O	O	O	O	O	O
08	Officer	Female	38	X		O				
09	Officer	Female	28	X		O	O	O	O	O
10	Officer	Male	29	OO			O			
11	Officer	Female	31	X			O			
12	Instructor, Design Department	Female	48	OO		O	O	O	O	O
13	Design Student	Male	26	X		O				O
14	Design Student	Male	22	X		O				O
15	Design Student	Female	22	X		O				
16	Design Student	Female	41	OO		O				O

*** OO = a participant with ceramic art making experience at an intermediate level.*

The transition of the POMS-T scores before and after the program from hand pressing and stamping indicates that ‘Depression-Dejection,’ ‘Vigor,’ ‘Fatigue,’ and ‘Confusion’ improved in the same direction. The result from hand pressing on mold type A, The ‘Vigor’ score increased while scores in ‘Tension-Anxiety,’ ‘Depression-Dejection,’ ‘Anger-Hostility,’ ‘Fatigue,’ and ‘Confusion’ decreased. For the stamping workshop, ‘Depression-Dejection,’ ‘Fatigue,’ and ‘Confusion’ decreased while ‘Vigor,’ increased. Meanwhile, ‘Tension-Anxiety,’ and ‘Anger-Hostility,’ maintained the same level (Figure 12).

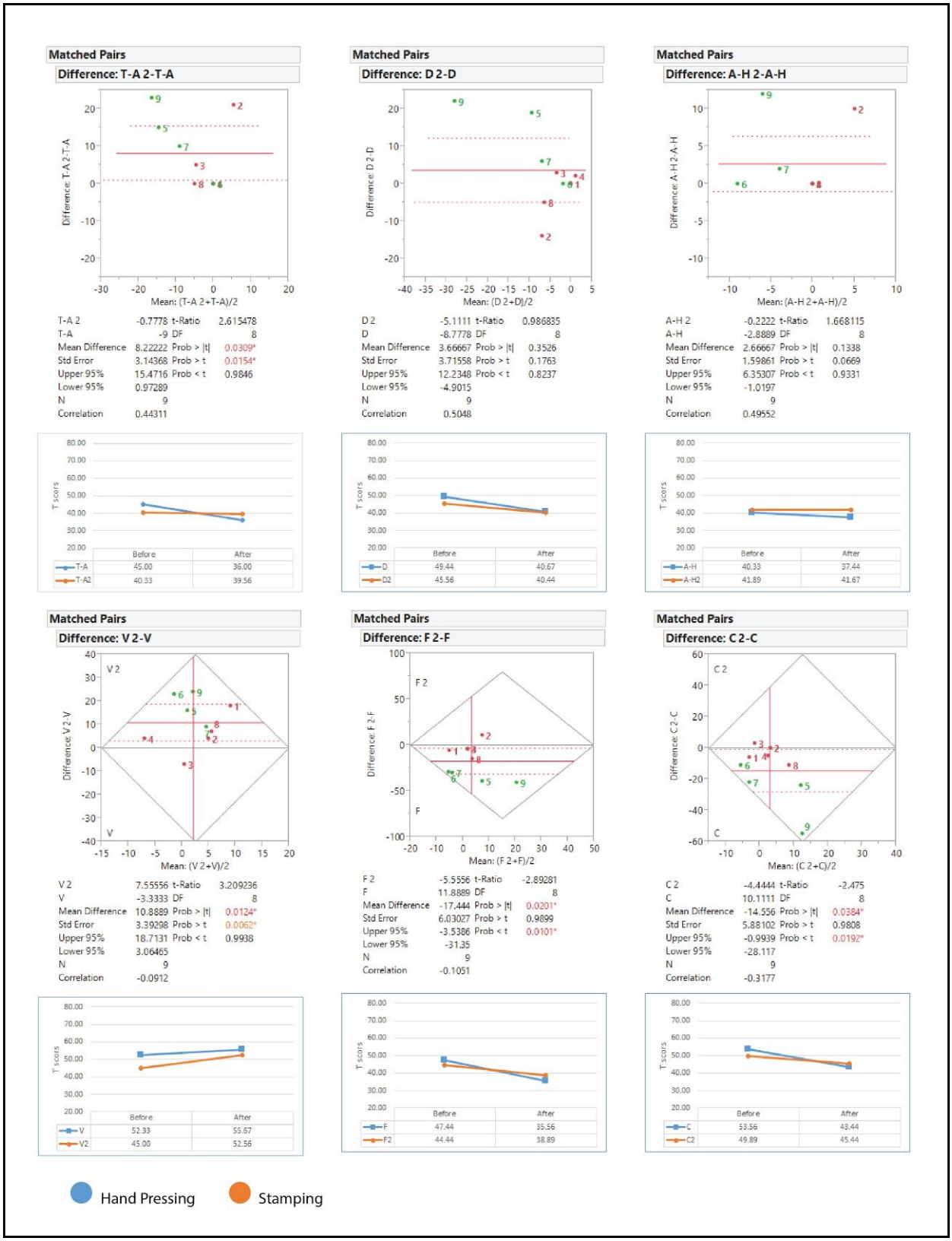


Figure 12. The transition of the POMS T-scores before and after operating experiment workshops, comparing hand pressing and stamping in the type A mold.

Considering the finished work, works from the hand pressing program reveal participants' personal characteristics; it is easier to identify each one's work. In contrast, works from the

stamping program look similar (Figure 13 and Figure 14). Moreover, comments such as “難しい-Muzukashii” appeared on the written description after the stamping workshop but not in the hand pressing.

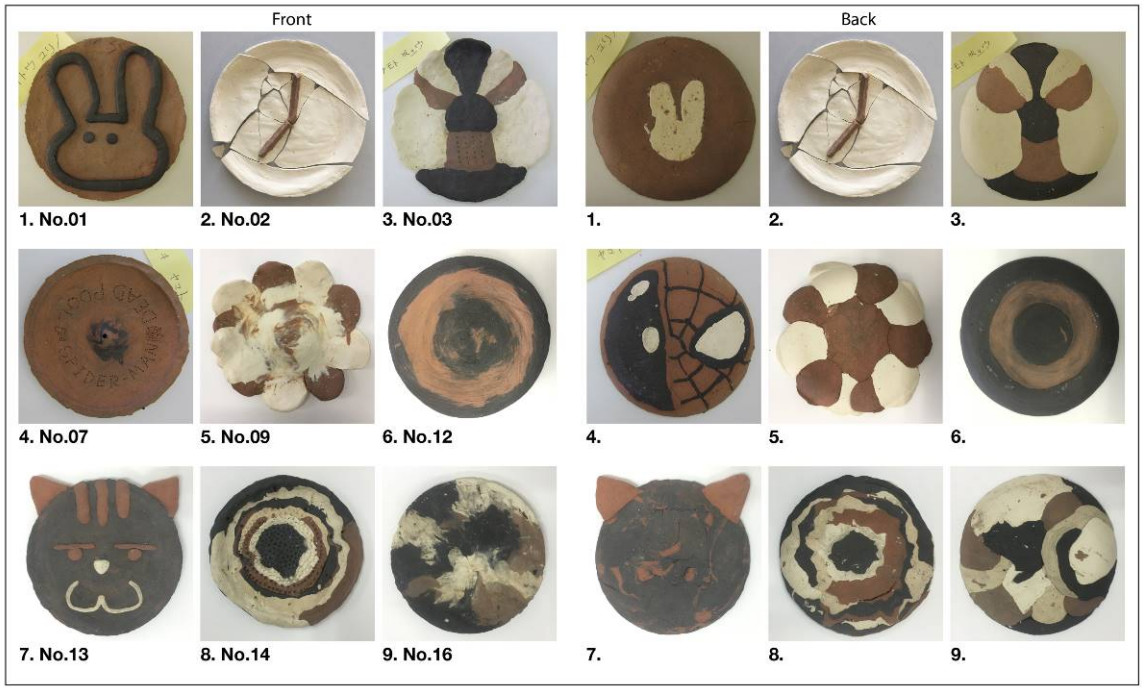


Figure 13. Complete works from hand pressing with the Type A mold workshop.

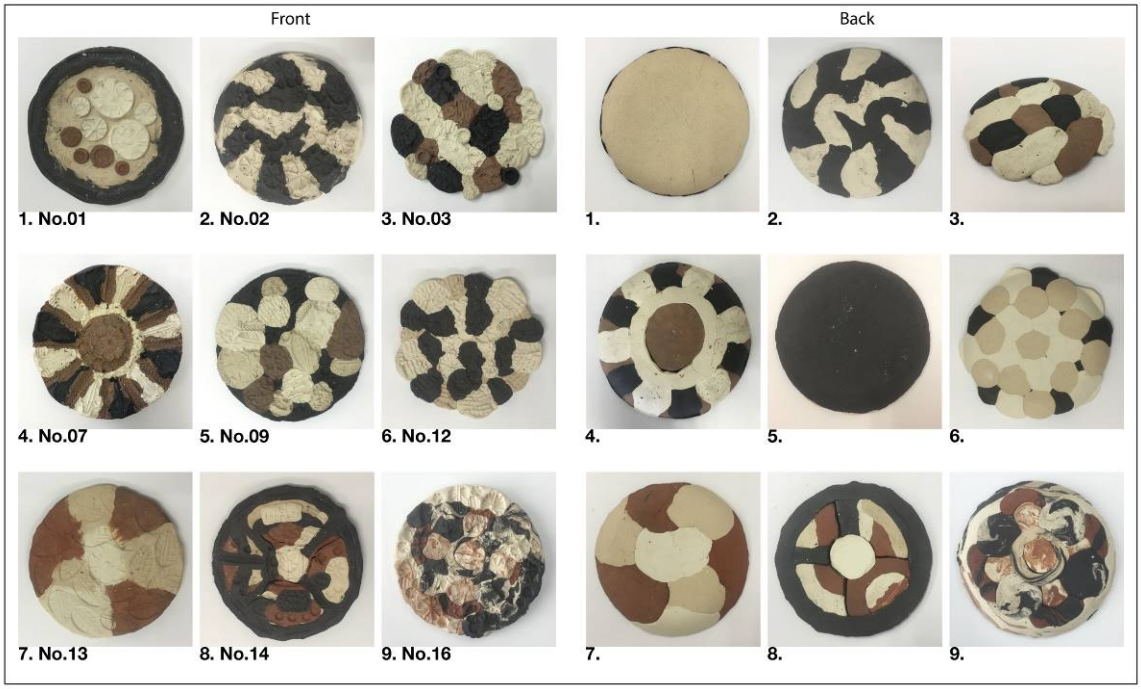


Figure 14. Complete works from Stamping with mold Type A workshop.

4.5 Participants’ emotion reflecting upon finished work

The group of participants who have high 'Vigor' scores expressed words or sentences that indicate feelings of satisfaction and motivation and implied the next goal for the following

workshop or described completed works being as their intention or not. They showed positive attitudes even when their completed works did not turn out like they expected. They did not hesitate to express their personality. Participants who continued workshops until the end of the experiment program were in this group. Another impressive group is the group of participants who had high 'Confusion' scores after cogitating their finished work. They described feelings of disappointment and some contrast words in the same sentence without relation. The transition of the POMS T-scores also presented some contrasting results from the three instruments.

Because participants did not take their complete works with them immediately after the workshop, their mood might have changed on a different day. Therefore, this study decided not to compare mood after cogitating finished works with mood before and after operating the workshop. Results from after cogitating finished works was investigated using the POMS T-scores indicating whether they were higher or lower than the means which was set at a score of 50. Then, relationships of the POMS T-scores' transition with participants' expression through write-up examination and complete works was explored.

5 Discussion

5.1 The effect of the form

The form that needs physical tension might affect one's emotional expression potential. Even statistical results from the second phase of the experiment did not show a clear distinction between types of mold affecting mood and expression. The Type A mold has a larger transition of the POMS T-score than the three other types, especially the decrease in 'Tension-Anxiety,' 'Depression-Dejection,' 'Fatigue,' and 'Confusion,' as shown in Figure 10. These results have to be viewed with caution because of the small sample size. The type A mold is a round, small, shallow plate that is similar to "Torisara-取り皿" in Japanese eating culture. Torisara are not only used in daily life for meals but also seen at homes and restaurants. The related form which intimates with participants might flow with them as recognizable. Also, when the flow has to release, the expression can show easier. Moreover, the deep form effect on wrist movement was found in the observation.

5.2 Effect of the pressing techniques

Tools in the experiment workshops limited freedom of hands and finger movement. Nitrile gloves were more appropriate protectors than tongs and food wrap as they can support free hand movements. Also, the hand pressing technique allowed hands to contact clay more effortlessly than the stamping technique. The result of the first experiment program indicated that participants tend to be stuck in the process. They might struggle to finish their work and lose the flow of expression. The obstacle was an unsuitable tool associated with vexation. Moreover, the results of stamping workshops exposed that tools affected self-expression potential. Consistent with the effort-driven reward circuit theory, hand movement significantly affects our brain. In the same vein, Hinz (2009) posits that "without mediators, the experience is likely to be too immediate and absorbing to provide for contemplation" (p. 33).

5.3 Non-verbal modes of expression

Participants' mood can be elicited by three instruments. Symbolic or abstract scratch was recorded by clay. These clues represent non-verbal modes of expression. Humans can

utilize language to conceal their true emotions and select a way to speaking depending on occasion. For artwork, particularly art for self-expression, emotions are absorbed by the media. In particular, participants' mood can be traced by how creators manipulate clay. Consideration of art elements in workpieces with write-up examinations and the POMS measure can help a provider recognize participants' moods in multi-perspective. For example, in the case of participants who have high 'Confusion' scores after cogitating their finished works, this may indicate the situation of dissimulation. Therefore, the result of POMS or verbal-languages might not confirm their real emotions. Also, art elements alone are difficult to prove the meaning of the individual expression.

6 Conclusion

Experiments provide preliminary evidence of pottery making for mood change and self-expression. This study verifies that “Press into a Pot” can influence participants to develop their emotion and expression in positive ways even when they did not touch the clay directly. The balance of hand movement limitation is necessary for ceramic art workshop design. Given the conditions, workshop providers should design a process that allows participants to express themselves with less obstruction. Specific trials also help the providers to compare the participants’ result.

However, there are several limitations of this study to consider. First, the study demonstrated mood change and expression of pottery making in healthy adults. Moreover, the experiments were conducted at a university, and the sample size was small. It does not verify the same workshops would be effective in clinical groups. Nevertheless, the results were considered to the overall efficiency of “Press into a Pot” workshop design but moods and expression improvement in the individual need for future exploration especially participants’ mood and expression after considering fired work. Future research should be conducted in a real hospital setting in order to investigate actual moods and expression caused by the workshop. Type of a patient also should be controlled, and the positive impact against patients wellbeing need be given into consideration.

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Presence of Motion Lines in Human Pictograms: Analyses and Evaluations

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A human pictogram is a graphic symbol with a human shape that is widely used in public signage. In this paper, we focus on the motion line in pictograms (i.e., the direction in which the human shape is moving) to improve the understandability of human pictograms, and we define understandability from the following three aspects. First and second, whether the meaning of the pictogram can be recalled rapidly and correctly, and third, whether the pictogram is easy to understand. A motion line is an expression technique that is used mainly in comic book illustrations to express quickness, surprise, shock, and so on. Ten topics of human pictograms both with and without motion lines were created through Pictogramming, a pictogram authoring tool. The experiment was performed with 39 examinees to verify the understandability of these ten topics. In the experiment, a questionnaire was used to assess the recalled meaning of the pictogram, the time that it took for examinees to recall that meaning, and the pictogram's value of understandability. We used the Mann-Whitney U test and Fisher's exact test and determined that human pictograms with motion lines are more understandable than human pictograms without motion lines in some cases. We concluded, therefore, that the understandability of pictograms can be improved with the inclusion of a motion line.

Keywords: human pictogram; motion line; Pictogramming

1 Introduction

A pictogram is a graphical symbol that is used to represent a semantic concept based on the meaning of its shape (Ota, 1993). Given the importance of standardizing, the ISO (International Organization for Standardization) or JISC (Japanese Industrial Standards Committee) deliberate and design the standards for pictograms. For example, the ISO standards for pictograms are represented through the "Graphical symbols – Public information symbols" (ISO 7001) and "Graphical symbols – Safety colours and safety signs –

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Registered safety signs" (ISO 7010), whereas the corresponding JISC standard is the JIS Z 8210. Because of the work of these organizations, pictograms have been standardized in various fields such as counselling, safety, and facilities management. Additionally, ISO 3864 and JIS 9101 contain guidelines for symbols relating to prohibition, attention, instruction, and safety. Normally, pictograms are designed by the guidelines to provide information regarding a human's action or status. Human-shaped pictograms, especially, are widely used in various international standard pictogram sets. The appendix of ISO 3864 provides guidelines for how to depict human-shaped pictograms.

Pictograms are used globally and are the subject matter of many recent studies in fields such as intercultural communication (Mori, Takasaki, & Ishida, 2009) and semiotics (Hassan, 2017) due to globalization and the rapid increase in tourism worldwide. There is an especially large body of research related to the use of pictograms as Augmentative and Alternative Communication (AAC) (Martínez-Santiago, García-Cumbreras, Montejo-Ráez, & Díaz-Galiano, 2016). At the moment, many pictograms are used at public facilities, such as airports, train and bus stations, bus stops, and other public locations around the city.

In this paper, we focus on the motion line in human pictograms and experimentally verify its understandability and other characteristics. We define understandability from the following three aspects. First and second, whether the meaning of the pictogram can be recalled rapidly and correctly, and third, whether the pictogram is easy to understand.

The motion line is a popular technique used in comic books and cartoons. It depicts information about the effects of an object, such as its speed, length of path, and degree of rotation (Kato, Shibayama, & Takahashi, 2004). The motion line has several potential characteristics, such as speed line, concentrated linework, flash, and so on. The speed line can express quickness, the concentrated linework can accentuate a person or a scene, whereas the flash can express surprise and shock.

2 Relevant studies

There are few studies that address the understandability of human pictograms; relevant studies include Kitagami, Inoue, and Nishizaki (2002), who evaluate the understandability of word-level visual symbols, and Fujimori, Ito, Durst, and Hashida (2007), who evaluate emotional awareness regarding different arrangements of pictograms. There are, however, many studies about motion lines. For instance, Kato et al. (2004) developed a tool that allows users to add motion lines and other animation effects easily and effectively. Carello, Rosenblum, and Grosofsky (1986) reported that the number of people who felt "Man is running" or "Man is moving" increased when a motion line was added to a pictogram depicting a "person who is running." Many researchers reported that humans can intuit motion when an object that is accompanied by a motion line from as early as five years old (Friedman & Stevenson, 1975; Gross et al., 1991; Mori, 1995). Burr and Ross (2002) confirmed that streak which is drawn in the direction of the associated motion (i.e., motion streaks) influence recognition of motion direction. Kawabe and Miura (2008) demonstrated that when a motion line is added to a ball that is moving, humans can intuit the direction the ball is moving in depending on the direction of the motion line.

However, there is a lack of research focusing on the efficacy of motion lines in human pictograms.

3 Outline of the experiment

3.1 Creating human pictograms and motion lines

We created human pictograms and motion lines for our experiment. We used "Pictogramming[1]" (Ito, 2018), which is based on two words: "pictogram" and "programming". The basis of this application is the use of a human pictogram, and it is a pictogram authoring tool developed by Ito.

Figure 1 is a screenshot of the Pictogramming application. A large human-shaped pictogram is displayed in area A, the human pictogram display panel. The panel can display either the front or side views of the human pictogram, as defined by the ISO 3864 Appendix, where both comprise nine parts: the body and head (considered as a single part), two upper arms, two lower arms, two upper legs, and two lower legs. The size of each part conforms to the dimensions specified in ISO 3864 (see Figure 2).



Figure 1. Screenshot of "Pictogramming"

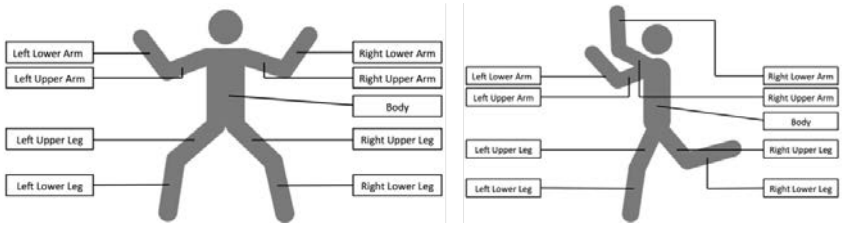


Figure 2. Front and side views of a human pictogram

Operations on the human pictogram are input and defined in area B, the program code description area. The commands are classified into two types: 1) the "Pictogram Animation Command," which changes the shape of the human pictogram and 2) the "Pictogram Graphics Command," which is very similar to turtle graphics in that it can draw a motion line easily. Turtle graphics is one of graphic outputs. In Turtle graphics, by giving instructions to move to the virtual turtle onscreen, we can draw the movement trajectory as graphic, so everyone including a person who does not understand coordinate system can draw graphic easily by combination simple procedures. Command names and arguments can be easily intuited from personal experiences and existing knowledge. The commands and movements of the human pictogram have fine granularity. Pictogram graphics focus on the movement of the human body, and pictogram animation focuses on the rotation of human body parts. The combination of these two types of commands is a unique feature of Pictogramming. Figure 3

[1] https://pictogramming.org/?page_id=470

shows an example of pictogram animation, pictogram graphics, and a combination of both types.

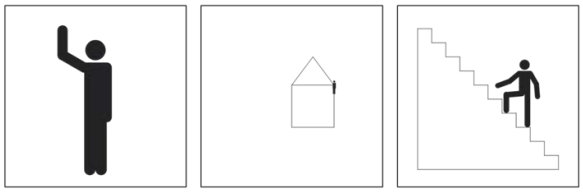


Figure 3. Examples of outputs from Pictogram Animation (left), Pictogram Graphics (center), and a combination of both types (right)

Also, the commands for creating the symbols for warning, prohibition, instruction, and safety are readymade. Figure 4 shows an example of the symbol created by Pictogramming.

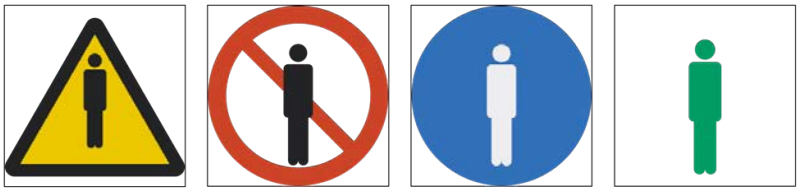


Figure 4. Example of outputs from Warning (left), Prohibition (second from left), Instruction (second from right), and Safety (right)

Figure 5 shows a sample code. Pictogramming adopts original commands based on separating operation code and arguments with blanks. Figure 6 is executing the output “Warning; uneven access / up” with the sample code shown in Figure 5.

```
01: // Creates the mark of attention
02: A
03: // Changes the human pictogram to side views
04: SD
05: // Changes the scale of the human pictogram
06: SC 0.1
07: // Pictogram Graphics
08: MW -170 230 0
09: PEN DOWN
10: PENW 10
11: MW 220 0 0
12: MW 0 -40 0
13: MW 100 0 0
14: PEN UP
15: MW -165 -175 0
16: // Changes the scale of the human pictogram
17: SC 0.65
18: //Pictogram Animation
19: R BODY -15
20: R RUA 70
21: R RLA 10
22: R LUA -40
23: R LLA 20
24: R RUL 60
25: R RLL -50
```

Figure 5. Sample code

In the sample code in Figure 5, comments can also be written using the “`//`” sign. Lines 7 to 15 are in accordance with Pictogram Graphics; these lines draw a step. The “`M`(ove) `W`(ait)” command shown in Line 8 means move 170px in the positive x-axis direction and 230px in the negative y-axis direction. The next command is not executed until this movement is completed. Lines 19 to 25 are in accordance with Pictogram Animation. The “`R`(otate)” command means rotate a part of the body. For instance, “`R RUA 70`” shown in Line 20, means rotate the Right Upper Arm (RUA) 70 degrees counterclockwise. If a third argument is added, the time for rotating can be designated. However, a third argument is omitted in this paper because a non-animated image is needed.



Figure 6. “Warning; uneven access / up” by sample code (Figure 5)

Furthermore, Pictogramming can easily save the pictograms that are created. When users want to save the pictogram as a picture, they just click button labeled C in Figure 1.

Last, Pictogramming has another feature which the effect of syntonic learning can be obtained. Syntonic learning is noted to be important in programming by Papert who developed the programming language "LOGO" . To actualize syntonic learning, in Logo, the user can execute commands by pretending to be a turtle using their own bodies. On the other hand, in Pictogramming, syntonic learning can be obtained by using human pictogram instead of turtle because the human pictogram resembles a body that represents the ego and the illustrated pictograms represent one’s culture.

3.2 The purpose

The purpose of this experiment is to assess our understanding of human pictograms with and without motion lines. Hereafter, a human pictogram without a motion line will be called “without motion line” and a human pictogram with a motion line will be called “with motion line.”

The examinees answered three questions regarding “without motion line” and “with motion line” in this experiment. There are ten images each of pictograms “without motion line” and “with motion line.” Hereafter, a “without motion line” OR “with motion line” pictogram will be referred to as a “type,” whereas a “without motion line” AND “with motion line” will be referred to as a “topic.” Moreover, in this experiment, we developed the questionnaire system to measure the time it takes the examinees to answer. The interface of the questionnaire system is shown in section 3.5.

3.3 Topics

Figure 7 shows the topics that were used in the experiment. We selected ten topics based on whether they met the following three conditions:

1. Being a safety sign as defined by ISO 7010 or JIS Z 8210.
2. Over half body of human pictogram is depicted in the pictogram.

3. Original pictogram consists motion line, or if not, human pictogram in which original pictogram is in a state of motion.

In Figure 7, the left side of each topic is “without motion line,” the right side is “with motion line,” and the types that are boxed are defined by ISO 7010 or JIS Z 8210. Additionally, the numbers under the topics denote the order of the questions, and the phrase in parentheses shows the associated meaning as defined by ISO 7010 or JIS Z 8210.

Table 1 shows how each topic is defined under either ISO 7010 or JIS Z 8210, and a brief explanation of motion lines is used in each type. In the column “Definition,” ISO means it is defined under ISO 7010, and JIS means it is defined under JIS Z 8210, and in the column “Topics,” the number represents the order of the question and the phrase in parentheses indicates the definition under ISO 7010 or JIS Z 8210.



Figure 7. Ten topics used in the experiment

Table 1 Ten topics adopted in the experiment

Topics	Definition	Motion line	
		Style	Summary
1 (Warning; Obstacles)	JIS	Flash	Collision
2 (Warning; Overhead)	JIS		
3 (Warning; Slippery surface)	JIS	Speed line	Motion by human pictogram
4 (Warning; Drop)	JIS		
5 (Warning; Drop)	ISO		
6 (Warning; Slippery surface)	ISO		
7 (Warning; Floor level obstacle)	ISO		
8 (Warning; Falling objects)	ISO		Motion by objects
9 (Prohibition; Do not rush)	JIS		Motion by human pictogram
10 (Prohibition; No pushing)	ISO		

3.4 The examinees

The examinees comprised 39 students at the School of Social Informatics, Aoyama Gakuin University. All examinees were familiar with using computers and therefore, could easily operate the questionnaire system. In this experiment, the 39 examinees were divided into two groups: one for answering questions about pictograms “without motion line,” and the other for answering questions about “with motion line.”

3.5 The experimental procedure

The following is the experimental procedure.

1. The experimenter provides a simple explanation of human pictograms. The experimenter then explains the following (approximate duration of the explanation is three minutes).
    a. Pictograms are used worldwide as a symbol representation system, and they are used at public facilities such as airports, train and bus stations, bus stops, and at other public locations around the city.
    b. Given the importance of standardizing, ISO or JIS deliberate and design the standards for human pictograms.
    c. ISO and JIS design the guidelines for symbols denoting prohibition and attention, and in this experiment, the pictograms based on these guidelines are used.
2. The experimenter divides the examinees sitting in front of computers into two groups: one for answering questions about pictograms “without motion line” and another for answering questions about pictograms “with motion line.”
3. The experimenter gives three directions to the examinees.
    a. The examinee must answer only questions asked of his or her group.
    b. The examinees must answer questions according to the questionnaire system.
    c. The questionnaire is configured with ten types, and each topic necessarily expresses a different concept.
4. The examinees answer about ten types in total, and each type has three questions. Therefore, there are 30 questions in total, and all questions are on the test by questionnaire system. They stare at all types of pictograms with 640x640 pixels in an area of about 3.5 cm x 3.5 cm, so the examinees can see the motion line clearly. The following are the three steps outlined by the questionnaire system, and Figure 8 shows an exam of a display screen in these steps.

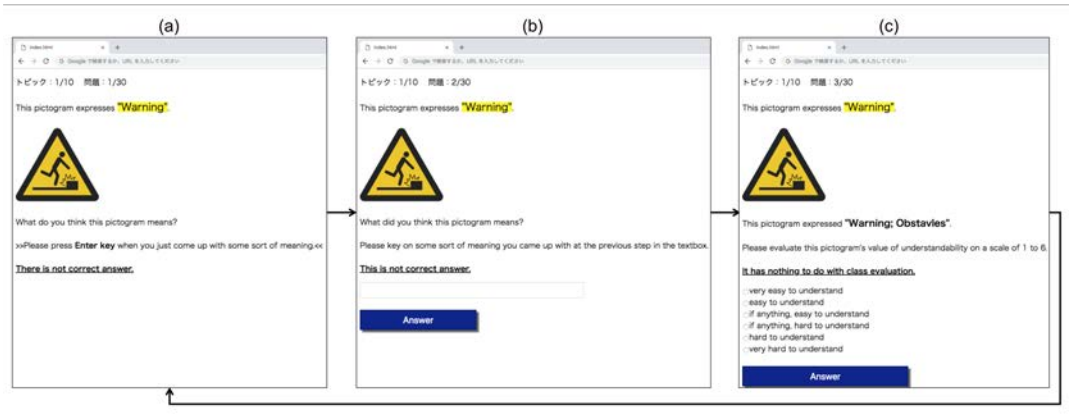


Figure 8. A display screen in the questionnaire system

    a. First, the questionnaire system displays only a picture of a human pictogram. Figure 8 (a) shows an example of a display screen. The examinees think about the meaning of the type displayed, and press the Enter key when they infer some sort of meaning. After this, the questionnaire system moves on to the second step. In this step, the questionnaire system measures the time it takes the examinees to answer, which is defined as “recall time.”
    b. Second, the examinees type in the meaning they came up with in the first step in the textbox given. After that, the questionnaire system moves on to the

final step. Figure 8 (b) shows an example of the display screen. This answer is defined as “recall content.” If a textbox is empty, the questionnaire system does not move on to the final step.

c. Third, the questionnaire system displays each human pictogram type’s meaning as defined under ISO 7010 or JIS Z 8210. The examinees evaluate the type’s level of understandability on a scale from 1 to 6 after they compare the presumed meaning they came up with in the first step to the type’s meaning as defined by ISO 7010 or JIS Z 8210. The following is the 6-grade evaluation: 6-very easy to understand; 5-easy to understand; 4-if anything, easy to understand; 3-if anything, hard to understand; 2-hard to understand; and 1-very hard to understand. Figure 8 (c) shows an example of a display screen. This answer is defined as “value of understandability.” Also, if an examinee does not select the type’s “value of understandability,” the questionnaire system does not move on to the next question.

4 Experimental results and considerations

This section discusses the experimental results and considerations from the viewpoint of topics or persons.

Table 2 Experimental results and results of the test

Topics	Motion line	Recall time			Recall content		Value of understandability								
		mean (sec.)	SD	p-value	concordance rate	p-value	the number of answers 1	2	3	4	5	6	mean	SD	p-value
1 (Warning; Obstacles)	X	5.427	2.228	0.767	1.000	0.008	0	3	5	8	5	2	3.913	1.164	0.114
	O	5.728	2.269		0.688		0	0	3	4	7	2	4.500	0.966	
2 (Warning; Overhead)	X	7.948	10.213	0.133	0.478	1.000	0	4	3	6	7	3	4.087	1.311	0.236
	O	4.353	1.887		0.500		1	1	3	0	6	5	4.500	1.592	
3 (Warning; Slippery surface)	X	5.526	3.928	0.079	0.783	0.370	1	2	7	7	4	2	3.739	1.251	*0.002
	O	3.662	2.444		0.938		0	1	2	0	5	8	5.063	1.289	
4 (Warning; Drop)	X	8.310	5.994	0.855	0.391	1.000	1	4	8	5	3	2	3.478	1.310	0.892
	O	8.264	7.349		0.375		1	5	1	4	3	2	3.563	1.590	
5 (Warning; Drop)	X	5.912	3.195	0.832	0.261	*0.004	2	5	7	4	4	1	3.261	1.356	0.158
	O	5.188	2.283		0.750		0	4	2	4	2	4	4.000	1.549	
6 (Warning; Slippery surface)	X	5.972	3.860	0.251	0.783	0.370	1	5	3	8	6	0	3.565	1.237	0.055
	O	4.484	2.322		0.938		0	1	2	5	6	2	4.375	1.088	
7 (Warning; Floor level obstacle)	X	4.151	1.883	0.657	0.957	0.139	1	2	3	4	7	6	4.391	1.469	0.207
	O	5.963	7.467		0.750		2	2	0	6	5	1	3.813	1.515	
8 (Warning; Falling objects)	X	5.747	3.187	*0.009	0.870	0.415	2	5	1	2	6	7	4.130	1.817	0.230
	O	3.333	1.516		0.750		0	0	1	4	5	6	5.000	0.966	
9 (Prohibition; Do not rush)	X	5.011	3.970	0.458	0.957	1.000	0	2	0	4	10	7	4.870	1.140	0.033
	O	3.801	2.155		1.000		0	0	0	1	5	10	5.563	0.629	
10 (Prohibition; No pushing)	X	5.560	3.930	0.563	0.565	0.785	1	3	3	7	6	3	4.000	1.382	0.271
	O	6.404	4.560		0.625		0	1	2	4	6	3	4.500	1.155	

Note: The number of answers is 23 “without motion line” and 16 “with motion line” in every Topic.

Table 2 shows the results of the experiment as well as the results of the Mann-Whitney U test about “recall time” and “value of understandability,” and the results of Fisher's exact test about “recall content.” The Mann-Whitney U test is conducted in order to verify whether a significant difference is acknowledged between “without motion line” and “with motion line” regarding “recall time” and “value of understandability;” Fisher's exact test is conducted in order to verify whether a significant difference is acknowledged between “without motion

line” and “with motion line” regarding “recall content.” Also, an asterisk (*) is used to designate items with a significant difference ($p < 0.01$). Student's t-test is general statistical significance test, but because normality about “recall time” and “value of understandability” between “without motion line” and “with motion line” is not acknowledged by the Shapiro-Wilk test, the U test is utilized. In Table 2, a number in the column “Topics” shows the sequence of questions and the phrase in parentheses shows the meaning as defined under ISO 7010 or JIS Z 8210.

Next, Figure 9 shows a graph of cumulative ratio for “recall time” by persons. The horizontal axis shows time (sec.) and the vertical axis shows rate of answers. The rate is cumulative, so the values of rate represent answers that have been given by the time shown on the horizontal axis. For instance, in “with motion line” of a topic for 1 (Warning; obstacles), the value of 5.2 on the horizontal axis means that half of the examinees have finished answering by the 5.2 second mark. In Figure 9, the maximum value of the horizontal axis (sec.) is 10. In some types, the rate does not approach 100% because there are examinees who did not finish answering until after the 10-second mark. Also, the number of answers in the time range (0.2 seconds) is large enough to make the slope steep. Note, the numbers that are written under the graphs represent the order of the question, and the phrase in parentheses indicates the meaning as defined under ISO 7010 or JIS Z 8210.

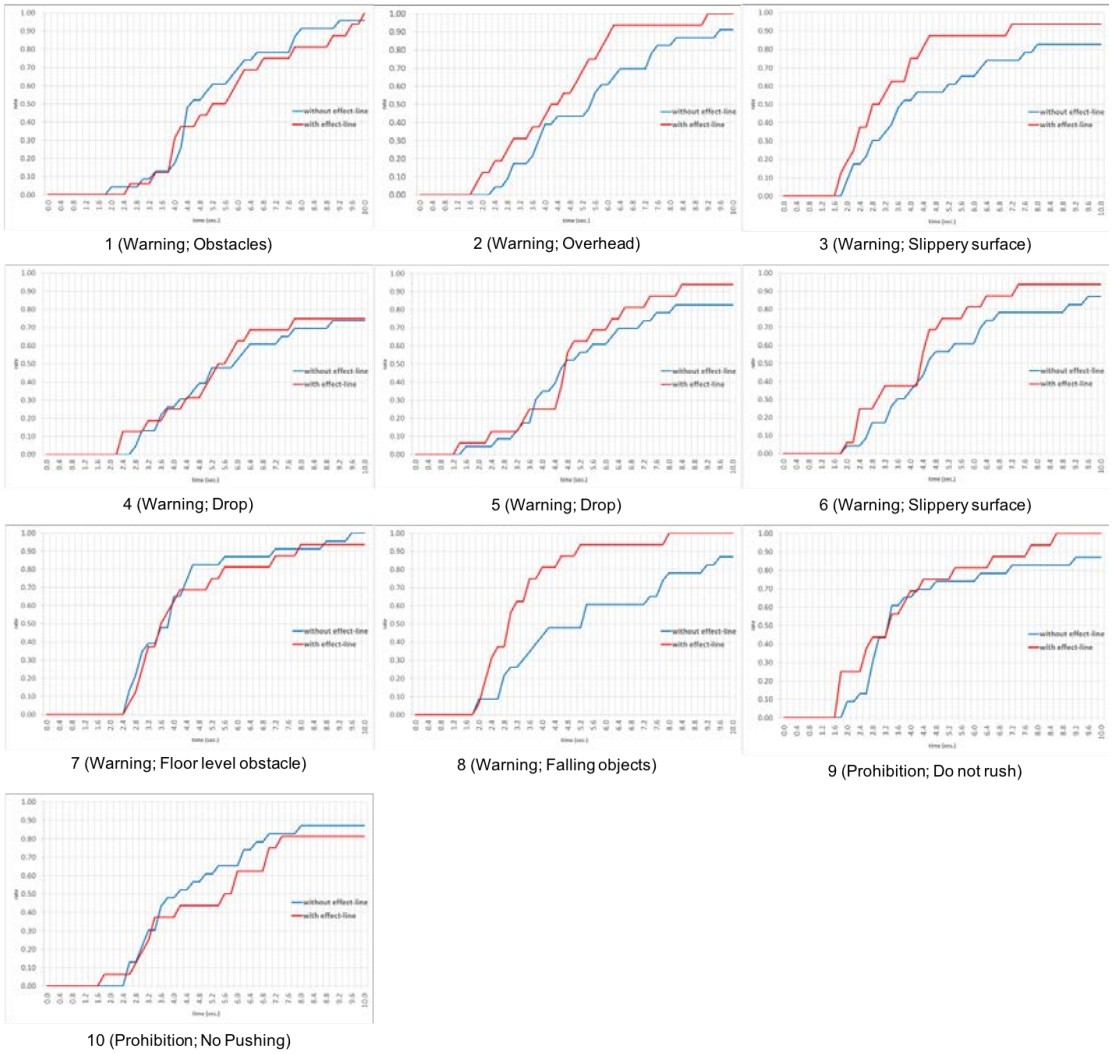


Figure 9. Cumulative ratio for “recall time”

4.1 Understandability

Regarding “value of understandability,” a significant difference was identified, implying that “with motion line” is more understandable than “without motion line,” which is acknowledged in topic 3 (Warning; Slippery surface). In topic 3 (Warning; Slippery surface), the horizontal plane is not drawn although it is drawn in every topic except for topic 9 (Prohibition; Do not rush). For that reason, it is difficult for examinees to regard the motion direction of human pictograms as being either vertical (dropping) or horizontal (slipping). This phenomenon can be caught from some examinees' description "Caution; Fall" in "recall content" for "without motion line." of topic 3 (Warning; Slippery surface)

Incidentally, in topic 9 (Prohibition; Do not rush), the horizontal plane is not drawn either, but no significant difference is acknowledged in this topic, presumably because of the high penetration rate on this topic. Today, this topic is presented at many public transportation depots and public facilities in order to improve public etiquette and the examinees are likely to have learned this topic in advance. Therefore, because it is easy for the examinees to recall the meaning even when the horizontal plane is not drawn, the “concordance rate” and “value of understandability” are high in both categories, “without motion line” and “with motion line.”

4.2 Recall time

In “recall time,” we found a significant difference with the “with motion line” being more understandable than “without motion line” in topic 8 (Warning; Falling objects), two features of which can be read from Figure 9. First, when we compare the rate at which the examinees have finished answering in the same timeframe both “without motion line” and “with motion line, the ratio in “with motion line” is almost higher than it is in “without motion line.” Second, the convergence of answers is fast in “with motion line,” but slow in “without motion line.” In total, 93.75% of the examinees had finished answering within 5.2 seconds in “with motion line,” but 48.00% of them had finished answering by the same time in “without motion line.” Additionally, whereas all examinees have finished answering by 10.0 seconds in “with motion line,” the rate is less than 90.00% in “without motion line.” In short, the rate by 10.0 seconds in “with motion line” is very high, and the gap between “with motion line” and “without motion line” is more than 10.00%.

The graph in topic 3 (Warning; Slippery surface) fits the said two characteristics in topic 8 (Warning; Falling objects). In topic 3 (Warning; Slippery surface), we found that “with motion line” is significantly more understandable than “without motion line,” which was acknowledged regarding “value of understandability” in section of 4.1. Then, we inferred that short “recall time” is relative to understandability intuition; thus, “recall time” is relative to “value of understandability.” However, in topic 8 (Warning; Falling objects), “with motion line” is significantly more understandable than “without motion line,” which we acknowledged about “value of understandability,” as mentioned in section 4.1. Moreover, “recall time” is not correlated with “value of understandability” ($r = -0.262$). Therefore, we observed answers for each person; however, there are a few answers where “value of understandability” has a high value, although “recall time” is over 10.0 seconds. This experiment was done in small groups—39 people—so a few errors have a huge effect on experimental results. Hence, we designed the experiment for large crowds of over 100 people to reverify our results.

4.3 Recall content

Regarding concordance rate of “recall content,” there was a significant difference in “with motion line” being more understandable than “without motion line,” as acknowledged in topic 5 (Warning; Drop). By contrast, in topic 4 (Warning; Drop), regarding the concordance rate of “recall content,” “with motion line” is less than “without motion line.” Moreover, in topic 4 (Warning; Drop), the mean value is almost the same between “without motion line” and “with motion line” with regards to “value of understandability” and “recall time.”

“With motion line” of topic 4 (Warning; Drop) and “with motion line” of topic 5 (Warning; Drop) have similar meanings but their pictographic representations differ. For both types, the motion line’s style is a speed line, and these lines represent motion in human pictograms. There are seven types of speed lines in usage. Please refer to Table 1 in section 3.3 for details. Speed lines are drawn in the opposite direction of the associated motion except for in topic 4 (Warning; Drop) because speed lines wherein multiple lines are drawn in the direction opposite to the direction of objects that are side by side is the most typical (Hayashi, Matsuda, Tamamiya, & Hiraki, 2012). By contrast, in topic 4 (Warning; Drop), it is difficult to draw motion lines based on said theory without changing the design and size of the original pictogram. Therefore, in topic 4 (Warning; Drop), the motion line is drawn in the same direction as the motion, and we researched the impact on understandability. As a result, in topic 4 (Warning; Drop), it proved difficult for the examinees to understand the motion direction depicted in a human pictogram, so it is assumed that understandability in “with motion line” is not high. This phenomenon can be caught from some examinees’ description “Warning; Jump” in “recall content” for “with motion line” of topic 4 (Warning; Drop). Hence, given the experimental results of topic 4 (Warning; Drop) and topic 5 (Warning; Drop), it is suggested that the most typical motion line by Hayashi et al. (2012) is valid for human pictograms too.

4.4 Considerations for use in real life

Pictograms are seen from a distance in real life. This is because pictograms are used as a way of not only communicating the notions of attention and prohibition, as we focus on in this experiment, but also for instruction and safety. Pictograms are designed so that many people can see them easily. However, because the ease of visibility in pictograms relates to their size, color, figure, and so on, one could speculate that a particular kind of display method for pictograms would increase their visibility further. For instance, in the case of motion lines, making the line thicker could improve visibility from long distances.

5 Conclusion and foresight

In this paper, we researched the difference in levels of understandability between pictograms with and without motion lines experimentally in order to improve the understandability of pictograms based on the results of “recall time,” concordance rate of “recall content,” and evaluation of “value of understandability.” Some topics showed a significant difference in human pictograms with motion lines in that they were more understandable than human pictograms without motion lines. Hence, we conclude that the understandability of pictograms is improved by the addition of motion lines.

However, there are two limitations in this experiment. First, the number of examinees is small, as mentioned in section 4.2. Second, the order of questions is fixed. Hence, the influence due to the order of questions is observed in some topics. For instance, in topic 6

(Warning; Slippery surface), there were some examinees who answered, “Warning; Slippery surface” as “recall content.” “Warning; Slippery surface” is the meaning defined by ISO 7010 or JIS Z 8210 in topic 3 (Warning; Slippery surface). Therefore, from now on, we will conduct experiment the by increasing the number of examinees and changing the order of questions in order to verify our results. Furthermore, we will research the drawing method and creation guideline of motion lines. Finally, we will address the expression of pictograms and function enhancement of Pictogramming (Ito, 2018).

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Product user testing: the void between Laboratory testing and Field testing

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User testing will frequently make the difference between an excellent product and a poor one. Moreover, in certain fields such as medical device development or training, the defence field or automotive industry, such testing can literally be the difference between life and death. Unfortunately, design teams rarely have the luxury of either time or budget to user test every aspect of a design at every stage, and so knowing where and when to devote time to testing, and the fidelity required for accurate results are all critical to delivering a good result.

This paper introduces research aimed at defining the optimum fidelity of mixed-reality user testing environments. It aims to develop knowledge enabling the optimisation of user testing environments by balancing effort vs. reward and thus developing critical and accurate data early in the design process.

Testing in a laboratory setting brings advantages such as the ability to limit experimental variability, control confidentiality and measure performance in great detail. Its disadvantages over 'in the wild' approaches tend to be related to ecological validity and the small but vitally important changes in user behaviour in real life settings. Virtual reality and hybrid physical-virtual testing environments should theoretically give designers the best of both worlds, finding critical design flaws cheaply and early. However, many attempts have focussed on high fidelity, technology-rich approaches that make them simultaneously more expensive, less flexible and less accessible. The final result is that they are less viable and hence somewhat counter-productive.

This paper presents the results of testing at a variety of fidelity levels within a mixed reality testing environment created by a team of artists and designers. It concludes with a series of recommendations regarding where and when fidelity is important.

Keywords: Products; product design; industrial design; mixed reality environments; user centred design; user testing environments; fidelity; usability

1 Introduction

It is generally recognised that it is important to iteratively create and test prototypes during the product design and development process (Boothe, Strawderman, and Hosea 2013). In some fields such approaches are mandatory. For example, user testing of prototypes is essential for computer-embedded medical products as enshrined in BS EN ISO 9241-210:2010. Legal issues notwithstanding, a good Product Design Process (PDP) requires

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user testing throughout the design process (Hare, Gill, Loudon, and Lewis, 2014; Rubin and Chisnell, 2008) including at the earliest low fidelity stages. Usability testing of low fidelity models usually takes place in a controlled laboratory setting (Kaikkonen, Kekalainen, Canker, Kallo, and Kankainen, 2005) both for ease of access and so tests can be regulated. Unfortunately, such settings are unlikely to match the cultural, social and physical environment where the resultant product will be used, which tends to limit the validity of any resultant usability data.

Literature on testing environments goes back a long way. Dahl, Andreas and Svanaes (2009), for example, found that the social and physical attributes of an environment are often ignored or given low priority when testing a prototype, and highlights the need to consider their implications in design testing. Even further back, Brehmer and Dorner (1993) found that while field research is often too complex to be practical, laboratory testing doesn't offer enough complexity for the often critical fine grain conclusions. Later literature shows that testing prototypes 'in the wild' can be achieved e.g. Woolley, Loudon, Gill and Hare (2013). That research found that context of use had a marked effect on the results of usability tests, particularly when exploring the effects of subtle but important design details. The study concluded that in-context and laboratory testing each have benefits and drawbacks. For example, prototypes of computer-embedded products – the subject of that particular study - that are robust enough for testing in the wild, are often costly in time and money. More recently, Kjeldskev and Skov's (2014) review 'Was it was worth the hassle?' concluded that while a definitive answer has not been reached in the laboratory vs. field debate, it is not whether one or the other is better, but 'when and how' that is significant. Their research concluded that field studies offered little value apart from the 'ecological validity' – the degree to which a recreated environment emulates the real environment. Other literature explores the potential role of virtual environments in this regard. For example, Deniaud, Honnet, Jeanne and Mestre (2015) recognised the need to evaluate virtual environments, describing two types of validity: absolute and relative. Absolute validity concerns achieving the exact same data from real and virtual testing environments, while relative validity describes the achievement of different results that are "*in the same direction and have a similar magnitude".*

What is the optimum fidelity for a user testing environment in order to meaningfully inform design decisions early in the design process, before a design team has committed to a particular design path? The answer is not yet known, but a number of studies have found that surprisingly strong results can be achieved with low fidelity environments. IDEO coined the phrase 'experience prototyping' around 20 years ago (Buchenau and Suri, 2000). Their work included the mocking up of real world environments at the concept generation phase and has shown that creative thinking can enable the prototyping of relatively complex real-world scenarios without a lot of either time or technology. In a completely different field, work conducted by a surgeon and his team established that a low fidelity mixed-reality environment could be effective in training medical students in surgery techniques (Kassab et al., 2011). In this case, the authors made recommendations on how to decide what should be physical and what should be virtual based on where the users' attention needs to be, with physical objects being used in the areas of greatest focus. The authors report that taken together, the physical-virtual environment created an overall sense of immersion without intruding on the task at hand. Dahl et al's (2009) work contributes additional underpinning theory here, describing environment fidelity requirements as being predicated on the

behaviour needs of the participant in that environment: Where is the attention? What influences decision making? The theory is further supported by Lessiter, Freeman, Keogh, and Davidoff's (2001) ethnographic studies of a hospital training environment focussed on how real visual cues are used to heighten participants' Presence and confidence in the simulated environment, with 'Presence' being defined as *"a user's subjective sensation of 'being there' "* in a simulated environment.

1.1 The Perceptual Experience Laboratory (PEL)

PEL is a mixed reality research laboratory created by a multi-disciplinary team of artists and designers. Its ability to project experiential perspective displays is literally unique – and will be the subject of another paper. Among other things, the laboratory was built to fill the void between traditional laboratory and 'in the wild' user testing. It is purpose-built to afford the restricted and consistent testing conditions of a standard usability laboratory within simulated context-of-use environments. It enables a mixed-reality method that couples physical objects with a 5K, 200° panoramic visual surround screen, artificially added smell and 3D ambisonics to engender an appropriate sense of presence. On the experimental monitoring side PEL has three video cameras to capture activity from various angles, omni-directional mics, heartbeat variability and galvanic skin monitors and state of the art wireless eye-tracking. All of these are linked to software systems that allow all data to be captured on a single timeline for detailed analysis. The current PEL is a development of an original prototype developed by the lead author. At that stage it consisted of a wooden frame and bedsheets that formed a back-projected surface. This was used as a proof-of-concept demonstrator via experiments investigating the extent to which low-fidelity virtual props might suffice in early product testing.



Figure 1: (left to right) St Athans hangar, PEL mock-up (exterior), PEL mock-up (interior)

Method

For this study PEL was employed to test the usability of a low-fidelity prototype of a product then under development for cleaning the flying surfaces and fuselages of a passenger aircraft. The product itself was being developed with the authors' input through a Knowledge Transfer Partnership (KTP). During the KTP the authors visited St Athens airfield, UK to gain a close insight into the problems with existing aircraft cleaning systems. Security was strict, with a sponsored escort, photographic ID and extensive paperwork required. The experience highlighted the complexity of conducting research in the wild for environments of this nature.

The prototype was tested in a series of four simulated test environments – in this case simulations of St Athans aircraft hangar - each at a different level of fidelity to evaluate whether the fidelity of simulation affected the identification of key usability issues. The water tank prototype was a low-fidelity cardboard mock-up. The poles and cleaning head were also low fidelity but had moving parts and thus demanded a higher degree of interaction.

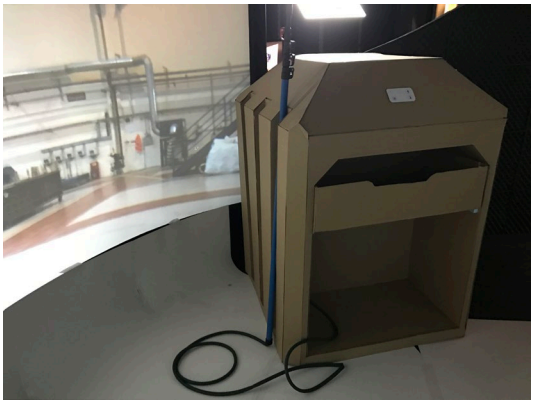


Figure 2: Low-fidelity prototype of the cleaning system

A key aim of the tests was to establish the *Face Validity*[1] (sometimes called *Physical Validity*) of *Presence*[2] (Slater, 2003) of the environment. Face Validity is a well-tested technique developed by Kelly (1927) to ensure answers relate to questions in the way they are intended to. In this case, the authors used Face Validity to determine which fidelity levels of simulated environments provoke the strongest feeling of Presence (Deniaud et al., 2015). The four simulations are described briefly below:

***Environment 1 (E1)*:** Projected images of the St Athans hangar, smell, sound recorded at St Athans and a 1:1 scale mocked-up fuselage section and product prototype. Participants wore a high visibility jacket (as required by all users of the St Athans hangar).

***Environment 2 (E2)*:** Projected images of the hangar, a 1:1 scale mocked-up fuselage section and product prototype. No sound, smell or high visibility jacket.

***Environment 3 (E3)*:** As *Environment 2* but without projected imagery.

***Environment 4 (E4)*:** Product prototype only.

The test design followed standard usability process with one facilitator controlling test conditions to ensure they remained constant. A mixed method approach was used; a combination of Kassab et al's (2011) method with questions used to evaluate the Face Validity of the simulated environment combined with the Systems Usability Scale (SUS) approach developed by John Brook (Bangor, Kortum, and Miller, 2009). The SUS has been used extensively in the product, systems, web and media development industries to establish a perspective on overall usability. Used primarily as an Investigative tool, it uses 10 Likert questions, alternating between negative and positive. Results are converted to a positive ordinal number using the Brook's method and converted to a percentile. A value below 68 indicates usability issues, while:

> *"products that scored in the 90s were exceptional, products that scored in the 80s were good, and products that scored in the 70s were acceptable. Anything below a 70 had usability issues that were cause for concern." Bangor et al (2009)*

[1] Defined here as *"the extent to which experts agree that the measures capture the intended construct"* Reimer, D'Ambrosio, Coughlin, Kafrissen, and Biederman (2006).

[2] Presence is defined here as the degree to which a participant feels they are present within a simulation – without necessarily believing it to be real.

Note that normalized in terms of a SUS scale is not a statistical calculation arrived at by the mean and standard deviation of a particular result, but a sector agreed score used to normalize the data relative to the sector - in the case of the SUS at 68. The SUS is a means of summatively recognizing usability faults in a product or system as a whole. It is used to identify usability faults in a design at a global level and has to be used in conjunction with ethnographical techniques to identify detailed faults.

A pilot study was run to ensure the tests were appropriately set up (Rubin and Chisnell, 2008; Leedy and Ormrod, 2010). Each participant was asked for consent to complete the relevant ethical participation paperwork before completing a biography questionnaire. The product test was designed to reflect the types of exploratory tests typically used early in the design process and so utilised low fidelity prototypes or "horizontal representations" of a concept that allow for surface interaction usability to be ascertained.

Participants were asked to "walk through" the whole user experience of the cleaning device rather than being given specific tasks (Rubin and Chisnell, 2008). Participants were asked to assemble the product, clean the fuselage and put the product away. Participants completed two post-test questionnaires: The SUS, to ascertain prototype usability, and a questionnaire on the environment to assess the level of Presence. While post-completion questionnaires rely on memory and latent experience (Jokinen, Silvennoinen, Perala, and Saariloma, 2015), questionnaire completion in real time is impractical. It was felt that their use was valid in combination with the think aloud protocol to capture real time conscious thoughts (Eccles and Arsal, 2017) and video recordings to capture unconscious action. Taken together, these methods allowed for some measure of triangulation.

Changes made, as a consequence of the pilot study, included covering the support frame of the fuselage mock-up (as it was too distracting); re-positioning PEL's cameras to accommodate the unusually large props, and using panoramic rather than fish-eye images. It also became evident that PEL's floor needed to be covered to better simulate the hangar's concrete floor – with cardboard used for the purpose. It was also evident the prototype needed more functionality to get full value from the tests and so a hose was added to make more visual sense of the water tank and the cleaning poles.

1.2 Participants

A total of 24 participants were recruited using *Convenience Sampling* - a nonprobability sampling method (Etikan, 2016). Each participant experienced the same prototype and completed the same task, but after every sixth participant the environment was changed. This allowed observations to be made on the impact different fidelity testing environments had on the behaviour of a participant and the types of usability issues identified and focused on during and after the test.

Participants (17M, 7F) were undergraduate students aged between 18 and 25. English was the first language of all participants. A biography questionnaire ascertained prior cleaning experience ('Yes':19) and aircraft hangar experience ('Yes': 3). Lack of aircraft hangar experience was not deemed to be problematic as it was probable the index product in question would be used by students in a summer job, i.e. the task was assessed as a low skilled job, with specialist expertise or tacit knowledge not required.

2 Data capture

Data was captured using quantitative and qualitative research methods. A think aloud protocol was used during the tasks and participants were audio and video recorded, with Observer XT software being used to capture the data on a common timeline for correlation and analysis.

Post task, the SUS and Kassab et al's (2011) question set were used to ascertain Face Validity of the environment. The SUS was used to determine the usability of the low fidelity prototype product, while the Kassab et al questionnaire assessed the validity of the simulated environment. Face Validity questions were presented in Likert Scale format with a 6-point scale used because studies have found they offer more discrimination on attitude, perception or opinion than 5-point scales. Chomeya's (2010) study also highlighted reliability as a factor in opting for 6-point scale. Participants were asked to circle one number, 1 = not at all, and 6 = very much. Mode and Median were used to identify preferences and opinions. This use of ordinal data is used rather than analysing the mean, which should only be used for ratio data. Non-parametric statistics were used because they are more appropriate for data founded on opinion. Note that while capturing ordinal data allows for directionality in preference it does not afford proportional analysis – e.g. that something is 'twice as good'. In other words, the results cannot measure in-between the intervals (Dawson, 2013) and the data captured in this study affords descriptive statistics due to the sample size.

Table 1: This table is representative of the Face Validity questions asked during the test

This simulation is a realistic representation of an aircraft hangar?	1	2	3	4	5	6
The simulation scenario is realistic?	1	2	3	4	5	6
The equipment used in the simulation is realistic?	1	2	3	4	5	6
The simulation 'felt' like being in an aircraft hangar?	1	2	3	4	5	6

While the sample was the appropriate size for a user test, as noted by Nielson Norman (2012), it was evident that it was not big enough for credible statistical analysis. It was therefore imperative that the qualitative data was captured to help make sense of the data collected.

3 Results

1. The aim of the study comprised of three objectives:
2. Ascertaining the product's overall usability using the SUS questions based on product testing.
3. Testing the Face Validity of each environment using the Likert Scale questionnaire to ascertain the characteristics of an optimum product-testing environment.
4. Gathering qualitative data about the user experience of the product, based on observations and audio and video recordings of the task, to explore the '*why*' of the results.

3.1 Questionnaire Results

Face Validity analysis was first conducted on the level of Presence achieved in the simulated environment. The 1 to 6 Likert Scale used made a score of 4 and above positive and 3 and

below negative indicators respectively. The Mode and Median results showed Presence as being most marked in Environments 1 (E1) and 2 (E2), while the lower fidelity Environments 3 (E3) and 4 (E4) returned negative indicators (see *Table 2* below).

Table 2: Collective Narrative: Presence Central tendencies.

Measure	MODE	MEDIAN
E1	4	4
E2	4	4
E3	3	3.5
E4	1	2.5

Table 3: Systems Usability Score

SUS
67.1
57.5
76.7
72.5

While the prototype under test remained constant in all four environments, the SUS results (see Table 3) for E1 and E2 fell into the category of "*cause for concern*" by the SUS scale definition (67.1 and 57.5 respectively). In contrast, while the level of Presence was reduced in E3 and E4, overall usability scores of 'acceptable' were achieved at 76.7 and 72.5 respectively.

Analysing the overall Face Validity results, by summing the Mode values across the four Face Validity questions for each environment, showed E1 to have the highest value, with a total Mode value of 17 (see Figure 3 below). E2 and E3 both achieved slightly lower Modes of 14 while E4 was clearly differentiated with a Mode of 8. A review of the sum of Median values across the four Face Validity questions, for each environment, showed the midpoint reference in E1 as 16.5, E2 as 15, E3 as 13 and E4 as 11 (see Figure 3 below).

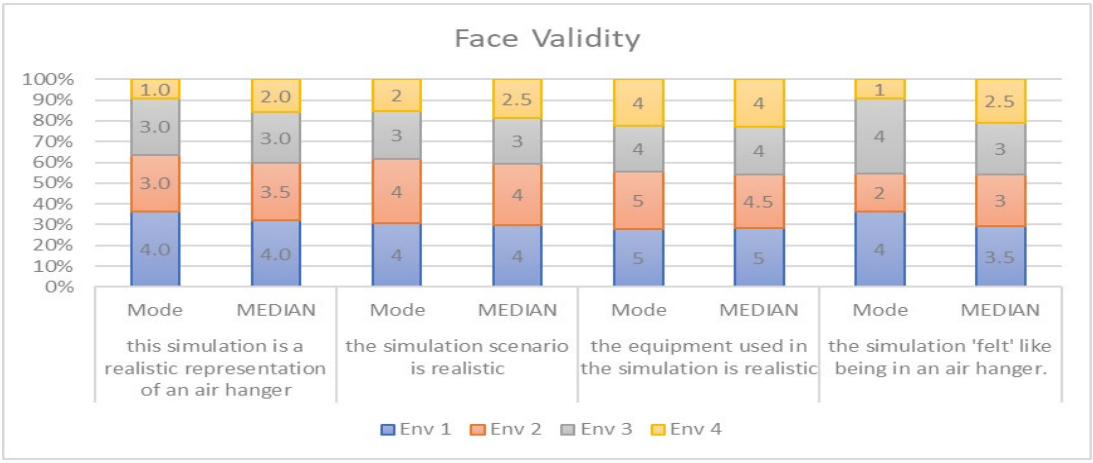


Figure 3: Central Tendencies of the Face Validity Likert Scale

The average time taken for a participant to complete the study is shown in Table 4 below. They show similar results for E1 - E3 (Range = 108 to 132 seconds), while the user testing in the low fidelity E4 was markedly different, with tests taking an average of 367 seconds to complete.

	Seconds
Env. 1	132
Env. 2	134
Env.3	108
Env. 4	367

Table 4: Average task completion time

3.2 Observation and Audio Analysis

Observations of participants' interaction with the prototype and analysis of their qualitative comments highlighted a number of 'errors' – or, more accurately ways in which the prototype's intended use was not understood by the participant. Careful analysis of the video and audio data revealed a series of key themes concerning how the Environments affected participants' interaction with the prototype. For example, 'Confusion' was a term used by 50% of participants in E4 and 33% in E3 but only 17% in E1 and E2. E1 was also found to be better for uncovering serious design flaws. For example, participants in E1 found issues with the design of the product cleaning head. Audio data using the Think Aloud Protocol included apparently innocuous phrases such as *"the bottom squidgy kept flipping up and down".* This referred to the fact that the head would sometimes flip, exposing its edge, a problem categorised as a catastrophic design fault that might damage the aircraft's pressure hull. Analysis of the written comments and audio playback showed that E1 clearly caused participants to uncover usability issues around the cleaning head and the poles, while the main body / water tank component (the component requiring the least interaction) dominated the observations made in the lowest fidelity environment E4. Perhaps even more interestingly, participants in E2 and E3 interacted with and commented on the entire prototype. Only one participant in E4 even turned the device on, with one other saying that they should, but not doing so. Three participants didn't interact with the product prototype at all, but instead just talked about it from what they could see. In contrast, all participants in E1 and E2 turned the device on. In fact, the video footage showed all participants cleaning the fuselage and actively mimicking real world actions with the prototype in every environment apart from E4.



Figure 4: Fuselage prop in PEL

The critical design fault with the cleaning head of the prototype was identified by 50% of participants in E1; 67% of participants in E2; 17% of participants in E3 and 0% in E4. A review of the audio data found only positive comments about E4, but a more careful examination of the type of comment made found that they offered no insight into functionality that had not been explicitly built into the low fidelity prototype. Observations tended to be speculative and lack depth. For example, the "*product was simple and easy to use so no*

complaints, maybe improve the aesthetics of the main unit". In E1 – E3 the fuselage was the clear focus of attention, with all participants actively using the prototype to simulate cleaning the fuselage.

4 Discussion

The Face Validity results demonstrated that the higher the fidelity of the user testing environment, the stronger the measure of Presence. This was somewhat as expected since it confirms Kassab et al's (2011) findings of how to heighten the sense of Presence in a simulated environment via the selection of key objects from the real world. The difference between the results achieved in E4 and the higher fidelity environments E1, E2 and E3 is also less than surprising but a nonetheless useful confirmation of expectation.

More surprising was the comparative underperformance of the prototype in the SUS tests in the highest fidelity environment E1. While it created the greatest sense of Presence, its SUS performance was actually worse than the much lower fidelity environment E3. While E4 also scored relatively well in the SUS, analysis showed that participants tended to focus solely on the prototype rather than the interaction between the prototype and – in their case imagined - context to make their judgements on the product's performance. This resulted in participants looking rather than interacting. It would appear that E4's reliance on participants' imagination about the real-life scenario led to over speculation and presumption. Therefore, while E4 did help gain user insights about the physical design of the product, it was less useful for gaining insights into key usability issues in context. As the lowest fidelity environment, E4 was easier to set up, but it delivered fewer insights and took much longer to deliver results. The average amount of time taken to complete a task in E4 was 367 seconds, compared to 108 seconds in E3 and with less useful results. It would appear that participants' lack of attention and focus in E4 was closely linked to the lack of simulation, which seemed to impede their ability to engage meaningfully with the product and thus give useful feedback. For example, E4 participants tended to get confused about where they were in the test, repeating actions they had already completed or failing to acknowledge that the product would need to be turned on. This confusion was not at all apparent to the participants themselves however. In response to the Face Validity statement *'the equipment used in the simulation is realistic',* participants in the lower fidelity environments E3 and E4 scored just as highly as those in E1 and E2, with a Mode and Median of 4. One explanation might be ambiguity in the statement: participants may have been referring to the model as 'equipment' rather than the testing environment as a whole. Another statement *'the simulation felt like being in an aircraft hangar'*, garnered a different and unexpected result. Participant replies for E1 and E3 scored a Mode of 4, while those in E2 scored a Mode of 2. One explanation could be that the product had the worst usability feedback in this environment supported by constructive comments, so the low score might be a result of participant frustrations. The SUS scores show a more reliable – if unexpected - pattern: as the fidelity of the simulated environment decreases, the overall perception of usability of the prototype increases with both E3 and E4 achieving SUS scores in the 70s (i.e. within the *"acceptable"* range). E3 yielded similar Face Validity results and time taken to complete results as the higher fidelity E2 environment, which further confuses the issue. The SUS scores showed usability as 'acceptable' in E3 when there was still a critical fault in the design (the potentially dangerous flaw with the cleaning head). This fault was not identified in E3 even though the fuselage was used in E3, evidencing that E3 yields better prototype

usability findings. However, E2 identified design flaws that should have been found at this stage of the design process, distinguishing E2 as a more informative environment.



Figure 5: User test E2 in PEL.

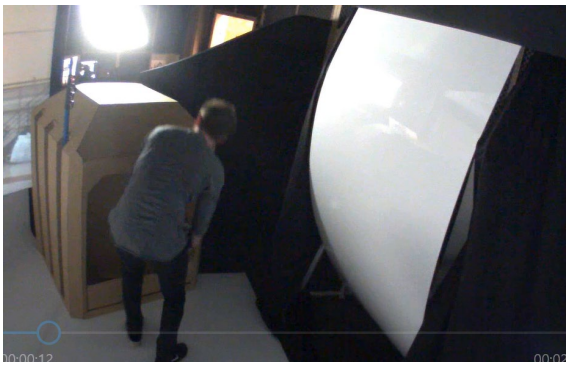


Figure 6: User test E3 in PEL

The trial proved inconclusive regarding the importance of high-fidelity environment details such as the use of the 'high viz' vests and smell in heightening Presence. However, E1 did achieve a higher Face Validity response to the statement '*the simulation feeling like being in an aircraft hangar*' than E2. Since the vest and smell were the only points of difference, it is tempting to conclude that they contributed positively to the overall experience, but there is no specific evidence of this.

In summary, E4 is clearly an outlier and the usability results are not as powerful because of the lack of reference to the context of use. E1 and E2 achieved similar Presence results and raised similar usability issues. If reference is made to Nielson Norman Group's work on effort against financial benefit, then E2 offers the return required in identifying usability flaws early in the design process, against effort made to produce the environment.

The trials had one further interesting outcome: the designer of the low-fidelity prototype watched the product trials via a live video feed and made changes to the concept in real time and in response to user interactions with the prototype. This was unanticipated, but clearly potentially powerful, since he was literally designing in direct response to user feedback, unfiltered, and in real time. In other words, the line between testing and design became distinctly blurred.

5 Conclusions

The purpose of this study was to establish the optimum context fidelity of a user-testing environment. The findings showed that the highest-fidelity environment yielded improved Presence and an assumption can be made that when presence is heightened, the context of use influences the amount of prototype usability issues found. The high-fidelity environments also clearly highlight more usability issues than the low fidelity environments, but time spent on extra detail such as smell and props such as vests will not necessarily deliver benefit.

The authors therefore concluded that simulating the context of use while testing a low fidelity design prototype early in the design process significantly affects the type of usability issues identified, but that the effect of fidelity is far less linear than previously thought. The first surprise was that although Face Validity was strongest in the higher fidelity environments, there was no major difference in Face Validity scores between the E1, E2 and E3 environments. The big drop in Face Validity was associated with E4, the lowest fidelity

environment and effectively the experiment's datum, being a representation of a standard laboratory test. This 'context-less' approach had the least impact when participants were trying to identify flaws in the physical aspects of the proposed design as opposed to the interactions between the user, product and environment. The benefit of including visual cues as to the product's intended environment of use was clear, but as noted above, it was the fidelity of those cues that provided the study's most unexpected result. E1 achieved the greatest sense of Presence and the expectation had been that this would translate into better data coming from the product trials. In the event, more usability flaws were identified in E2, with the inevitable conclusion that higher levels of Presence are not necessarily required in product testing scenarios. Future studies should seek to test the reproducibility of this intriguing result at greater scale, enabling a revisiting of Kjeldskev and Skov's (2014) conclusions on the 'When and How' of laboratory vs. field-testing, as well as Deniaud et al's (2015) 'Why'. Such work will give test moderators the appropriate tools to appropriately assess effort versus reward and select the most appropriate testing environment to identify critical usability issues early in the design process. The next study will be conducted in three different environments, the real context, the laboratory and another laboratory equipped to the fidelity of Environment 2 as identified in this work. The focus will be on product usability with 15 participants in each environment and will aim to differentiate the role of each environment at different stages of the design process. This next study will not focus on which environment is most appropriate, but when each environment should be used.

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Re-Designing Design - Design Principles Based on Historical Analyses of Human Emotions and Values

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We propose a set of design principles for designing a sustainable community. First, we analyze how our emotions and values have shaped human history and vice versa. Based on this analysis, we have implemented many projects in several local communities in Japan in which we tried to draw on local resources and wisdom to create values for the communities. Through these projects, we proposed a set of design principles. We try to design environments to encourage consumers to gradually become designers who design and create what they need, instead of depending on the mass production/consumption system that often causes many environmental/social problems. By making the processes of production and available actions visible, we strive to activate our emotions that have evolved to design tools to survive in natural environments for millions of years. Also, we need to encourage authentic values in order to connect individual interests and social contexts.

Keywords: Human Values, Emotions, Sustainable Society

1 Human Values and Global Issues

It is difficult in our modern society to recognize how our daily behaviour is linked to global issues such as environmental degradations, depletion of natural resources, and social inequality, which makes it difficult to realize sustainable societies. We propose a set of design principles for sustainable societies, based on some analyses of how such situations arose in the human history.

What makes the relation between our daily lives and global issues invisible is the mass production and consumption system we all depend on (Illich, 1973). This system seems to rely on the value “the more/bigger the better” which we apply to profits, properties, and organizations. Although this value may seem natural, in the hunter gatherer society in which humans had survived for over 99% of our history constantly moving from one place to the next, “more” or “bigger” must have been a negative value. For at least 2 million years after our ancestors started to create/use tools, they used only tools which they could carry. “Just the right size” must have been the value that they acquired to survive. However, after they started farming

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about 11,000 years ago, they suddenly started to build bigger and bigger tools, houses, and communities. Only 5,000 years later they were building huge constructions like the pyramids and large cities. This suggests that "the more/bigger the better" is a value that we acquired only very recently in our history. Judging from the history of large civilizations like Egypt, Rome, and Easter Island which collapsed when they kept building large constructions and used up their natural resources, we can infer that this value is not sustainable. (Diamond, 2011)

This research has three major components tied together: a conceptual framework based on analyses of human history; projects in the social contexts of local communities; and design principles for designing the projects based on the conceptual framework. In the next section, we will discuss the conceptual framework for understanding how human emotions have shaped our society based on our values in different stages in human history. In section 3, we will list some design principles we have previously derived from the framework. Section 4 will describe some recent projects we have developed as attempts to tackle problems in several communities in Japan. In the final sections 5 and 6, we will conclude with new design guidelines for sustainable society we have developed through these projects.

2 The Framework: Values, Emotions and the Human History

2.1 Emotions as a System of Urges

Let us try to trace how our history brought forth the value "the more/bigger the better" and how it in turn has driven our history. For this purpose, we need to understand the origin of human emotions because our emotion drives our behaviour based on our values, thereby linking value and history. Urge theory by Toda (1981) postulated that our emotions evolved as a system of "urges" that urges behaviours necessary to survive in natural environments. An urge is a set of emotions and actions that is activated in certain circumstances. Once activated, an urge prepares the body and cognitive system to react to the situation properly and triggers a set of actions that are optimal for survival. Toda analysed human behaviours in various emotional states and concluded that behaviours produced by the urge system optimized for survival in the natural environments no longer function properly in our modern, civilized society resulting in behaviours that appear irrational.

We focus on two kinds of urges that function when we design and use tools.

- As "**Learning Urges**" (because they are essential for learning new skills and knowledge), we consider a "curiosity urge", an urge to know or understand something better, and a "challenge urge", an urge to try some action even if success is not guaranteed.
- As "**Social Urges**" (because they are essential for maintaining a society), we consider a "gratitude urge", an urge to thank someone who does something good for us, and "contribute urge" (Toda's "help urge"), an urge to help someone in need or contribute to something.

Now we can analyse how these urges are likely to be activated in different kinds of environments.

- **For Learning Urges:** In natural environments, curiosity and challenge urges are likely to be activated often, because users of a tool (for cooking, hunting, etc.) could observe the processes of making something that tended to be visible. Thus, when a less experienced user of a tool observes a more experienced user using it, s/he is likely to get curious and challenge her/himself to try it. Curiosity and challenge urges support each other because actions reveal more processes and curiosity reveals more actions.
- **For Social Urges:** For people living in natural environments, the gratitude and contribute urges are likely to be activated often because the process of using the tools tends to be visible. Thus, cooking and eating foods will activate a gratitude urge toward people and natural resources that produce them, and a contribute urge to protect them.

Table 1. Learning Urges and Social Urges, their conditions for activating

Urge Types	Urges for Knowledge	Urges for Action
Learning Urges	Curiosity	Challenge
Social Urges	Gratitude	Contribution
Activation Condition	Process is Visible	Actions are Visible

2.2 Urges, Values and History Drive Each Other

We can try to trace, at major turning points in human history, what the values and subjects of people's urges were and how they moved human history.

2.2.1 Hunter Gatherer (more than 2,000,000 years, more than 99% of human history)

During the hunter gatherer period when people produced what they needed, "empowering people" was the value, and the learning and social urges must have been devoted to mastering and improving their hand tools. Everyone needed to learn to design what they required to survive, accumulating knowledge, artifacts, and activities. (Figure 1)

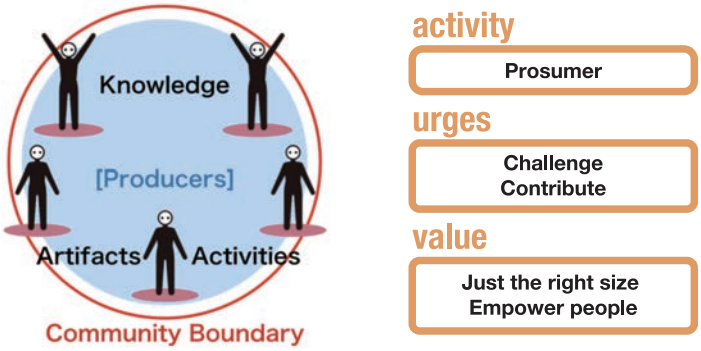


Figure 1 Hunter Gatherer Community - everyone produced.

2.2.2 Farming (11,000 years, less than 1% of human history)

With the start of farming, the value shifted to "the bigger the better", and settled societies started to grow larger. Some groups with accumulated knowledge became the elite class and it took only several thousand years for their urges to construct the pyramids, large cities, and churches. In contrast, producers who supported the

consumption of the elite groups with hand tools likely kept the value of empowering people. (Figure 2) Thus, the separation between social design/construction by the elite group and product design/construction by the producer group made their processes invisible to each other, which made it difficult for their social urges to function properly; e.g., politicians did not help farmers, and farmers were not motivated to contribute to their societies. As Diamond (2011) pointed out, many great civilizations collapsed when the elite class insulated themselves from the problems occurring within their societies.

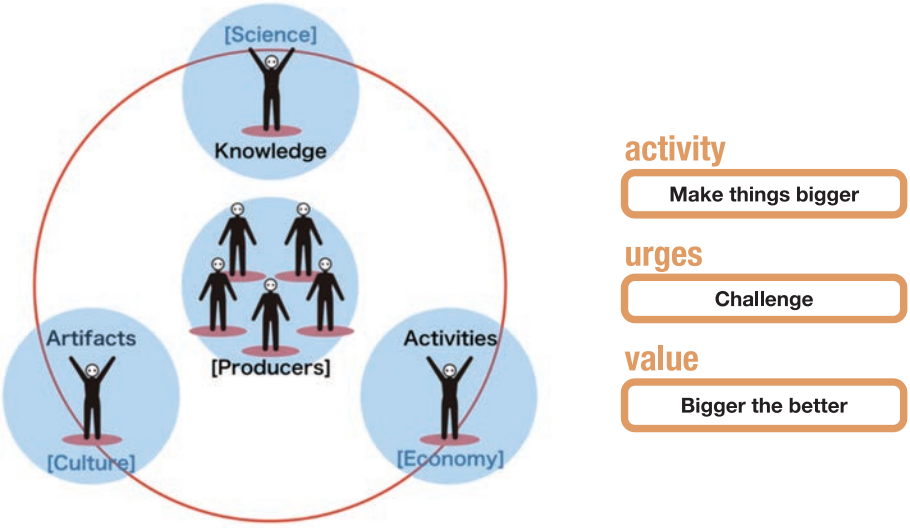


Figure 2 After Farming – Separation starts between elite consumer groups and producer group.

2.2.3 Industrial Revolution (300 years or less, 0.01% of human history)

After the industrial revolution began 300 years ago in Europe, and later in many other regions, fossil energies and machines that enabled mass production transformed the producers' value of "empowering people" to workers' value of "minimal human power". Many producers have been and many still are being assimilated into cities as workers/consumers, thereby making production processes even less visible to each other, and making it even harder for learning and social urges to function properly. For example, when city dwellers use complicated modern tools like an air conditioner or a microwave, they rarely feel curious about their mechanisms, feel challenged to construct/fix/improve them, or appreciate the value of the energy resources, as we would when using tools burning firewood. (Figure 3)

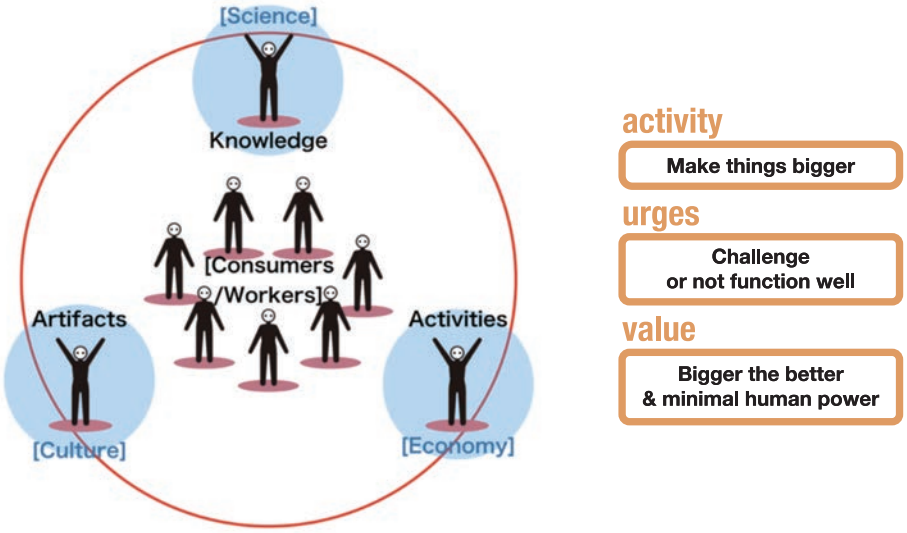


Figure 3 Industrial Revolution: Producers assimilated in large cities and became Consumers/Workers. Production processes became invisible.

3 Design Principles

As we discussed in section 2, many current social problems stem from the changes in our social structures which have made the production processes less and less visible which in turn made our learning urges and social urges difficult to function. This analysis led us to the following design principles. (Miyata & Ho, 2017)

- Design activities so that learning urges function properly:
  - Make the processes of production visible in terms of their mechanisms (curiosity urge).
  - Make the activities of production available (challenge urge)
- Design activities so that social urges function properly:
  - Make the production resources visible by facilitating design using local resources and wisdom. (appreciation urge)
- Design activities so that learning urges and social urges are linked:
  - Make the actions for contribution visible by identifying a value that attracts both individual learning and social interests (contribution urge)
  - Social urges can activate learning urges by recognizing skills/knowledge that once learned would enable one to contribute.
- Facilitate the value of “empowering people” by encouraging design by hands and interacting with people with passions.

4 Projects based on the principles

We have applied these principles in many projects that we have developed as attempts to tackle various problems in our local communities. As the authors work in universities located in different parts of Japan, all the projects involved students collaborating with people in the local communities. We describe below some recent project in each community. The authors and some of their students collaborated or

participated in many of the projects, discussed the project designs, analysed their observations, and developed the ideas discussed in the previous section and the following section.

4.1 Farm AR Project (Toyota)

In "Farm AR Project" (Miyata, Ueshiba, & Harada, 2018) in Toyota City, a group of design students visited young farmers who are striving to produce good quality organic foods for the community with aging and shrinking farming population. The students listened to the farmers' stories and observed them working in the farms. This triggered the students' social urge to contribute to the mission of the farmers who work hard to produce their foods which in turn triggered their learning urge to create AR (Augmented Reality) works to express the farmers' passion to consumers. The AR works were then incorporated in the menu of a restaurant run by the farmers using their products so that customers could view movies and animations showing the farms and messages from the farmers.

4.2 Rambling Design (Hachinohe)

In "**Rambling Design**" (Yokomizo, 2019) in Hachinohe City in northeast Japan, instead of giving design students tasks or goals to achieve, they were encouraged to immerse themselves in an old community where local people are striving to keep local tourism and businesses alive. The students listened to people and observed activities until the local resources and values became visible to them. They then tried to express their findings to the community as design components for wrapping paper. The citizens immediately found contexts to fit the designs in meaningful ways and together they created wrapping paper designs. (Figure)

4.3 Kizukai Project (Hakodate)

In "**Klzukai Project**" (Harada, 2018) in Hakodate City in northern Japan, students and teachers studying design and engineering visited a forestry/lumber factory, and listened to the timber workers and lumber producers, as they touched and smelled the wood in different stages of production. Then they visited a community composed of a shrinking and aging population and listened to the people striving to live there. They brainstormed ideas to help the community by using resources from the local forest in an attempt to connect the two contexts that they had just experienced. Using prototypes that they built the students explained their ideas to some people in the community. The community members gave them comments and advice that revealed their wishes and concerns, from which the students could learn new social contexts. Finally, students designed an event with live performance and a bar in an old house renovated by local group for which a group of students who participated in the same project in the previous year constructed some pieces of furniture using local woods.

4.4 World Environment Project (Toyota)

In "**World Environment Project**" (Miyata & Ho, 2017), a group of design and engineering students from Hong Kong Polytechnic University and Chukyo University visited craftsmen and farmers in rural areas in Toyota City in central Japan to observe, experience and learn traditional hand crafts such as bamboo basketmaking, indigo dyeing, weaving and papermaking, as well as organic farming such as rice planting and tea picking. Analyses of the students' reflection included expressions indicating learning urges (curiosity or

challenge) in every activity, and social urges (appreciation or motivation to contribute) when they not only observed local masters working but also experienced working with the masters.

5 Toward Designing for Sustainable Society

During the projects described in the previous section, we analysed how the design of activities, including locations, people and tools for communication, encouraged interaction among the people involved, including behaviours, narratives, designs created, and reflections. From these analyses, we identified some guidelines for overcoming our dependencies on the modern systems of mass production/consumption and find a path to a sustainable society. Below we try to summarize these guidelines.

5.1 Connecting Learning and Social Urges with Authentic Values

As we have discussed, it is important that the urges are driven by values that are sustainable. If learning urges are driven by unsustainable values such as “the bigger the better”, behaviors that ignore broader social contexts may result. As we pointed out already, this seems to have happened behind many current social problems. In our projects we found that authentic values seem to emerge when learning and social urges are connected. (Figure 4) We also observed that the learning and social urges were connected and they facilitated each other when one or more of the following conditions were present.

- Activities involved experiences of physical materials in authentic environments using bodies and five senses to find meanings in the real contexts, rather than reading written materials or just talking about ideas. Authentic environments seem important because local resources and values are visible in the ways people lead their daily lives.
- The participants (students and local people) were encouraged to express the meanings they had found as **narratives**. In other words, designs emerged in the process of creating narratives, rather than just thinking about ideas. Narratives seemed to connect physical (learning) dimensions and mental (social) dimensions.
- We went back and forth between **social urges** in constructing relations with people, and **learning urges** in constructing relations with component parts and mechanisms. For example, in the Kizukai project described above, the students went back and forth between physical experiences and communicating with people in the community.

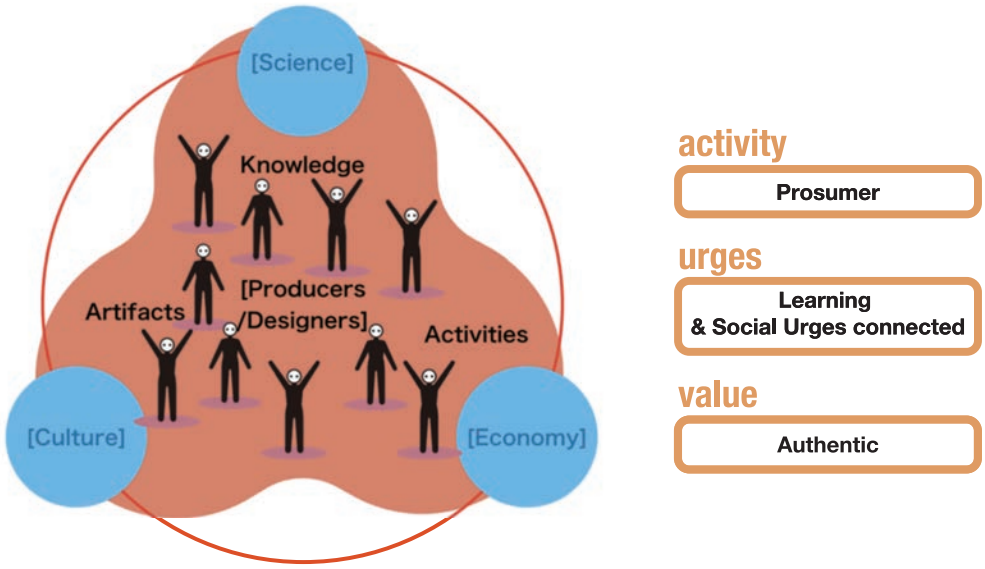


Figure 4 Our vision: Designers encouraging people to produce. Learning and Social Urges are connected with authentic values.

6 Conclusion

In our modern societies, almost everyone depends on the system of mass production/consumption. It would be very hard for politicians, company managers or factory workers to change the system they are directly immersed in. It would be relatively easier for a consumer to make small changes in their consumption behaviour – to design and make something instead of buying it. If enough consumers change their consumption patterns and gradually become producers, their choices would be a powerful encouragement for the other groups like politicians and managers to change. The role of designers is not to design things for consumers to buy and consume. Instead, designers should encourage consumers to become designers who design/make what they need and appreciate local resources and wisdom, thereby recognizing the value of their own design in their community. The projects and the principles we have described will be valuable for others developing projects in their own communities.

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Yasushi Harada: Infographics design for attractive knowledge sharing. Real Time Documentation for experience visualization. Design for community contribution. “Design in the Community 7: Decomposition and Reconstruction of Designing Activities in Local Communities”, Bulletin of Japanese Society for the Science of Design 2019

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Redevelopment or Gentrification? Community-led perspectives in the co-designing of urban housing

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Designing urban environments poses a number of challenges when faced with developmental crises such as gentrification. Despite recent and sustained net increases in UK housing stock, the supply of new housing fails to impact rates of statutory homelessness - raising the question; for whom/for what purpose new developments are designed. Community-led design (CLD) initiatives offer alternative models of development, and this paper seeks to gather the insights of community designers asking how we can design redevelopments without gentrifying. Participants from five CLD initiatives took part in a workshop aimed at understanding their basic assumptions about gentrification and an urban design practise fit for the future. These participants understand gentrification as a process of social exclusion within competing interpretations of value. They express a desire to fundamentally renegotiate the hegemony of the financial incentives that underlay the social relations of production in housing, which they view as at their best illegitimate and at their worst exploitative. CLD is often characterised as a gentrifying force itself, appealing to the so-called “creative class”. However, this workshop reveals that CLD practices often place their primary focus on creating equitable social relations. Indeed, the qualities of these social relations and their change/sustainability seems to determine the perceived quality of design decisions and the perceived value of the design process. In this sense, CLD practices can be characterised as a ‘radical form’ of design practice because of their emphasis on problematising current infrastructures for collaboration and their emphasis on revealing exploitative relations.

Keywords: gentrification; community-led; housing; co-design

1 Introduction

‘Since money, materials, land and authority to act were necessary and since the ruling power was the only force capable of furnishing him with these means, the architect had to identify himself with it, even transforming himself into its operative appendage’ – from Giancarlo De Carlo’s lecture ‘Architecture’s Public’ (Jones, Petrescu, & Till, 2013)

Housebuilding in England has been steadily rising since around 2014, following a six-year slump after the 2007/8 financial crisis. New development has been so sustained that the number of dwellings has almost returned to its pre-crash peak (see figure 1), yet the country is struggling with housing shortage. In 2016/17 net additional dwellings were up 0.92% on the previous year, with the vast majority of gains resulting from new builds (HCLG, 2018).

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These additional homes failed to have any impact on the rates of statutory homelessness, with households in temporary accommodation rising over the same period by 8% (DCLG, 2017). This rise in statutory homelessness cannot be explained away as population growth, with average rate of annual change in the UK as a whole sitting far lower at 0.6% (World Bank, 2019). Part of the explanation is that the stock of *vacant* dwellings rose faster than houses were being built - a 2.7% increase – creating the extraordinary situation in which the number of vacant properties (605,891 dwellings) vastly surpasses the number of statutory homeless (82,310 households) (HCLG,2018). In short, we are building new developments, but they are not developments that are designed with the purpose of housing those who need it.

If it is not housing need that has fuelled the sustained growth in housing stock, then what? As figure 1 shows, since the late 1980's the additions to the housing stock have come largely from the private sector, with new developments of social housing by local authorities all but disappearing. This transition is to what David Harvey terms the 'speculative city' (2013), where housing acts as part of the machinery of capital accumulation. In fact, the *National Planning Policy Framework* (HCLG, 2019) places 'significant weight' on new developments supporting economic growth. This attention to growth shifts the emphasis away from housing and on to the land it is built on, with the

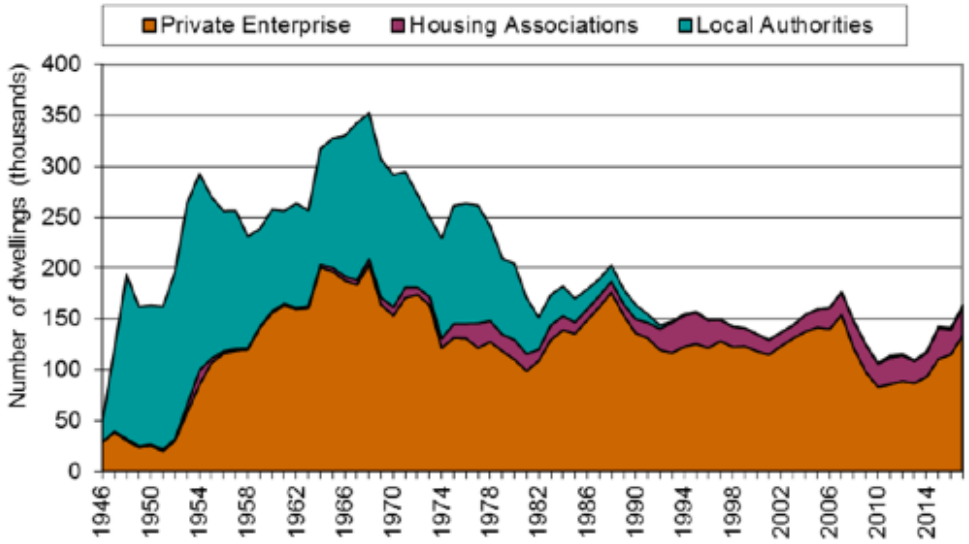


Figure 1. Permanent new build dwellings completed, by tenure, England 1946 to 2017. Source: Ministry of Housing Communities and Local Government 2018

speculation of investors driven by the differential existing between the current value of land and its potential value following improvements. This is known as the 'rent gap' theory of gentrification (Smith, 2002), a process which leads, in its worst cases, to the displacement of a land's use and/or its inhabitants.

So, the explanation for the continued housing crisis is (at least in part) the heavily financialised housing market. However, each one of these new developments has been produced by architects and designers. Acting as De Carlo's 'operative appendage' to the ubiquitous power of financialisaton, urban development is *designed* to maximise the highest return on investment. Design's role in this production of neoliberal space is in the formal presentation of goods and services (Julier, 2013) – e.g. condominiums and their aesthetic

signifiers of luxury and modernity. In these contexts, CLD initiatives offer alternative models of development, initiated and steered by grass roots community organisations. They make design interventions into their built environment with their own radical interpretations of design practise and the socio-spatial issues they associate with development, often offering alternative designs in opposition to accepted models and practises. This application of adversarial design (DiSalvo, 2012) to the context of housebuilding, offers an opportunity for design research to delve deeper into practises not driven by private profit and to understand the nature of opposition to current modes of design, the theory behind radical design interventions, and begin to co-create a picture of the principles driving radical design practises in urban redevelopment.

2 The workshop

To investigate these lines of enquiry, participants from five CLD initiatives took part in a cultural animation (CA) workshop. CA is a method of knowledge co-production, where the aim is to bring participants' basic assumptions about their lives, their work, or their environment out into the open to be interrogated and discussed collaboratively (Kelemen, Surman, & Dikomitis, 2018). This is achieved by mediating discussion through arts-based activities such as the creation of artefacts, creative writing exercises, or drama games in an attempt to "animate" narratives which may have become fixed, inviting participants to engage with questions about their lives and work from reinvigorated perspectives. In the metaphorical space that this animation has created it is possible for new insights and lines of enquiry to be made by participants, facilitators, and researcher collaboratively. Asking participants to think about abstract concepts in metaphorical spaces can be informative as individuals tend to *think* about abstract ideas metaphorically in the same sense as when we engage in discourse about them (Casasanto & Bottini, 2014). This is revealing of the ways our interactions with the material and societal environment structure our mental existences. In addition the use of narrative to gain a deeper understanding of participant perspectives is not uncommon in organisational research, including using creative writing to explore potentially dangerous or taboo dilemmas (Feldman, 2004; Gabriel & Connell, 2010). In CLD research these narratives are important to understand, as notions of community and leadership can be difficult to pin down. This research shares an understanding of community with Benedict Anderson, that all communities are "imagined" and should not be analysed in terms of falseness or realness but 'in the style in which they are imagined' (2006). In this sense, it is the stories that people tell themselves about the work that they do that is the unit of analysis. The data created in these workshops is in part processed collaboratively with participants - allowing them an opportunity to analyse and interpret insights generated about themselves and others - but also independently by the researcher relating the insights and/or enquiries generated in the workshop to prior knowledge of the participants' work.

In this research the aim of the CA workshop was along two lines of inquiry. First it was necessary to understand participants' basic assumptions about gentrification. This meant understanding individual participants' assumptions, but also how they perceive gentrification as an organisation, and in turn whether or not these assumptions were applicable to the experiences of the other individuals and organisations in the room. Second, the workshop aimed to gather participants assumptions about what the solution to these problems might look like. This line of enquiry covered both how they perceived the solutions to the problem of gentrification, as well as how the social relations between stakeholders and their relations

to the sites of redevelopment could be structured differently. These basic assumptions about gentrification and the social relations underlying it form elements of each organisations approach to CLD. In describing their views about these phenomena, participants outline the theory underlying their design practise offering an opportunity for design researchers to understand what motivates their desire for community intervention.

2.1 Workshop design

CA workshops are typically carried out by a team comprising researcher and facilitators, with facilitators enabling CA activities while the researcher makes observations in situ. All of the activities in the workshop were designed by the researcher utilising techniques common to the CA method and were undertaken following three briefing sessions with facilitators. The aim of these sessions was to ensure that facilitators had an understanding of how the activity was to be deployed, what data the team were hoping to collect, and what provocations were permissible/necessary. The workshop was composed of a number of activities with the objective of gathering participant's assumptions about gentrification, positioning CLD across a socio-material landscape, and models of redevelopment fit for the future. This paper will focus on 4 cinquain created in the workshop and constructed around the themes of gentrification and redevelopment fit for the future. These materials provide insight into the theory underlying each organisations design approach and how these approaches alter the impact and meaning of gentrification.

2.1.1 Cinquain 1

A cinquain (as shown in figure 2) is a five-line poem, commonly used in CA research to gather an agreed set of language and themes with which to discuss the topic of the workshop. Participants are tasked with gathering language from the group to define and describe a problem – in this case gentrification. The collection of this language includes group discussion of the problem's causes as well as its outcomes. Participants are then invited to select from an assortment of items and props one object for each word they have selected to act as a symbol of that concept (see figure 2).

This activity produces data in four ways. First participants discuss the problem between themselves as they decide collaboratively on what words to include in the cinquain. Here they relate personal experiences and the experiences of undertaking their work as organisations. Then there is the cinquain itself which represents an agreed set of themes and language, generated collaboratively across individual participants and organisations. A second round of discussion then takes place as part of the selecting of objects, where the aim is to probe further into the basic assumptions at play. By asking participants to consider their chosen terminology from an additional layer of abstraction, the aim is to uncover more nuanced meaning and discover any potential divergence in understanding between participants. Groups then present their work back to the other participants in the room, justifying and elaborating on the themes and language they have chosen collectively, and providing an opportunity for other workshop participants to make interventions and develop new lines of inquiry.

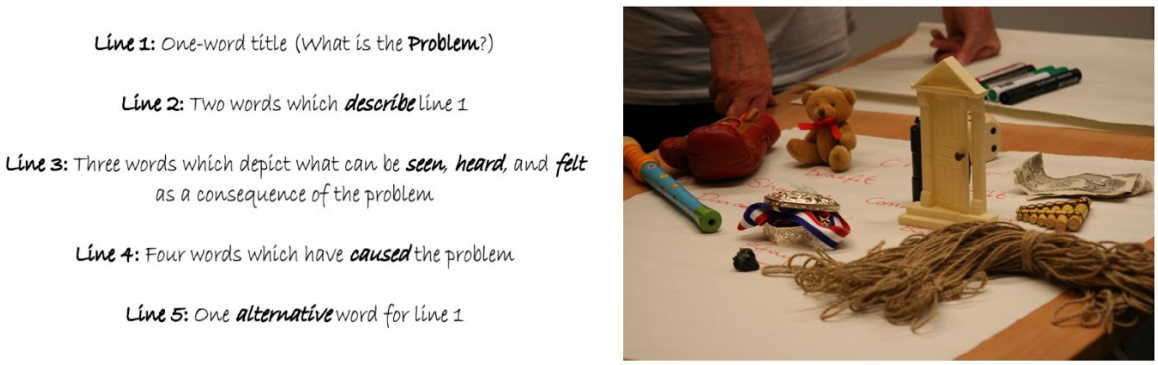


Figure 2. A typical structure for a cinquain in cultural animation (left) and a selection of objects chosen in a cinquain exercise (right).

2.1.2 Cinquain 2

Here the aim is to gain insight into participants basic assumptions about what the solutions to the problem might look like. This might include possible actions, models for future engagement, or highlight current barriers to participants' work, using the same process used to identify the problem, only now exploring models of redevelopment fit for the future. Participants are invited to discuss how the image differs from the first cinquain, exploring whether common themes are arising, if common language that is being used, and if any actions have been identified. This stage of the workshop consolidates generalisable themes and ideas. It also presents an opportunity to gather data that could inform necessary actions to improve CLD practise or improve its interactions with outside actors.

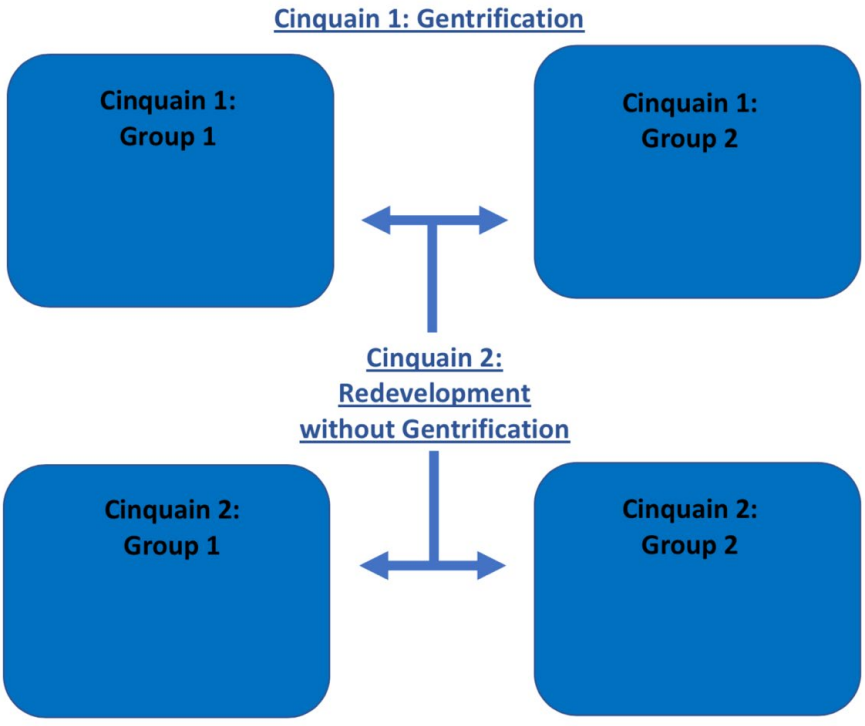


Figure 3. Expected cultural animation data.

2.2 Workshop data coding

Workshop participants comprised ten members from across five CLD initiatives. Between

them they represented three cities – London, Liverpool, Edinburgh – and were selected to participate following scoping interviews with each initiative. They included:

- Fountainbridge Canalside Initiative (FCI) – a community organisation local to the area of Fountainbridge who are collaborating with developers and the local authority on the redevelopment of a former brewery site, on which they undertook a series of "meanwhile" projects, with community members. (Participants coded – FCI1 and FCI2)

- London Community and Neighbourhood Cooperative (LCNC) – A community of interest based in home education and alternative living. The group are designing an intergenerational straw bale apartment building that emphasises small, sustainable, and communal living. (Participant coded – LCNC)

- Wards Corner Community Coalition (WCC) – A grassroots community organisation who oppose the demolition and redevelopment of the former Wards department store in Tottenham. The group have designed an alternative plan for the site as an opposition to the proposed redevelopment, emphasising restoration of the building over redevelopment. (Participants coded – WCC1, WCC2, WCC3)

- Granby 4 Streets Community land Trust (GCLT) – A turner prize winning group of residents who have regenerated houses on a street of disused terraces in Liverpool, producing interior-design artefacts such as mantel pieces, tiles, and doorknobs. (Participant coded – GCLT)

- Three members of St Ann's Redevelopment Trust (StART) – A group of residents and workers in the London borough of Haringey, undertaking a community-led redevelopment of a former hospital site. (Participants coded – StART1, StART2, StART3).

2.3 Workshop data analysis

In this section I will present the work and artefacts produced by participants, as well as detailing key moments in the discussion facilitated. I will then relate the participants assumptions to three inter-related categories of CLD practise which are renegotiation of the social relations which create gentrification, limitation of the socio-spatial issues associated with gentrification, and acts of design activism which are symbolic of a community's agency.

2.3.1 Cinquain 1: Understanding the problem

The first group comprised members of FCI, StART, and WCC. When tasked with creating a cinquain around the problem of gentrification, three participants across two organisations (StART2 and WCC1 and 2) were interested in viewing gentrification in binary terms as potentially positive and negative relative to perspective. Whilst there was some disagreement - with StART1 challenging the view of gentrification as a neutral concept - the discussion none the less continued on this basis. The discussion was broad, covering topics such as collective power ('Juntos' -Spanish for together), activism ('dancing'), 'greed', and social cleansing ('Stay'). This paper will focus on the group's discussion of value, the crucial dimension in the all their dialogue. Group 1 produced their problem cinquain as follows:

Change
(The problem)

Benefit profit
(Two words that describe the problem)

Shadow community Juntos
(What can be seen, felt, and heard)

Dancing greed building collaborating
(4 words that have caused the problem)

Stay
(An alternative word for line one)

The group chose to articulate gentrification as a problem relating to 'change'. From the outset this concept was presented as binary (potentially positive and negative), reflecting the view that 'change' can be necessary. This was stated particularly in relation to housebuilding, as rationalised by WCC1 in her reflections on development in her area.

[T]hey're sticking this 23-storey tower block at the end of my road, against all our…whatever we've tried. I have to think about that positively, I have to think that that's home for 500 people in this very small space.

The neutrality of this change is swiftly brought into question by WCC2 drawing attention to the profit motive driving the design ('they wouldn't be doing this without profit'). This establishes a binary in assumption, with WCC1 highlighting the use value of design outputs, and WCC2 highlighting their exchange value - or more broadly, gentrification as a problem of land value ('Benefit' and 'profit'). The group accredit exchange value as the driving force in design decisions such as maximising the number of units on any given site. In their selection of the term 'shadow' as what can be *seen* as a result of this change WCC1 states that '23 stories, that is literally going to throw a shadow to the end of my road' with FCI1 offering 'that goes under profit'.

Having described gentrification as a profitable change, the group noted that it can be profit going out of the community or into it. This indicates that their assumptions about gentrification do not *only* relate to a change in land value, but also a change in the configuration of socio-material networks.

[C]hange is good, but when it's not for your community, when it's bringing in a completely different group of people who have different resources to your community then it sets up a tension which is negative. (StART2)

In StART2's terms external 'communities' introduction into a locality - and the consequent redistribution of resources – creates tension between networks. In a later exchange StART2 begins to expand upon her view stating that '*I* see community, because we have an empty space at the moment, and I see a community building on that space'. This statement that she sees an empty space on which a community *could* build, is an assumption that land holds not simply use value, but a kind of speculative use value - which she suggests drives ideation in CLD processes. This is set against the kind of speculative exchange value the group perceive as currently driving design processes.

In summary, group 1's basic assumption is that gentrification is a problem associated with exchange value driven change. The outcome of this change is that new developments are designed with maximum profits in mind (building high-rise with the inclusion of as many units as possible). These developments attract newcomers to the area, leading to a redistribution of resources, which runs counter to the benefit of the existing community.

Group two was made up of members of FCI, StART, LCNC, WCC, and GCLT. Again, the group discussed the topic broadly, covering ideology ('capitalism') and hierarchy ('paternalism'), though this paper is focussed on the main thrust of their discussion which viewed gentrification as a problem of social exclusion. Group 2 produced their problem cinquain as follows:

Erasure
(The problem)

Invisible violence
(Two words that describe the problem)

Disruptive death despair
(What can be seen, felt, and heard)

Greed capitalism paternalism arrogance
(4 words that have caused the problem)

Obliteration
(An alternative word for line one)

The group chose to understand gentrification through the lens of 'Erasure'. As with group 1 this can be seen as viewing gentrification as a problematic change, with the emphasis placed in this instance on physical and social removal. As their object for this concept the group chose a brush (see figure 4), 'not to paint something on, but to brush it away. To rub it out' (LCNC, Feedback). Their rationale was based in their discussions around social exclusion. The group described this perceived problem as a form of 'invisible violence' seen as literal violence to the built environment and its inhabitants. The violence of gentrification is reflected in Neil Smith's work on the revanchist city (1996), in which Smith compares the 'gentrification frontier' and the 'frontier' imagery used in the design of posters and advertisements for new development, to the frontier narrative of the United States in the late 1800's; leading to the deprivation and forced relocation of native Americans. In this instance the group included as outcomes of this social exclusion first 'disrupt[ion]' which FCI2 connected to *The Shock Doctrine (Klein & Smith, 2008)* a theory which posits that crises can be exploited to push through controversial policies while citizens are too distracted by disorder to resist. GCLT associated this disruption with disinvestment, broadening the scope of social exclusion to include economic exclusion as well - in this case, communities being excluded from investment.

'You can see it in what happens to the area, you see the rubbish building up, you see the neglect'.

Disinvestment is a crucial dimension in Smith's rent gap theory (1979), in which economic withdrawal from an area (de-valuing the worth of the improvements on a piece of land) precipitates cataclysmic re-investment (re-designing the land for a more profitable use) and consequent gentrification. The ultimate outcome of the necessary social/economic exclusion to create the rent gap is delineated as follows.

[P]eople actually die, because they are forced out of where they live. We've lost our members. (GCLT)

The causation of early death - attributed here to economic and social exclusion – is defined by the group as resulting from physical displacement from the outputs of urban design (in

this case housing). There are some data sets to support this, with reports noting an increase in deaths of people who are homeless or in temporary accommodation (ONS, 2019). The group offer the word ‘obliteration’ to epitomise social exclusion. When selecting an object to represent this obliteration they chose a blank scroll (see figure 4), providing the following rationale.

This is the social contract which has been obliterated. These are the laws, this is the charter. It's gone, we don't have it. We fought hard for it. The magna carta. Kill the king. (StART3)

Here the group articulate social exclusion as a breakdown in legitimacy of the authority of the state over the individual. The group expand on the exclusion caused by gentrification as they see it to include not only social and economic exclusion, but exclusion from state processes.

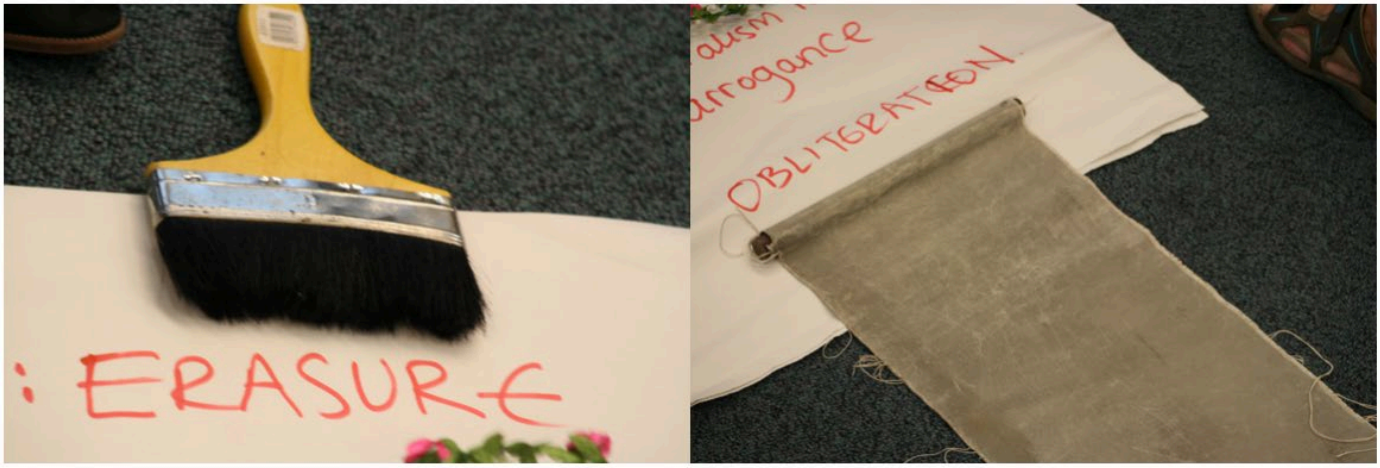


Figure 4. Group 2 chose a brush to illustrate being wiped away by ‘erasure’ (left) and a blank scroll as the social contract which has been obliterated.

To summarise, group 2 - as with group 1 – articulate gentrification as a problem associated with change, expressed through the lens of removal. This removal was understood by the group as a product of social exclusion, drawing particular attention to the violence they associate with it. The outcomes of this social exclusion are delineated as disinvestment in buildings and services, causation of early death, and a physical exclusion from the outputs of urban design. They express a crisis of legitimacy in the actions of the state in facilitating development (including by extension designers acting as DeCarlo’s operative appendage).

2.3.2 Summary cinquain 1

Participants basic assumptions about gentrification can be broadly categorised as gentrification as *value change* and gentrification as *social exclusion*. Group 1 view gentrification as a set of socio-spatial issues resulting from the struggle for hegemony between two competing interpretations of the value of design outputs (use vs exchange), whereas group 2 see the problems associated with gentrification as arising from social exclusion from the processes and outputs of design, which arise through exploitative social relations.

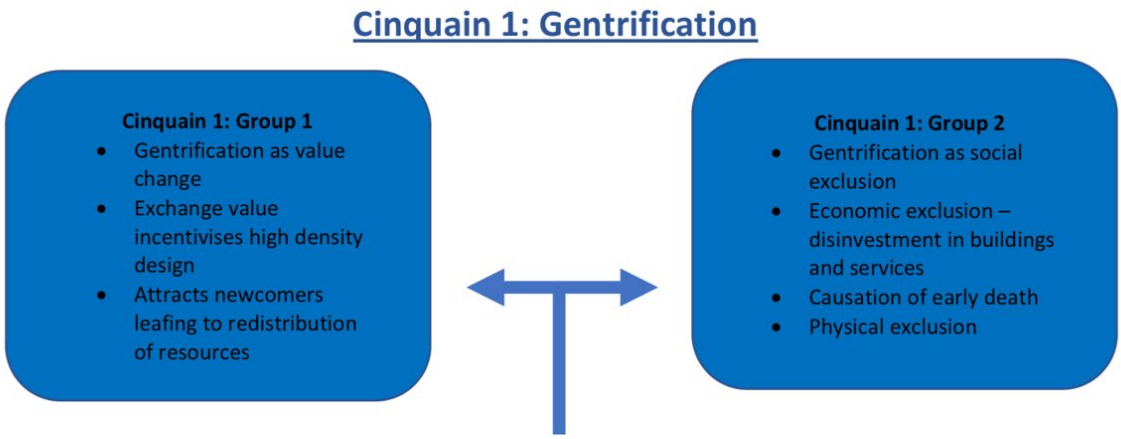


Figure 5. Cultural animation data collected for both groups from cinquain 1

2.3.3 Cinquain 2: Understanding the solution

Group 1 decided to keep the word 'change' as the foundation of their second cinquain. There was a challenge to this decision from StART1, who questioned the necessity for change and expressed a desire to preserve community and culture stating that if it must be change, it should be 'consultative' and 'community-led'. Group 1's second cinquain went as follows.

Change
One word which represents a positive future

Wellbeing engagement
Two words which describe it

Light community juntos
What can now be seen, heard, felt

Dancing feeding growing equalising
Four Actions that create the change

Justice
An alternative word for line one

In the above discussion around 'engagement', the group focussed on the need for transparent design processes. As their object for this word they chose an open doorway (see figure 7), stating in the feedback that '[t]his is our housing that has now opened up, to whoever wants to be involved' (WCC1, Feedback). This places the locus of attention on open design processes and community engagement as a legitimate mode of redevelopment. In describing the outcomes of their vision of 'change' in line three, the group's conversation was mainly focussed on economic redistribution. The object chosen to represent community was money (see figure 7), with '[f]eeding' and 'growing' being expressed in terms of investment that could 'equalise'. This was particularly in relation to 'feeding' where the group referenced economic redistribution citing 'all the money off in the Cayman Islands' that should be 'spread around' (WCC1, Feedback) as a way of providing communities with the investment they need. In the final line of their cinquain the group decided that their alternative word for the 'change' they felt necessary, was 'Justice'. For this they used a piece of rock (see figure 9) stating that, '[j]ustice is our rock, where we want to end up, and begin from', reinforcing the groups key focus on equality.



Figure 7. Group 1 chose an open doorway as symbolic of the concept of engagement (left) and money as symbolic of investment (right).



Figure 8. Group 1 chose to use a rock to illustrate that justice was at the foundation of the work that they do.

To summarise, group one still recognise the need for change in their communities, however they identify that this change needs to be designed with the involvement the community affected by it. The group predict that the outcomes of a participatory change will be a transparent process involving any stakeholder who wishes to participate. It is noted that for this change to be created some redistributive form of investment into the community is required to help them develop. The group see that justice has to be both the foundation and the aim of any change that can happen without causing gentrification.

The second group set out to define their cinquain for change as contrary to the situation that currently exists as they perceive it. They placed their emphasis on maintenance of the built environment *and* the social environment and defined a need for transparency to raise awareness of citizens' capacity to act. Democratic control of the economy was highlighted as a necessary action, with the legitimacy of the state being derived from citizen participation in the design process. Group 2's cinquain for change went as follows.

Sustainable

One word which represents a positive future

Visible commonweal

Two words which describe it

Creative life love
What can now be seen, heard, felt

Reciprocity cooperation justice R.E.S.P.E.C.T
Four Actions that create the change

Creation
An alternative word for line one

Keeping as their object for line 1 a paint brush, the group stated that ‘instead of covering it makes new, and it makes new sustainably’ (GCLT, Feedback). As with group 1, group 2 discussed transparency. In this case what is ‘visible’ is the ‘commonweal’, a Scots term meaning ‘the common wealth that we have to share’ (FCI2, Feedback). This alludes to the idea that design outputs have to be sustainable but sustainable in a way that is visibly for the common good.

As with group 1, in line 4 of the cinquain whilst discussing the actions necessary to create change sustainably the question of money was raised. The group stated that ‘we control it now, it is controlled by the commonweal’ (FCI2, Feedback). In contrast to group 1, here the emphasis is on economic control by the community - as opposed to redistribution through investment – with the assumption being that community control would mean control by the ‘commonweal’. In the final line the group offered as an alternative word for sustainability ‘creation’, they chose as their object the same scroll as they used in their first cinquain, only now it has been filled again, indicating the creation of a new social contract based on these terms.

To summarise, group 2 view redevelopment without gentrification as redevelopment that is undertaken sustainably and is evidently in the shared benefit of all. The outcome of this sustainable redevelopment should be to reverse the destructive trends of current models. The group viewed it as necessary in achieving sustainability, that some degree of economic control be given to communities as part of the establishment of a new social contract.

2.3.4 Summary cinquain 2

In the two pictures of redevelopment without gentrification the groups continued to work through the lens of change. What they created can be categorised broadly as equitable change (group 1) and ecological change (group 2). The picture of equitable change focusses on participation in the design process, with the group highlighting the redistribution of wealth through investment as a necessary action in achieving equity. The picture of ecological change assumes that sustainability is achieved through development designed in best interests of all. It emphasises the creation of a new social contract that reverses the destructive forces of current models and highlighted the need for some form of economic control by the community, perhaps in an effort to cut loose one of the threads tying designers to the ruling powers.

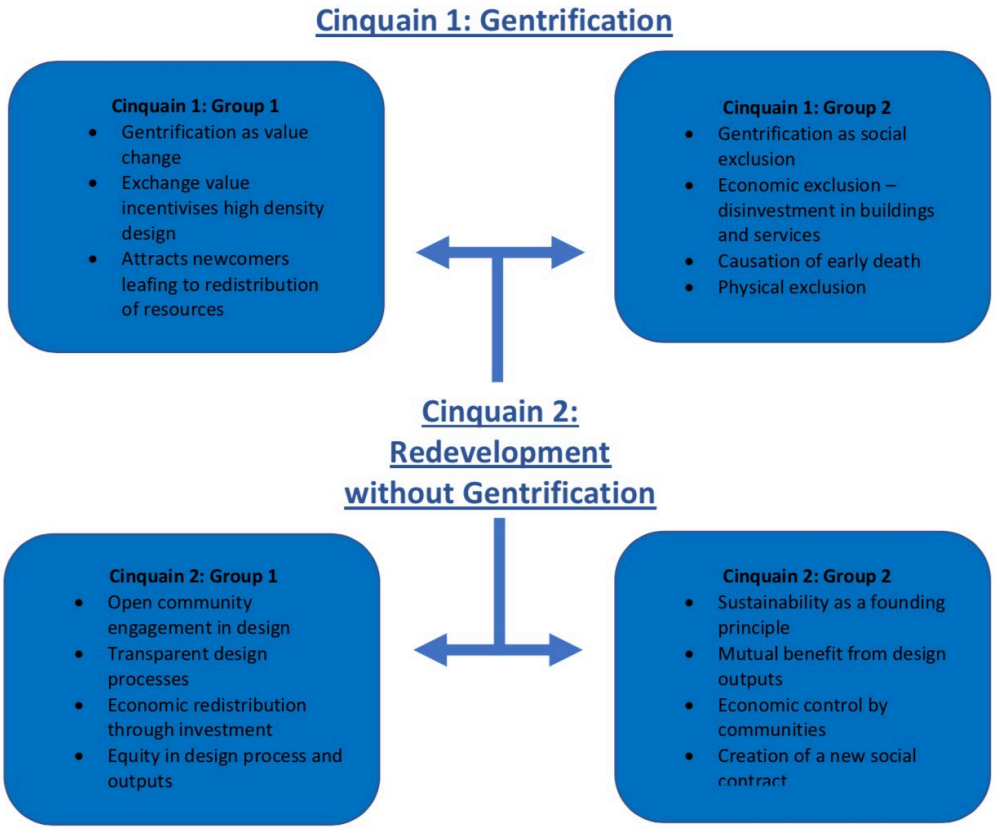


Figure 9. All cultural animation data collected from both groups

3 Conclusion

Participants basic assumptions about gentrification can be categorised as understanding gentrification as both value change and social exclusion. In both groups' explorations of redevelopment without gentrification, a desire was expressed to fundamentally renegotiate the social relations of production underlying gentrification – i.e. the relation to the built environment that says that the maximum return on the exchange value of a site should be central in its design even if resulting in social exclusion. Participants have a clear desire to participate in the design process viewing this as a method through which to guarantee equitable design solutions and return legitimacy to urban design.

So how can CLD practises guarantee these equitable and legitimate outcomes? First there are CLD practises which achieve to some degree this renegotiation of the social relations described above. This necessarily entails the removal of land and/or property from the market place, a kind of re-commoning, enabling design of buildings and space to be entirely dictated to by the needs, desires, and tastes of the end users. Of the initiatives attending the workshop this includes community land trusts like StART, GCLT, and LCNC in which land is democratically owned, developed, and designed to provide affordable homes to CLT members in perpetuity. Second there are CLD initiatives whose work places limitations on the socio-spatial issues associated with gentrification. This includes groups like WCC, who's designs – whilst viewed as a more equitable output for local users – work within the current confines of the speculative land market. Finally, there are groups engaged in design activism in the sense delineated by Markussen (2013), where aesthetic interventions are made as disruptions to existing systems, creating a space in which ways of living and working can be

engaged with critically. We can take here the work of FCI and it's "meanwhile" projects, in which a range of temporary design outputs such as a community pavilion and a theatre space were used as a living demonstration of the kind of exuberant and diverse space that could exist, inviting local citizens to engage with council and developers about the kind of development they would like to see.

There is a tendency in design thinking to view problems as arising from a lack of innovation. Participants in this workshop point to the need to acknowledge in design processes the existence of exploitative social relations, offering a range of practises with which to challenge the design of the urban landscape. To relinquish the role of 'operative appendage' to the dominant ideology of our time, design must build renegotiation, limitation, and activism into its practise.

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Rehabilitation Design Intervention for Older Adult Women through Community-based Co-Design Activities

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This study focused on rehabilitation design intervention for older adult women with low-back pain through community-based co-design activities. The aim was to gain insights from co-design approach to rehabilitation design for older people. A series of collaborative design activities were arranged to organize the design phases and get the data that guide the contents in the subsequent phases by evaluating and adapting initial conditions and design solutions. Firstly, we conducted an exploratory research to analyse the current situation for health conditions and identify major health problems related to older people. In this stage, we found that low-back pain is the major health problem among older adult women from the community of older people in the senior care centre. Secondly, the results of co-design activities were presented, which defined design target and specifications that lead to the early design and development of rehabilitation design intervention. Finally, a confirmatory research was conducted in which the effect of the rehabilitation design intervention on muscle activation level and low-back pain intensity of the older adult women was measured. The results showed that the intervention has positively influenced both muscle activation level and low-back pain intensity. This study can be concluded that the collaboration among multiple stakeholders can enable clear views on the end-user's abilities in design research, which minimize the gap between community members who are central to the study and the design team. The outcomes of such collaborations can contribute to the design of a rehabilitation intervention for affordable healthcare system and also to the portability and ubiquity of the exercise training for older adult women.

Keywords: rehabilitation design intervention; community-based co-design; low-back pain

1 Introduction

Owing to the progressive decline in health and physical fitness of the ageing population, there is an increase in the number of people with chronic pain that result in disability (Pericu, 2017; Blaschke et al., 2009; Groeneveld et al., 2013). The major decline is the rate of spine related disorders that is relatively higher in old age and causing chronic low-back pain (Hayden et al., 2005). The rate of low-back pain is 60–85% during a person's lifespan (Lizier et al., 2012; Andersson, 1999). The pain is itself a common symptom mostly in older adult

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women (Jaul and Baron, 2017) and 90% of cases are nonspecific because it is not attributed to a recognizable known pathology (Mahel et al., 2017; Balagué et al., 2012).

Due to a number of side effects of the institutionalized care, such as surgery, drug remedies, and non-medical interventions, the importance of rehabilitation through exercise interventions is increased (Piette, 2010; Schreiber et al., 2015; Tones et al., 2006). In old times, rehabilitation was used to recognize the requirements of populations with disabilities. In recent years, the focus has been towards the needs of older people in the community with or without disabilities (Kumar, 2009). Most rehabilitation centres tailor their own objects based on the user's needs and desires. Patients or trainers use universal products as a foundation to design their own personalized objects for healthcare (De Couvreur and Goossens, 2011).

There is an increasing interest in the potential of design approaches towards rehabilitation design by addressing fundamental and yet practical challenges to the healthcare of ageing population. Designers are interested to facilitate co-design activities in the context of healthcare with the aims to positively change the current practices and behaviours (Chamberlain and Partidge, 2017). Co-design is recognized for its benefits in reaching deeper understandings on circumstantial user requirements, and improved value and design process (Steen et al., 2011).

Co-design can generally be applied in situations where subjects are marginalized but experts of their own domain and well-informed about their needs and capabilities that can significantly influence the design process (Ssozi-Mugarura et al., 2017). Older adults with indigenous knowledge (Winschiers Theophilus et al., 2010), deaf people (Blake et al. 2014; Blake et al. 2011), homeless individuals (Southern et al. 2014; Yoo et al. 2013), and children (Bossavit and Parsons 2016; Sanders, 2000) are the key examples of the subjects that form community groups for a deeper understanding of the situations in which implementations can take place over an active engagement and involvement (Dearden, 2008; Ssozi-Mugarura et al., 2017). Community groups are also distinguished by age, gender, and physical capabilities (DiSalvo et al., 2012).

The present study focused on rehabilitation design intervention specifically developed for older adult women suffering from low-back pain. The study was carried out using community-based co-design activities. This approach is developed by Blake et al. (2011) and further studied by Ssozi-Mugarura et al. (2017) to evolve a method that can facilitate collaboration for mutual benefit. It has two parts: co-design and community-based. In a co-design approach, all stakeholders, including designers, researchers, clients, and community groups who will ultimately benefit from the co-designing experience collaborate creatively in the whole design process (Steen et al., 2011; Groeneveld et al., 2013; Sanders and Stappers, 2008). Community-based is endorsed by applying design methods in the context of a community of people (Blake et al., 2011; Groeneveld et al., 2013).

In the present study, the collaboration has taken place with 20 older adult women from the community of older people in the senior care centre, a physician, rehabilitation therapist and exercise trainer, a medical student, and the design team with three design researchers. The purpose of the study was to gain insights into the benefit that co-design approach might have on rehabilitation design. For this, we arranged a series of collaborative design activities and organized the design phases to get the data that guide the contents in the subsequent phases by evaluating and adapting initial conditions and design solutions.

We firstly conducted an exploratory research to analyse the current situation for health conditions and identify major health problems related to older adult women. In this stage, low-back pain was identified as a major health problem among the older adult women from the senior care centre. Secondly, the results of co-design activities were presented, which defined design target and specifications that lead to the early design and development of rehabilitation design intervention for older adult women. Finally, we conducted a confirmatory research to assess the effect of the intervention on muscle activation level and low-back pain intensity with older adult women.

2 Research Methods

This study is based on Community-based Co-design process, which includes participatory action research and design approaches, such as contextual inquiry, quantitative and qualitative research designs. The outcome of these approaches can be much more than the design solutions. In the present study, we made initial engagement with older people in the senior care centre through workshops, focus group discussions and observations. The workshops were lasted for five hours in length each day from 2-3 days. Co-design ideas regarding rehabilitation design were expressed in open discussions where each participant shared their experience regarding health problems associated with older people and its possible solutions were highlighted. Older people shared their opinions about the current exercise training programs and its side effects, such as conservative treatments, hard core exercise training with discomfort and tiredness.

According to Ssozi-Mugarura et al. (2017), community-based co-design is achieved through a six cyclical and iterative research process (See Figure 1). In this process, situation analysis is conducted to understand the current conditions. This step identifies the current problem in the present context. This makes ways for collaborative design in which the focus is specifically towards the end-users because their interests are the driving force behind the design process and they are the main stakeholders involved in defining the problems, articulate design criteria and help in design solutions (Groeneveld et al., 2013). In collaborative design, the foundational knowledge of the design situation is gained from other stakeholders on a community level, such as the older people, physician, therapist, exercise trainer and the senior care centre. Moreover, the design phases are organized to get the data that guide the contents in the subsequent phases by evaluating and adapting initial conditions and design solutions. The summary of the process is presented in the following subsections.

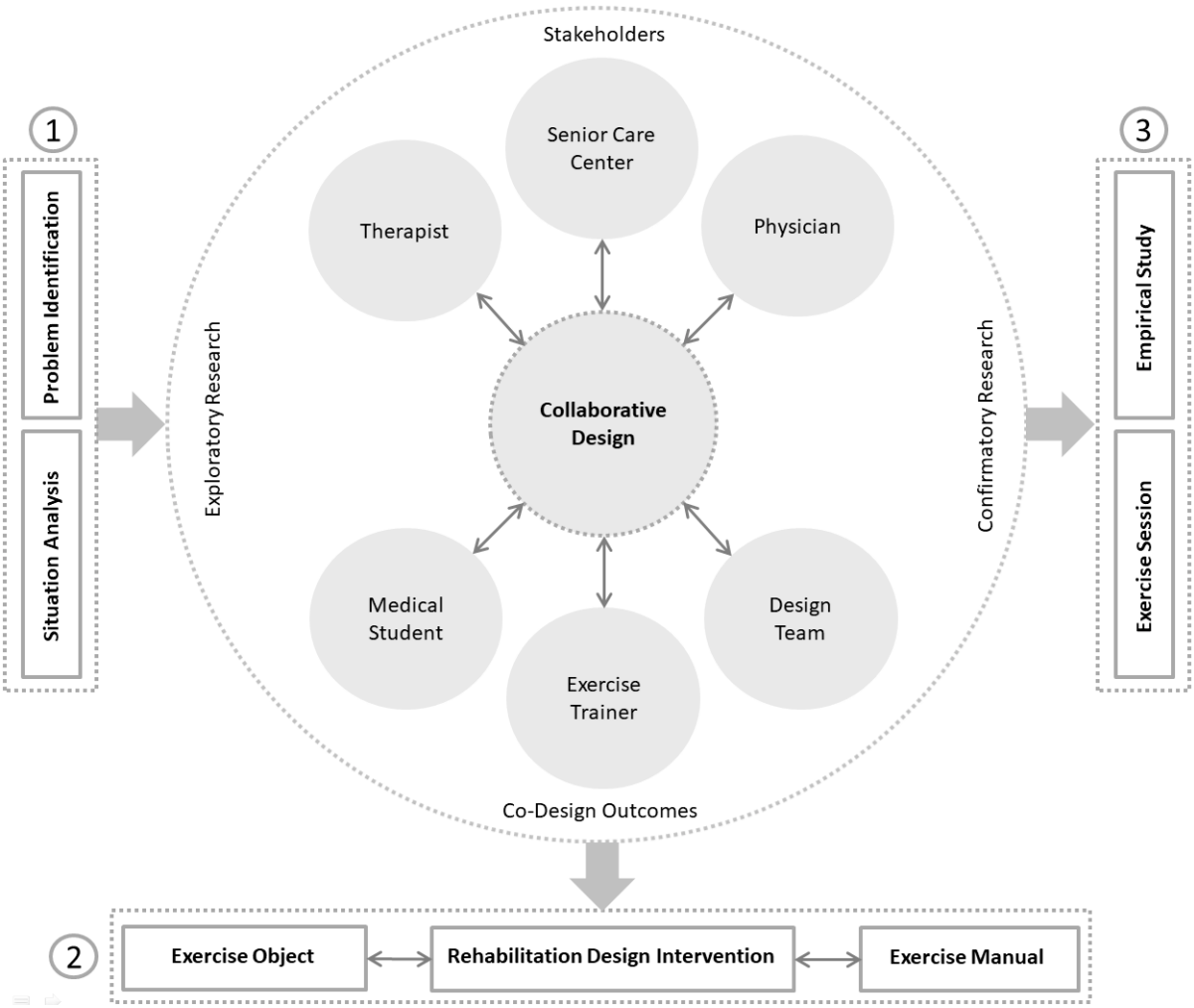


Figure 1. Iterative community based co-design research process for Rehabilitation Design

2.1 Exploratory Research

We thoroughly discussed with the physician, therapist and the exercise trainer about the spine abnormalities that cause low-back pain, and its possible solutions in the rehabilitation design settings. This was a discussion session in which the partners shared their past experiences to construct a view on the context of spine related disorders. The therapist and the trainer had trained several patients who had spine abnormalities in the local training centre. During the session, they also shared their training manuals and customized objects. The physicians discussed muscle anatomy and shared some cases in which the patients were treated with the same abnormalities. This session determined three factors that contribute to low-back pain: *spine abnormalities*, *poor posture stability*, and the *back muscles stiffness*.

We arranged several meetings with the senior care centre in Ulsan City in South Korea regarding the arrangement of collaborative study by presenting our study protocols, objectives and the outcomes. The centre's officials were agreed to collaborate with us, and thus they announced it to the older people in the care centre and around one hundred older people were agreed to participate in this study.

We arranged a workshop in the senior care centre in which we listened to the voices of the older people and their experiences with low-back pain (See Figure 2 as an example). Most

of the older people were suffering from spine related disorders and some of them had spine surgeries due to which they had low-back pain.



Figure 2. Senior care centre, exercise training centre and workshop settings

Based on the informed consent, a total of 30 older adult women were exposed to a medical check-up and a radiographic examination using X-ray imaging in a local clinic with the physician. 20 older adult women were found to have low-back pain. They also had major and minor spine deformation based on the medical reports. We arranged another workshop with these patients along with the therapist and the trainer to discuss the pain management. During the workshop, the therapist and trainer showed their training manual and exercise object and trained some patients for a while. They used a customized training object with an inclined slope with 20°, which was made by the training centre for muscle stretching exercise and asked their opinions regarding the training. We collected answers like, “intensive exercise training cause discomfort and tiredness”, “the exercise is helpful for muscle stretching and better than conservative treatments” and “I felt some muscle fatigue due to muscle stiffness”. This activity helped us to address the areas in the body where the patients felt fatigue during the training. These areas were traced by applying the existing methods those from Lehman et al. (2004), and Vera-Garcia et al. (2010) to find appropriate muscles for which a specific training can be designed. These muscles were Latissimus Dorsi (LD), and Lumbar Erector Spinae (LES).

Firstly, we studied the anatomy of the muscles specified in the previous stage by the physician and the therapist and conducted literature review on the training exercises for muscles around the spine. We arranged several discussion sessions with the therapist, trainer, physician and the patients and discussed a concise literature study on the muscle stiffness and its specific training. The rationale was to design a training that can manipulate the back muscles (LD and LES) to keep the spine within the normal curvature, thus the conforming symptoms of low-back pain can be prevented. This session was very informative, which inspired us to further the study. Based on several exercise trials with the patients, consulting previous studies, such as Rainoldi et al. (2004), Nam et al. (2017), Ginn and Halaki (2015), and Lovell et al. (2012), we designed a 15-step training manual with the customized training object based on 20° inclined slope surface. The customized object is presented in Figure 3 as an example.



Figure 3. Inclined sloped training object used for training

2.2 Confirmatory research

During the co-design activities, we noticed that the patients were excited about the exercise training. Thus, we decided to conduct an empirical study with the patients for a period of five weeks. Although this period was not enough for the completion of the training but our intention was to observe some effects of the training on the patients. Generally, a longitudinal study required an adequate amount of time to achieve the study objective; however the patients had different time schedules and daily life routines and some were not available. As such, we could not extend the training period. Based on the consent of the patients, we conducted the training sessions with eight patients from Monday to Friday and Saturday and Sunday was set for resting. We conducted two measures: Self-report low-back pain intensity (LBPI) using Post Wong-Baker Pain Rating Scale[1] with anchors (0 = “No Pain”, 10 = “Worst Pain”), and muscle activation level (MAL) using electromyographic (EMG) activity. The rationale behind these measures was to observe the effects of the design intervention on the patients’ muscles and pain intensity. Figure 4 shows the EMG activity as an example.

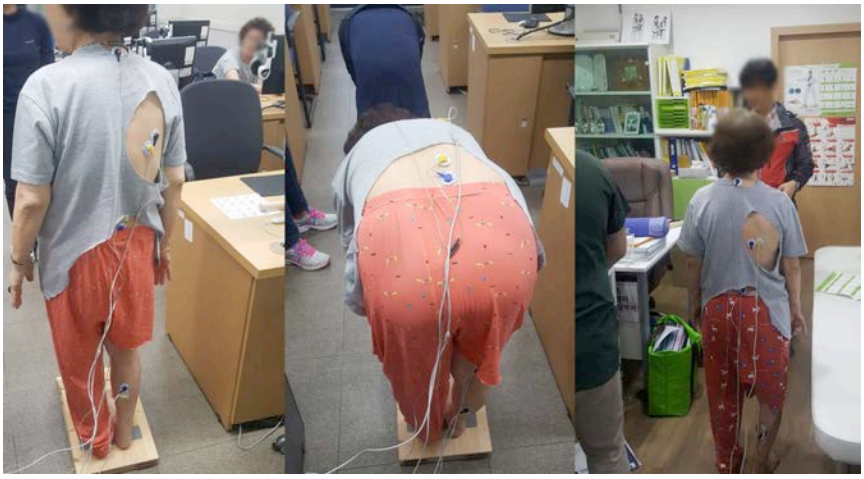


Figure 4. EMG activity

The EMG data was collected simultaneously from LD and LES muscles using surface bipolar electrodes from eight older adult women. For this purpose, a 4-channel EMG device (sEMG-4, PolyG-A, Laxtha, Ulsan, Korea) was used. The electrodes were placed on the specified muscle bellies at standardised sites (Lehman et al., 2004; Vera-Garcia et al., 2010). After cleaning the skin with ethanol, disposable Ag/AgCl surface electrodes disks with a

1For Wong-Baker Faces Pain Rating Scale: http://wongbakerfaces.org/

diameter of 11.4 mm were placed on the sites. The sampling rate was 256 Hz and the signal was amplified with an overall gain of 210.084 and filtered to produce a bandwidth of 4–120 Hz using band pass. Besides, Notch filters were used at 60 Hz. The data was recorded and digitize using Laxtha Telescan 2.89 software. We developed a program in Matlab for EMG signal normalization for further analysis.

The self-report LBPI measurement was conducted after each day exercise training while the MAL measurement was arranged on every Friday for a period of five weeks. To obtain MAL for each muscle, we firstly collected the maximum voluntary contraction (MVC) of the specified muscles (MVC Value) for five seconds. Subjects were asked to ramp up to maximum power over the first two or three seconds, retaining full effort for the remaining time. MVC is a standardized method for measuring the strength of muscles. We then recorded the muscle activation level (Raw EMG Value) during the exercise training. The normalized EMG data was obtained by dividing the raw EMG values by MVC values and multiplied by hundred (Sousa et al., 2012).

3 Results

3.1.1 Workshop results

During the co-design process, all patients were directly involved in the training and the subsequent discussions on each exercise step. The report of workshop activities showed that the participants had concerns about some of the steps in the exercise training because of the discomfort and fatigue caused by the training. The report revealed that these steps required much time to complete the whole training while the target users were the older population who is a vulnerable group of the society. In any case, they might be felt fatigue and lost stability and because of their worsening of fine motor skills (Tufail and Kim, 2017), they might be dropped or slipped from the training objects. Therefore, the design intervention was made by eliminating eight steps that contributed to discomfort (See Table 1). In addition, the slope angle of the exercise object was reduced to 15 degree slope inclination.

Table 1 The 7-step training manual along with the specified muscles and location

	Training Step	**Muscle**	**Location**	**Body Position**
1	Standing position (Normal standing)			Standing on feet
2	Maintain standing posture and breathe long			Use inclined plane with 15° slope
3	Standing with hands up	LD and LES	Lateral trunk around the spine	Lateral Bending
4	Bending towards right and left side			Right bend
5	Making an S shape with the body			Left bend
				Forward bend
6	Expanding hands forward			Flexion
7	Bend Forward and Downward			Forward bend
				Downward bend

3.1.2 Empirical results

The rehabilitation design intervention was evaluated by using empirical analysis. For this purpose, we used repeated measure ANOVA design. The dependent variables were LBPI measured through post subjective self-report responses, and MAL for LD, LES, AM, and GM muscles based on objective measures of the normalized EMG data collected for a period of five weeks. The independent variable was the rehabilitation design intervention with five

levels (Week 1 to Week 5) of the within subject factors. Follow-up post-hoc comparison using LSD test was conducted to explore a significant main effect of the design intervention with the five levels on LBPI. The same procedure was applied to examine the effect of the design intervention on MAL for each muscle.

The results indicated that the LBPI score statistically differed across each level of the rehabilitation design intervention: $F(4, 28) = 15.65$, $p < 0.05$, $\eta p2 = 0.691$ (See Table 2).

Table 2 LBPI score across the design intervention levels

	Mean	**S.D**
Week 1	6.25	0.98
Week 2	5.83	1.22
Week 3	4.45	0.46
Week 4	4	0.94
Week 5	3.62	0.33

As shown in Table 2 above, the mean LBPI score at week 1 and week 2 was higher than that of week 3, week 4 and week 5. It indicates that participants perceived certain decrease in the pain intensity when the exercise was continued in the later weeks. As shown in Figure 5, the score of LBPI was lower at week 5, which indicated that when the exercise is continued the pain intensity is decreased. These findings clearly indicate that the rehabilitation design intervention can positively influence the pain intensity with the ongoing exercise training using the intervention (See Figure 5).

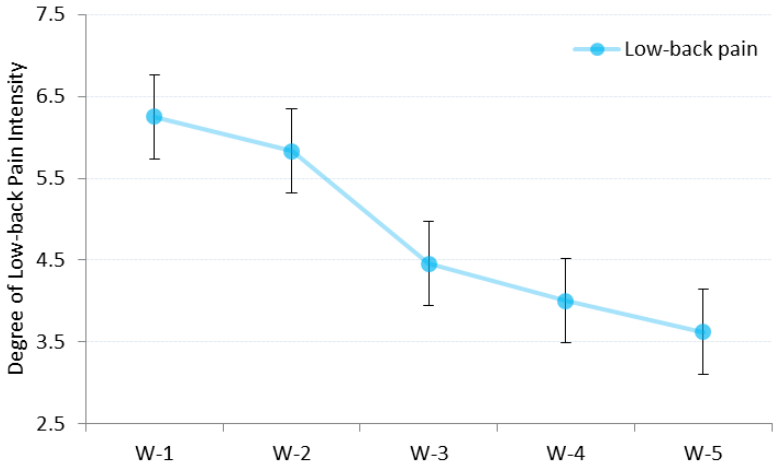


Figure 5. Low-back pain intensity with five weeks training

We performed repeated measure ANOVA tests to measure the effect of the design intervention with five levels on MAL of LD and LES muscles.

The results showed that MAL for LD muscle differed significantly between the intervention levels: $F(2.03, 12.23) = 5.37$, $p < 0.05$, $\eta p2 = 0.472$ on a greenhouse-Geisser correction (See Table 3). However, this difference is against our assumptions that the muscle activity level gets higher when the muscle is effectively trained with the exercise. There was no statistical difference between the mean LD at week 1, week 3 and week 5, indicating that the rehabilitation design intervention retains the muscle activation level of LD muscle in the later weeks.

The results showed that MAL for LES muscle differed significantly between the intervention levels: $F(2.14, 12.85) = 22.13$, $p < 0.05$, $\eta p2 = 0.787$ on a greenhouse-Geisser correction. It indicates that the rehabilitation design intervention significantly influenced the muscle activation level of LES muscle.

Table 3 Muscle activation levels of LD and LES

	Muscle	Mean	S.D
Week 1	LD	29.61	7.57
	LES	18.39	4.21
Week 2	LD	20.69	8.94
	LES	34.48	10.91
Week 3	LD	28.96	8.10
	LES	39.36	8.70
Week 4	LD	23.74	7.75
	LES	38.17	8.57
Week 5	LD	27.99	13.64
	LES	36.29	12.33

As shown in Table 2 above, the mean LES muscle at week 1 was lower than the mean LES muscle at week 2, week 3, week 4, and week 5. It indicates that the intervention design increased the MAL for LES and maintained the muscle strength in the later weeks (See Figure 6).

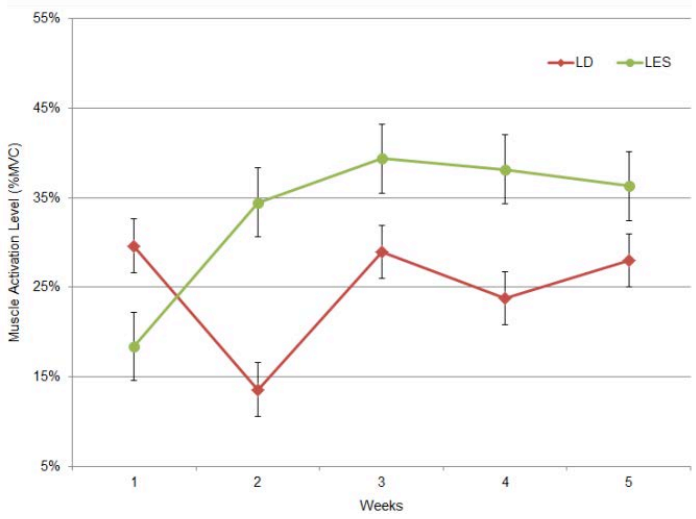


Figure 6. Muscle activation level for LD and LES muscles with five weeks training

The above results showed that the rehabilitation design intervention positively influenced both muscle activation level and low-back pain intensity. The muscle activation level can be increased by training the muscles that can ultimately decrease the low-back pain intensity. However, the effect of the intervention design on the low-back pain and muscle activation level is lower because the specified duration of the exercise training is not enough due to which some participants reported additional time period for muscle training.

3.1.3 Interview results

Overall, the patients expressed positive views about the exercise training in the subsequent interviews. A summary of the interviews are presented below.

- All patients were grateful that the training helps decrease the pain, some patients believed that the training also decreased their leg pain
- The exercise object with 15 degree slope angle benefits muscle relaxation and posture correction
- Patients requested to take the training object to their homes to keep the training continue
- Patients believed that the training helps them on their knees, shoulders and waist exercise
- Some patients mentioned to suggest the training to their friends and families

As the patients were active partners in the co-design process, thus we valued their opinions and desires, which they expressed throughout the study. As per their request, we provided them the exercise manual along with the training object so that they can continue the training in their homes. Once they trained their muscles successfully with the intervention design, they will contact us again to further the design and development process. Overall, we noticed considerable improvements in the patients' health condition based on the current findings.

4 Discussion and Conclusions

This study presents rehabilitation design intervention using community-based co-design activities. A sequence of methods was used to define a design target based on low-back pain caused by spine related disorders experienced by older adult women. Community-based co-design has provided significant results. A design solution was conceptualized and iteratively developed in discussion with various partners in the co-design activities. The solution provided in this study has the potential to reduce low-back pain intensity by inducing muscle stretching exercise and posture correction training. Studies have shown that poor posture and inadequate body movements reportedly increase spine deformations that ultimately cause low-back pain though age factor, fitness, stress and physical and occupational overload also contribute to the pain (Searle et al., 2015). Low-back pain is a backache associated with muscle stiffness located under the last rib and above the lower gluteal muscle folds with or without leg pain (Chou et al., 2007). We found that the low-back pain intensity was decreased in the last week training comparing with the training on week 1. Similarly, we found that the muscle activation level was increased in the last week training when compared with the first week training. This shows that low-back pain intensity is associated with the muscle activation level. Although the results of the training were significantly effective but there were a number of issues that needed to be address in order to use the exercise object for household training purposes. This issue was raised when the patients showed their interest to continue the exercise training after the duration of the five weeks study. The object was made of wooden boards that needs significant changes in its shape and structure. It has a poor mechanism for angle adjustment, stable angle fixation and folding function for portability, which made the use of the object challenging because the target users were a vulnerable group of the society. Thus, future work should be conducted to design the object that meets the above issues. The internal and external properties of the exercise object involved system level design that assembles the product properties and

components from the concept development, determine the combination among the components, and demonstrate the detail design for design verification, testing, and refinement should be studied (Lee et al., 2017). Moreover, the shape of the human body, various angle adjustment and stable angle fixation mechanism should also be considered.

The rehabilitation design intervention may contribute both to the affordability of the healthcare and also to the portability and ubiquity of the exercise training based on its ease of use. The intervention is especially design for the ageing population; they can perform the training at anyplace as the exercise object is lightweight and small in size. The participants are currently using the rehabilitation design intervention in their homes, which is a commitment to a long-term collaboration beyond the initial design for experiment and remains an important aspect of the community-based co-design process. This study concludes that the collaboration among multiple stakeholders enable clear views on the end-user's abilities in design research, which minimize the gap between community members who are central to the study and the design team who are external researchers. Further study will be carried out into the application and adaptation of the approach in following development phases of the current rehabilitation design intervention by contacting the patients to understand the long-term effect of the exercise training.

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Seeking Emotions in Mobility Experience Elicitation: A Singapore-France Comparison

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Designing mobility experiences is complex. Technical issues can be out of a designer's scope or require the long-term development of solutions. Emotions and contexts shape user perceptions of experiences – the stronger the emotional reaction, the better people remember the experience. In this exploratory study, the focus is on the research stage of the design process and seeks to identify and characterise the interactions leading to emotional responses in users' mobility experiences. Three methods were applied to two studies in Singapore and Paris, France to collect people's lived experiences with mobility: diary cards, user journey maps and text stimuli. Results showed that people tend not to perceive mobility experiences emotionally. When they do, the emotions trend negatively due to deviations from expected service performance. An evaluation of the methods used led to a proposed set of parameters for the development of a tool to design emotional experiences.

Keywords: emotional design, empirical design, data collection methods, user experience, mobility

1 Introduction

Designing mobility experiences on public transport is an endeavour due to the complexity of product-service systems, which include infrastructural and operational requirements reliant on non-design departments. The drivers of public transport passenger satisfaction and affect have multiple directions of causality – variables play both positive and negative roles in impacting fatigue or un/pleasantness (Mokhtarian, Papon, Goulard, & Diana, 2015). Since people best remember experiences associated with strong emotion (Van Hagen & Bron, 2014), emotion can aid designers in the research stage with users to identify key concerns (Desmet, Fokkinga, Ozkaramanli, & Yoon, 2016). The overall goal of the study is to identify opportunities for 'quick wins', instead of solving the problem with technical solutions. The authors propose to modify users' perspectives of their experiences by inserting emotionally-driven design interventions at key moments to amplify positive and mitigate negative emotions for improved mobility experiences (Figure 1).

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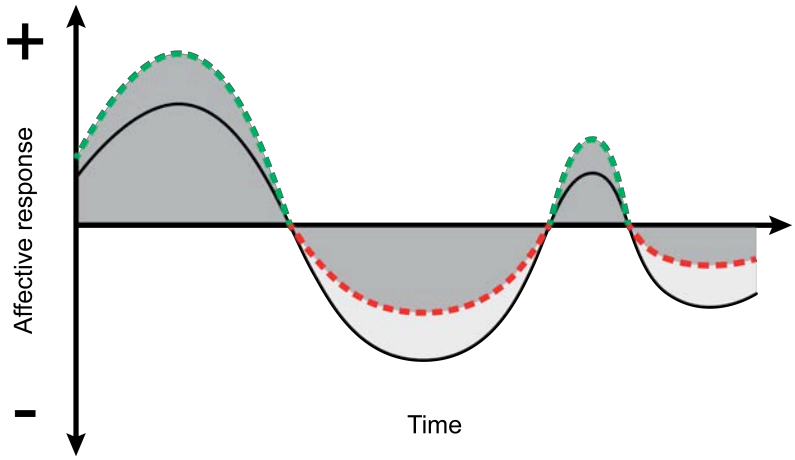


Figure 1 Amplifying peaks and mitigating dips, based on the peak-end rule (adapted from Van Hagen & Bron, 2014).

2 Deconstructing Mobility Experiences and Emotions

Woodcock et al. (2014) propose a description of door-to-door passenger experiences in 7 travel stages. Al Maghraoui et al. (2019) propose a traveller experience conceptual model (TXCM) connecting traveller interactions with artefacts, travel episodes, and travel problems experienced by people in their everyday life, whatever the transport mode.

Law et al. (2009) include in the experience framework what happens before and after the interaction between the user and mobility system. An important subjective dimension relates to emotions. Desmet (2012) elaborates the emotional state in user experiences by breaking down the sources of emotions: the system, meaning of the system to the user, interaction, activity facilitated by this interaction, effect of the system on the user, and other people involved.

3 Methodology

The main research question is: which data collection methods are most suitable for collecting affective data from mobility experiences? Two qualitative studies using three approaches were conducted in Singapore and Paris, France. Each approach aimed to deconstruct the travel experience to provoke participants' recollection of their lived mobility experiences. The diary cards and user journey maps focused on both positive and negative experiences, while the text stimulus stressed negative experiences or problems. The cards and text stimulus were expected to lead to isolated instances of experiences, while journey maps would produce storylines. Methods were chosen to elicit emotions related to an activity based on text and/or graphic prompts.

In Singapore, two methods were used: diary cards (Brown, Sellen, & O'Hara, 2003) and user journey maps (Oliveira et al., 2017). Participants (n=8; 4 females; age groups of 15-44 years) were recruited, through online ads, to represent diverse genders and ages. They received cash tokens for their time.

In France, an approach derived from text stimuli was used (Goldschmidt & Sever, 2011). The participants (n=6; 3 females; mean age: 29 years) were researchers from the institute. Participants in the 'expert' groups had experience in urban mobility. The 'non-expert' group had expertise in engineering. The setup was designed to detect the influence of mobility

expertise on the formulation of mobility problems. The assumption was that mobility experts would be able to generate a larger number and span of mobility problems.

3.1 Diary Cards

The diary cards (Figure 2) comprised 7 open-ended questions to provoke organic perceptions about mobility and public transportation. Each took about 5-10 minutes to complete at home. The cards started with ‘What words or phrases come to your mind when you think about mobility?’ Some broader questions included ‘How or what do you feel about public transport?’ while more specific ones were: ‘What infrastructural elements did you interact with? How did you interact with it?’



Figure 2 Cards from the sensitising exercise to increase participants' consciousness of their mobility experiences.

3.2 User Journey Maps

After one week, participants returned for a 1.5-hour group workshop where they mapped their experiences in response to different prompts. Journey maps broke down experiences into their elements to identify key interactions and their specific details. In addition to details like ‘people’ and ‘artefact’, the template aimed to capture emotions on a bipolar positive-neutral-negative scale. When detailing their experiences and resulting emotional responses, participants were encouraged to describe the emotional valence and intensity, or add labels, e.g. angry, relieved. The journey maps were digitally transcribed and organised into the seven travel stages (Woodcock et al., 2014) and the categories ‘pre-trip’, ‘intra-trip’ and ‘post-trip’.

3.3 Text Stimulus

Similarly, the Paris study provided 11 textual categories as stimuli to elicit responses. The case study was a rapid transit bus line connecting a public transport hub to a business district where the participants commuted daily. The control group was instructed to record travel problems without the stimulus. The experimental group was prompted by textual categories after 15 minutes of unprompted problem generation. Objective’ categories described technical or contextual sources of problems (e.g. Weather, Operation – ‘For me, the system is not well operated’), while the ‘subjective’ categories represented elements connected to personal perceptions or actions (e.g. Emotion – ‘My emotions feel troubled when there is a problem with my trip’). The categories were obtained through a grounded theory approach (Al Maghraoui, 2019): individual interviews covering a large spectrum of

travel problems exclusive to specific transportation modes (e.g. cycling, driving) were conducted until saturation.

4 Results

4.1 Diary Cards

Participants' answers fell into six general themes (Table 1). Two participants used emoji in their responses (Figure 3); these were considered emotional responses.

Table 1 Sample answers for the diary cards fell into six distinct themes. Emphasis added in bold.

Theme	n	Sample answers
Functional attributes	8	"Time of arrival; crowdedness" "Reliability; convenience; comfort"
Relation to daily life	4	"Necessity! I have license & can't drive." "Convenient way for daily commute"
Emotional responses	4	"**Disappointment** when it comes to the frequent train breakdown… it is **frustrating** to see the train breakdown as a normality…" "**Mad** if they are spoilt [because] you are LATE & not your fault."
Enhancing personal ability	3	"To be able to travel between places"
Abstract concepts	2	"Movement. Connectedness. Inclusive. Fast. Time and space."
Related elements	2	"Public transport; electric scooters, bicycles; cars, buses, trains; walking"

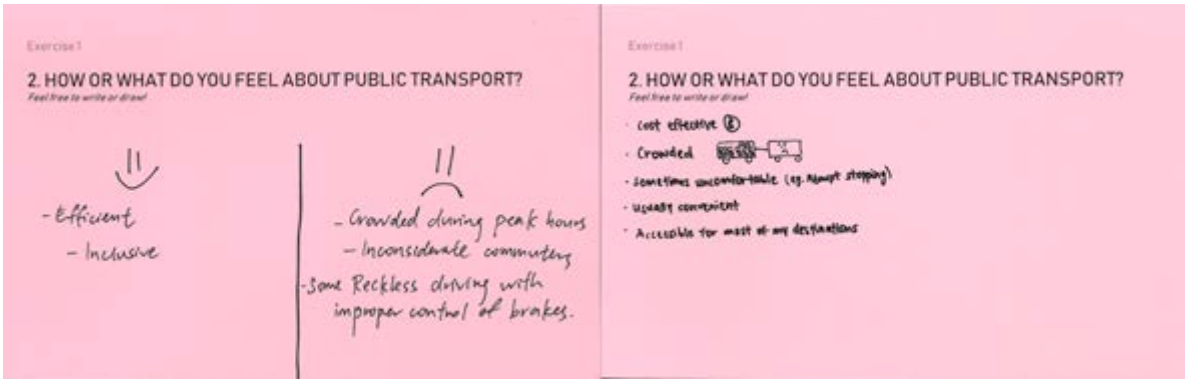


Figure 3 Using emoji was categorised as an emotional response.

4.2 User Journey Maps

One prompt asked participants to describe their most recent mobility experience, which was the journey to the study venue. Another prompt asked participants to describe a recent positive or negative experience (Figure 4). Participants' responses varied in style, content and detail. The mappings showed that experiences perceived as positive or negative could contain emotional responses of either valence. In an echo of the diary cards, functional attributes were a common cause of travel problems.

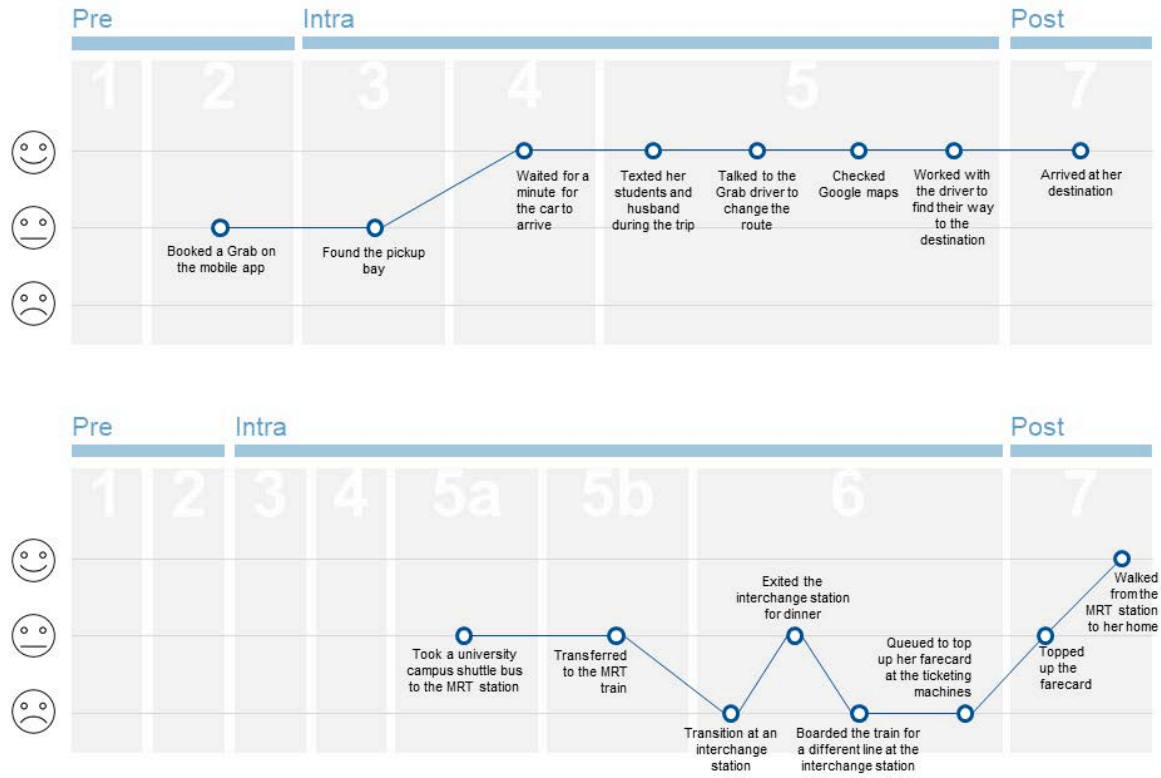


Figure 4 The affective state of one participant improved whenever she reached her destination in two positive experiences. (top) A ride-hailing trip; (bottom) A bus and MRT trip.

4.3 Text Stimulus

Statements containing affective responses are presented in Table 2 (non-expert group) and Table 3 (urban mobility expert group). For both groups, the travel problems either caused negative emotions during the pre-trip stage or left a lasting negative effect on participants' emotional states post-trip.

Table 2 Selected travel problems of the non-expert group illustrating affective responses. Emphasis added in bold.

Time	Travel problems with emotional responses
9"	**Shocking** driving
15"	Always crowded, so we arrive **without motivation** to work
32"	When the bus is full, attitudes of a few people can be **disturbing**
40"	It feels like we play sports when we take the bus, so it feels like a physical and **emotional effort**
46"	Why don't we have Wi-Fi by bus, or a little music to **relax** people!

Table 3 Travel problems of the expert group illustrating affective responses. Emphasis added in bold.

Time	Travel problems
26”	After a bad trip, we are **not in the right mood** for work
38”	Prices **don't motivate** people to take the bus, partially as tickets are expensive
50”	We feel **less safe/comfortable** when there are a lot of people around on the bus

Due to the structure of the diary cards, responses generated isolated instances of issues. Upon examination of the timestamps from the category stimuli in Table 2 and Table 3, no proximity was found, also confirming the expected output of isolated instances.

The next section compares the findings from each method to identify dominant themes and define parameters for an emotional design tool.

5 Discussion: Implications for the Design of Emotional Mobility Experiences

5.1 Practical Perspectives on Mobility

Participants began the diary cards and text stimulus without prior priming. The problems expressed resulted from mismatches between functional service expectations and the actual service rendered. The results support the finding that people tend to focus on practical concerns for mobility experiences (Guell, Panter, Jones, & Ogilvie, 2012) and generally do not perceive commuting as positive or negative experiences (Krome, Walz, & Greuter, 2016). The meaning (Desmet, 2012; Shove et al., 2012) of mobility appears to correlate strongly to functional attributes, suggesting that they are fundamental to positive mobility experiences.

5.2 Intra-trip Interventions and Pre-trip Preparations

The stages which most shaped Singaporean participants’ experiences happened intra-trip, i.e. stages 3 to 6, when they are physically on the move. Peaks of either valence tended to occur during stages 4 (interaction with the transport service) to 6 (interchanges/transfers). This suggests that interventions should occur during the intra-trip stage for greater impact on experience evaluations, since most participants consider pre- or post-trip interactions to a lesser extent. However, in the Paris study, participants entered negative emotional states pre- and post-trip. The subjective categories ‘mind’, ‘emotion and ‘arrival’ in the text stimulus might have prompted such reflection. Whether this is a cultural difference in experience evaluation, or a result of the method used, could be further investigated.

5.3 Feeling Emotional… or Not

The journey map results support the finding in Van Hagen and Bron (2014) that people tend to remember the extremes in their experiences. However, it is unclear why some experiences are remembered positively despite emotional dips, and vice versa. This could be because people disregard subtle emotions when evaluating an experience (Kahneman & Egan, 2011). Additionally, the duration of effect for each interaction resulting in an emotion could be explored. For instance, a trip’s cost has longer-lasting effects as it permanently alters a user’s financial state, whereas crowded vehicles are a temporary problem, resolving once the user or other passengers alight. For several participants, the cessation of the negative interaction led to a spike in positive affect. This could be because the user is removed from the event, e.g. leaving the bus where the poor riding experience occurred. In

other words, it is not a positive pull factor but the elimination of a negative push factor which resulted in the concluding positive perception of these experiences. Using push/pull factors in designing interventions can help to achieve target emotional responses.

5.4 Reflections on Methodology

The phrase 'how or what do you feel' in the diary cards sparked more affective responses than 'what words or phrases come to your mind…', suggesting that the language used can better provoke emotion elicitation. Narratives produced by the user journey maps showed clearer links between interactions and emotions than in the text stimulus. However, it is unclear how individual events influence a passenger's overall perception of the experience. Future work could delve into understanding the value of using journey maps over text stimuli.

In the journey maps, some participants could only remember emotions felt at specific points during the experience, while others were able to chart their emotional journey throughout. This could be because participants were asked to recall experiences which may have occurred some time ago. The challenge in collecting self-report emotional data on lived experiences lies in closing the distance between event occurrence and data collection, without interrupting the flow of the experience and resulting emotions. An ethnographic video captured on the move and replayed to participants could "articulate their experiences of fleeting sensations" (Spinney, 2011).

A simple bipolar scale was used in the journey maps in an inductive approach. Having a set of labelled emotions – e.g. angry, frustrated, joyful – for subjects to refer to when expressing the type and intensity of emotions felt could better guide dialogues.

As the three methods were conducted in two locations, the generalisability of findings is limited. All three methods should be repeated in each country with more rigorous sampling. However, the study identified challenges associated with each method to elaborate a methodology for the mobility context in future work, as discussed in the next section.

6 Proposed Parameters for an Emotional Design Tool for Experiences

Existing tools measure emotional responses for product design (Desmet, 2018), psychotherapy (Bradley & Lang, 1994), environments (Han, Back, & Barrett, 2010; Russell & Pratt, 1980), advertising (Morris, 1995; Sacharin, Schlegel, & Scherer, 2012) and marketing (Richins, 1997). Based on the findings from the three methods, parameters are proposed to guide the development of an emotional design tool (Table 4).

Table 4 Proposed parameters based on findings in the discussion in Section 5.

Findings	Proposed Parameters	Application Examples
5.1, 5.2	Captures data from functional attributes and each stage of the experience	Data on emotional reactions to the presence/absence of information at bus stations, or long travel times
5.2, 5.4	Phrased and structured to discretely provoke affective responses	Ask subjects about their emotions without emphasising one dimension (e.g. positive-negative, arousal levels) over another
5.3	Captures intensities and temporal dimensions to determine the effect of affect over time	Capture data, with valence and levels of intensity over time, to see how emotional responses interact throughout the experience

5.4	Feeds into a storyline framework	Record and link emotional reactions to specific instances (of interactions) within an experience
5.4	Self-report, ease of use to collect data during / shortly after the experience	Take-home questionnaires which can be distributed to subjects
5.1, 5.3, 5.4	Able to collect varying granularities and types of data,	For greater granularity, use a Likert scale with 7 anchor points compared to 3. To include labels, such as “happy, sad, upset”
Based on the case study	Application to experience design in product-service systems	Mobility experiences on public transport

Expected benefits of the tool include capturing data on affective responses to guide the design of experiences for emotional contrast, i.e. experiences containing both positive and negative affect. Furthermore, identifying specific affective responses can lead to the definitions of *emotional harmonies*, which are proposed as combinations of emotions leading to positive (or negative) evaluations of the experience.

Since the results indicated slight variances in responses between Paris and Singapore, the tool could be tested in both contexts to explore sociocultural effects.

7 Conclusion

Designing experiences with emotions changes how research and analysis is conducted. Through the identification of key positive or negative moments, designers can improve the creation of desirable mobility experiences. Findings from this paper will aid the development of a tool for the emotional design of experiences in complex product-service systems. While the case study focuses on mobility, the methods described could be applied to other domains to compare results.

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Stigma Probe: A Design Toolkit for Managing Older Adults' Stigmatisation Perception on HMWs

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HEALTH MONITORING WEARABLES (HMWs) are a recent technological trend that assists older adults in healthy ageing. Many older adults, however, do not accept, or may discontinue, the use of HMWs due to a phenomenon known as stigmatisation perception. To help HMW designers overcome this problem, this study reviews the literature on social psychology and design theory and deduces the conceptual composition of stigmatisation perception and the causes behind it. From there, it creates a stigmatisation perception research model, and finally, by investigating novice designers' understanding of stigmas, we summarise the difficulties and needs at different stages of design thinking. On this basis, the study proposes employing the design-thinking toolkit *Stigma Probe* to assist designers in developing a sensitivity to stigma issues at their various stages and offer solutions. Finally, the toolkit is used for testing in design workshops. The results show that *Stigma Probe* can gradually motivate novice designers to understand stigma issues and reduce older adults' stigmatisation perceptions.

Keywords: stigmatisation perception; older adults; novice designer; design thinking; design toolkit; IASDR

1 Introduction

Ideally, HMWs can provide meaningful health data and information, keep track of older adults' physical conditions, report emergencies to their families and medical centres, effectively forecast and intercept potential hazards in older adults' lives, and improve the everyday safety and independence of their lives (Fang & Chang, 2016; Kang et al., 2010). Still, it is not easy to make older adults voluntarily accept health monitoring technology, and stigmatisation perception is one of the major difficulties that designers need to overcome. (Rashidi & Mihailidis, 2013; Yusif, Soar, & Hafeez-Baig, 2016). For example, Holzinger et al. (2010) found that older adults are willing to buy hazard-warning smartphones for others but are not willing to use it themselves because they believe they are for patients with heart disease. Pritchard and Brittain (2015) also found that while alarm pendants are convenient, efficient and cost-effective, older adults nonetheless resist this kind of product because they feel stamped with a negative, ageist label. The author also found that stigmatisation perception will weaken older adults' motivation to use them, leading to an insufficient variety

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of new design schemes. It follows that stigmatisation perception is an exceedingly confounding obstacle to the design of HMWs.

The purpose of this study, then, is to develop a design toolkit to enhance designers' sensitivity to stigma issues and their ability to resolve older adult, stigma-induced perception problems. The study started from literature on social philosophy and design theory, analysed the conceptual composition of stigmatisation perception and the causes of its formation in the context of design and constructed a stigmatisation perception research model. By investigating the understanding of stigma issues among novice designers, this study summarises their problems and needs at different stages. From there, the study proposes a design-thinking toolkit named *Stigma Probe*, which is used for testing in design workshops. Finally, the influence of this toolkit on novice designers is discussed.

2 Related Works

2.1 The Formation of Stigmatisation Perception in HMWs

Stigma studies derive from social psychology. Goffman (1963) found an important correlation between stigmas and stigmatised persons' social identity and argued that stigmas are formed in the chasm between real and virtual social identity. Based on Goffman's theory, Link and Phelan (2001) pointed out that the concept of stigma rests on the labelling of social identity, stereotyping, separation, status loss and discrimination. As a keyword in stigmatisation perception, the social identity issue is integral to design research. In light of design semiotics and product semantics, what people wear, consume or use can define their social identity as well as their differences (Csikszentmihalyi & Rochberghalton, 2002; Krippendorff, 2006). Therefore, some products, such as Rolex watch and Apple watch, are deemed as the symbols of identity and status of their users.

Besides the value of social identity, the Stigma-induced Identity Threat Model (SITM) summarised by Major, can also provide a valuable perspective to analysing design-induced stigmatisation perception (Major & O'brien, 2005). This recursive model interprets stigmatisation perception as an evaluation of identity threat. Its root causes are collective representations of the social culture a stigmatised person might find themselves in, along with the negative situational cues they encounter and prominent personal characteristics. Furthermore, Vaes (2014) once developed a stigma-induced product evaluation model with an evaluation tool on the basis of design theories regarding emotional design and product semantics and related concepts and their relationships. His study revealed stigma-related evaluations from three sides—user, spectator and culture—and provided designers with a design strategy capable of interrupting stigmatisation.

Interestingly, not all gerontechnology induces stigmatisation perception. Some protective, assistive and wearable products are more susceptible to stigma than others (Jacobson, 2014; Parette & Scherer, 2004; Vaes, 2014). HMWs are often included in three product categories. First, we combined stigma-related findings found in relevant studies with previously proposed theories. Then we attributed HMW-induced stigmatisation perception among older users to three levels: identity perception, social experience and design presentations. These three levels interact and reinforce each other, eventually forming the elders' strong stigmatisation perception and rejection of some HMWs (Figure 1):

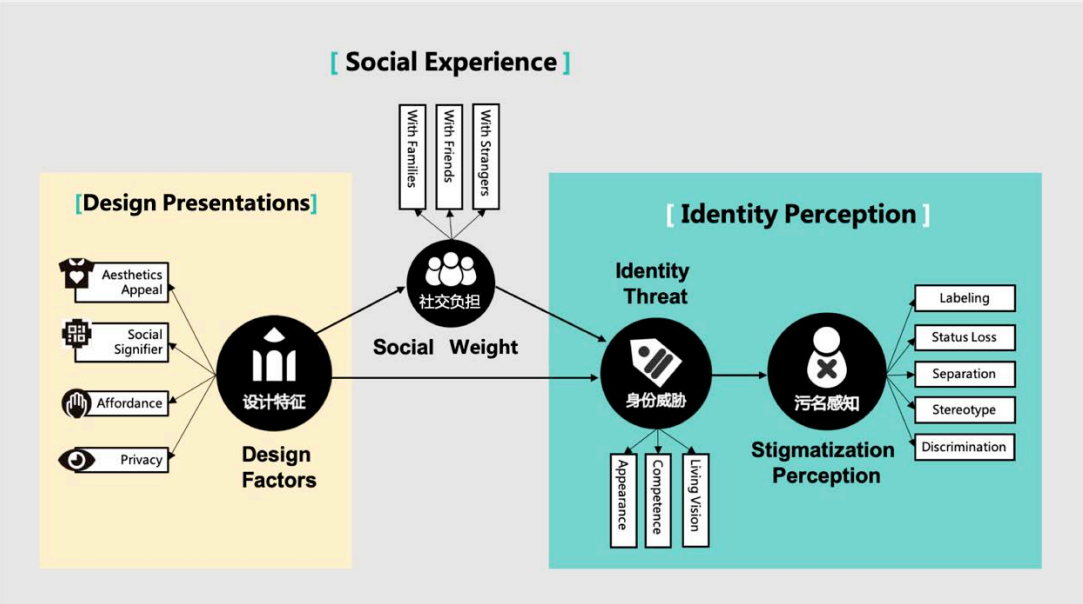


Figure 1. Three Levels of Problem about HMWs-induced Stigmatisation Perception among Older Adults

(1) Identity Perception - identity threat perceived by older adults: In line with the SITM viewpoint (Major & O'brien, 2005), older adult's recognition of identity threat is a key indicator for discerning the existence of stigmatisation perception. In an investigation of stigmatisation perception induced by smartwatches, older adults were found to attach to them many negative characteristics. They thought its target users were older adults with cognitive disorders, physically handicapped or lonely, isolated shut-ins. They did not wish to be associated with those users. The characteristics involved appearance, competence and their vision of older adults.

(2) Social Experience - Everyday, wear-induced social prejudice and undesirable interactive experience. Social prejudice is a set of shared concepts that fall into the category of collective representation, what Steele (1997) calls "a threat in the air". Previous cultural probe studies among older adults describe the many social prejudices against wearable technology. For example, prejudices towards HMWs for the elderly, their clothing habits, what groups are or are not suitable for HMWs and so forth. These prejudices will influence their social interaction when older adults wear these products, whether they will attract excessive attention, be treated reasonably and even accepted or rejected by social groups and so forth. The formation of stigmatisation perception is directly related to negative social prejudices and interactions.

(3) Design Presentations - Some design characteristics that potentially induce stigmatisation perception are misused. A previous study has summarised the characteristics shared by stigma-inducing assistive products, such as lack of aesthetic appeal and complicated technical function (Carneiro, Rebelo, Noriega, & Pais, 2017; Jacobson, 2014; Vaes, Stappers, Standaert, & Desager, 2012). Evidence also pointed to a strong sense of conformity among elderly adults. Hence, HMWs need to reasonably fit into the daily living environments of older adults and match their daily clothing preferences. Through preliminary experiments, the researchers found design characteristics that can induce stigmatisation perception, including lack of aesthetic appeal, accentuated social signifiers, improper or unnecessary functions and underestimated privacy.

2.2 Empathic Techniques and Stigma-related Design Thinking Process

From identity perception to social experience then to design presentation, this study believes that a highly likely factor leading to HMWs-induced stigmatisation perception is ineffective communication between designer (or engineers) and end user in the design process. When designer misunderstands older users' identity, ability to use technology and real lifestyle, they are prone to simplify multilevel needs of older adults for wearable technology and design many products features that induce identity threat perceived by older users.

The key to user-centred design (UCD) is mapping rich information about users into the design space and building knowledge that others can use. Empathy design can pay close attention to special cues, such as user's negative emotions and time consumed to offer insights for innovation (Burns, Barrett, Evans, & Johansson, 1999). For stigma issues, empathic design-related mind-sets and tools can inspire designers to find and resolve stigmatisation perception, enhance their sensitivity to it and assist them in focussing on key elements of stigmatisation perception. In her masterpiece, *Disguised: A True Story,* industrial designer Patricia Moore described how she dressed up as an 80-year-old lady, entering society and finding abundant precious experience, including stigmatisation perception (Moore, Conn & Conn, 1985).

Currently, developing empathy with users has become a goal for most user researches. (Bruseberg & McDonagh-Philp, 2001; Suri, 2003; Mattelmäki, 2006). Design-thinking research conducted by Stanford University took building empathy as its first stage to inspire designers to consider user issues. We also associated stigmatisation perception issues with the same model, identified stigma-related objectives at different stages of design and handled stigma issue step-by-step in the process as demonstrated in Figure 2.

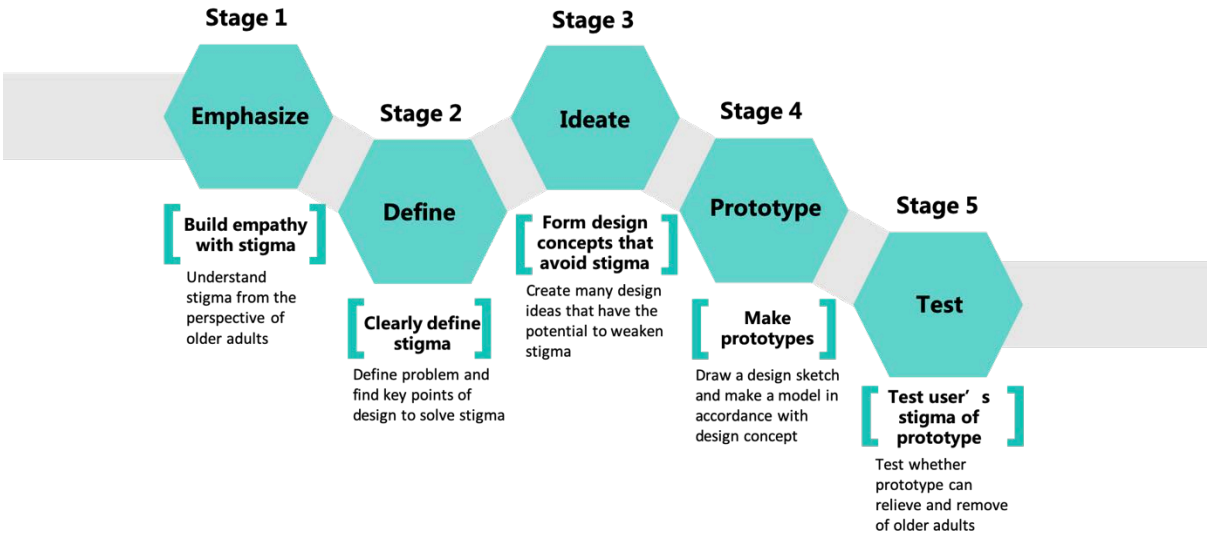


Figure 2. Stigma-related Design Thinking.

3 Research Methods

Based on the related works, we followed three steps to create the design toolkit: (1) analyzing needs for stigma design toolkit, (2) designing the design toolkit, and (3) evaluating the design toolkit. Each of the steps is described below.

Based on various works, we followed three steps to creating the design toolkit. We: (1) analysed the need for it, (2) design it and (3) evaluated it. Each step is described below.

(1) Analysing the need for a stigma design toolkit

Before designing the toolkit, we conducted a brief preliminary survey targeting novice designers in mainland China, namely undergraduates and postgraduates with little experience in design practice. We hoped to compile their insights into older adult stigmatisation perception via a semi-open questionnaire.

The questionnaire consisted of three parts: Part One had four questions pertaining to basic design information, including gender, grade, number of years of design education and professional development. Part Two involved their design experience in gerontechnology and their impressions of older adults. Part Three investigated the difficulties and other aspects to avoid stigmatisation perception in older adults. Respondents were invited to answer two additional questions regarding different stages of design thinking: (i) What problems and difficulties have you found at each stage? (ii) What kinds of design tools do you use?

(2) Designing the design toolkit

Armed with prior research data and insights of the novice designers, the research team produced the following viewpoints: (i) the toolkit should be flexible and easy to access and share; (ii) it should not only assist designers in developing sensitivity to stigma-related information at different stages of design thinking, but; (iii) it should also provide solutions to problems at different stages, including the collection and analysis of qualitative and quantitative data.

In the end, we proposed a design toolkit named *Stigma Probe*. This toolkit takes empathic thinking as its basis and provides five tools fitted to different research stages: Identity Image Card, Sensitive Experience Map, Stigma Insight Card, Design Strategy Cards and Stigmatisation Perception Evaluation Scale. These tools will be more fully explored later.

(3) Evaluating the design toolkit in the workshop

Stigma Probe was used for testing in the 'Wearable×Healthcare' workshop. The schedules of this workshop included a two-day meeting and a five-day social survey. Twenty undergraduate design majors were divided into four groups, each group including students from different specialties—visual communication, product design, digital media and fashion design. Each group was offered a uniform *Stigma Probe* Toolkit, with electronic components, sewing tools and moulding materials.

During the workshop, the participants were asked to use the *Stigma Probe* Toolkit to complete the entire design-thinking process and propose a wearable design and materials. After the workshop, the researchers found 30 elderly adults to examine the design schemes and utilise a stigmatisation perception scale to estimate their likelihood of inducing stigmatisation perception(s). Schemes submitted by each group were measured in terms of stigmatisation perception to deduce whether the toolkit effectively helped the participants avoid stigma problems.

4 Results and Discussion

4.1 Results of Analyzing Needs for Design Toolkit

4.1.1 Comprehensive analysis of participants

This survey collected responses from 37 design students: (1) 17 males and 20 females; (2) 29 undergraduates and eight postgraduates; (3) all participants had studied design for no more than five years; (4) 19 product design majors, eight interactive design majors, eight fashion design majors and two digital media majors.

An analysis of the participants' design experience in gerontechnology shows that: (1) 11 had not participated in any designs intended for older adults, versus 26 who had done so. The topics they had taken part in included assistive devices, such as wheelchairs, walking sticks and shopping carts, small gadgets like pill cases and portable massagers and smart technology products such as mobile applications, alarm apparatuses and smartwatches. (2) 28 respondents felt design for the elderly was so challenging, even daunting, that they felt compelled to offer assistance to elderly adult-related design projects.

Finally, the authors collected 66 descriptions of older adults used by design students in the Impression Description part. An analysis of these descriptions shows: (1) some descriptions are positive and include appraisals like 'industrious and thrifty', 'amicable and lovely', 'have a sense of proportion', 'love learning' and 'love life', which indicates that young students are capable of finding positive characteristics of older adults. (2) Negative impressions account for over 50% of all descriptions, e.g. 'lonely', 'low-mobility', 'vulnerable', 'have difficulty accepting something new', 'childish' and so forth, which suggests that design students also have many stereotypes about older adults.

4.1.2 Design Difficulties and Needs for Coping with Stigmatisation Perception

This part invited respondents to think about how to solve stigma-related problems at different stages of design by explaining a case of HMW-inducing stigmatisation perception, to write down the difficulties they had encountered and the help they needed. By sorting and summarising their answers, this part obtained the following results (cf. Table 1):

Table 1 Design Difficulties and Needs for Stigma-related Design Process.

Stages of design thinking	Objective and task	What are the difficulties in this stage?	Which design tools and assistance you do want?
Build empathy with stigmatisation perception	Understand stigmatisation perception from the perspective of older adults	• Lack of understanding of stigmatisation perception, don't know how to plan problems to survey; • Don't know how to build empathy, how to operate to save time, what problems are needed to be noticed in interview or observation.; • A huge generation gap with older adults, don't know how to communicate with them.	• A detailed understanding of stigmatisation perception; • Investigate question cues; • Operating procedure guidance.
Clearly define stigmatisation perception	Define problem and find key points of design to solve stigmatisation perception	• How to pinpoint key problems that induce stigmatisation perception of older adults; • How to effectively classify and converge problems collected;	• Direction of problem convergence; • Hints on key points.

Form design concepts that avoid stigmatisation perception	Create many design ideas that have the potential to weaken stigmatisation perception	• Don't know how to solve the problem after finding it; • How to choose a better scheme for further development.	• Need to know whether there is a case of removing stigmatisation perception; • Design scheme selection strategy.
Make design prototypes	Draw a design sketch and make a model in accordance with design concept	• Inspiration and strategy in the process of prototype design.	• Provide the possibility of testing the scheme on their own.
Test user's stigmatisation perception of design prototype	Test whether design prototype can relieve and remove stigmatisation perception of older adults	• How to estimate whether the scheme can remove stigmatisation perception; • If stigma issue still exists, how to quickly find the root cause.	• Technique able to effectively evaluate stigma-related problems.

4.2 Results of Designing the Design Toolkit

Based on thinking and discussion of the research team, we proposed the design-thinking toolkit Stigma Probe. This toolkit starts from the concept of empathy design, expands to issues related to stigmatisation perception and then explains thinking methods and workable operations according to the five stages of design thinking. This process assists designers in finding answers to stigma problems step-by-step. The toolkit contains the following five small tools:

(1) User Image Card (Left in Figure 2): The Image Card is used in the empathy stage to help designers collect design features in three ways—looks, living skills and a caring vision of older users. This leads designers to pay attention to and record sensitive identity characteristics of older users.

(2) Sensitive Experience Map (Right in Figure 2): The Sensitive Experience Map is also used in the empathy stage of design thinking to help designers collect and sort older users' relationships with family, friends and strangers, along with the lead designer, to find a reasonable interaction between users and stakeholders.

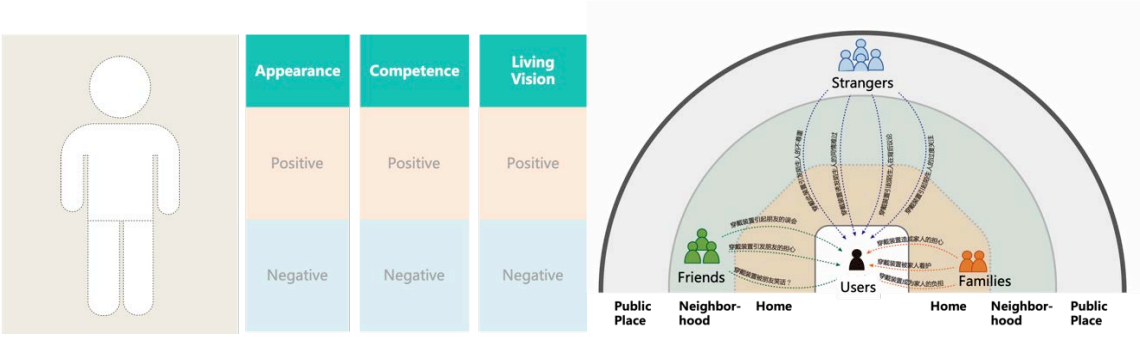


Figure 3. User Image Card (Left) and Sensitive Experience Map (Right).

(3) Stigma Insight Card: The Stigma Insight Card is used in the problem definition stage. The card prompts designers to summarise the keywords of stigma issues. It could lead

designers to think about potential concerns of users beyond just stigma and feasible solutions to form design concepts.



Figure 4. Stigma Insight Cards (Left) and Stigmatisation Perception Evaluation Scale (Right).

(4) Design Strategy Cards (Figure 4): Design Strategy Cards are used in the prototype design stage (Figure 4). The card includes 18 strategies to manage stigmatisation perception in design schemes. These strategies are derived from previous studies of other scholars and discussions among our research team. Moreover, the card has related illustrations and descriptions that can inspire designers.



Figure 5. Design Strategy Cards.

(5) Stigmatisation Perception Evaluation Scale (Right in Figure 3): The Stigmatisation Perception Evaluation Scale is used in the testing stage. The author once experimented with evaluation indicators in this scale. The results showed that they can effectively probe the existence of stigmatisation perception and reveal the underlying problems. A designer can use this scale to evaluate their design and collect user opinions after providing design schemes and product prototypes to users to ascertain whether their design can avoid stigmatisation perception.

4.3 Results of Evaluating the Design Toolkit

We evaluate the efficacy of the *Stigma Probe* elements to negate stigmatisation perception. Our research team conducted a design workshop called 'Wearable×Healthcare'. All participants were novice designers from different specialties who not only had limited experience designing HMWs but also need the opportunity to get to know each other. As the 'icebreaking' session, the workshop attendees used the unit where they learned to design

wearable electronic components and circuits. This process not only helped team members get to know each other but also let them become familiar with the essential conditions to make an HMW. After the icebreaking, four groups of students designed the survey according to their topics and with *Stigma Probe*, came up with their design schemes, made design prototypes and conducted prototype tests and scheme optimisations. In the end, the workshop obtained four interesting HMWs design projects:



Figure 6. Activities in "WearableHealthcare" Workshop

Project 1: 'Ironman' Handband. This is intended for adults over 60 years old who do not exercise but who have the ability to act and care for themselves. It reminds older adults to exercise moderately by sending vibrations that monitor heartbeat changes and gauge the amount of exercise. It simulates sunscreen oversleeves, comes in a common white colour and is close-fitting and easy to wear and hide.

Project 2: 'HeartCare' Waistband. This device is intended for adults over 70 years old who are prone to chills and aches and have difficulty moving. Its function is to monitor daily heart rate, gather data to guard against heart disease and avoid medical emergencies, as well as help older adults with recovery from lumbar spondylosis. It looks like a wide waistband. With a low-key black colour and leather decoration, it is easy to match.

Project 3: 'Tongxuebao' Neck Massager. This product is for older adults prone to neck pain. It combines heartbeat monitoring with a neck massager, making HMWs a handy aid for older adults. It is matched with a remote-control wristband and a data-recording mobile application. This product can record users' state of health and give them the fun of monitoring their health.

Project 4: 'Mini Q' Cuff. This HMW is designed for sporty older adults and provides them with heartbeat monitoring of motor processes. Its exterior design simulates a common towelling cuff. The display screen can be hidden inside the waist and be lightened when a hand is raised. It is easy to use and hide for older adults.

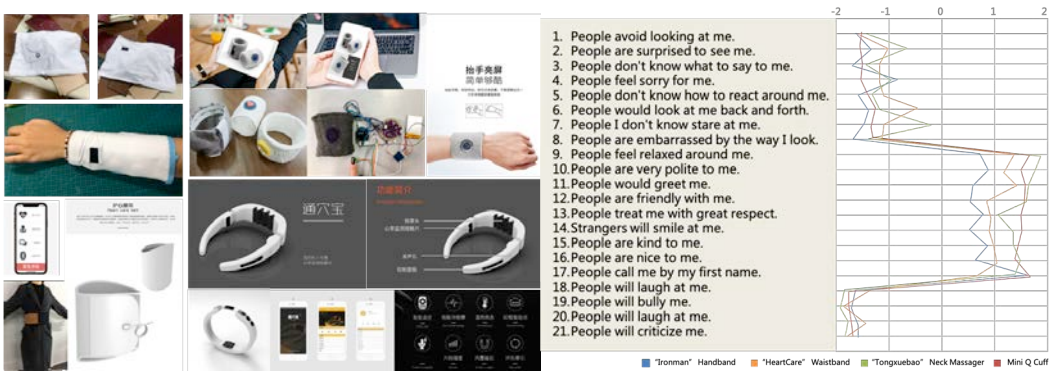


Figure 7. Four Projects Designed during "Wearable × Healthcare" Workshop (Left) and Older Adults' Stigmatisation Perception on the Four Projects (Right)

Following workshop, the researchers invited 30 older adults to evaluate the prototypes of the four innovative HMWs in terms of the Perceived Stigmatisation Questionnaire (Lawrence, Fauerbach, Heinberg, Doctor, & Thombs, 2006). Fourteen of the 30 were male, 16 were female. The youngest was 60 years old, while the eldest was 78. Eleven were comparatively healthy, 12 reported chronic cardiovascular disease, while the remaining seven had lumbago, neck ache or other conditions. The results showed that when they wore the HMWs in their daily lives, they did not induce other people's confusion and staring behaviour, hostile behaviours, nor did they reduce people's friendly behaviours (Right in Figure 7).

4.4 General Discussion

This study gone through three stages. Its purpose is to explore how to assist designers in coping with stigmatisation perception-related problems in designing HMWs, and some phenomena and problems revealed in this process are worth reflecting on. At the first stage, we collected the difficulties that designers have in design thinking about stigmatisation perception and their requirements for design tools. The researchers found that novice designers' negative stereotypes about the elderly are universal rather than exceptional. Meanwhile, they have a limited understanding of the concept of stigma and they are more likely to have troubles in the empathy stage of design thinking due to their limited design experience, so gradual operating guidance is more in need than an evaluation tool simply leading the concept; at the second stage, the design team tried to develop the details of design toolkit, and the needs of different stages of design thinking were taken as the bases for designing the small tools. The research team needed to anticipate various scenarios that designers may encounter and make the small tools connected and easy to operate; at the third stage: assessed the influence of design toolkit by performing the experiment of the open workshop. The researchers found that infiltrating stigmatisation perception-related points of information into the design process step by step can help enhance novice designers' understanding of stigma issue and lower the level of difficulty in dealing with stigma problems. Feedbacks given by the students after the workshop show that they gained a more comprehensive and prudent understanding of the needs of older users and had less stereotypes about older adult, and it can enhance their positive understanding of the aging process, which was manifested in their design schemes in many aspects.

5 Conclusion

This study started with the analysis of HMW-induced stigmatisation perception among older adults. It identified the difficulties and related needs that designers must meet step-by-step.

The research team successfully designed a design-thinking toolkit called *Stigma Probe* containing five small tools, namely Identity Image Card, experiment crisis map, stigma insight extraction card, design intervention strategy and stigmatisation perception evaluation scale. This toolkit sought to reduce cultural complexity between HMWs, older adults and their social environments, simplify key information which designers need to notice in the face of stigmatisation perception and provide them with operational approaches for each stage of design-thinking. This toolkit was tested by the workshop and the results proved that the toolkit can indeed effectively lower the probability of inducing stigmatisation perceptions of older adults. A follow-up study will further test and optimise the toolkit in order to expand the influence of the toolkit. The author is sincerely grateful to the participating adults and the student respondents who received the survey, students who participated in the workshop and experts and scholars who offered great help to this study. Thank you for your precious time and valuable information.

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The effect of visual complexity and task difficulty on human cognitive load of small screen devices

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With the popularity of smart phones, the design of mobile interface has gained more and more attention from researchers due to the increasing need to utilize all aspects of design knowledge. However, only few studies have focused on the cognitive aspects of designing mobile phone interfaces, especially the interaction between visual complexity and task difficulty. Therefore, the purpose of this study is to investigate the effect of visual complexity and task difficulty on human cognitive load with mobile-sized interfaces. This study presented 36 college students with mobile pages of three levels of complexity on desktop in a mobile sized screen and collected their eye-movement data by eye-tracking apparatus while they performed tasks of varying difficulties. We found that user satisfaction was more related to extraneous cognitive load (visual complexity), while task completion time, fixation count and fixation duration was more related to internal cognitive load (task difficulty). We also found that the optimal complexity level varies according to different tasks and users achieved the highest efficiency when interacting with moderate visual complexity in difficult tasks. This was the first study to explore the relationship between visual complexity and task difficulty of mobile size interface by using eye-tracking technique. Our results obtained could providing a scientific basis for interface design of small screen devices.

Keywords: visual complexity; task difficulty; cognitive load; eye-tracking technique; mobile-sized interface.

1 Introduction

Nowadays, Internet media has gradually replaced traditional paper media and become the first channel for the public to obtain news information. Mobile news, as a form of knowledge presentation[1], is the media to shape ones' attitudes, beliefs, and behaviours[2]. According to iiMedia Research, the number of mobile news users in China has increased to 646 million in the first quarter of 2018 [3]. Besides, the usability research on mobile interface design has gradually gained the attention of academia and business fields. However, very little research has attempted to measure how much and how efficient users comprehend the news. Due to the limitation of the mobile-size screen, the content of the mobile interfaces must be more concise and effective, which requires designers to organize information effectively in a reasonable layout. Therefore, designing effective and logical layout and content to accommodate to the visual behaviour of human has become the focus of designers and

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researchers of human-computer interface (HCI). Excellent interface layout and suitable amount of information can provide users with good user experience and reduce their cognitive load, which make the process of knowledge acquisition much easier.

2 Theoretical background

2.1 Visual complexity and its outcomes

Visual complexity is an important factor leading to high cognitive load, which can be defined as “the amount of variety in a stimulus pattern” [4]. Geissler et al. [5] believed that stimulus complexity should consist of the number of elements, the level of dissimilarity between elements, and the level of unity between elements. The definition of webpage complexity is developed based on stimulus complexity, which refers to the amount of information that a site is offering [6]. Deng and Poole further divided visual complexity into two dimensions [7]: (1) visual diversity, which refers to the number of different elements (e.g., text, graphics); (2) visual richness, which refers to the amount of each element. Previous studies showed that website complexity affects user outcome, however, researchers have not reached an agreement on their relationship. On one hand, many experimental studies support the point that users prefer interfaces with low visual complexity. Pandir and Knight [8] found a negative relationship between complexity and pleasure in website perception. Deng & Poole [8] found that perceived visual complexity was negatively related to aesthetic perception. Choi & Lee [9] suggested a simplified interface design of visual display attributes contributes to positive satisfaction evaluations when users engage in communication, information search, and entertainment activities. On the other hand, Berlyne [4] first proposed that the relationship between website complexity and user outcomes could be described as an inverted U-shaped curve which users achieved the highest efficiency when interacting with moderate visual complexity compared with low and high level visual complexity. Recently, Spiekermann and Korunovska [10] suggested that users become more creative and thoughtful until visual complexity reached certain point, but after that point, creativity significantly reduced. Lin et al. [11] found that visual complexity of e-commerce websites had a significant effect on users’ pleasure, and the effect could also be described as an inverted U curve.

2.2 Task difficulty from cognitive perspective

There is no clear definition of task difficulty. In resource requirement viewpoint, task difficulty is defined as resources requirement of human information processing [12]. Resource could be referred as cognitive demands [13,14], physical and mental demands [15,16], and short-term memory requirements[17]. In other words, users would invest more resources during more complex task because of limited human information processing resources. Task difficulty is an important factor that influences task performers’ mental workload and predicts human performance and behaviour [12,17]. In the field of human-computer interaction, Wang et al. [18]showed that for simple tasks, the simpler the interface, the better their performance would be; for difficult tasks, their task completion time (TCT), fixation count, and fixation duration were all at the highest level with webpages of medium visual complexity. Huang & Zhou [19]found that TCT and perceived cognitive workload increased more for difficult tasks than in simple tasks as the number of links on the mobile websites increased.

2.3 Cognitive load theory

Sweller [20] proposed cognitive load theory to describe the limited capacity of working memory. According to this theory, people would feel overwhelmed when the amount of

information exceeds a limit. He believed that there are three types of cognitive load: intrinsic cognitive load links to the stimuli's content or the task itself that can not be altered by users; extraneous cognitive load depends on the presentation forms, and germane cognitive load that involves information consolidation can be decreased by appropriate structure and layout design. Hence, we can infer that visual complexity relates to extraneous cognitive load, while task difficulty relates to intrinsic load.

2.4 Studies on different devices

Several studies explored differences in user behaviour on different devices. Jones et al. [21,22] conducted a behavioural experiment and found that user performance dropped as screen size reduced because it would be more difficult for users to make good judgements or to gain a general overview effectively on smaller screens. Kim et al. [23] found that users had more difficulty extracting information from search results pages on smaller screens although they exhibited less eye movement as a result of infrequent use of the scroll function. However, there were no significant difference between the 2 screens in terms of TCT on search results pages and the accuracy of finding answers. Sohn et al. [24] conducted an online shopping experiment on mobile phones and tablets, and found that participants were more likely to feel spatially crowded in visually complex surroundings on mobile phones than tablets, which leaded to lower satisfaction.

However, no study has explored the influence of visual complexity and task difficulty on mobile users' cognitive load. Therefore, in the present study, we systematically investigated the effects of visual complexity and task difficulty on human cognitive load and performance with mobile size interface indexed by eye-tracking technique.

3 Research methods

3.1 Participants

36 college students (15 male) were recruited from Zhejiang University. All participants had normal colour vision and normal or corrected-to-normal visual acuity. Participants were 22.28 (SD=1.86) years old on average and were all right-handed. This research complied with the American Psychological Association Code of Ethics and was approved by the Research Ethics Board of the Department of Design, Zhejiang University. Written informed consent was obtained from each participant.

3.2 Experimental materials

We used Eyelink-1000 produced by SR research to collect the eye movement data of the right eye. The sampling rate was 1000 Hz. The experimental stimuli was presented on the 19-inch Dell display, of which the screen resolution was 1024*768. The distance between participants' eye and the display was 60cm. We produced three types of news interfaces with different visual complexity levels through Axure RP8 by manipulating the number of pictures per news (as shown in Fig.1, the interfaces from left to right correspond to low complexity, moderate complexity, and high complexity respectively).

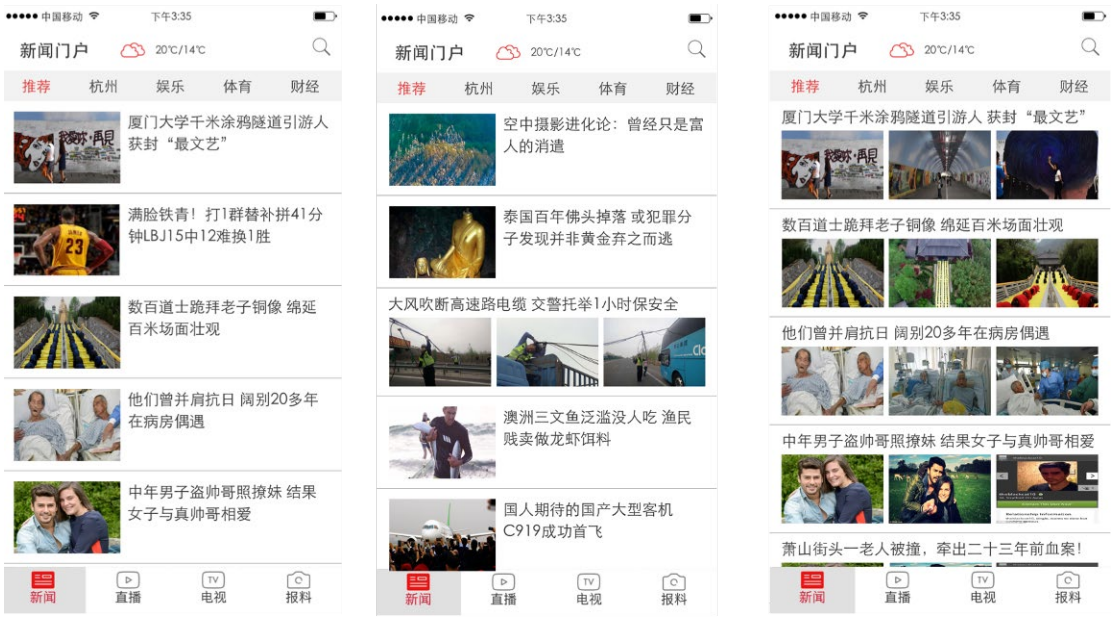


Figure 1. Three types of interface with different visual complexity levels.

3.3 Experimental task

In this study, we manipulated three difficulty levels of tasks based on the information processing model from the perspective of resources [12,25] that users usually performed on mobile phones. Browse task: Participants were required to browse the interfaces like how they usually do on the mobile phone, and they can end the trials as they like by pressing space. This is the simplest task in our study, which was similar with the study of Tuch et al. [26]. Search task: Participants were required to find an asterisk in the given stimuli, and press space as quickly as possible. This task simulates searching for a particular target of interest on an interface. This procedure requires visual resources to detect and psychomotor resources to make a quick response, which is more difficult than the *browse* tasks. Answer task: Each trial started with a question (the question was "to find news that took place abroad"). Participants could then proceed to the first page and look for the answer. Participants needed to press space first and then announce the desired information loudly once they find the answer. This process requires not only cognitive resources to process textual information, but also short-term memory resources to recall the key words, which makes the task the most difficult one.

3.4 Experimental procedure

In the present experiment, we adopted a within-participant design to investigate the effects of two main variables: task difficulty (3) × visual complexity (3). The present experiment was composed of 3 blocks (one task difficulty for one block), and each block included 3 trials (visual complexity). To minimize the carry-over effect, the order of the presentation of 3 trials was randomized for the participants while the order of blocks was counterbalanced across participants. At the beginning of each block session, participants performed two practice trials for around 30s to familiarize themselves with the procedure, followed by experimental tasks with 3 different levels of visual complexity trial. The block interval was 60s. After each block, participants were required to rate the subjective evaluation, including perceived task difficulty, perceived visual complexity and satisfaction with the interfaces by using a 7-point Likert scale. At the end of the experiment, participants were required to fill out a post-

experiment questionnaire, which include basic information, such as age, background, familiarity with news applications and using mobile devices, and rank the difficulty of the given three tasks. The entire experiment took approximately 20 minutes for each participant to complete.

3.5 Eye-tracking metrics and data analysis

This study adopts eye-tracking technique to observe users' fixation behaviour for different tasks on mobile-sized interfaces. We chose fixation duration, fixation count, and pupil size as fixation metrics. Among them, fixation duration and fixation count are the most commonly used metrics to measure visual attention [27]. Fixation duration can reflect how much effort is required for information processing. Longer fixation duration implies that information is more difficult to extract or from another perspective, more attractive [27]. The fixation count shows the total number of fixations on a given object [28], which reveals the interests of attention. Pupil size is often considered to be associated with cognitive load [29–31], and the greater the pupil size is, the higher the human cognitive load in the task [32,33]. We employed this metric to measure the difficulty of tasks. TCT, which reflects users' task performance was also taken into account. Less TCT usually indicates more efficient decision-making and better design interface[18]. We employed analysis of variance (ANOVA) for TCT and fixation duration, with a log-transformation *log(x+1)* to maintain the normality assumption because TCT and fixation duration did not meet the normal distribution[34]. We adopted generalized linear mixed models (GLMMs) with a Poisson distribution and logarithm link function for fixation count. For the case of factors that did not satisfy Mauchly's test of sphericity before repeated measurement ANOVA, we applied Greenhouse-Geisser correction. The significance level in this study was set at 0.05.

4 Results

4.1 Background information

At the end of the experiment, we asked participants to evaluate their familiarity with mobile phones and news applications by using 7 points Likert scale. The average familiarity with the mobile phone was 5.18 (SD=0.93), that is, all users were familiar with the usage of mobile phones. For news APP, the degree of familiarity was 4.65(SD=1.28), which means that most users were familiar with news APP.

4.2 Manipulation check

At the end of each task, we conducted a subjective evaluation of visual complexity and task difficulty using 7 points Likert scale. We found a significant main effect on visual complexity ($F(2, 70) = 49.608$, $p<0.001$), participants rated higher scores when visual complexity increased ($p<0.001$). We also found a significant main effect on task difficulty ($F(2, 70) = 22.879$, $p<0.001$), participants rated higher scores when task difficulty increased ($p<0.001$). These results confirm that we have successfully manipulated visual complexity and task difficulty.

4.3 Task completion time(TCT)

Before conducting repeated ANOVA, we used *log(x+1)* to transform the data of TCT to maintain the normality assumption which is the same as the study of Kim et al.[27]. A significant main effect of task difficulty was noted in TCT ($F(2, 70) =52.096$, $p<0.001$). Generally, TCT of *search* task was shorter than that of the other two tasks (search vs. browse: $p<0.001$; search vs. answer: $p<0.001$), while there was no significant difference between browse and answer ($p>0.05$). No significant main effect of visual complexity in TCT was found ($F(2, 70) =2.428$, $p>0.05$).

The interaction with task difficulty and visual complexity reached significance (F (2.717, 95.080) =4.679, p<0.01, Fig.2). TCT obtained after high visual complexity was significantly longer than that produced after low visual complexity for search tasks (p<0.05). For answer tasks, TCT obtained after medium complexity was relatively shorter than that of low visual complexity and high visual complexity (medium vs. low: p<0.001; medium vs high: p<0.05), and TCT produced after low complexity was marginally longer than that of high complexity (p=0.05), which showed a nearly U-shaped curve.

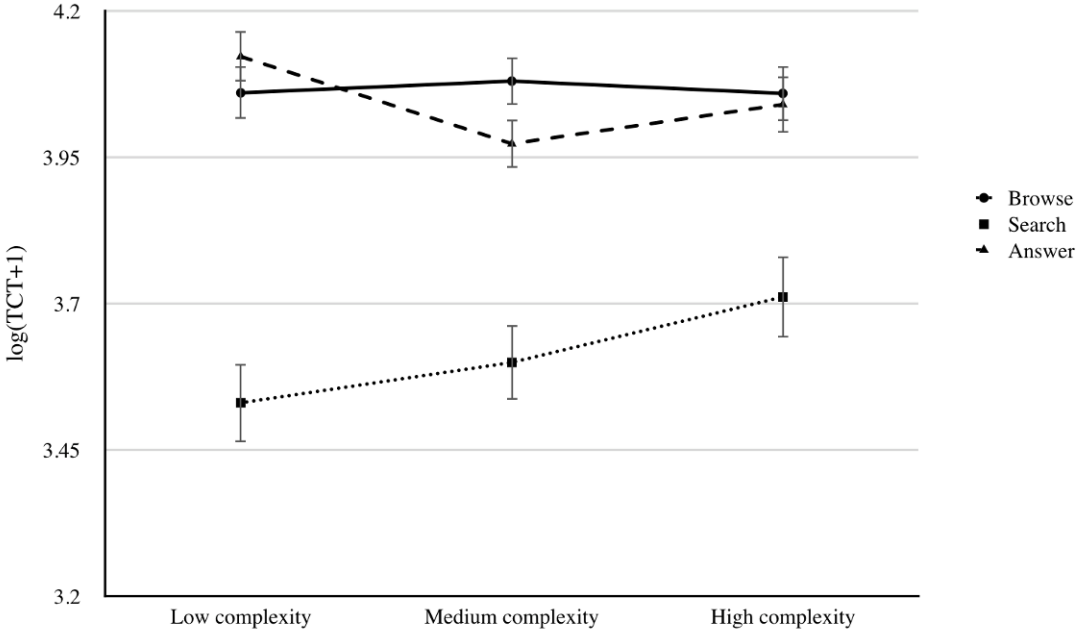


Fig. 2. TCT of three complexity levels in each task.

4.4 Fixation count

We found significant main effects of task difficulty and visual complexity on fixation count (χ^2=1475.060, df=2, p<.001; χ^2=41.397, df=2, p<0.001). Generally, fixation count of search task was significantly lower than that of browse and answer tasks (search vs. browse: p<0.001; search vs. answer: p<0.001). From perspective of visual complexity, fixation count obtained after high visual complexity was significantly higher than that of low and medium complexity (high vs. medium: p<0.05; high vs. low: p<0.001), fixation count obtained after low visual complexity was significantly higher than that of medium complexity (p<0.001).

The interaction between task difficulty and visual complexity in fixation count was also significant (χ^2=83.935, df=4, p<0.001). A post hoc test showed that fixation count obtained after higher visual complexity level was more than that of others in search tasks (p<0.001), and fixation count obtained after medium complexity level was obviously less than that of low and high answer tasks (p<0.001) which showed an obvious U-shaped curve (see Fig. 3).

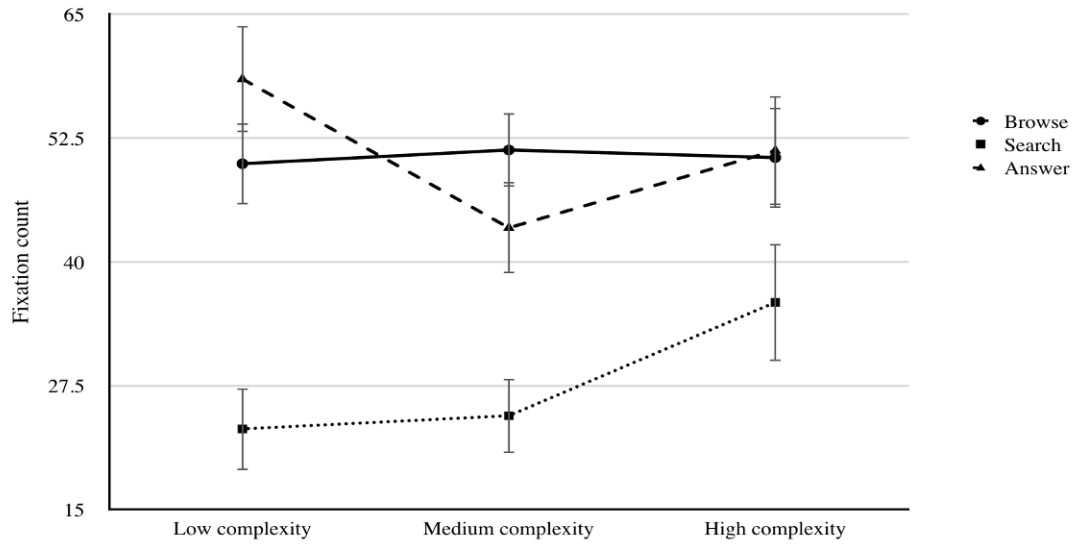


Fig. 3. Fixation count of different visual complexity in each task.

The results of post hoc test from the perspective visual complexity were shown in Fig.4. In condition of low visual complexity, fixation count of search task was significantly lower than that of browse and answer tasks ($p<0.001$), and fixation count of browse tasks was lower than that of answer tasks ($p<0.001$). In condition of medium visual complexity, fixation count of search task was significantly lower than that of browse and answer tasks ($p<0.001$). However, fixation count of interfaces with medium complexity in browse task was higher than answer task ($p<0.001$), which was different from low level. In condition of high visual complexity, fixation count of search tasks was also the lowest ($p<0.001$), but fixation count between browse and answer had no significant difference ($p>0.05$).

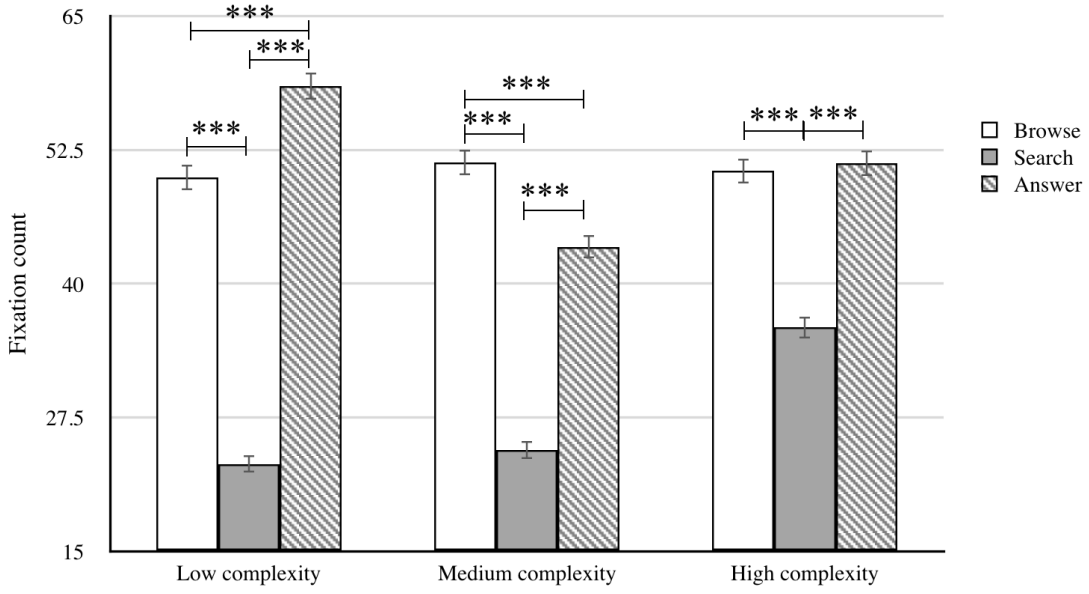


Fig.4. Fixation count of each task with different visual complexity.

4.5 Fixation duration

A significant main effect of task difficulty was found ($F(2, 70)=57.286$, $p<0.001$), whereas no significant main effect of visual complexity was found on fixation duration ($F(2, 70)=1.442$, $p>0.05$). Generally, fixation duration of search tasks was shorter than that of browse and answer (search vs. browse: $p<0.001$; search vs. answer: $p<0.001$), however the difference of fixation duration between browse and answer tasks was not significant ($p>0.05$).

The interaction with task difficulty and visual complexity in fixation duration reached significance ($F(2.922, 102.280)=3.942$, $p<0.05$). The post hoc test showed that fixation duration obtained after high complexity was significantly longer than that of low one in search task ($p<0.05$); however, the fixation duration produced after low visual complexity was significantly longer than that of medium and high one in answer tasks (low vs. medium: $p<0.001$; low vs. high: $p<0.05$) (see Fig.5).

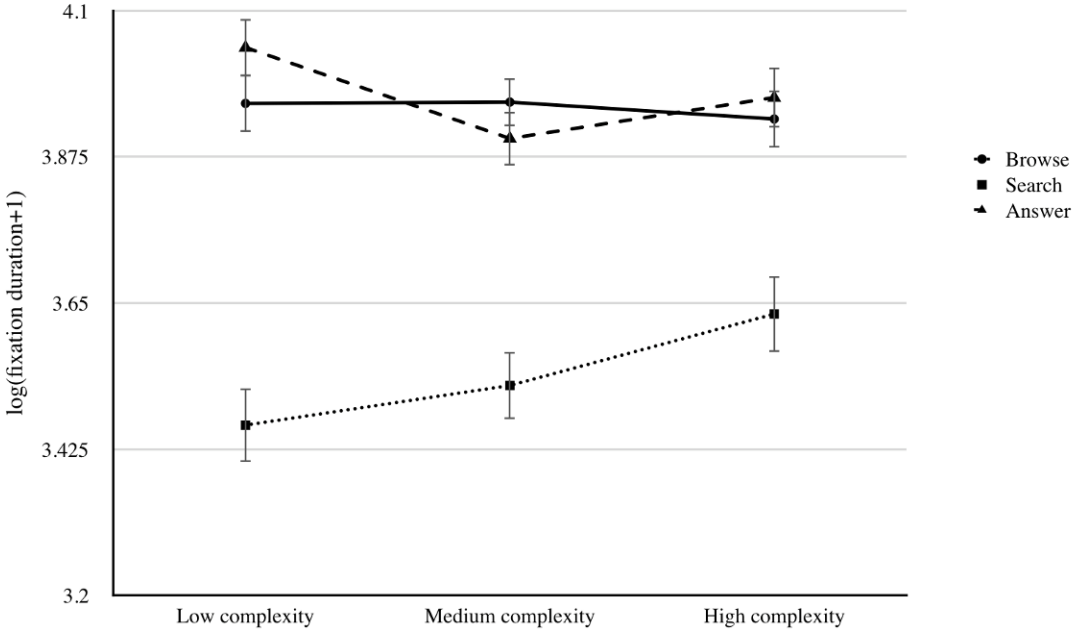


Fig.5. Fixation duration of each task and visual complexity.

4.6 Pupil size change

Because the individual difference of pupil size varies widely, we adopted the change of pupil size (the change of pupil size = pupil size- average pupil size of each participant) for analysis. A negative value indicates myosis, and a positive number indicates mydriasis. After two-factor repeated measures ANOVA, we found significant main effects of task difficulty and visual complexity on the change of pupil size ($F (2, 70) =29.345$, $p<0.001$; $F (2, 70) =12.063$, $p<0.001$), the interaction between task difficulty and visual complexity in the change of pupil size was not significant ($F(4, 140)=.633$, $p>0.05$). A post hoc test showed that there were significant differences among the three tasks (see Fig.): the change of pupil size of task answer was significantly bigger than that of task browse task ($p<0.001$), and the change of pupil size of search was significantly bigger than that of browse task ($p<0.001$).

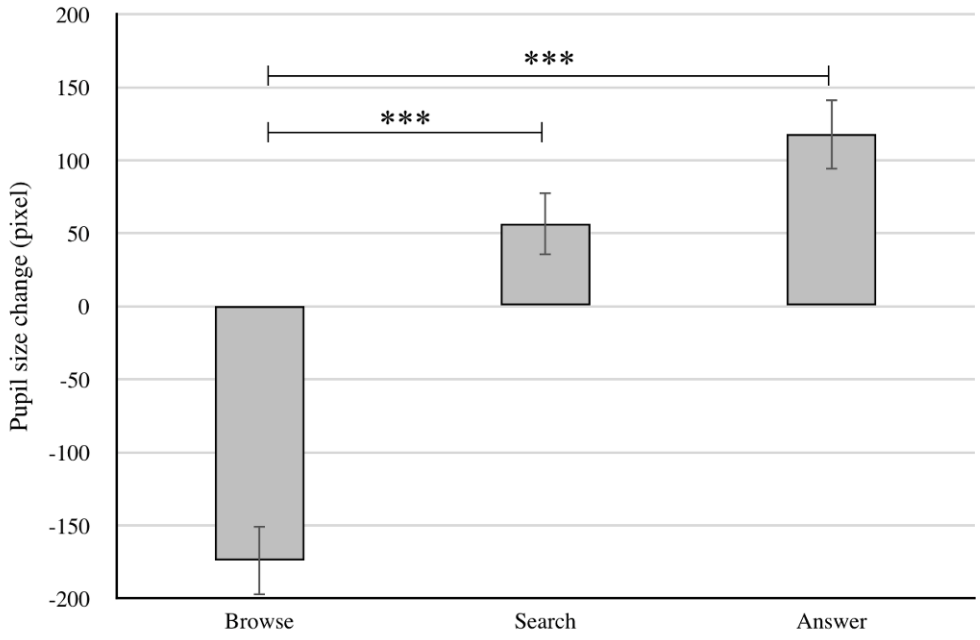
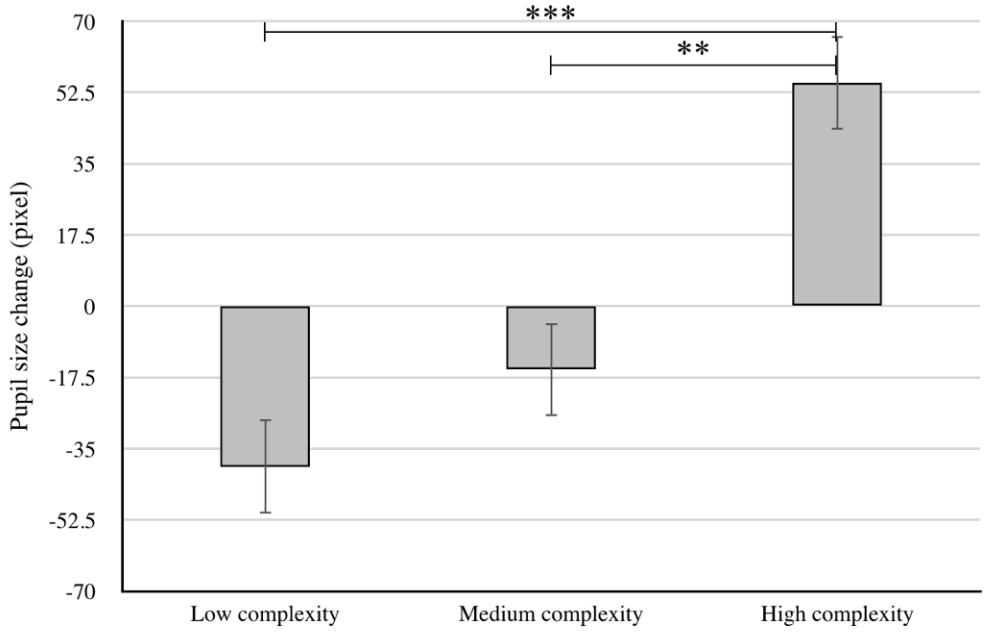


Fig. 6. The change of pupil size of each task.

Fig.7 showed that the change of pupil size obtained after high complexity was significantly bigger than that of medium and low one (low vs. high: $p<0.001$; medium vs. high: $p<0.01$).



** indicates p<.01;
*** indicates p<.001.

Fig. 7. Pupil size change of visual complexity levels.

4.7 User satisfaction

At the end of the experiment, participants were required to rate their satisfaction after each task using a 7-point Likert scale. We found that only visual complexity had main effect on satisfaction ($F(2, 70) = 22.879$, $p<0.001$). Post hoc test showed that participants were more

satisfied with lower complexity level (low vs. medium: p<0.01; medium vs high: p<0.001; low vs. high: p<0.01) (see Fig.).

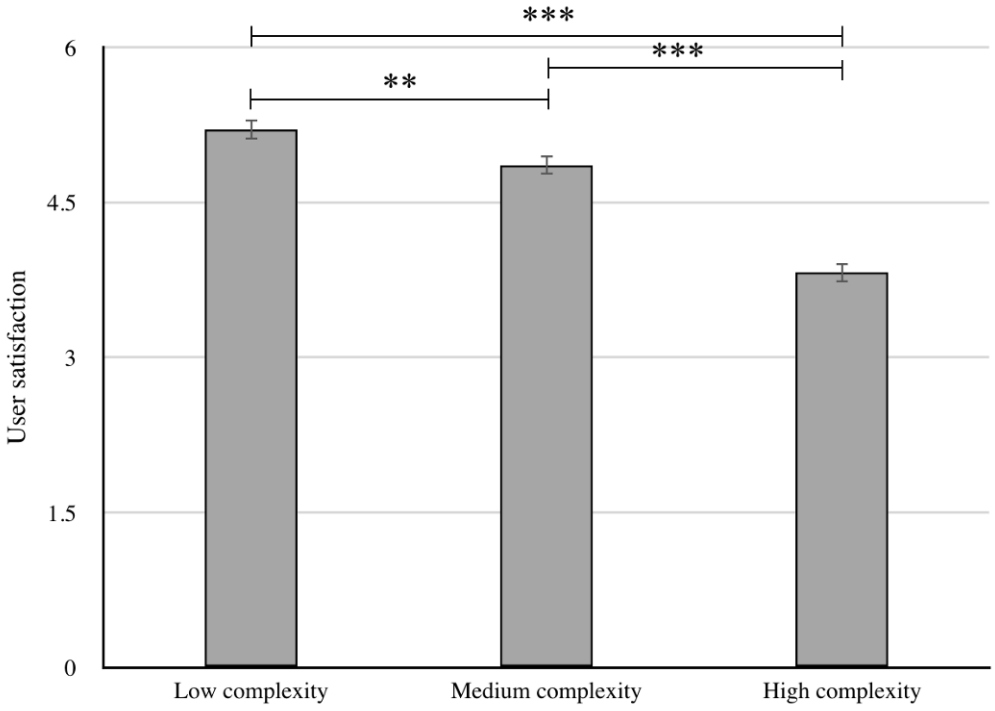


Fig. 8. User preference of three complexity degrees.

4.8 Correlation Test

In the correlation test, we excluded the data of browse, because this task had no clear goal that made the values higher than other tasks. Table 1 showed the results of correlation test. There was a significant positive correlation between TCT and the change of pupil size (r=.990, p<0.01), between fixation count and the change of pupil size (r=1.000, p<0.01), and between fixation duration and the change of pupil size (r=.880, p<0.01). High positive correlations were found between TCT and fixation count (r=.990, p<0.01), between fixation count and fixation duration (r=.880, p<0.01), TCT and fixation duration (r=.867, p<0.01).

Table 1: Correlations between variables

	TCT	Fixation count	Fixation duration	Pupil size change	Satisfaction
TCT	1	-	-	-	-
Fixation count	.990**	1	-	-	-
Fixation duration	.867**	.880**	1	-	-
Pupil size change	.990**	1.000**	.880**	1	-
Satisfaction	0.024	.014	.051	.013	1

*** p<.01, * p<.05*

5 General discussions

5.1 User behaviour in each task

Again, as mentioned before: the fixation count shows the total amount of attention on a given object [28]; longer fixation duration implies that information is more difficult to extract or from another perspective, more attractive[27]. Less TCT usually indicates more efficient decision-making and better design interface[18]. In our current study, in browse tasks, we found no significant difference in TCT, fixation count and fixation duration among 3 levels of visual complexity, which suggests that the user's browsing behaviour are independent on visual complexity. Since search tasks only require low HIP resources to match asterisk, we found that TCT, fixation count and fixation duration produced after high visual complexity was significantly longer than that of lower ones. This result is similar to the simple task in the study of Wang et al.[18]. Answer tasks required participants to understand the problem and the content of the news, and then find the right answer, hence requiring more HIP resources and short-term memory. We found that TCT, fixation count and fixation duration obtained after medium complexity was significant shorter than that of other two visual complexities, showing a nearly U-shaped curve. This result supplements the Berlyne's theory that a page must surpass a certain minimal level of complexity but not be too complex to achieve optimal effectiveness[4], and is partly supported by Huang & Zhou [19] who found that TCT increased more for difficult tasks than in simple tasks as the number of links on the mobile websites increased. However, this result is incongruous with the finding of Wang et al. [18], who found that for difficult tasks, TCT, fixation count, and fixation duration were all at the highest level with webpages of medium visual complexity. Previous study showed that users had more difficulty extracting information [23] and making good judgements[21,22] on smaller screens compared with larger screens. Therefore, for interfaces in mobile size, it seems that, appropriate visual complexity (not too high or too low) could help users to achieve best efficiency and performance. Considering the effect of visual complexity on human eye movement, we found that fixation count obtained after search task is lower than that of browse tasks and answer task regardless of visual complexity. As we know that the fixation count shows the interests on a given object, these results indicate that, compared to search task, browse tasks and answer task could attract more of the user's attention in mobile-sized interface. Furthermore, we noted that fixation count of browse tasks was lower than that of answer task in low visual complexity, while it was higher than that of answer task in medium complexity. Considering the browse task as a baseline, interfaces with low visual complexity hinder the completion of answer tasks, while interfaces with medium visual complexity improves user performance. However, interfaces with high visual complexity offering excessive information distracts users while browsing.

5.2 Subject evaluation

Subjective satisfaction scores of mobile-size interfaces were collected by 7 points Likert scale at the end of each task. We found that participants were more satisfied with low complexity level than medium and high visual complexity, whereas no significant main effect was found on task difficulty. In other words, participants preferred low visual complexity, which is independent of task difficulty. This finding is in line with the result of previous study that suggested a simplified interface design contributes to positive satisfaction in webpage[9]. In this study, we found that users were more satisfied with simpler interface regardless of task difficulty, however, the change of user performance were related to different tasks. This indicates that user satisfaction may contradict with user performance in tasks requiring high level of cognitive processing, for example, answer task in this study.

5.3 Cognitive load

Pupil size is considered to be associated with cognitive load, and the greater the pupil size, the higher the user's load in the task [35]. According to Sweller's theory[20], task difficulty is related to intrinsic load, while visual complexity is related to extraneous load.

We found a significant main effect of task difficulty on pupil size change, the pupil size change of answer tasks was significantly bigger than that of search tasks, which means that intrinsic cognitive load of human increased as task difficulty increased. Considering the effect of task difficulty on eye movement and user behaviour, we found that, except the condition of browse tasks, TCT, fixation count and fixation duration with answer tasks were at a higher level than that of search tasks. These results suggest that varying intrinsic cognitive load might be one of the reasons that induced the change of eye movement and user behaviour for answer and search tasks. However, we found that, the pupil size change of browse tasks was significantly smaller than that of task search, while TCT, fixation count and fixation duration in browse tasks were at higher level than that of search task. In the present study, compared with search tasks, participants could end the trial without an obvious goal in browse tasks led to longer TCT, longer fixation duration and more fixation counts. Therefore, we think that these results might be caused by the characteristics of the task itself. We found a significant main effect of visual complexity on pupil size: the pupil size of high complexity was larger than that of low and middle ones, which means that extraneous cognitive load increased when visual complexity increased. With regard to the effect of visual complexity on subjective satisfaction, we found that participants were more satisfied with lower complexity level than medium and high visual complexity. In other words, participants preferred low visual complexity, which is independent of task difficulty. These results suggest that higher extraneous cognitive load of high visual complexity might lead to lower satisfaction, while lower extraneous cognitive load might induce higher satisfaction on mobile-size interface.

6 Conclusion

In conclusion, we found that task difficulty had an effect on behavioural performance (TCT, fixation duration and fixation count), which is caused by intrinsic cognitive load. Furthermore, we also found that user satisfaction is more related to extraneous cognitive load, such as visual complexity. We suggest that interfaces for users to search should be designed as simple as possible in order to maximize user performance, while interfaces requiring users to extract information should be of moderate complexity level.

This was the first study to explore the relationship between visual complexity and task difficulty of mobile size interface by using eye-tracking technique. Our results obtained could provide a scientific basis for interface design of small screen devices.

Further effort would be needed to confirm whether these results could be used in real mobile environment. Because there are many dimensions affecting interface complexity, such as the layout and length of interfaces, we should study the effect of other dimensions on users' outcomes in the future.

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The Evaluation about a Sense of Speed, Danger, and Being Disturbed for Road Marking on Expressway

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The risk of traffic accident is high in the curve section of Expressway. A road marking is used to arouse attention and deceleration to drivers. They were reported that a deceleration mark has an effect on a speed reduction, and a sense of speed changes in accordance with an installation interval. A colored pavement is used giving a sense of danger utilizing the effect of color. However, there are no case to verify the effect of combining road markings with "a sense of danger" and "a sense of being disturbed" of drivers. There, we clarified the relationship between the constituents of the road marking and the driver's senses. We selected three deceleration marks, as “Dot line”, “Arrow” and “Optical dot”, and three pavements, as “Standard”, “Red colored” and ″Red stripe”. These are main road markings used on Japanese expressway. Experiment participants answered three senses, as “A sense of speed”, “A sense of danger" and “A sense of being disturbed”, after a driving simulator test. As the result of analysis, we got the following knowledge, such as 'There are no interaction for any sense in combination between deceleration marks and colored pavements', 'Arranging large deceleration marks in the center on a lane increases a sense of speed', 'Arranging small deceleration marks in the center on a lane increases a sense of being disturbed' and 'Red colored pavement and red stripe greatly affect an amplification of a sense of danger’. Finally, based on these knowledges, we designed a road marking pattern.

Keywords: drive simulator; traffic safety; template; sensory evaluation experiment

1 Introduction

On expressway, the occurrence probability of a traffic accident is high at the curve section. The main factor of it is "over speed". Many kinds of traffic safety measures are installed on expressway for drivers to slow down. For example, there are the direct messages to a driver, such as a draw attention sign and a letter sign on a road surface or on a guidepost. And also, a road marking, such as a colored pavement or a deceleration mark, is made indirectly use of urging safety driving. Table 1 shows major road markings made before the curve section on Japanese expressway. The road marking can be easily transmitted messages to the driver, because of occupying a large proportion of the driver's view. Furthermore, road markings without languages are important as a universal design because of appealing to the driver's senses and being able to climb over a language barrier.

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The main role of the road marking is to give the driver a sense of speed and a sense of danger before the curve section. By this, drivers can reduce a speed in advance. "A sense of speed" means whether drivers got the faster sense or not for the actual speed. "A sense of danger" means whether drivers got the sense of danger or not by the road marking.

On the other hand, when a road marking gives a sense of being disturbed to a driver, it is concerned that the concentration of the driver will be inhibited. So, it has to be evaluated that whether a road marking gives "A sense of being disturbed" or not to a driver.

Several previous reports focused on "the relationship between deceleration marks and a sense of speed." However, there was no report that "a sense of being disturbed to road markings", "the relationship between elements of road markings and a sense of danger and a sense of being disturbed", and "the combination effect by elements of road markings such as the colored pavement and the deceleration mark".

It is essential to know these points in order to design a road marking that can urge the speed reduction safely and suitably, while the consideration of the psychological state of drivers.

Therefore, in this study, we clarified the relationship between elements of the road marking and a sense of speed, a sense of danger and a sense of being disturbed. The purpose of this study was to know the design method of road markings, which has not been clarified so far.

As elements of road marking in a research subject, we selected three colored pavements and three deceleration marks. These are major road markings on Japanese expressway as introduced in Table 1.

In each verification, we used a driving simulator. Furthermore, based on the experimental results, we designed the road marking as an application example.

Table 1. Traffic safety measures for speed control

	Direct message	Indirect message	
Road markings	 Text instruction	 Colored pavement	 Deceleration marks
Other	 Attention signboard	 Arrow marks on the wall	 Guide light

2 Review of previous studies

In this chapter, we describe the previous research about road markings to be the indirectly message and the position of this research.

On Japanese expressway, the deceleration mark, such as “Red colored pavement” and the “arrow” deceleration mark is frequently made use of expecting to slow down (Table 2).

There are some reports that the deceleration mark has an effect on the speed reduction. Studies on the effect of deceleration mark was started in the 1960 's. Denton (1966, 1971, 1976, 1977) reported that a deceleration mark has an effect on a speed reduction. Because, drivers are given the illusion of an excessive speed when they pass over the deceleration mark. In addition, he showed that a sense of speed of drivers was changed according to the installation interval of the deceleration mark by the indoor experiment using a driving simulator. HAN, TAMAKI, ONO, SASAKI, SUDA & IKEUCHI (2012) showed that oval dot marks (hereinafter referred to as “optical dot”) have an effect on the speed reduction by doing the enforcement on a real road. Kawata, Nagami, Kiyomiya & Nakagawa (2012) evaluated the effect on a speed reduction by the road markings using a driving simulator. Samples were composed “Red colored pavement” and deceleration marks of “Dot lines”. As the result, it was cleared that if easy-to-recognize figures were deployed at a short pitch, it was effective to control the speed.

″Dot line” is normally used to make keeping drivers in the center of a lane. However, a dot is recognized also as a figure by a driver. And “Dot line” also has an effect that a driver feels the lane to be narrowed. So, the “Dot line” is also expected to contribute to slow down, like the other road markings. For the above reasons, we treat also the “Dot lines” as a deceleration mark in this study.

Even the outside of Japan, deceleration marks are made use of slowing down. Andrew and Cherie (2010) introduced deceleration marks of various countries at the report of "Effectiveness of transverse road markings on reducing vehicle speeds". In this report, “Transverse road markings” are made use of increasing the driver's awareness of danger and reducing a speed. As for “Dragon teeth road markings”, the average of vehicle speed decreased by 8-14% in a result of the driving test. In Virginia, “Zig zag road (2015)” was installed to warn drivers’ approaching the intersection of walking and cycling trails. It had effect for drivers to reduce 5 miles per hour. However, these cases targeted not an expressway but a local road. Therefore, it is not clear the effect about them in driving with a high speed.

There are few reports about the colored pavement, but the colored pavement has some merits. The colored pavement increases the skid resistance of tires, give a sense of danger for drivers, and increase an attention to drivers. Aoki (2009) pointed out that the colored pavement had the effect of increasing the driver’s awareness to traffic safety. For giving a sense of danger and increasing driver's attention, the psychological effect of color is skillfully utilized in a traffic safety field. Especially, red color has the meaning of danger and the function of increasing attention. Shuto-kosoku (2019), Japanese metropolitan expressway, laid the red colored pavements to urge a driver’s attention at the curve section where cars run over-speed.

In the above, we introduced the cases of installation of deceleration marks and colored pavements, and reported about the decelerating effect. But there were very few reports that mentioned the psychological effects to the driver. YOTSUTSUJI, XING, YONEMURA, KAI, MATSUMOTO and KITA (2018) conducted experiments using the NASA-TLX evaluation

index developed by NASA, but they did not mention the detail such as mental demand or frustration.

Knowing the psychological effects is essential for identifying the factors of the effects and designing. For example, it needs to raise a sense of speed and a sense of danger to warn drivers that excessive speed may cause an accident. On the other hand, if road markings give for drivers a sense of being disturbed, it is concerned that the concentration will be inhibited. For drivers keep a safety driving, it must be able to concentrate driving without being disturbed.

However, there are no reports about a sense of being disturbed by road markings. In addition, there are no studies to examine the colored pavements increasing a sense of speed and a sense of danger while reducing a sense of being disturbed.

On actual roads, the colored pavements and the deceleration marks may be used at the same time. Nevertheless, no research has examined the combination effect of road marking patterns and colored pavements, too.

Therefore, in this study, we clarified the relationship between elements of a road marking and a sense of speed, a sense of danger and a sense of being disturbed. Elements of the road marking were three colored pavements and three deceleration marks. Furthermore, we designed a road marking pattern as an application example based on the experimental results.

Table 2. Examples of road marking

	Deceleration mark			Colored pavement	
Express -way	 Dot line	 Arrow mark	 Optical dot	 Red stripe	 Red colored
Local road	 Transverse road marking	 Dragon teeth	 Zig zag road (2015)	 Blue colored	 3D sign
	Andrew and Cherie (2010)				

3 Outline of experiment

3.1 Experiment objects and simulation environments

As experiment objects, we selected three deceleration marks, as “Optical dot”, “Dot line”, and “Arrow”. And we decided three pavements, as “Standard pavement”, which is a common asphalt pavement, “Red colored pavement”, which is a completely covered red color on asphalt pavement and “Red stripe pavement”, which is on a red stripe marking on asphalt pavement. These are the typical road markings used in Japan.

Based on the road marking of a metropolitan expressway, we set the driving environment, such as section one was a standard section, section two was a deceleration introduction section (from 200 to 100 m in front of the curve), and section three was a deceleration

section (from 100 to 0 m in front of the curve). Road model had one way two lanes. This is the typical cross section on a metropolitan expressway. Experiment participants drove with 80km/h through the standard section. Then, they slowed down as needed at the curve section or before the curve section.

We arranged deceleration marks a wide pitch at the deceleration introduction section and at a narrow pitch in the deceleration section (Figure 1). We also arranged “Red stripe pavement” as same pitch as the deceleration mark and arranged “Red colored pavement” at the deceleration section. Table 3 shows the pitch and the size of three deceleration marks and three pavements in two sections. We selected the pitch referred to the case installed in Japan. We set that the 3 type deceleration marks times 3 type pavements equalled 9 types (Table 4) as the experiment objects. In addition, for the road space simulation, we used the software and hardware called UC-win / Road made by Forum 8 Co., Ltd. (Figure 2).

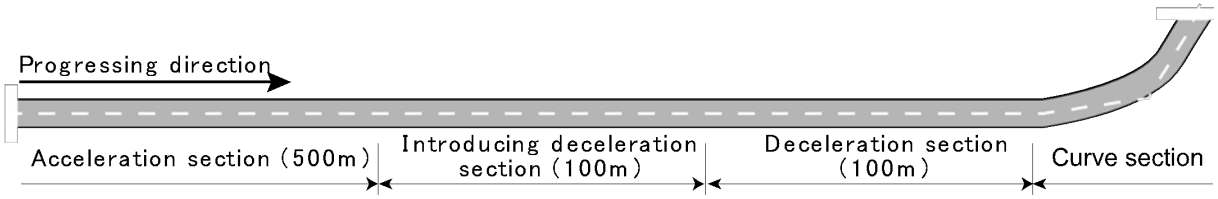


Figure 1. Road surface configuration in simulation space

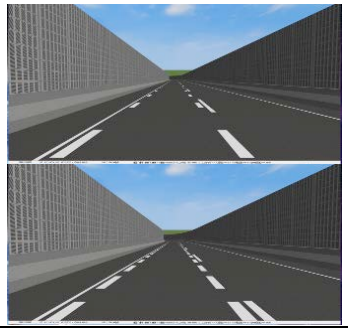
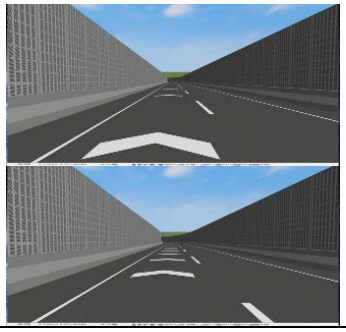
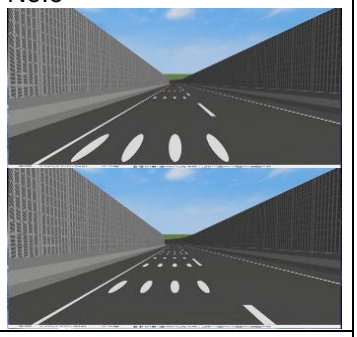
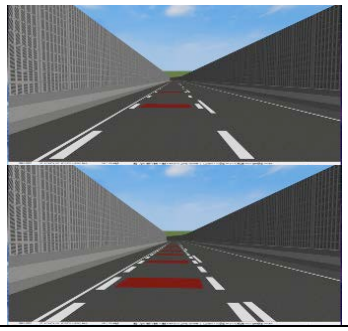
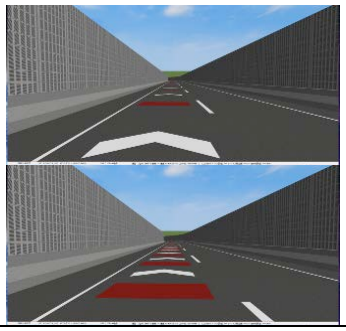
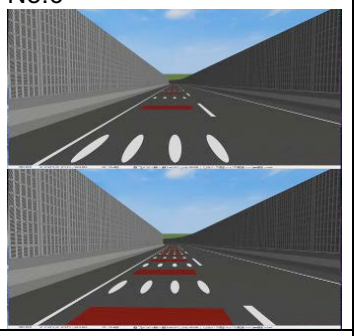
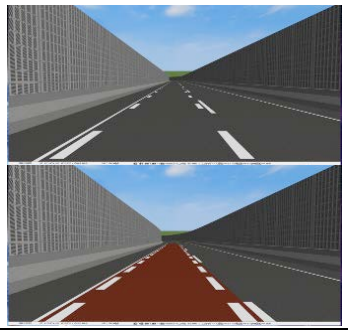
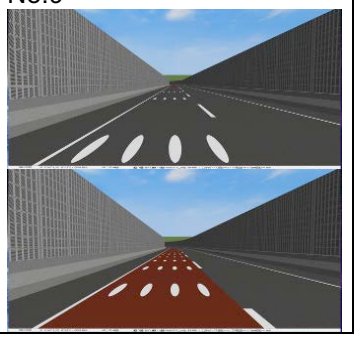
Table 3. Gap length and pattern size in each sample

		Introducing deceleration section	Decelerating section
Deceleration mark	Dot line	2m 6m	2m 3m
	Arrow	2m 12m	2m 6m
	Optical dot	2m 12m	2m 6m
Road pavement	Standard		
	Red stripe	1.5m 12m	1.5m 6m
	Red colored		



Figure 2. Experiment by driving simulator

Table 4. Experiment scene

		Deceleration mark		
		Dot line	Arrow	Optical dot
Road pavement	Standard	No.1 	No.2 	No.3 
	Red stripe	No.4 	No.5 	No.6 
	Red colored	No.7 	No.8 	No.9 

Upper image: Introducing deceleration section Lower image: Deceleration section

3.2 Method of experiment

The experiment participants were 20 students who were early 20's and held driver's licenses.

To nine objects, they operated the driving simulator, and after that they answered the interview-based inquiry. In other words, the trial number of operation and answer was 9 times per a participant. Before these experiments, they drove another course, in order to get used to the operation of the driving simulator. The sense evaluations in their answers were about 3 topics, such as "A sense of speed (Whether you got the faster sense or not.)", "A sense of danger (Whether you got the sense of danger or not.)" and "A sense of being disturbed (Whether you got the sense of being disturbed from road markings or not.)".

Participants answered in each of three senses by 5 levels SD method, like "I do not feel: 0 point", "I hardly feel: 1 point"," I feel a little: 2 points", "I feel: 3 points" and "I strongly feel: 4 points" (Figure 3). In addition, the experimental objects were randomly presented for each a participant.

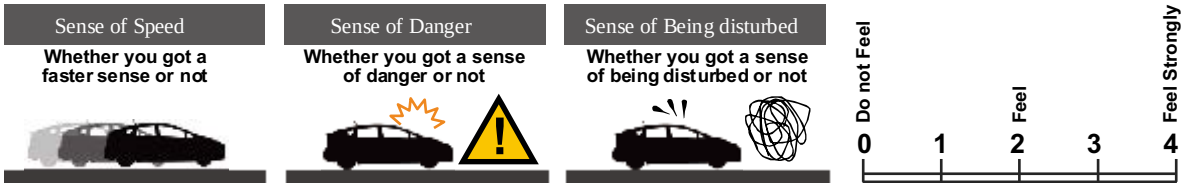


Figure 3. Evaluation items and evaluation criteria

4 Analysis of experiment results

We analyzed the experimental result by two-way analysis of variance (two-way ANOVA). Analysis targets are the evaluations of a sense of speed, danger and being disturbed to deceleration marks and pavements. By these analyses, we revealed the relationship between the evaluations and the elements of road marking.

4.1 Relationship between "a sense of speed" and elements of road marking

Table 5 shows an average and a standard deviation in 9 samples. Figure 4 shows an interaction diagram. The higher point shows that a driver feels faster. The highest score was 2.7 points, as the combination of "Red colored pavement" and "Arrow", and the lowest score was 1.5, as the combination of "Standard pavement" and "Dot line". From two-way ANOVA, we acknowledged a significantly different ($p<.05$) at the main effectiveness of deceleration mark ($F(2, 171) = 3.85$). We did not acknowledge a significantly different at the main effectiveness of pavement ($F(2, 171) =.71$), ($p=.50$) and the interaction effect between deceleration mark and pavement ($F(4, 171) =31.20$), ($p=.31$). Based on a multiple comparison result (Tukey method) of main effectiveness for deceleration mark, we acknowledged a significantly different between "Arrow" and "Dot line" ($p<.01$), and between "Arrow" and "Optical dot" ($p<.1$), shown as Figure 5 a). Based on these results, we could indicate following points.

1. All participants similarly felt a sense of speed, because the point of a sense of speed was distributed the neighbourhood of 2.0.
2. A sense of speed with "Arrow" was larger than that with "Dot line" and "Optical dot".
3. The element of colored pavements did not affect the participant's sense of speed.

Table 5. Average and standard deviation of evaluated point about sense of speed

		Deceleration mark		
		Dot line	Arrow	Optical dot
Road pavement	Standard	1.5 (1.1)	2.3 (1.2)	2.1 (1.4)
	Red stripe	1.9 (1.0)	2.1 (1.3)	1.9 (1.1)
	Red colored	2.1 (1.4)	2.7 (1.0)	1.7 (1.2)

( ): standard deviation

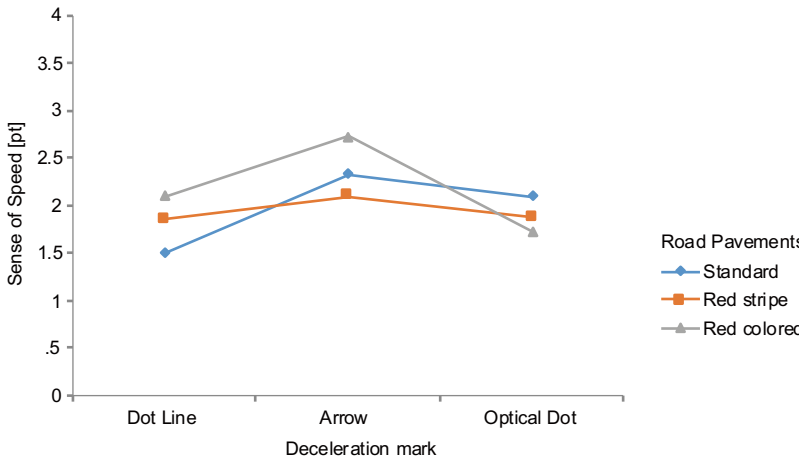


Figure 4. Interaction diagram about sense of speed

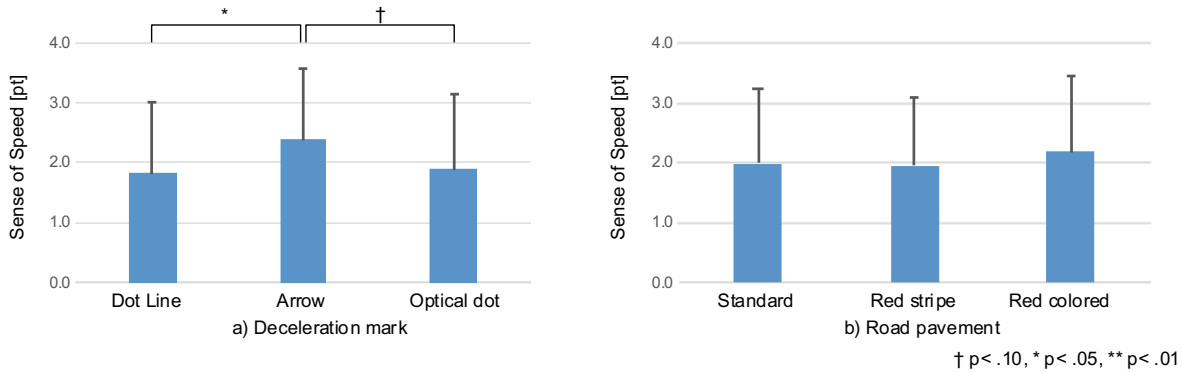


Figure 5. Main effect about sense of speed (Average and standard deviation of each level)

4.2 Relationship between "a sense of danger" and elements of road marking

Table 6 shows an average and a standard deviation in 9 samples. Figure 6 shows an interaction diagram. The higher point shows that a driver feels more dangerous. The highest score was 2.4 points, as the all combination with "Red stripe pavement", and the lowest was .3 points, as the combination of "Standard pavement" and "Dot line". From two-way ANOVA, we did not acknowledge a significantly different ($F(2,171) = 1.83$, $p = .17$) at the main effectiveness of pattern. We acknowledged a significantly different at the main effectiveness of pavement ($F(2, 171) = 36.26$, $p < .01$). We did not acknowledge a significantly different at the interaction effect between deceleration marks and "Red colored pavement" ($F(4, 171) = .43$, $p = .79$). Based on a multiple comparison result (Tukey method) of main effectiveness for deceleration mark, we acknowledged a significantly different between "Standard pavement" and "Red stripe pavement", and between "Standard pavement" and "Red colored pavement", shown as Table 6 and Figure 7 b). We acknowledged a significantly different between "Standard pavement" and "Red colored pavement" ($p < .1$), and between "Standard pavement" and "Red stripe pavement" ($p < .01$), shown as Figure 7 b). Based on these results, we could indicate following points.

1. The element of deceleration mark affected small to the sense of danger.
2. The sense of danger with “Standard pavement” was smaller than that with “Red colored pavement” and “Red stripe pavement”.
3. It could not be confirmed the combination effect of “Arrow” and colored pavements.

Table 6. Average and standard deviation evaluated point about sense of danger

		Deceleration mark		
		Dot line	Arrow	Optical dot
Road pavement	Standard	.3 (.5)	1.0 (1.2)	.6 (.9)
	Red stripe	2.4 (1.0)	2.4 (1.1)	2.4 (1.3)
	Red colored	1.7 (1.4)	2.2 (1.3)	2.1 (1.5)

( ): standard deviation

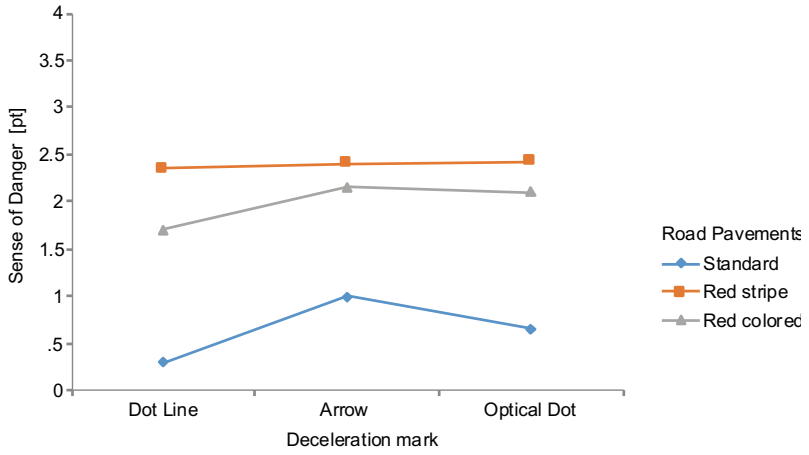


Figure 6. Interaction diagram about sense of danger

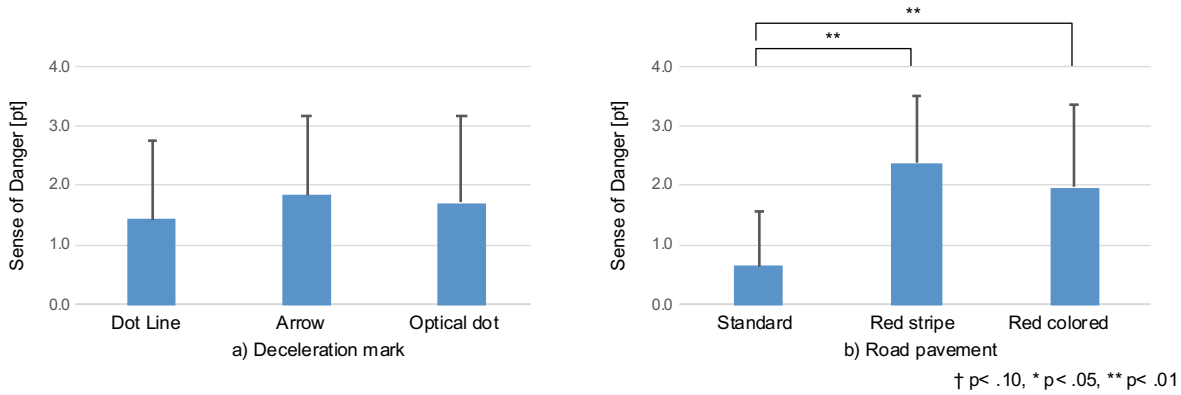


Figure 7. Main effect about sense of danger (Average and standard deviation of each level)

4.3 Relationship between “a sense of being disturbed” and elements of road marking

Table 7 shows an average and a standard deviation in 9 objects. Figure 8 shows an interaction diagram. The higher point shows for a driver to feel more being disturbed. The highest score was 3.3 points for the combination of “Red stripe pavement” and “Optical dot”, and the lowest was 0.5 points for the combination of “Standard pavement” and “Dot line”.

From two-way ANOVA, we acknowledged a significantly different at the main effectiveness of deceleration mark (F (2,171) =18.62, p<.01) and the main effectiveness of pavement (F (2, 171) =23.31, p<.01). We did not acknowledge a significantly different at the interaction effect between deceleration marks and “Red colored pavement” (F (4, 171) =.51, p=.73). Based on a multiple comparison result (Tukey method) of main effectiveness for deceleration marks, we acknowledged a significantly different between “Dot line” and “Optical dot”, and between “Arrow” and “Optical dot”, shown as Figure 9 a). We acknowledged a significantly different between “Standard pavement” and “Red colored pavement” (p<.1), and between “Standard pavement” and “Red stripe pavement” (p<.01), shown as Figure 9 b). Based on these results, we could indicate following points.

1. The participant felt that “Optical dot” was more disturbed than “Arrow” and “Dot line”.
2. The participant felt that “Red stripe pavement” was most disturbed, and “Red colored pavement” was more disturbed” than “Standard pavement”.

Table 7. Average and standard deviation of evaluated point about sense of being disturbed

		Deceleration mark		
		Dot line	Arrow	Optical dot
Road pavement	Standard	.5 (1.1)	.9 (1.2)	1.5 (1.2)
	Red stripe	1.9 (1.3)	2.2 (1.2)	3.3 (.9)
	Red colored	1.3 (1.4)	1.8 (1.3)	2.9 (1.2)

( ): standard deviation

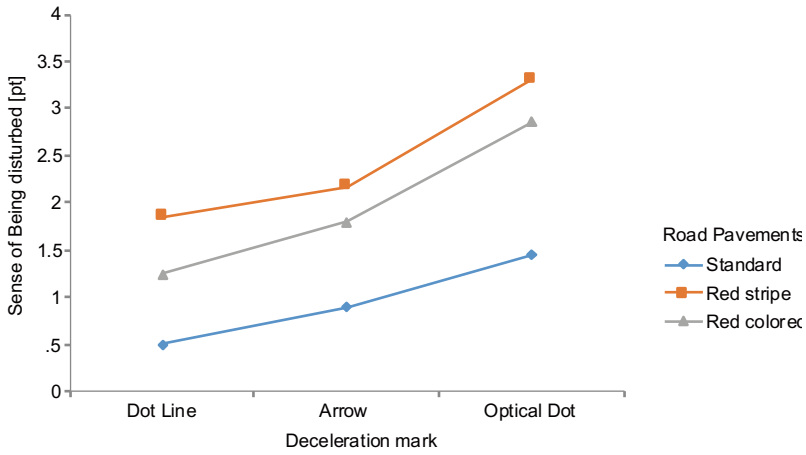


Figure 8. Interaction diagram about sense of being disturbed

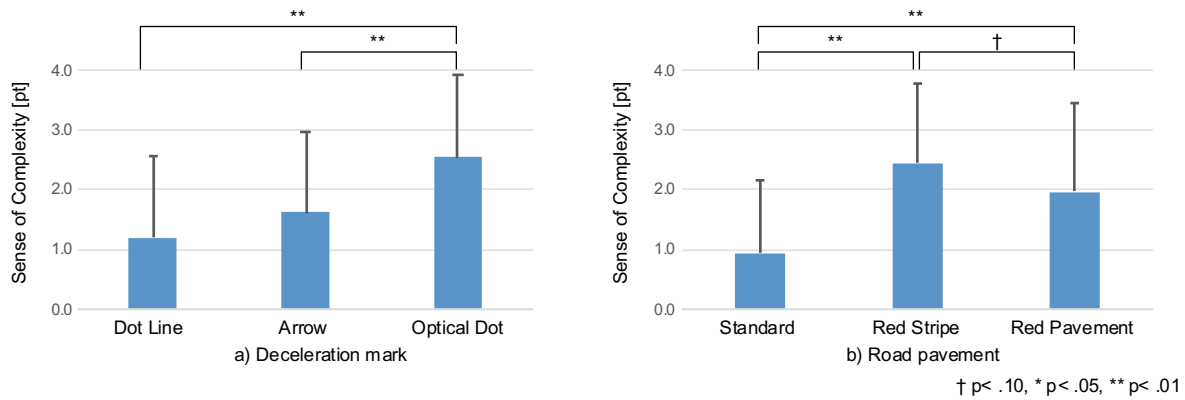


Figure 9. Main effect about sense of being disturbed (Average and standard deviation of each level)

5 Conclusions

In this study, we evaluated a sense of speed, a sense of danger and a sense of being disturbed given by the elements of road marking using the driving simulator, and we investigated the relationship between senses and elements. Its purpose was for us to accomplish the guideline of designing the road marking.

5.1 Conclusion and future issues

In below, we summarized the major knowledges about the road marking got in this study, divided into a deceleration mark and a pavement.

Deceleration mark

1. Similar to previous studies, a sense of speed became higher by the arrangement of deceleration mark. Especially, the center arrangement of a big pattern, like "Arrow", made a sense of speed higher.
2. Drivers evaluated that "Optical dot" made a noticeable sense of being disturbed, compared to "Arrow" and "Dot line".
3. It was small that the difference between senses of danger occurred by deceleration marks. We considered that it was caused by the center arrangement of many small marks on a lane.
   Based on the mention above, we concluded as follows. In the case of being willing to increase a sense of speed of a driver, it is effective to arrange the big deceleration mark on a center of a lane. On the other hand, if aiming to reduce a sense of being disturbed of drivers, it is not better to arrange the many of small marks on a center of a lane.

Pavement

1. About ae sense of speed, we did not confirm the significant difference between "Red stripe pavement" and "Standard pavement", and between "Red stripe pavement" and "Red colored pavement". So, we considered that a pitch of red stripes did not affect the change of a sense of speed in the case of being small contrast of brightness between the figure as a colored pavement and the ground as a standard pavement.
2. Participants felt the strongest disturbance by “Red stripe pavement”.
3. About a sense of danger, “Red stripe pavement” and “Red colored pavement” were a significantly higher point than “Standard pavement”. Based on this, we confirmed that the meaning of red color had an advantage in drawing attention for a danger, similar with knowledge so far. However, “Red stripe pavement” made a sense of being disturbed. So, on using the red color for pavement, it is important for the red color to carefully select only the appropriate locations.

Relationship between deceleration mark and pavement

It was cleared that the deceleration mark and the colored pavement gave an impression to the driver independently. Because, from the experiment results, we could not confirm the interaction, that is, a synergetic effect, between a sense of speed, a sense of danger and a sense of being disturbed.

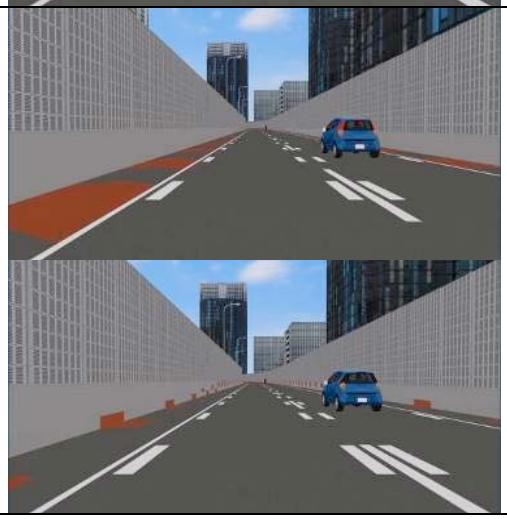
Task from now on

In this study, we evaluated only the road marking. However, Oguchi, Nigorisawa, Konuma & Shikata (2005) reported that the marking pattern on the wall surface affected a sense of speed. So, it also needs to verify the effects for other visual elements, like the traffic sign or the marking pattern on the wall surface, assuming the actual road space. In addition, in order to control a sense of speed by the deceleration mark, it is necessary to clarify other arrangement methods and the contrast value of brightness between the pavement at appropriate section and the figure. According to colored pavements, it is also necessary for us to evaluate a sense of danger and a sense of being disturbed by other colors. On the other hand, to make the verification results more credible, we consider (think) that above experiments will need (have to) target not only 20's experiment participants but also the other age.

5.2 Design example applied by this result

Finally, based on the experiment result and the discussion, Table 8 shows the design example of a road marking for the purpose of the speed reduction and the drawing attention at a curve section. The road marking pattern on a center of a lane raised not only an effective sense of speed but a sense of being disturbed. Then we propose the better design that the "Dot line" is arranged on a road surface at the introducing deceleration section, and moreover the "Red stripe pavement" is arranged from a road shoulder to a wall surface in former purpose. This proposal is used "Red colored pavement" during the curve section in order to raise a sense of danger. We expect this proposal to be able to improve a sense of speed and a sense of danger without a sense of being disturbed.

Table 8. An example of road marking design

Design point	Image
Standard section	
Introducing deceleration section "Dot line" in the lane and "Red stripe pavement" at the road shoulder make a driver to raise a sense of speed. To reduce a driver's sense of being disturbed not to arrange a pattern on a center of lane. "Red stripes" at road shoulder move to a wall surface gradually.	

Deceleration section “Dot line” and “Red arrow” on the wall make a driver’s sense of speed raise more.	
Curve section “Red colored pavement” makes a driver’s sense of danger rise.	
Standard section	

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The Furniture of Science Fiction: Studying Audience Cognitive Mechanisms to Understand How Designed Objects Convey Social Ideas through the Semantic Differential Method

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People obtain information from the physical world and continuously organize this stream of stimuli data via a complex process known as cognition formation. Due to its the complexity of this process, it is difficult to accurately express and assess people's cognition of objects. However, for designers, understanding the logic and principle behind an audience's cognitive process is essential for their design activities. This study focuses on the cognitive mechanisms of audiences obtaining social-information generated from designed objects. The study seeks to establish an updated cognitive model, building on the hypothesis that audiences form cognition about the social environments of objects through the perception of physical features of and emotional responses to objects. To test this hypothesis, an integrated design research methodology was designed based on the Semantic Differential Method (SDM). An object from a science fiction (Sci-Fi) film was selected as an example to research how designed objects convey social information. The results largely validate the hypothesis by revealing that audience cognition exists at different interconnected levels. The findings of this study can help designers better understand audience cognitive mechanisms, and the methodology described can be a useful tool for designers to obtain and analyse audience cognition of objects through the design process.

Keywords: Design Research; Cognitive Mechanisms; Semantic Differential; Science Fiction

1 Introduction

The purpose of this research is to study audience cognitive mechanisms to understand how designed objects convey social ideas. In this study, the *audience* refers to the group of people who encounter a work of design. Encountering an object includes perceiving the object through the senses, such as vision and hearing as well as interacting with the object, such as usage behaviours. The *cognitive mechanism* is defined as the principle and logic behind people's mental actions or processes of acquiring information, which mainly focuses on the processes and outcomes of cognitive behaviours. *Designed objects* refer to any physical objects that have been designed by people to distinguish from natural objects that have not been processed by people. *Social ideas* refer to the social information carried by

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objects, through their production and use in human social environments. Specifically, this includes social conditions of politics, culture, economy, technology, and resources available from the natural environment.

1.1 Science Fiction Films

It has been more than a hundred years since the production of *A Trip to the Moon* (1902), generally considered the first science fiction (Sci-Fi) film. Even though Sci-Fi films are born of the popular culture industry, there are many masterpieces with deep thinking on the human condition in this genre. In a certain sense, Sci-Fi films are thought experiments about the possible future of human social development; therefore, they often express powerful social ideas. They usually construct a singular landscape that is outside reality to contemplate the absurd consequences of human development and explore the ethical dilemmas of human society under particular circumstances. Sci-fi films reflect on the history, the present, and the future of human society—often with profound implications or critique.

Because Sci-Fi films are to some degree social experiments, their creators often adopt vanguard or extreme means of expression. As a result, the visual style of Sci-Fi films is often intense and distinct. In the context of the Sci-Fi film genre, imagination and social thinking are expressed through specific design elements. In other words, the visual elements are the manifestation of the film creators' deep thinking about human society and the thinking are the logical supports behind the visual and set design.

Sci-Fi films are highly dependent on environmental settings, with visual elements playing an important role. Successful Sci-Fi films require consistency in the logic of the narrative, which means film objects, such as props or scene settings, need to fit into the portrayed social environment. Therefore, compared to other genres of films, the designed objects in Sci-Fi films have a greater sense of existence and often carry metaphors about the social environment being explored.

1.2 Audience Cognitive Mechanisms

The study of the information conveyed by the product belongs to the category of product semantics. Krippendorff and Butter (1984) first proposed this term in the Industrial Designers Society of America (IDSA)'s journal Innovation. They defined "product semantics" as both an inquiry into the symbolic qualities of things and as a design tool to improve these cultural qualities (Krippendorff & Butter, 1984). According to Demirbilek and Sener (2003), product semantics study how to identify appropriate visual, tactile and auditory information and incorporate it into product design. The study of product semantics includes the whole process of incorporating and interpreting the meaning of products. The study of audience cognitive mechanisms focuses on mental actions or processes on interpreting the meaning of objects.

Any object that exists in the physical world contains and provides information, and human mental actions or processes for acquiring this information is the cognition of things ("Cognition," 2016). This information is usually about the object itself and its environment. As intelligent beings, humans can directly perceive individual and specific entities as well as understand the surface connections and relationships of objects. They use existing knowledge and previous experience to mentally establish connections, to form concepts of things, to rationalize and judge confrontations with new things, and to solve problems or reconcile inconsistencies.

An audience's cognition of objects is often considered subjective and difficult to accurately express and assess. The cognitive model, previous experience, context and an audience's immediate emotional state, all affect cognition of a specific object at a particular moment. Therefore, cognition of any given object could vary widely between different independent audiences. Moreover, the dominant cognitive outcomes can be formulated in many different forms, such as emotions, feelings, thoughts, ideas, and so on. Therefore, it is extraordinarily complex and challenging to get accurate information about an audience's cognition of an object.

However, for design activities, it is essential to obtain a determined audience's cognition of objects. Norman (1988) pointed out that design is an act of communication. A designed object is a medium that connects its creators and audiences across time and space. Beside the physical properties, functions, and interaction modes of an object, the information contained by the object also includes the aesthetic perspective, attitude, and social contexts (or assumptions) of its creators. As the object interacts with audiences in increasing degrees of intimacy, it inevitably carries more information about time and space: history and environment. Giving information to objects and extracting information from objects are two relatively independent processes. From the moment the object is fully realized through production, interpretation of the object is out of the creator's control. Any audience has the opportunity to interpret that object without considering the designer's intentions. However, cognitive responses of an audience can provide important feedback for designers to evaluate and reflect on their design activities. Therefore, designers, as creators of objects, can benefit from effective tools and methods to better understand audience cognition of objects.

While our cognitive process is complex, cognitive behaviours follow general rules. Through reasonably designed methods, cognition can be evaluated and understood—at least to some extent. Cognitive psychologist Broadbent (1958) studied the cognitive model of humans in his book "Perception and Communication" and proposed the "filter model of attention." His study showed some common mechanisms for people's cognition. According to anthropologist Brown (1991), there are universals common to all human societies. Cognitive science shows that human beings have formed commonalities in underlying psychological mechanisms during the long evolutionary process. For example, Gestalt psychology revealed the general cognitive law of the relationship between parts and the whole (Koffka, 1935). A recent psychological study shows that even for a novel object, people still have at least some shared impressions (Kurosu & Todorov, 2017).

1.3 Hypothesis of the Study

Norman (2004) created a model which indicates that human reaction to design exists at three levels: visceral (appearance of the objects), behavioural (how the objects perform), and reflective (users' personal feelings and opinions about the objects). Based on Norman's theory, an updated cognitive model was proposed as a hypothesis to explain audiences' cognitive mechanisms on acquiring social environment information from objects (Figure 1). Cognition of objects can be divided into three levels. The first is the Sensory Level (Level 1). An audience cognition at this level is based on sensory information directly conveyed through physical features of the object (e.g., material, shape, and colour). Cognition at this level forms instantly without much reflection. Based on cognition acquired at the Sensory Level, after some mental processing, more abstract impressions and responses are formed at the Concept Level (Level 2). Finally, the audience forms cognition indirectly through

association, imagination, and reflection based on abstract information, such as metaphor or symbolic of the object, at the Reflective Level (Level 3). In this study, cognition at the Reflective Level is particularly related to information on the social environmental (social ideas), as conveyed through the objects. Although these three levels are independent, there are relationships between them. The concrete physical features are the basis of cognition at all three levels, and cognition formed at the second and third levels are based on interpretation of the cognition at the first level. The Concept Level is the bridge that connects the Sensory Level and Reflective Level. Cognitions at the second level and third level are abstract and are the results of the combination of concrete information and existing cognition.

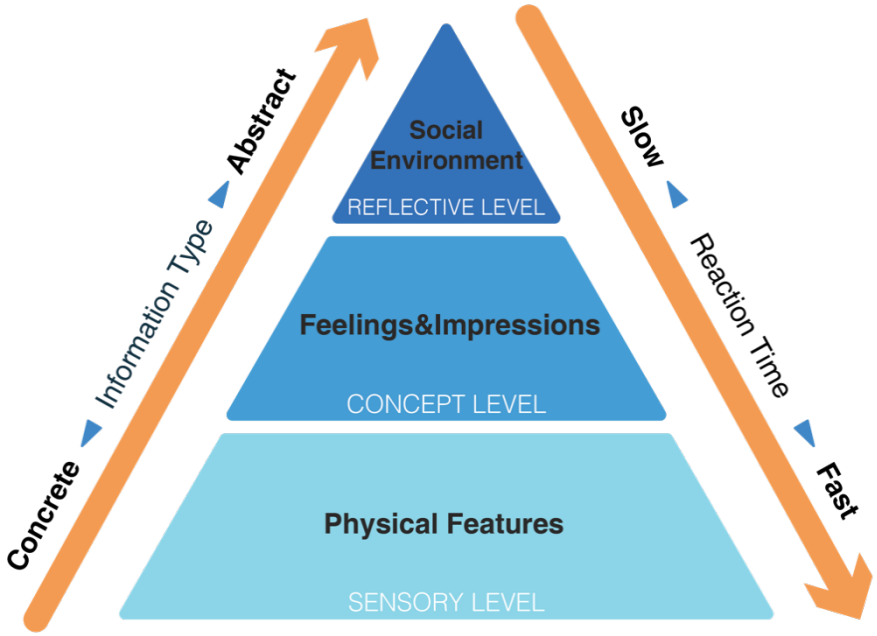


Figure 1 Cognitive Model Proposed in this Study

2 Methods

2.1 Research Method

Based on the proposed cognitive model (Figure 1), this study attempted to reveal patterns of audience cognitive mechanisms by studying how objects in Sci-Fi films convey social-environment information. Researcher designed an integrated research method utilizing the Semantic Differential Method (SDM) and Structured Interview. SDM is a type of a rating scale designed to measure the connotative meaning of objects, events, and concepts (Osgood et al., 1957). It consists of testing and analysis, in which users assess an object according to a list of semantic attributes (Demirbilek & Sener, 2003). These attributes are defined by pairs of antonymous adjectives (bipolar adjectives), which lie at either end of a qualitative scale. For example, “Cold” and “Warm”, “Good” and “Evil”, or “Happy” and “Depressed.” Most frequently, research participants are asked to score their attitudes to an object on a set of scales (Kumar, 2013).

The integrated method was applied to a singular object, the Djinn Chair (Figure 2) from the famous epic Sci-Fi film *2001: A Space Odyssey* (1968), to obtain and analyse the cognition

of audiences. Djinn chair is representative of the futuristic design style of the 1960s, created by French industrial designer Olivier Mourgue in 1965 (Fiell & Fiell, 1997).



Figure 2 Djinn Chair

Researcher extracted attributes of the chair according to the three levels of the hypothetical model. A seven-point semantic differential scales were used to measure participants' cognition of each attribute. At the Sensory Level, attributes were primarily concerned with physical features of the object, such as shape, colour, material, and texture. At the Concept Level, attributes included impressions, feelings, and opinions, such as "Luxurious" or "Plain." At the Reflective Level, seven attributes were used to measure the anticipated conditions of the social environment in which the chair might exist: social order, social structure, cultural tolerance, economic development, technology development speed, natural resources, and natural environment. Researcher selected bipolar adjectives deemed to best describe the attributes. This research did not try to study whether audiences' cognition is consistent with the film content, rather the study focused on relationships between cognition of the social environment as they derived from the sensory and conceptual impressions.

After the attributes and bipolar adjectives were determined, the questionnaire was created. The questionnaire was comprised of seven sections, including both quantitative and qualitative questions. In part 1, participants were asked to write down first impressions of the objects and aimed to obtain cognition formed first by participants. In parts 2, 3, and 5, semantic differential scales were used to obtain participants' cognition at three different cognitive levels. In part 4 and part 6, researcher interviewed participants to obtain more information about the cognition formation process. In part 7, participants were asked to answer several questions related to the research topic to understand participants' personal characteristics, including their perceptions of Sci-Fi generally. Parts 2 (Level 1, Sensory Level), 3 (Level 2, Concept Level), and 5 (Level 3, Reflective Level) are the main parts of the questionnaire, examples of which are given in Figure 3.

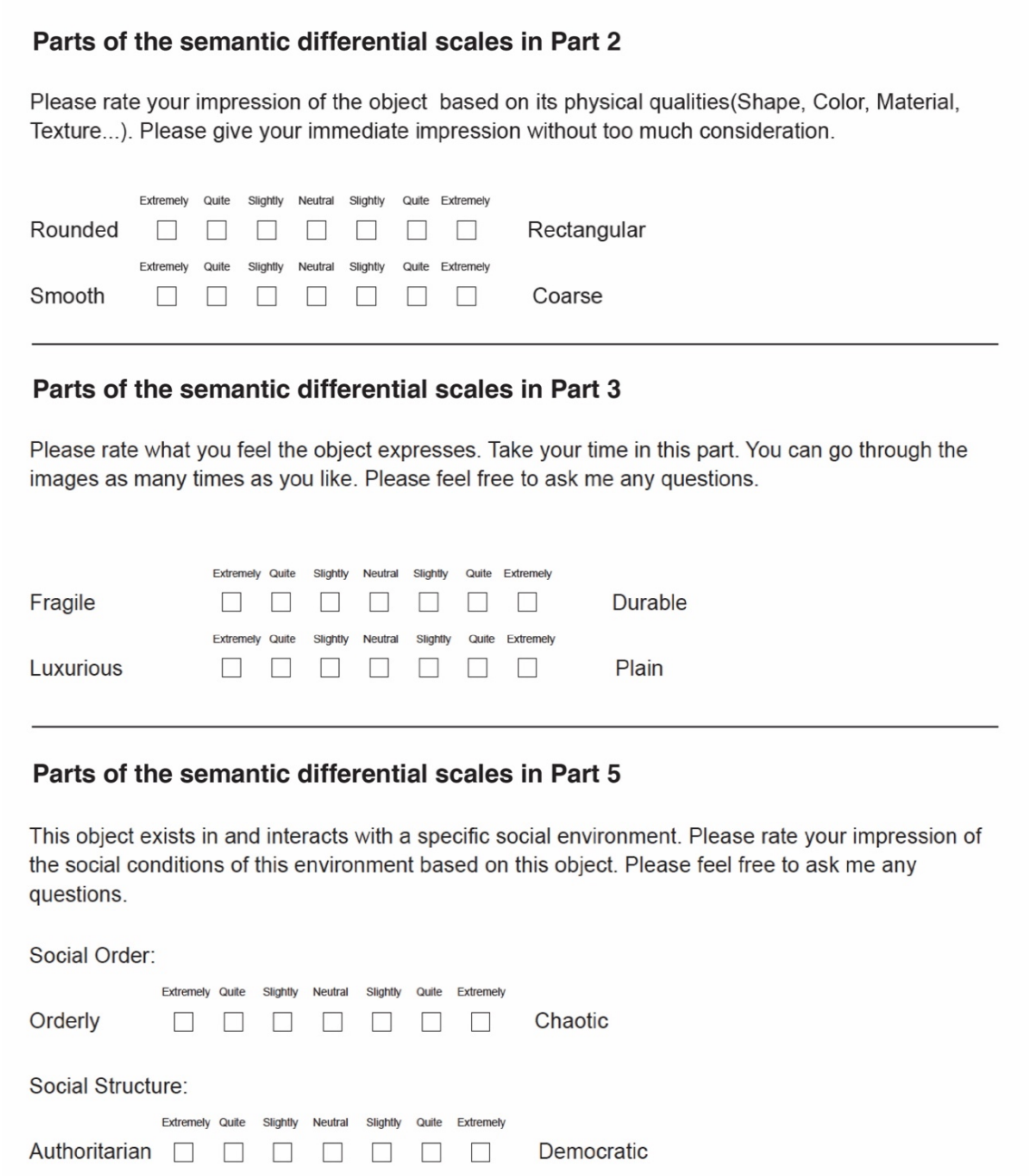


Figure 3 Representative Parts of the Questionnaire

In each individual survey, the object image (Figure 2) was shown to the participant. Participants were then asked to complete the questionnaire based on the image. The instructions given to participants during the survey followed a prepared research protocol and were adjusted only slightly based on different responses of each participant. All the research sessions were recorded with prior consent of the participants.

Twenty-two subjects participated in the research (15 females and 7 males). All were 20-40 years old students in the Master of Design Program (MDes) at University of Cincinnati. Nine of the participants had previously watched the film *2001: A Space Odyssey* (1968), but none of the participants recognized the object as being from that film.

2.2 Data Processing

After the questionnaire was completed, the responses for the semantic differential scales were converted into quantitative data by assigning values to different points in the scale (Figure 4). All data collected from participants were analysed to study the relationship between the three cognitive levels—especially, the relationship between the Reflective Level and the other two levels. The statistical software, SPSS Statistics, was used to conduct the correlation analysis. Further analysis, such as regression analysis, was conducted based on the results of the correlation analysis. The analysis of qualitative data obtained from interviews primarily aimed to obtain the cognitive logic of participants to support the analysis of the quantitative data.

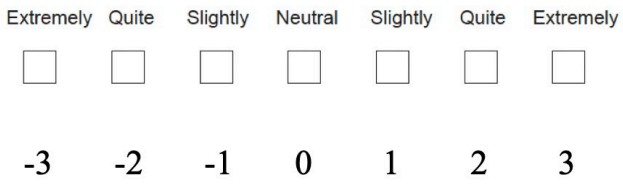


Figure 4 Value Assigned to Different Points in the Scale

3 Results

3.1 Correlations between Cognition at Different Levels

The rating results for each attribute—responses from 22 participants—comprised one data set. Each data set was treated as one continuous variable. All 31 variables (31 semantic differential scales in total) were divided into three different groups according to their relevant cognitive levels. There were eight variables in group 1 (Level 1), 16 variables in group 2 (Level 2), and seven variables in group 3 (Level 3). The correlation analysis was used to establish possible connections between two variables in two different groups.

This study used the Pearson Correlation Coefficient (PCC) to measure the statistical relationship or association between two continuous variables. It was developed by Karl Pearson (1895) and is regarded as one of the best methods of measuring the association between variables of interest.

Based on the analysis, all attributes with correlations are shown in Table 1. Whether the correlation is positive or negative is related to the sequence of the two adjectives in a pair of bipolar adjectives. To ascertain the neutrality of the question in the research, the sequence of adjectives was randomly set. In Table 1, all correlation relationships have been converted into positive correlations by converting the sequence of two adjectives in one pair of bipolar adjectives.

Table 1 Attributes with Correlation

Bipolar adjectives of Attribute A	Bipolar adjectives of Attribute B	Coefficient of Determination
Depressing-Happy	Cold-Warm	44.50%
Understandable-Incomprehensible	Whole-Combined	30.70%
Harmonious-Discordant	Whole-Combined	30.50%
Understandable-Incomprehensible	Warm-Cold	29.60%
Masculine-Feminine	Heavy-Light	26.10%
Practice-Decorative	Hard-Soft	23.90%
Masculine-Feminine	Cold-Warm	23.60%
Practice-Decorative	Heavy-Light	22.70%
High-tech-Low-tech	Hard-Soft	22.30%
Creative-Unoriginal	Clean-Dirty	20.80%
Classy-Vulgar	Coarse-Smooth	19.60%
Social order: Orderly-Chaotic	Clean-Dirty	21%
Social order: Orderly-Chaotic	Heavy-Light	18.60%
Social order: Orderly-Chaotic	Understandable-Incomprehensible	44.50%
Natural Resources: Scarce-Abundant	Particular-Common	27.00%
Social Structure: Authoritarian-Democratic	Luxurious-Plain	24.40%
Social order: Orderly-Chaotic	Practice-Decorative	22.20%
Culture Tolerance: High-Low	Classy-Vulgar	20.20%
Natural Environment: Thriving-Ruined	Obedient-Rebellious	18%
Note		
	Correlations Between Sensory Level and Concept Level (1-2)	
	Correlations Between Sensory Level and Reflective Level (1-3)	
	Correlations Between Concept Level and Reflective Level (2-3)	

The results show there are correlations between different attributes and these correlations occur between any two cognitive levels of the three. Specific to the two correlated attributes, this correlation is further reflected in the relationship between two specific characteristics of the attributes. For example, the attribute assignment “Happy-Depressing” is correlated with attribute assignment “Warm-Cold”, corresponding to specific assignments within these two attributes: “Depressing” is related to “Cold” and “Happy” is related to "Warm.” Since the correlation has been converted to positive correlation, while not very accurate, this can be interpreted that if the participant perceives the object as “Warm” rather than “Cold,” he/she has a greater chance of feeling that the object is “Happy” instead of “Depressing,” and vice versa.

The existence of correlations partially illustrated the rationality of the cognitive model proposed in this study. Particularly, the relationships between attributes at the Reflective Level (social environment) and attributes at the other two cognitive levels (Sensory Level and Concept Level) can exemplify the hypothesis of this study: audience cognition exists at different interconnected levels.

The regression analysis was then performed on each pair of correlated variables to measure the degree of the correlations. The results revealed that the degree of correlation for different pairs of related attributes is different, which means some correlations are stronger than others. The difference in the degree of correlation is illustrated by the coefficient of determination. The different degrees of correlations can be interpreted as: A pair of attributes with a larger coefficient of determination has a stronger correlation in participants’ attribute assignments. Take the example of participant’s cognition on the social order of the environment. As shown in Table 1, there are four attributes correlated with participants’ opinions of social order. Based on the coefficient of determination, it is reasonable to draw the conclusion that, compared to the assignment of “Heavy”, “Understandable” is more related with the assignment of “Orderly” in the cognitive interpretation of participants.

3.2 Hierarchy of the Cognitive Model

The analysis of the coefficient of determination further validates the hierarchy of the cognitive model proposed in this study. By calculating the average of all coefficients of determination between two cognitive levels, the “average coefficient of determination” can be determined. This can be used to measure the degree of correlation between two cognitive levels. Shown in Table 2, the average coefficient of determination between two adjacent levels (1-2, 2-3) are close and greater than the average coefficient of determination between nonadjacent levels (1-3). In other words, the correlation between adjacent levels is stronger than nonadjacent levels, which matches the hierarchy of the cognitive model.

Table 2 Average Coefficient of Determination between Two Cognitive Levels

Correlation between Levels	Average Coefficient of Determination
1-2	26.75%
2-3	26.05%
1-3	19.80%

The analysis of qualitative data indicates that there is a sequence to the formation of different levels of cognition. In part 1 of the questionnaire, researcher collected the words participants used to describe their first impressions of the object. There are 95 words in total, sorted according to the cognitive levels to which they belong. Forty-five of the words belong to the Sensory Level, forty-six of them belong to the Concept Level, and only four words belong to the Reflective Level. Figure 5 shows the distribution. With almost 95% of all words belonging to the Sensory and Concept Level, it is reasonable to assume that the formation of cognition at the Sensory Level and Concept Level happens prior to the Reflective Level.

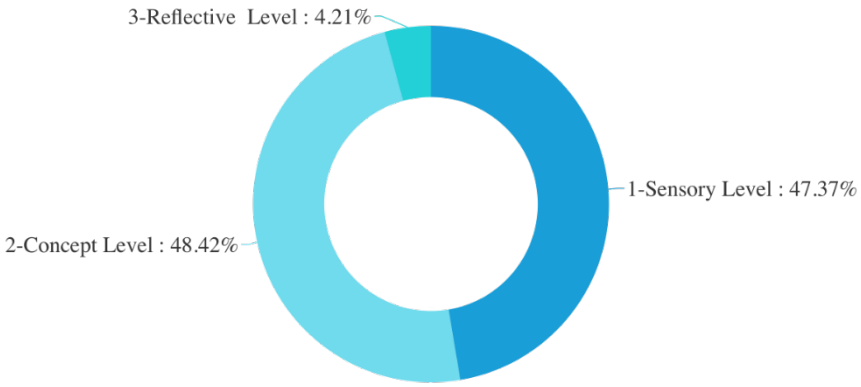


Figure 5 Distribution of First Impression of Participants

Further analysis of the interview data indicates the formation of cognition at the Sensory Level occurs prior to the formation of cognition at the Concept Level. According to the interview data, cognition at the Sensory Level is the basis for cognition at the Concept Level. For example, the two most frequent words at the Concept Level are “Comfortable” and “Feminine.” According to most participants, the perception of “Comfortable” was based on the perception of “Soft”, and the perception of “Feminine” is based on the “Pink” colour and “Round” shape. “Soft”, “Round”, and “Pink” all belong to the Sensory Level. Even when participants used words belonging to the Concept Level to express their first impressions,

they still based this on their cognition of the Sensory Level. In the interviews, participants indicated they did not use words associated with the Sensory Level to express their first impressions as they preferred to express the concepts and opinions they felt they had formulated rather than the “too obvious to say” physical features at the Sensory Level. Therefore, the process of obtaining information and forming cognition is sequential, which is reflected in the reaction time of cognition formation. It is not a strict sequence, but it does illustrate that cognition is generally formed first at the Sensory Level, followed by the Concept Level, and finally at the Reflective Level (social environment).

4 Discussion

4.1 Interpretation Process

The research results illustrated the rationality of the hierarchy of the proposed cognitive model. It is reasonable to infer the progressiveness of the cognitive levels, that is, the formation of higher-level cognition is largely based on lower-level cognition. The process by which audiences form higher-level cognition based on lower-level cognition can be called the "Interpretation Process."

There are large individual differences in this process, which is the direct cause of cognitive differences of audiences. Standard deviation is a measure that is used to quantify the amount of variation or dispersion of a set of data values. The standard deviation of each data set was calculated. When the standard deviation is larger, the participants’ cognition difference on that attribute is greater. By calculating the average of the standard deviation of attributes at the same cognitive level, the “average standard deviation” can be determined. This can be used to measure the degree of difference in the overall cognition of the participants at a certain cognitive level. Table 3 shows the average standard deviation of the three cognitive levels.

Table 3 Average Standard Deviation of Three Cognitive Levels

Cognitive Level	Average Standard Deviation	Approximation
3-Reflective Level	1.506	1.5
2-Concept Level	1.325	1.3
1-Sensory Level	1.347	1.3

The average standard deviation shows the degree of difference of participants’ cognition at the Sensory Level and Concept Level is close, but there are greater differences at the Reflective Level. The greater differences come from the Interpretation Process. Take Participant-1 and Participant-20 as examples. Figure 6 shows their rating responses of the attributes at the Sensory Level (semantic differential scales 1-8). It is obvious that they formed similar cognitive impressions at the Sensory Level. However, according to their interviews, they formed very different cognition interpretations of the social environment (Reflective Level) based on their similar impressions of the physical features (Sensory Level) of the object. Participant-1 thought the society the object would exist in must be a democratic society while participant-20 thought that society must be a totalitarian one. Figure 7 shows their different interpretation processes. They started from similar points but ended with completely different conclusions.

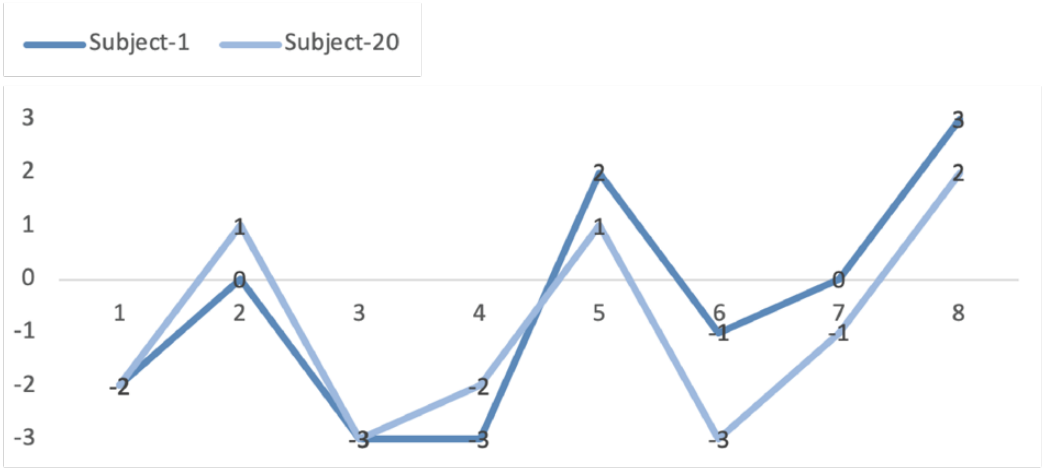


Figure 6 Rating Results of Attributes at the Sensory Level of the Two Participants

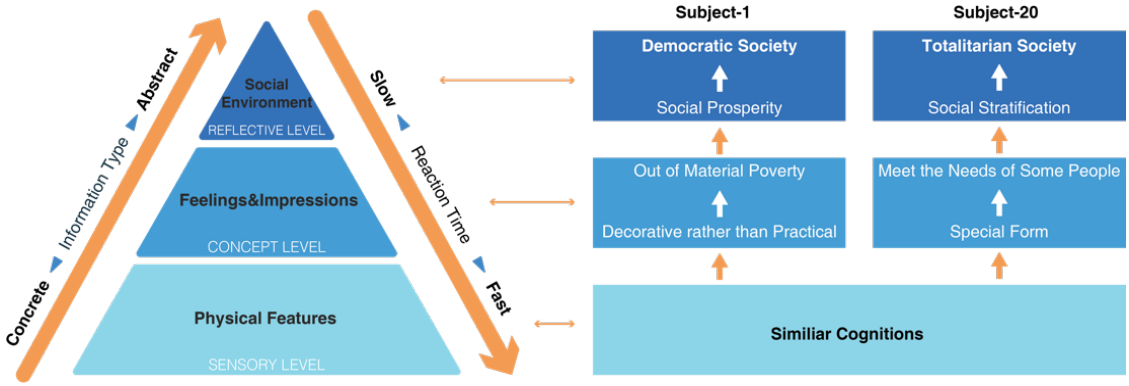


Figure 7 Different Interpretation Processes of Two Participants

The interpretation process is ambiguous and uncertain. When the information obtained by audiences is limited, which is very common in daily life, there will be more uncertainty in the interpretation process. For example, in this study, the chair image (Figure 2) and the sentence “this is a chair that comes from a film” were the only information given to participants. When participants talked about their opinions of the social environment information, the most common sentences were “I am not sure” and “I don’t have enough information to judge.” Under this circumstance, the social ideas they formed are blurred and uncertain. This uncertainty illustrates the complexity of the formation of cognition at the Reflective Level compared to the cognition at the Sensory and Concept Level.

4.2 Practical Application for Designers

Because of the characteristics of the objects in Sci-Fi films discussed above, this study selected one object that came from a Sci-Fi film. However, the research methodology used and results concluded in this study are not limited to furniture or objects in Sci-Fi films. Designed objects in real life also convey rich social information. In fact, the Djinn Chair was designed for commercial production prior to the creation of the film. The chair was later chosen by the director Kubrick to use in the film because of its unique design style. The methodology proposed and tested in this study can be customized and used in design activities to augment the design process, including during early stages of product development.

The applied research methodology combined with the Semantic Difference Method (SDM) and the Structured Interview can be an effective tool to help designers carry out design activities. Whether for commercial or experimental purposes, whether responding to external requirements or self-driven, designers are always translating social ideas into material forms. These ideas may be claims, values, or unquestioned assumptions. Most of them are abstract and operate at the second and third cognition levels (Concept Level and Reflective Level). However, in the process of designing, what designers deal with are not ideas but the concrete features of designed objects such as shape, colour, and materials. These operate at the first cognition level (Sensory Level). It is essential for designers to build a bridge to connect the abstract ideas they aim to express to the concrete features they design. The basis of this bridge is understanding the cognitive mechanisms of their audiences.

The core idea of this methodology is to study the connection between abstract and concrete information in the cognition of audiences, which is valuable to all design activities. Specifically, it can be used across different phases of design activities. In the preliminary research phase, it can be used to conduct research to understand the cognitive characteristics of the target user group. During the ideation phase, this methodology can provide quantitative data to inform design decisions. In the evaluation phase, it can be used to collect feedback on designed objects from specific audiences, augmenting decision-making for finalizing the specifications of an object's design.

4.3 Conclusion

Based on previous research, this study proposed an updated model (Figure 1) to explain audience cognitive mechanisms for interpreting social ideas (social environment information) from designed objects. Using the Semantic Differential Method (SDM) as the central method, an object from a Sci-Fi film was selected as the object to study. The study results validate the rationality of the cognitive model. The results show audience cognition operates at different levels, which include the Sensory Level (Level 1, physical features), the Concept Level (Level 2, feelings and impressions), and the Reflective Level (Level 3, social environment). There are correlations between cognition at different levels, and the degrees of these correlations are different. The abstract cognition at higher-level are based on the concrete cognition at the lower-level. The process of obtaining information and forming cognition at lower-level occurs prior to the high-level process in general, suggesting a sequential nature to the levels' relationships. The cognitive model proposed in this study can help designer better understand the mechanisms of audience cognition.

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The influence of facial photo processing on interpersonal impressions

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In recent years, the act of “emphasizing” facial photographs to improve the attractiveness of the face has become a notable practice in young people. The meaning that face photo processing has is due to the desire to become closer to an ideal face or to be evaluated by others with the appearance of print seal machines, photo-processing applications, and social networking services. This research specifically investigated what kind of impression photographs with facial processing make. We conducted two experiments. The results of Study I show that the impression made by the eyes and the jaw is greatly involved in the impression made by the entire face, regardless of whether it is male or female. In the case of a male face, the results of Survey II showed that an impression of manliness was based on the eyes, and an impression of warmness was based on the jaw. In the case of female faces, it was revealed that the impression of naturalness was based on both the nose and jaw, and inclusion was based on both the eye and jaw. According to the survey results, processing performed on the eyes and jaws is greatly involved in the formation of the facial impressions, and it is possible to make a specific impression by adding the appropriate processing to these parts. In the future, we expect that it will be possible to process in accordance with the face, purpose, and scene by clarifying the influence that facial photo processing has on interpersonal impressions in more detail.

Keywords: photo processing; avatar; facial image

1 Introduction

With the development of image-processing technology in recent years, processing facial photos to appear more attractive has become popular. Young people, in particular, are applying image processing to their facial photos on a daily basis. In fact, according to a survey conducted by the MMD research institute in 2016 (MMD labo, 2016), 58% of smartphone owners (N = 167) aged 15 to 19 answered that they processed their own images taken with their smartphones. Facial photo processing is motivated by a desire to be evaluated positively by others and from the satisfaction that comes from getting closer to the ideal face along through the use of technologies such as print seal machines, photo-processing applications, and social networking services (SNS). Based on this background, this study focused on how the degree of processing affects the impression formed by others.

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2 Survey I: Analysis of the changes in impression resulting from different degrees of processing

2.1 Survey I

First, two average faces were made separately for men and women using Average Face Pro[1] for use in the evaluations. Next, using Adobe Photoshop[2], numerical values representing the degree of processing (i.e., 50, 100, 150, and 200) were applied to each facial feature (i.e., eyes, nose, and jaw) to create 32 sample images. To compare the sample images below and the original male or female average face, the change in impression was evaluated through seven-point scales running from strong to weak and good to bad (i.e., a Likert scale) as compared to the original image.

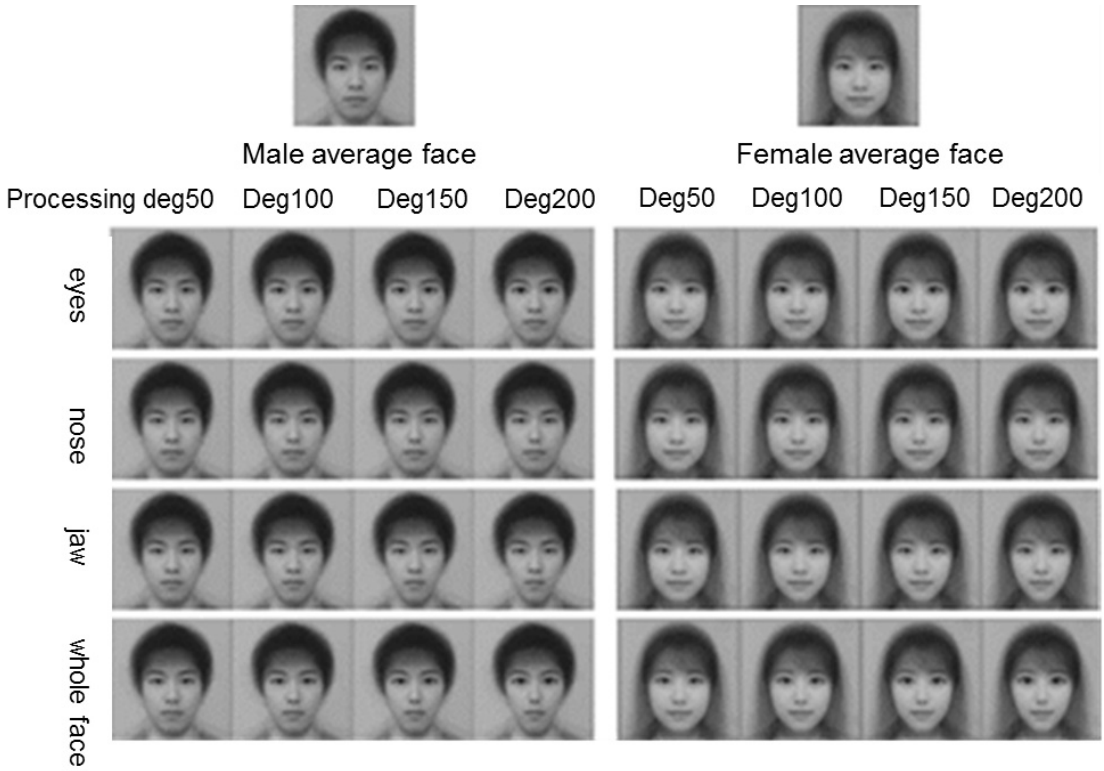


Figure 1. Sample image for impression evaluation

2.2 Survey I Outline

The survey period lasted from December 17, 2017, to January 2, 2018 and was distributed as a web questionnaire using Google Forms[3]. The number of acceptable answers was 110 (48 males, 62 females).

2.3 Survey I analysis and results

It became clear that photos with greater processing on the eyes and jaws were evaluated lower. It also become clear that processing applied to the eyes and jaws was greatly related to the impression of the entire face. The above-mentioned tendency was not seen in nose processing.

[1] Morphing application dedicated to face images

[2] Image editing software sold by Adobe Systems

[3] Questionnaire analysis service provided by Google

3 Survey II: Specific impressions and effects of optimal processing

3.1 Survey II

First, we identified the evaluation terms used to describe facial impressions. A total of 10 participants (6 males and 4 females) were shown 7 photos of their face, and an experiment was conducted to evaluate the impressions received aloud. As a result of the experiment, a total of 202 words were obtained. From that, after antonyms and synonyms were summarized, the frequency of word appearance was analyzed, and the top 17 adjective pairs were selected.

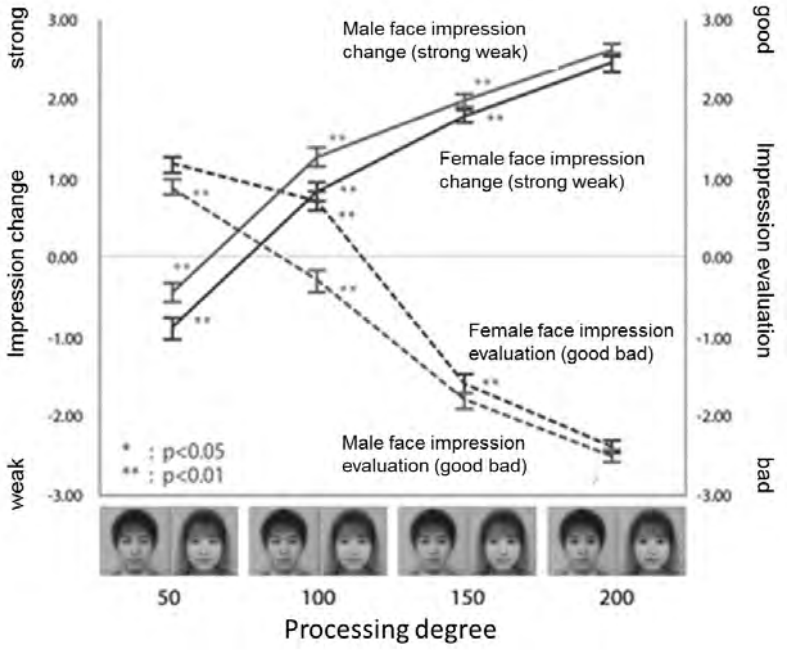


Figure 2. Analysis of image-processing degree, the initial impression, and resulting change in regard to the eyes.

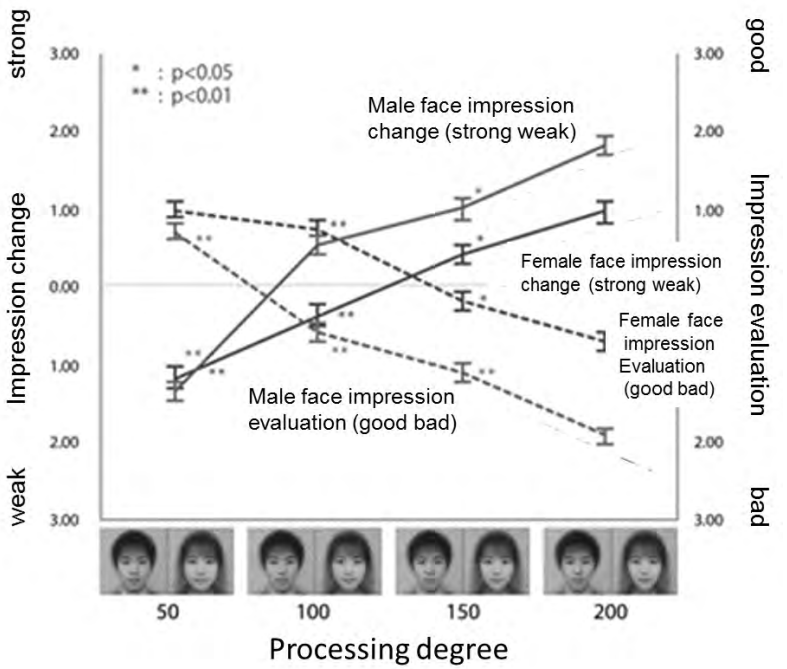


Figure 3. Analysis of image-processing degree, the initial impression, and resulting change in regard to the jaw.

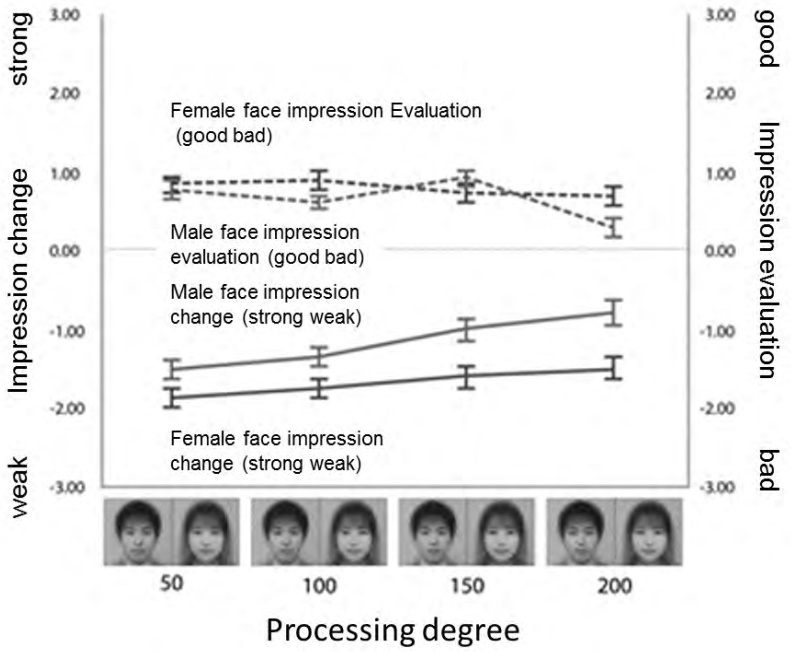


Figure 4. Analysis of image-processing degree, the initial impression, and resulting change in regard to the nose.

Furthermore, three adjective pairs were also selected from the previous research (Kato, Aoki, Shinohara, Murakami, & Miyazaki, 2015), and a total of 20 adjective pairs were selected.

3.2 Question item setting

The subjects were asked to operate Adobe Photoshop, and questions were asked to apply optimal processing to the average face used in Study I. Here, only the eyes and jaws were processed since processing applied to the nose did not affect impressions according to Survey I. In addition, the processing degree was kept within the range that Survey I identified as making better impressions (for male faces, 0–100; for female faces, 0–150). Then, the participants were asked for an overall concrete impression of the average face, their impression according to individual facial features, and whether the 20 adjective pairs selected in 3.1 applied.

3.3 Survey II outline

The survey period lasted from January 23, 2018, to January 27, 2018, and the method was an experiment using a questionnaire. The number of acceptable answers was 28 (15 male and 13 female).

Table 1. Results of factor analysis (male).

		I	II	III
10.	strong	**.916**	-.111	-.068
11.	healthy	**.915**	-.189	.182
18.	positive	**.632**	.331	-.291
8.	honesty	**.599**	-.202	.332
6.	bright	**.575**	.137	.047
19.	feminine	**-.563**	.038	.004
14.	fresh	-.051	**.871**	-.063
16.	elegant	-.258	**.681**	.267
2.	aesthetic	.097	**.640**	.129
13.	ambitious	.415	**.635**	-.258
5.	lean	-.480	**.530**	.091
17.	preferable	.198	**.448**	.242
12.	impressive	.108	.329	**-.693**
3.	warm	.114	.038	**.640**
4.	not afraid	-.095	.218	**.579**
15.	neat	-.116	.384	**.560**
7.	human	.109	.184	**.541**
1.	nature	.135	-.146	**.524**
20.	familiar	.343	.290	**.400**

Table 2. Results of factor analysis (female).

		I	II	III	IV
7.	nature	**.895**	.135	-.002	-.231
1.	not afraid	**.878**	-.185	-.102	.051
4.	familiar	**.869**	.248	-.042	-.158
20.	bright	**.805**	-.084	.059	.122
6.	healthy	**.614**	-.052	.266	.091
11.	fresh	**.593**	.142	.261	.116
14.	ambitious	**.475**	.409	-.038	.097
13.	smart	-.306	**.879**	.348	.086
9.	cleanliness	-.091	**.872**	.100	.156
15.	feminine	.260	**.674**	-.180	-.117
19.	positive	.245	**.454**	-.226	.150
18.	strong	.303	**.447**	.021	.184
10.	warm	-.097	.092	**.790**	-.213
3.	honesty	.173	-.200	**.581**	.312
8.	aesthetic	.177	.257	**.496**	-.162
2.	impressive	.211	-.128	.121	**.741**
12.	preferable	-.371	.266	-.225	**.596**
17.	elegant	.370	.260	-.056	**.576**
16.		-.114	.359	-.095	**.516**

3.4 Survey II analysis and results

First, a factor analysis[4] was performed using the main factor method in order to determine the elements of the impressions using 20 adjective pairs. In the case of the male average face, a three-factor structure was used, with the first factor being “male,” the second factor being “cleanliness,” and the third factor being “warmth.”

In the case of the female average face, a four-factor structure was used. The first factor was “natural,” the second factor was “intelligence,” the third factor was “capital force,” and the fourth factor was “elegance.”

Second, to find out how the multiple factors that were revealed by the factor analysis affected the impressions made by the facial features and how the impressions made by individual facial features influenced the overall impression, a distributed structure analysis[5] was performed.

[4] Using "IBM SPSS Statistics

[5] Using "IBM SPSS Amos

			Estimated value
masculinity	→	Eyes	**.61** *
masculinity	→	Eyes and nose	.38 *
masculinity	↔	warmth	-.43 †
cleanliness	→	Eyes and nose	**.81** ***
cleanliness	↔	warmth	.51 †
warmth	→	Eyes	**.81** ***
warmth	→	Jaw	**.53** **
warmth	→	Eyes and jaw	**.53** **
Eye	→	Whole face	**.54** ***
Jaw	→	Whole face	.19
Eyes and nose	→	Whole face	.01
Nose and jaw	→	Whole face	.05
Eyes and jaw	→	Whole face	.22

*** : p<.001 ** : p<.010 * : p<.050 † : p<.100

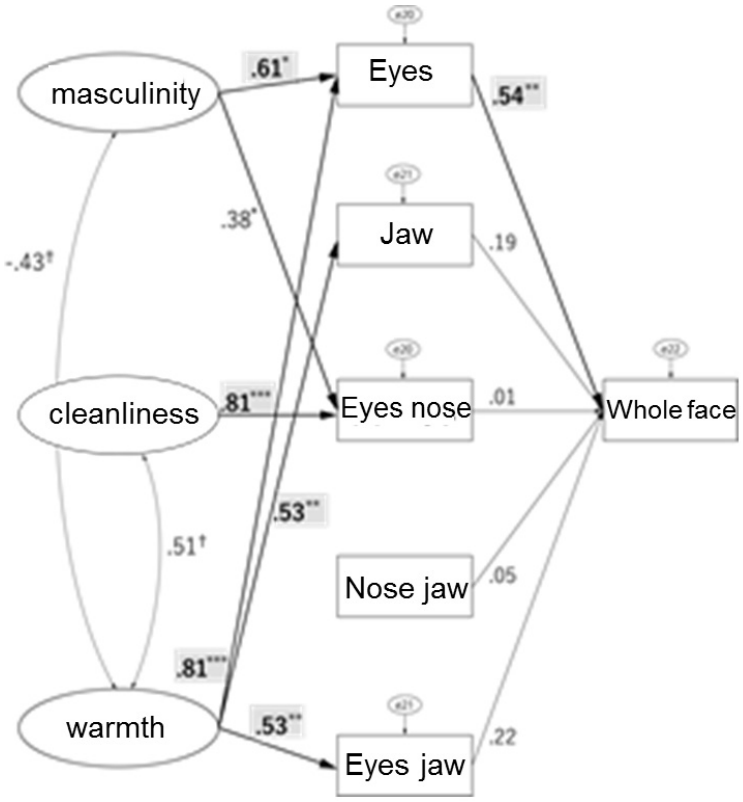


Figure 5. Covariance structure analysis results (male).

			Estimated value
natural	→	Nose and	**.50** *
natural	→	intelligence	.50 *
intelligence	→	elegance	.61 †
inclusion	→	Eyes and jaw	**.52** *
Eyes	→	Whole face	**.74** ***
Jaw	→	Whole face	**.25** **
Eyes and nose	→	Whole face	-.04
Nose and jaw	→	Whole face	**-.36** ***
Eyes and jaw	→	Whole face	.08

***: p<.001 **: p<.010 *: p<.050 †: p<.100

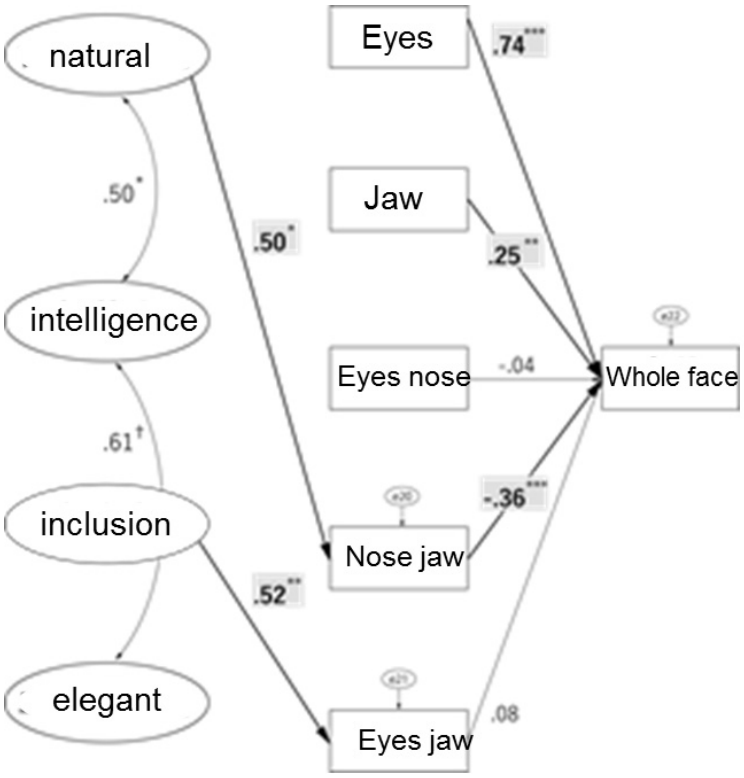


Figure 6. Covariance structure analysis result (female).

As a result of the distributed structure analysis, in the case of the male face, the eyes gave the impression of manliness and warmth, and both the eyes and nose gave the impression of cleanliness. In the case of the female face, the nose gave the impression of cleanliness. It

also became clear that naturalness arose from processing to the jaw, and an impression related to tolerance was observed from both the eyes and jaw. In addition, it was suggested that eyes or jaw affected the overall impression of both men's and women's faces. This supports the results from Study I.

4. Conclusion and discussion

Forming impressions of a processed face is largely related to the processing applied to the eyes and jaw, and it is possible to give a specific impression by applying the appropriate processing to those facial features. However, if the processing is overdone, then a decline in interpersonal impressions is inevitable.

Today, if an individual uses an SNS, they can publish photos of their own faces to strangers. People care about what others think so much that they feel they must rely on processing. As a result, the majority of faces are aggregated into the same category of "cute", even to the extent where it feels weird. Therefore, it is expected that in the future, processing that matches the face, purpose, and scene will be possible with the help of this research.

5. Unresolved and Future Prospects

(1) Construct and analyze highly accurate hypothesis verification models.
In Survey II of this study, a complete hypothesis verification model has not been created.
In the future, it is desirable to prepare a sufficient number of samples and reconstruct this further verification model.

(2) Confirm that the logic of this research is correct.
From this research, the part of the face that affects the impression of the whole face, the optimal processing and the impression became clear.
However, no complete causality verification has been obtained.
In the future, it is necessary to verify more specific impressions by adding various processes.

(3) Research the psychology hidden in the act of face processing
In this study, we dealt with impressions based on face processing.
However, it is necessary to study the internal issues such as why young people do face photo processing.

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The Relative Impact of User- and Marketer-generated Content on Consumer Purchase Intentions: The Case of the Social Media Marketing Platform, 0.8L

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This paper investigates the relative impact of user- and marketer-generated content on consumer purchase intentions and the way of designing an effective social media marketing platform by conducting a case study of the global social media marketing platform, 0.8L. Based on literature reviews of social media marketing and consumer purchase intentions, the case study was undertaken by making use of qualitative and quantitative results from a content analysis and a participatory survey. Firstly, about 450 consumer reviews about ten sunscreen products posted on the 0.8L platform were compared with their marketer-generated information. Next, 55 subjects took part in a participatory survey about their purchase intentions of moisturizing creams on the 0.8L platform. Results indicated that user-generated content (i.e. texts and photos) provided more personal experiences of the product usage process, whereas marketers focused on distinctive product photos and features. Moreover, customer reviews (particularly, high volume and narrative format) had more impact on purchasing decisions than marketer information in the online cosmetics market. Honest reviews (both positive and negative) of real users were found to help companies assess their newly-released products promptly and easily. In addition to the importance of customer-driven marketing practices, this study identifies distinctive UX design features to develop a competitive social media marketing platform, which facilitates creating and sharing sincere customer reviews that resonate with potential buyers.

Keywords: social media marketing; user-generated content; marketer-generated content; consumer purchase intentions; UX design

1 Introduction

The proliferation of social media created a whole new era for companies and brands. Social media has been widely regarded as “an effective mechanism that contributes to the firm’s marketing aims and strategy; especially in the aspects related to customers’ involvement, customer relationship management and communication (Alalwan, Rana, Dwivedi, & Algharabat, 2017, p.1178).” The number of global social media users reached 3.196 billion in 2018, up 13 percent from the year before (Kemp, 2018). According to eMarketer's US Social Trends report, social ad spending is predicted to increase by 19% in 2019, an estimated total of $37B (eMarketer, 2019). For instance, Barnes, Lescault, and Holmes (2018) found that

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nine in ten US Fortune 500 companies in 2018 have a public-facing Facebook page and that these companies also evaluate and adapt their usage of social media to increase engagement with consumers and resonate with younger users.

In the meanwhile, these social media channels allow consumers to play an increasingly active role in the marketing cycle by creating, distributing, and consuming digital content. Recently, consumers preferentially search for and trust organic, user-generated content (UGC) more than all other forms of advertising; therefore, companies have increasingly valued user-generated content in the marketing field. According to Stackla's Consumer Content Report, 87% of people said that UGC (including influencer-created content) highly impacts their purchase decisions, whereas only 13% of them mentioned the effects of brand-created content (Stackla, 2017). In addition, BrightLocal (2018) discovered that 85% of consumers trust online reviews as much as personal recommendations, and consumers read an average of 10 online reviews before feeling able to trust a local business. Consequently, customers can influence other potential buyers through online reviews, social media, and so forth during the pre- and post-purchase stages (Court, Elzinga, Mulder, & Vetvik, 2009)

In light of the aforementioned prevalence of social media marketing, a large volume of UGC has been created across diverse social platforms such as Facebook, KakaoTalk, Instagram, Youtube, and others in the South Korean digital marketing landscape; however, companies are still struggling to implement social media marketing practices strategically, and users must spend large amounts of time searching relevant and useful content. In particular, a number of well-written customer reviews have been generated and spread under the auspices of the company or brand. Accordingly, many doubts about the reliability of these consumer reviews have risen. In this context, the social media marketing platform 0.8L was established in 2015 with the aim of sharing honest consumer experiences. Currently, marketers from about 3,800 global brands utilize this platform as a strategic marketing tool. In this vein, the present paper conducts a case study of the global social media marketing platform, 0.8L in order to investigate the relative impact of user- and marketer-generated content on consumer purchase intentions and the way of designing an effective social media marketing platform.

2 Literature Review

2.1 Social Media in Marketing

Social media refers to websites and applications that are designed to allow for quickly creating and sharing of user-generated content among organizations and individuals (Filo, Lock, & Karg, 2015; Hudson, 2018). Over the past decade, social media applications have been utilized in a wide range of different contexts including education, social, politics, marketing, management, and others (Alalwan, Rana, Dwivedi, & Algharabat, 2017). In particular, the successful use of social in marketing is of considerable importance so that companies devote large budget toward social media marketing. Social media marketing activates "a dialogue often triggered by consumers/audiences, or a business/product/ services that circulated amongst the stated parties to set in motion a revealing communication on some promotional information so that it allows learning from one another's use and experiences, eventually benefitting all of the involved parties (Dwivedi, Kapoor, & Chen, 2015, p.29)." Indeed, social media provides marketers with remarkable opportunities to closely reach consumers and build more personal relationships with them,

as well as to completely change the way marketing content is created, distributed, and consumed (Godey et al., 2016).

2.2 Social Media Marketing Content and Consumer Purchase Intentions

In general, social media marketing content is classified into two main categories: user-generated content (UGC) and marketer-generated content (MGC). UGC literally refers to the content published on social media by internet users, whereas MGC presents the advantages and benefits of the products, mostly by endorsers and celebrities. UGC is perceived as more credible because it contains users' knowledge, experiences, as well as opinions/reviews about a product, a service, or an experience (Bahtar & Muda, 2016; Oum & Han, 2011). As one type of UGC, customer reviews can help consumers form an unbiased understanding of a product, construct a set of criteria for evaluating a product, make an accurate choice, and reduce the cognitive costs of making such as choice (Liu, Karahanna, & Watson, 2011). Gohm, Heng, and Lin (2013) statistically demonstrated that UGC has a stronger impact on consumers' purchase decision processes than MGC. Although UGC lacks official authority, "users may possess relevant expertise due to their firsthand knowledge or experience with a topic or situation, and thus may be accurately perceived by others as have a great deal of experiential credibility (Flanagin & Metzger, 2013, p.1626)."

Meanwhile, average ratings and descriptive comments are used as the main components of online consumer reviews (Fang, Ye, Kucukusta, & Law, 2016). Average ratings give an overview of the perceived quality of a product, whereas a single descriptive review (or comment) contains personal narratives of experiences with a specific product. Some studies indicated that customers are greatly influenced by average consumer ratings (BrightLocal, 2016). Conversely, Ziegele and Weber (2015) found that single vivid narratives could override their average ratings. Moreover, taking these two components together can determine the overall valence of each review, which is defined as the positive or negative orientation of information about an object or situation (Chan, Lam, Chow, Fong, & Law, 2017). Positive consumer reviews increase business results while enhancing the company's reputation, while negative reviews decrease consumer interest in the company's products/services (Anderson 2012; Pelsmacker, Tilburg, & Holthof, 2018). However, in some cases, negative reviews including a small amount of positivity result have stronger effects on their perceived usefulness by carrying more weight than positive reviews (Purnawirawan, Eisend, Pelsmacker, & Dens, 2015). According to Reevoo insight research, a few bad reviews gave consumers a reason to believe all other good reviews, and the reliability of the reviews increased by 68% when positive and negative reviews were exposed together (Reevoo, 2013).

Beside the valence of the review, the volume of reviews, one of the most critical review attributes, influences consumers' perception of user feedback (Duan, Gu, & Whinston, 2008). Several studies have noted that more online reviews lead to better business performance. For instance, Torres, Singh, and Robertson-Ring (2015) and Kim, Lim, and Brymer (2015) reported that the volume of reviews had a significant impact on online hotel booking and hotel revenues, respectively. Powell, Yu, DeWolf, and Holyoak (2017, p.1432) stated that "consumers preferred a product with more reviews to one with fewer reviews even though the statistical model indicated that the latter was likely to be of higher quality than the former."

3 Research Methodology

In order to investigate social media marketing practices within their real-world context, a case study was conducted with the global social media marketing platform, 0.8L. In order to increase research validity, the case study employed multiple sources of evidence from both qualitative and quantitative research methods, viz. a content analysis and a participatory survey, respectively.

3.1 Case Selection: 0.8L

As a social marketing service platform (PCs and mobile devices), 08.L connects product sellers and users with an emphasis on delivering pleasant experiences. On the platform, users try a variety of beauty and lifestyle products and share their post-experiences with others. The platform allows users to click a “Like” button on products that they want to try, to follow their favorite brands, and to post their real-world product usage reviews while sharing them through their own social channel accounts. For each product, the platform recruits influential users, who have over 10,000 followers of Facebook or Instagram, for 72 hours, and then delivers the product to them for free or at a lower price within 2-3 days. Then, the influencers generate and share their product reviews within 7 days. As shown in the left image of Figure 1, marketers present visually appealing photos and descriptions about their products to encourage users’ participation. Below the product information, 0.8L depicts the number of customer recommendations and average review ratings together with customer narrative reviews using card-based UI modules (see the center and right images of Figure 1). Moreover, the platform suggests more suitable products to relevant users by analyzing big data derived from their profiles and prior activities; therefore, this recommendation algorithm enables sellers to more effectively deliver their products to potential customers and to obtain real-time user feedback.

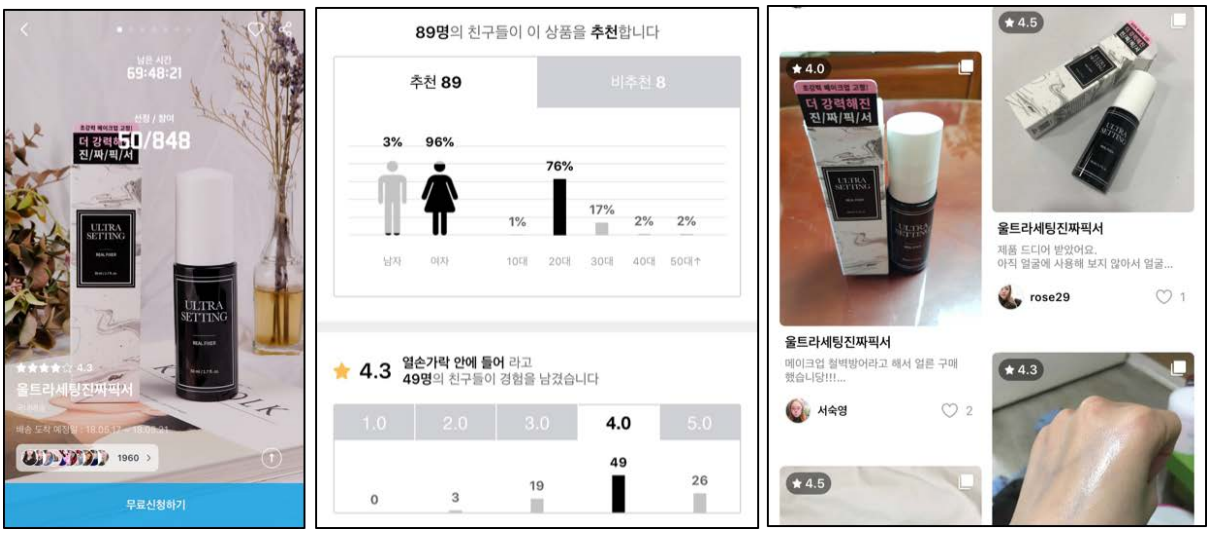


Figure 1. Screenshots of the 0.8L mobile app presenting (left) product information, (center) number of customer recommendation, average review rating, and (right) customer narrative reviews.

In order to deliver better UI/UX to users, in late 2017, the company launched its second version of the 0.8L mobile application, consisting of three main menus, as shown in Figure 2: “New Experience,” “Today’s Rank,” and “Pleasant Discovery.” In the “New Experience” menu, new products are updated every day so that users can examine, apply, and experience the latest products. The “Today’s Rank” menu shows the rankings of highly-rated products and brands, as well as the rankings of active and influential users. The platform

selectively displays about 40,000 honest reviews in the “Pleasant Discovery” menu for frequent user visits. After these upgrades, the 0.8L application received the Special Prize in 2017 from the Smart App Award Korea, which has become the most prominent domestic app competition. In 2018, the 0.8L app was also awarded the Digital Marketing Grand Prize from the Korea Competency Association (KMA). Nowadays, the platform promotes diverse products of about 3,800 global brands with more than 1 million domestic and foreign memberships.

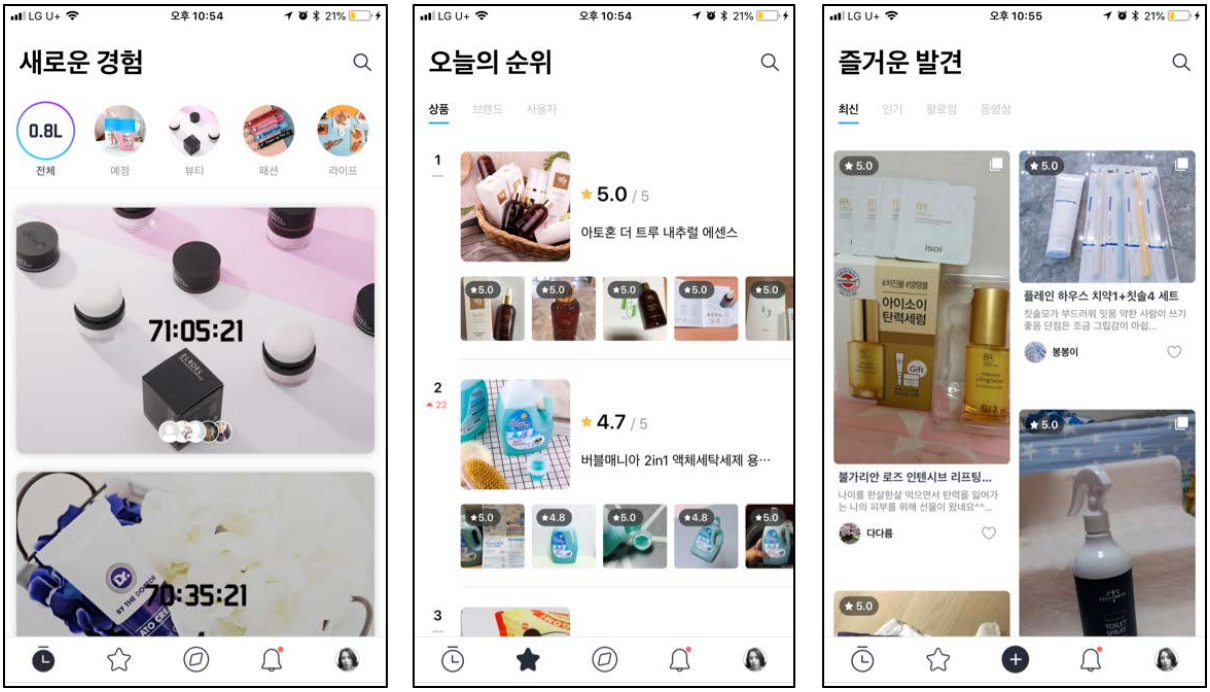


Figure 2. Screenshots of the 0.8L’s mobile app showing its three menus: (left) “New Experience,” (middle) “Today’s Ranks,” and (right) “Pleasant Discovery.”

3.2 Content Analysis

In order to investigate what kinds of consumer reviews are created on the 0.8L platform as compared with their marketer-generated information, a content analysis of its posted consumer reviews was performed in May, 2018. Consumer reviews on ten sunscreen products for sale were collected and analyzed. Between 45 and 50 recent reviews per product were gathered because the volume of consumer reviews varied according to the products. Therefore, 456 consumer reviews in total were coded by the following categories: reviewer (gender, number of followers, total number of reviews), average review ratings (product absorbability, persistence, and functionality), and narrative review content (text and photos). In particular, narrative customer reviews were sub-categorized into three types according to their dominant issues: (1) personal information (mostly, focused on their skin types and cosmetic preferences), (2) product usage experiences, and (3) product features (efficacy, package design, ingredients, aroma, texture, color, liquid type, etc.). Five coders including one author (two coders per product for increased data credibility) participated in the coding process. For increasing inter-coder reliability, one coder (the author) reviewed all the reviews in the sample at the end.

3.3 Participatory Survey

In order to identify influential factors that affected consumer purchase decisions on the 0.8L platform, in November, 2018, a participatory survey was undertaken about the purchasing

process of moisturizing cosmetic products. The survey data was collected from 55 university students (7 males and 48 females), ranging in age from 19 to 26 years old (M = 21.22, SD= 1.40). Before participating in the survey, the subjects were asked to download and install the 0.8L mobile application on their smartphones and then to create a user account along with learning how to use the app and how to participate in the survey.

The survey selected 54 moisturizing products of 20 domestic cosmetic brands sold in the 0.8L app during the survey period. The price range of the products was from 15 to 30 dollars. Firstly, the subjects could retrieve information on the 54 products by searching for moisturizers in the "Search" menu. Secondly, they looked at product information (i.e. text descriptions and photos) by swiping on the main images and clicking the related menus. For each product, the subjects also checked two numeric consumer review factors and several narrative consumer reviews: (1) consumer recommendation frequencies, which show how many reviewers recommended the product purchase by their gender and age groups; (2) consumer average review ratings, which represent how much reviewers liked the product on a 5-point Likert scale; and (3) consumer narrative reviews, which show reviewers' personal opinions and experiences along with their photos. The volume of consumer reviews for each product varied. Next, after searching and comparing the products, the subjects went through the pre-payment stage of purchasing a particular moisturizer. The purchase process took about 20-30 minutes.

After experiencing the real purchase process, the subjects answered the following questions: (1) What product did you choose and why did you choose it?; (2) What factors affected your purchase decision (prioritizing three among seven factors)?; (3) What was your favorite review?; (4) What was your least favorite review?; and (5) Do you have any other comments about the reviews and/or platform?

4 Research Results

4.1 Comparison of User- and Marketer-generated Content

For the total of 456 consumer reviews collected from the content analysis, only 3.51% (16 reviewers) was created by male reviewers. More female customers actively participated in creating the reviews about sunscreens. In general, reviewers with a large number of followers had generated more reviews since joining the platform; therefore, this research regarded them as more influential reviewers.

Through analyzing the other coded data about the reviews, this research found the following insights about the consumer reviews. Firstly, three average review ratings about product absorbability, persistence, and functionality showed mostly high scores. Figure 3 shows the average score of these three review ratings for each product in a range of 3.99 and 4.52 on the 5-point Likert scale. These results indicate that the average review ratings were not dominant factors in consumer's purchase decisions in this context. This finding contrasts with the great influence of average consumer ratings on the consumer decision journey (BrightLocal, 2016). Moreover, for the product (Product #9 in Figure 3) that received the lowest score (3.99), the overall valence of its reviews was further scrutinized; however, most of its reviews were unexpectedly positive overall. Coincidently, this product was assessed by more inexperienced reviewers compared to the other products, and these novices tended to evaluate more rigorously while some of the influential reviewers evaluated the products more generously.

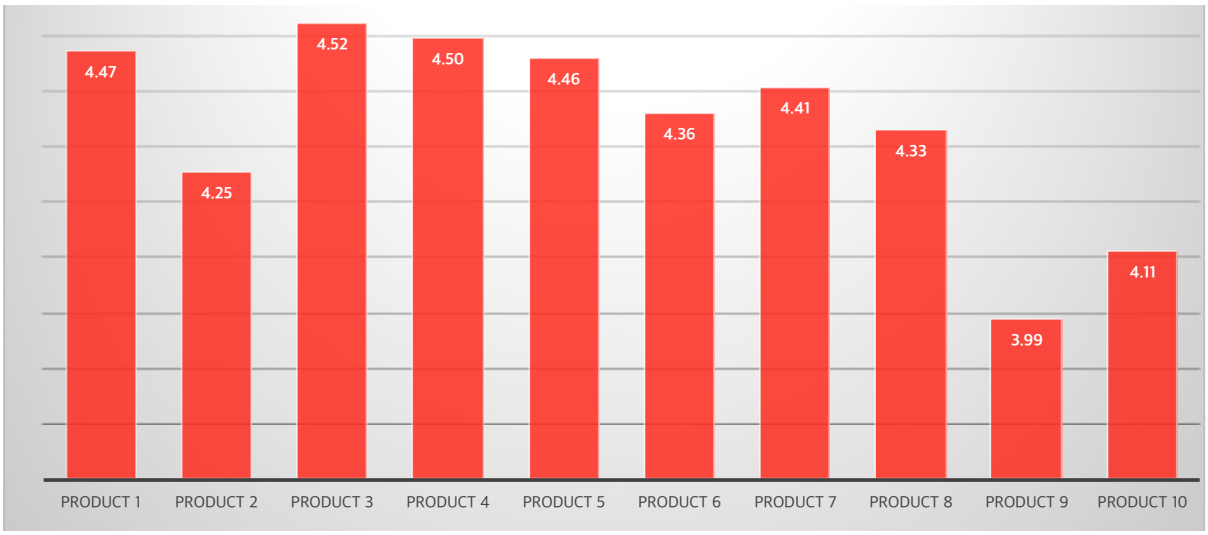


Figure 3. The average scores of the three review ratings for ten sunscreen products.

Next, for each product, 20 well-generated reviews were selected for exclusion of reviews that were poorly written in terms of their detail and quality. Then, the selected narrative customer reviews (N = 200) for the ten sunscreen products were classified into three groups including personal information, product usage experiences, and product features, as shown in Figure 4.

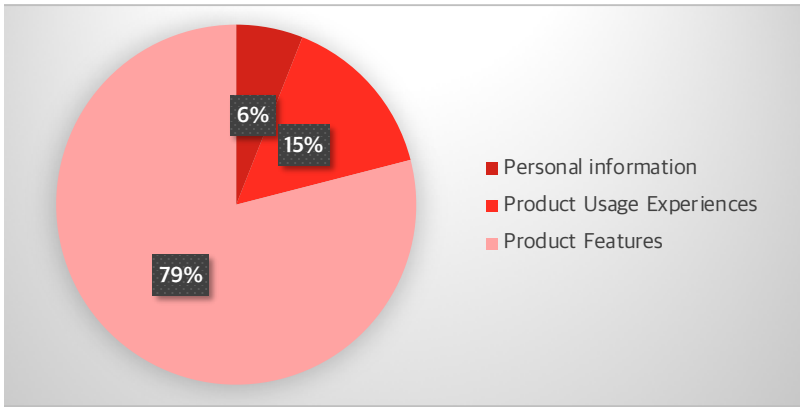


Figure 4. The distribution of the reviews according to three issue groups.

As many of the reviews were related with more than one group, the coders matched the dominant issue of each review to one of the three groups. Although about 80% of the reviewers wrote their posts mainly about diverse features of the products they used, the rest of them generated more personal-driven reviews. Although the reviews related with the product features mentioned the similar product information to that provided by marketers on the platform, these reviews also emphasized personal judgements and opinions about the product features. On the other hand, 21% of the reviewers shared information about their skin types, cosmetic preferences, and other more usage experiences. These reviewers also uploaded personal and realistic photos specifically showing how they used the sunscreens on their faces or other body parts, whereas most marketers provided a couple of high-quality photos highlighting the attractive product appearances (shown in the left and right images of Figure 1). From these pictures, potential buyers can experience the products indirectly and realistically. These results indicated that user-generated content (i.e. text and photos) provided more personal experiences of the product usage process (Bahtar & Muda, 2016;

Oum & Han, 2011). On the other hand, marketers focused on distinctive product features and appearance photos.

4.2 Customer Purchase Intensions on the Social Marketing Platform

In the participatory survey, 30 of the 54 products were selected by at least one subject. Half of them (17 products) were chosen by only one person while three products were chosen by 4, 5, and 6 people, respectively. These results show that most subjects were not just looking at the products retrieved on the top of the screen, but also scanning and comparing various products even within a short time. These three products that multiple people preferred at the same time had relatively larger volumes of customer reviews that were created with a composition of text and photos. Their larger volumes made the subjects consider them as more popular products. From a greater number of reviews, the subjects might get more diverse information about the products. In addition, the present research scrutinized the reasons why the subjects chose these 30 products in this survey; however, there were no common patterns because their reasons were diverse, including product features, product usage effects, personal skin types, higher customer recommendation frequencies, higher customer review ratings, larger customer review volumes, and others.

As for the question about what factors affected users' purchase decisions, seven factors were listed on the survey sheet. These factors can be categorized into the following two groups: (1) marketer-generated content, which includes brand, price, and product information; and (2) user-generated content, which includes the number of consumer recommendations, average consumer review ratings, narrative consumer review content, and consumer review volume. Respondents were asked to prioritize three factors that had the greatest impact on their purchasing decisions. Figure 5 shows how many people chose each factor as the first, second, and third most impactful. The first-ranked influential factors were sequentially consumer review volume (12 subjects, 21.80%), narrative consumer review (11), and product information (11). The narrative consumer review factor (17, 30.90%) was the most frequently selected as the second.

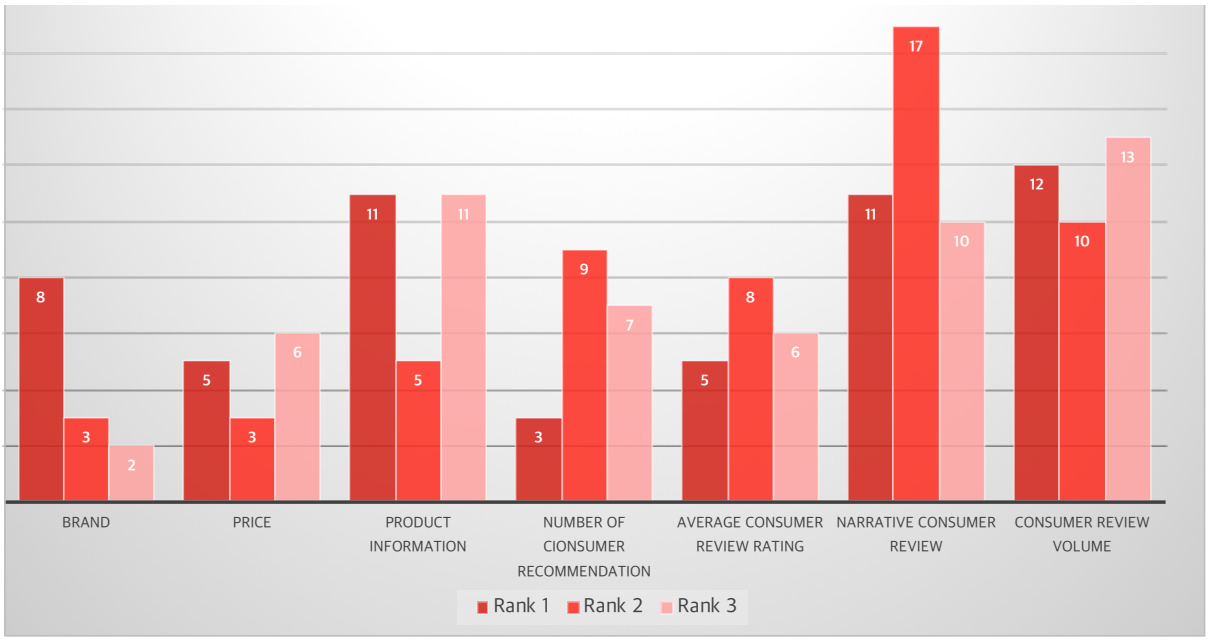


Figure 5. The first, the second, and the third rank sums for each factor.

Moreover, in order to compare each factor distinctively, the present study logically applied the rank ordered weights (3, 2, and 1) to the three factors because the importance and influence of the three factors was supposed to decrease from the first to the third factor. A weighted sum of each factor was then computed using Eq. (1):

$$Wx = 3Fx + 2Sx + Tx, \quad (1)$$

where Wx, Fx, Sx, and Tx denote the total weighted sum of the xth factor (from x = 1 to x = 7 in this experiment), the first rank sum, the second rank sum, and the third rank sum of the xth factor, respectively. For each factor, the total weighted sums were computed, as shown in Figure 6.

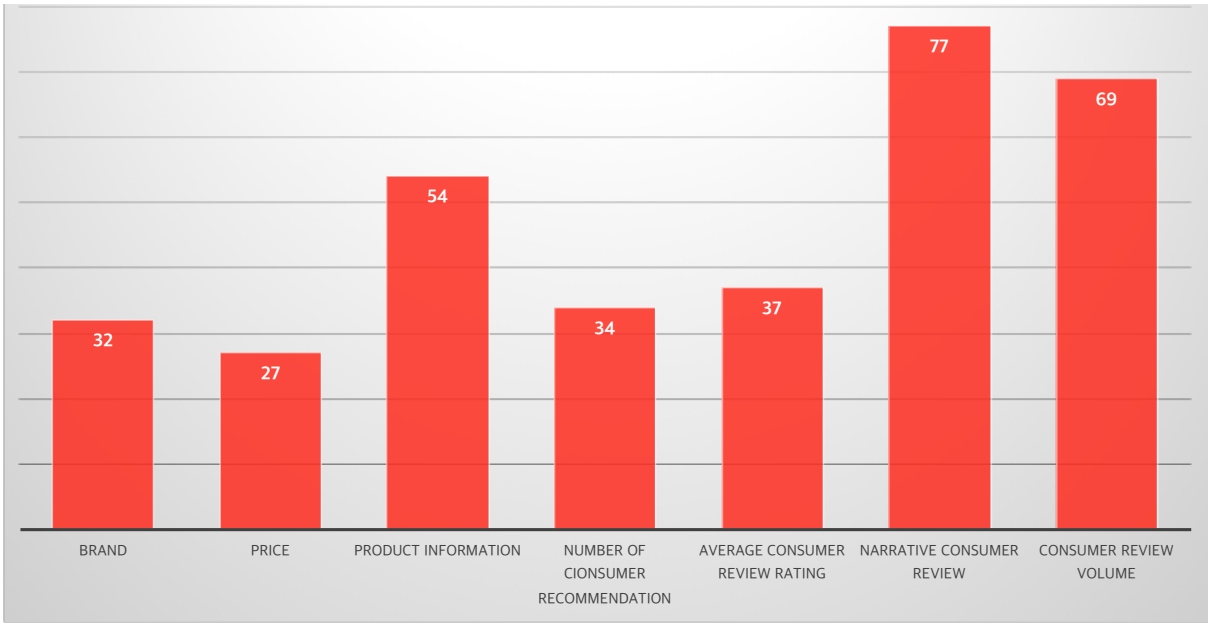


Figure 6. The total weighted sums for each factor (N=330).

As shown in Figure 6, the total weighted sums of four factors related to user-generated content (217, 65.76%) was twice those of three marketer-related factors (113, 34.24%). Remarkably, customer reviews (particularly, high volume and narrative content) had more impact on purchasing decisions than marketer-generated information in the online cosmetics market, as was found in a previous statistical study conducted by Gohm, Heng, and Lin (2013). Moreover, honest reviews (i.e. both positive and negative) of real users help companies assess their newly-released products promptly and easily. In particular, statistic information sources, like the number of consumer recommendations and average consumer review ratings, had less influence than narrative consumer review content, which provided a wealth of personal experience stories and realistic photos in the context of daily life (Ziegele & Weber, 2015). For example, one of the participants said, “My favorite review showed photos of the actual color on the back of hands.” The other participant mentioned that it was good to know the actual post-experience of people who have similar skin types. On the other hand, several participants mentioned the following issues for the unfavorable reviews: solely text-driven reviews without images, unconditional compliments, product appearance evaluations, generic product features, and others. Furthermore, the price and brand factors might have little influence on the purchase decisions because most of the suggested moisturizers were medium- and low-priced products of unpopular brands. Instead of the

price and brand, the subjects relied on detailed product information when they compared the products.

5 Discussion and Conclusion

In the digital environment, customers can move through their decision journey in fundamentally new ways. “Customers can gather information from focused research at search engines and read other customers' reviews on retailers' sites or third-party forums not controlled by the seller, and the initial demand to purchase could be created just by seeing a post on social networks (Kannan & Li, 2016, p.26).” Moreover, the rapidly growing social media channels have put consumers in the driver’s seat in the marketing field by allowing them to create and share their post-product experiences in a highly-efficient way. The influence of these user-generated content items on consumer’s purchase intentions rapidly increased more than that of other marker-generated content.

In this vein, the present research conducted a case study of 0.8L qualitatively and quantitatively to identify the relative impact of user- and marketer-generated content on consumer purchase intentions and the way of designing an effective social media marketing platform. From the results of the content analysis and the participatory survey, it was discovered that people tend to trust sincere consumer reviews more than marketer-generated advertising content (Gohm, Heng, & Lin, 2013). As shown in Figure 7, in the online cosmetics market, user-generated content relatively had stronger impact on consumer purchase intentions by providing personal experiences with product usage than in the case of marketer-generated content. In particular, the volume and narrative content of consumer provided the greatest influence on the participants’ purchase decisions (Duan, Gu, & Whinston, 2008; Powell, Yu, DeWolf, & Holyoak, 2017; Ziegele & Weber, 2015).

In 2016, BrightLocal found that customers are greatly influenced by average consumer ratings; however, in this research, the dependence on the other numeric components of UGC like the number of consumer recommendations and average review ratings appeared relatively lower. For the marketer-generated content, only few participants significantly considered the brand and price factors of the products, referring more to product information describing distinctive product features along with visually appealing product photos.

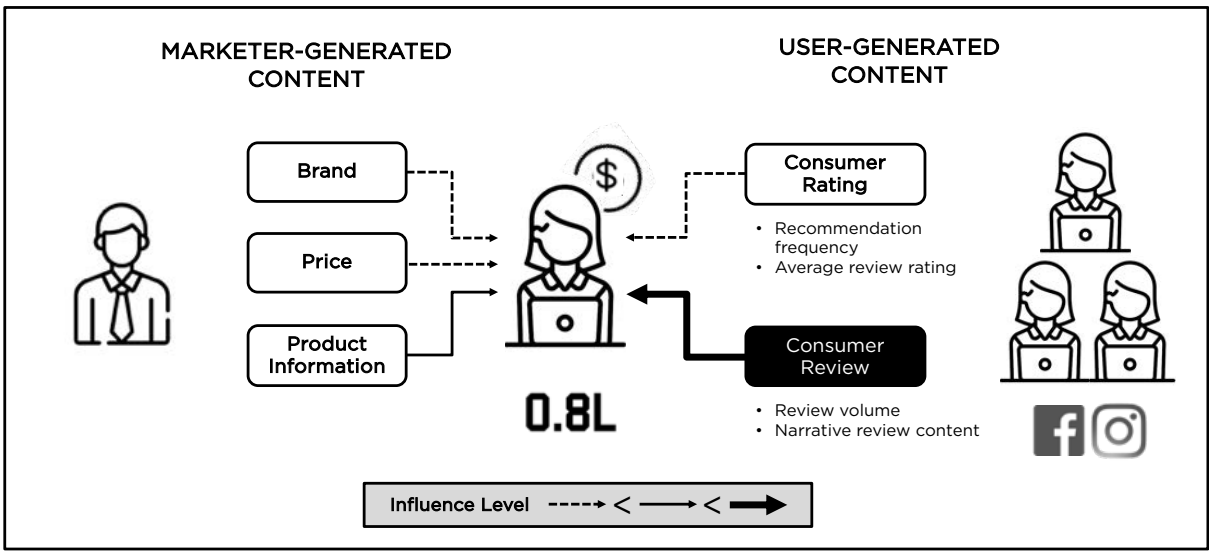


Figure 7. Influential factors on consumer purchase intentions.

Furthermore, honest review content (both positive and negative) of real users facilitated companies' assessment of their newly-released products (Reevoo, 2013). Especially, if companies effectively manage these negative reviews, they can provide the kind of highly detailed feedback that improves greater customer satisfaction and leads to product development.

Along with the importance of customer-driven marketing practices, the following UX design features were identified for developing a competitive social media marketing, which facilitates creating and sharing sincere customer reviews that resonate with potential buyers:

- Rapid consumer review process
  In order to generate a higher volume of customer reviews in a short time, the 0.8L platform encourages influencers to apply for and experience products within 72 hours; therefore, marketers can gather users' feedback in a prompt and highly efficient way. To facilitate this rapid consumer review process, the first landing page of each product highlights its high-quality images layered with bigger numeric typographies counting down the time (see Figure 1). This page emphasized a minimalistic look and feel.
- Customized product recommendation
  With its own algorithm that suggests products to consumers based on their profiles and prior marketing activities, the 0.8L platform can recommend more relevant products to the right consumers. At the same time, marketers can hear more prospective customer voices while testing the usability of their products with potential buyers.
- Playful shopping experiences with sharing honest reviews
  The latest renewal of the 0.8L platform focused on providing diverse fun experiences whenever users connect, as well as making them feel positive about the whole review process of searching, applying, and experiencing products: therefore, the platform launched three menus including the "New Experience," "Today's Rank," and "Pleasant Discovery." These services contribute to encouraging users to revisit to the platform and spend more time on the platform.

Finally, the present case study confirmed that users' sincere experiences and stories are effective marketing tools that contribute to improving the product purchase intention and conversion rate. Nevertheless, this research was conducted only on cosmetic products, so the scope of further research can be expanded into other product or service categories in the digital marketplace. In addition, although this research identified the aforementioned UX design features, marketing and design practitioners needs more hands-on design guidelines for launching more competitive marketing platforms. Thus, future research could focus on more practical design issues (i.e. design strategies and UX design guidelines) of social marketing platforms. It is hoped that this study will help marketers and sellers who want to create effective brand or marketing content through authentic user stories in the competitive social media market.

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Using the Technology Acceptance Model to Evaluate Behavioural Intention to Use Mobile Games—A Case of *Pokémon GO*

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As the Internet and mobile devices have increased in popularity, mobile phone games have become a mainstream recreational activity. Among them, Pokémon GO received considerable attention worldwide, and people gain a pleasurable experience and sense of novelty from this game. The goal of this study was to use the technology acceptance model to evaluate the attitude toward use and behavioural intention of users regarding the mobile game Pokémon GO. A questionnaire was distributed to Pokémon GO users who had played it on their mobile phone, and 56 valid questionnaires were returned. Descriptive statistics, a reliability analysis, and a regression analysis were conducted. The results revealed that the players' perceived usefulness and perceived playfulness significantly affected their attitude of use regarding Pokémon GO. Social interaction with players, flow, and user attitude affected their behavioural intention. The research results may serve as a reference for mobile game producers and subsequent related studies.

Keywords: Technology acceptance model; mobile game; flow; Pokémon GO

1 Introduction

With the increasing prominence of the Internet and mobile devices, popularity of online entertainment, and improvement in multimedia research and development technology, online games have become a popular and indispensable form of entertainment for people in Taiwan. In 2019, worldwide app store consumer spend will grow 5x as fast as the overall global economy. Consumer spend in mobile gaming will reach 60% market share among all gaming platforms (Lexi, 2018). This show that mobile gaming are more mature. According to a survey conducted in 2016 by the Market Intelligence & Consulting Institute, Institute for Information Industry on the application user behaviour of Taiwanese people, the five applications most frequently used by consumers belonged to the following categories: communication (73.3%), gaming (47.3%), photograph and video chat (17.6%), online shopping (15.5%), and music and sound effects (14.9%). Data have indicated that gaming has become the most prominent function of mobile devices, second only to communication. Therefore, many games are designed with short levels to enable players to experience a sense of entertainment and achievement upon finishing a level in a short time (Institute for Information Industry, 2016).

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Pokémon GO, which triggered enthusiasm worldwide for catching Pokémon, is a location-based augmented reality game. It has been free to download from the Apple Store and Google Play since July 2016. The game enables players to use real life as a platform for catching, fighting, training, and trading virtual monsters (i.e., Pokémon). (Taiwan Pokémon Information Site, 2017). Players can even compete with each other, make friends, exchange gifts, trade Pokémon, Adventure Sync, Community Day, and play in AR+ mode (United States Pokémon Information Site, 2018). After the launch of Pokémon GO, a Pokémon hunt trend spread worldwide. Although its popularity has diminished, numerous faithful players are still playing. According to statistics from the market research company Sensor Tower, Pokémon GO has made US$ 2.45 billion since its debut, and its revenue reached US$ 57.4 million (approximately NT$ 1.77 billion) in February 2019, indicating that users still demonstrate remarkably high levels of consumption (Mirror Media, 2019). In Taiwan, votes from Google Play users established Pokémon GO as one of the top five most popular games of 2018 (Chiao, 2018). Pokémon GO is first-to-market for a mainstream location-based AR mobile gaming experience, captured nostalgia within its target market and currently maintains a stronghold of active users. This popularity is attributable to the continual improvements that the official company has made to the game for maintaining novelty for the player, such as the additions of new characters and modes. The player can increase social interaction by sending Gifts or participating in a Raid or Gym Battle with others.

Information technology brings a lot of convenience to people, in order to understand the user's attitude and intention to use new technology, Davis, Bagozzi, and Warshaw (1989) proposed the technology acceptance model (TAM) on the basis of the Theory of Reasoned Action. The structure of TAM is as displayed in Fig. 1. In the model, the two constructs of perceived usefulness (PU) and perceived ease of use (PEU) are used to explain or predict the degree of acceptance or attitude toward using (AT) that a user has regarding a new technology. AT subsequently affects behavioural intention to use (BI). Furthermore, perceived usefulness and perceived ease of use are affected by several external variables. The TAM has been adopted by numerous empirical studies to determine whether a new technology system is accepted by users. It has also been integrated with different theories for expansion or application in various fields of research. Because TAM has evolved into a leading model in predicting and explaining an information systems acceptance, it is believed the TAM model is also appropriate to analyse the popularity of mobile gaming.

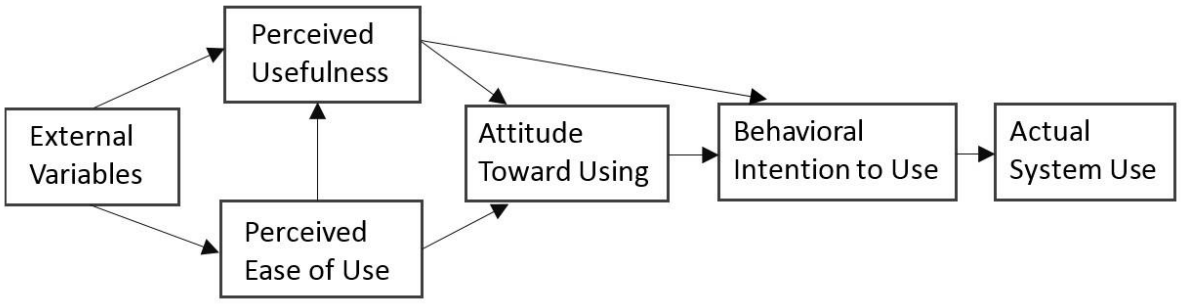


Figure 1. Theoretical framework of the TAM (Source: Davis, 1989)

Moon and Kim (2001) discovered that using only perceived usefulness and perceived ease of use could not fully explain and predict a user’s motivation. Therefore, they included Perceived Playfulness (PP) into the TAM for discussion. They defined PP as “The extent to which the individual Perceives that his or her attention is focused on the interaction with the

World Wide Web; Is curious during the interaction; and Finds the interaction intrinsically enjoyable or interesting." Peng (2017) used the TAM to discuss the use intention of augmented reality games, revealing that flow experience and perceived enjoyment have positive effects on intention usage. Perceived enjoyment (PE) is the extent to which an activity is perceived to be enjoyable without considering any performance consequences (Davis, Bagozzi, & Warshaw 1992). It is an intrinsic motivation referring to the pleasure and satisfaction from behavioural performance. Park, Baek, Ohm, and Chang (2014) proposed perceived enjoyment and usefulness as determinant variables of intention to use among players in mobile-social network games. Chen, Rong, Ma, Qu, and Xiong (2017) found that perceived enjoyment and perceived ease of use are the chief determinants of user attitudes to play mobile gaming.

The term flow was coined by Csikszentmihalyi in 1975. When people are focused on an activity, they filter out all unrelated sensory stimuli and transfer them into a shared model of experience without subjectively experiencing the passage of time, which is the state of flow. Csikszentmihalyi (1988) further proposed that flow experience occurs when an individual's skill and challenge are balanced. Individuals then act according to their psychological impulses. As the Internet has become more popular, flow theory has been used in computer and Internet research, which has indicated that the Internet use behaviour exhibits flow. Lee (2009) argued that the flow experience is a more important factor than perceived enjoyment in influencing customers' acceptance of online games and analysis reveals that gender is a key moderator of online game acceptance. The gaming industry has changed in response to the prevalence of the Internet. Games have developed from single or two player fighting games into online games that enable the interaction of multiple players. Choi and Kim (2004) classified the interactions engaged through computer games into two types: Users–system interactions (i.e., HI) and user–user interaction (i.e., SI). And proposed that if people achieve the optimal flow during the gaming process, they generate an intention to continue playing the game. Chang (2013) also affirmed that the interaction between users and social network games is an essential factor influencing user flow experience. When a game provides adequate goals and feedback and uses adequate tools to simulate interaction between the player and others, the player perceives a higher level of interaction with the game and can more easily achieve the flow state.

Psychologist Andrew Przybylski at the Oxford Internet Institute has studied what attributes are essential for games to have the chance of being successful. And noted that the key to establishing a fun experience for players of mobile games lies in providing the player with a sense of confidence and exploration as well as a platform with which to interact with other players. When a game satisfies these three criteria, the sense of fun experienced by the players of the game increases, and the game achieves market success (Baraniuk, 2016). Su, Chiang, Lee, and Chang (2016) proved that human-computer interaction (HI), social interaction (SI), skill (S), and challenge (C) independently positive influenced flow experience, and further positively influenced the player loyalty (PL) of mobile game users. In particular, the challenges and social interactions offered by a game increase player loyalty. In recent years, mobile gaming feature real-time discussion platforms, including in-game guilds, Facebook fan pages, and other online communities. Because it provides a social tie that enables them to build close relationships with other players. Pokémon GO can be considered the game that most satisfies the demands of the social media era. It encourages face-to-face social interaction as well as that between a virtual network environment and the

real world (Baraniuk, 2016). Mobile gaming is a new platform for people to play games with other friends. Because of the interactiveness of the game, players have mutual topics to discuss and can form a social space. Social interaction is an indispensable element in social mobile games.

The aim of this study was to integrate research in technology and psychology to investigate the user attitude and behavioural intention of domestic players toward Pokémon GO. The research goals were as follows:

1. Understand players' use behaviour of the mobile game Pokémon GO.
2. Investigate factors related to the behavioural intentions of Pokémon GO players.

2 Research method

On the basis of the results of the literature review, this study proposed an extension of the conventional TAM model including traditional factors such as Perceived Ease of Use (PEU), Perceived Usefulness (PU), Attitude Toward Using (AT), and Behavioural Intention (BI). Moreover, mobile gaming is a kind of social platform for users to share enjoyment and other experience. We also added several additional variables, such as Social Interaction (SI), Perceived Enjoyment (PE), and Flow (FL) to enhance the understanding of user's intention to play mobile games. Specifically, we adopted the degree of use of the mobile game Pokémon GO of individual players to investigate the correlations among the following research variables: SI, PE, FL, PEU, PU, AT, and BI. The research conceptual framework is depicted in Figure 2.

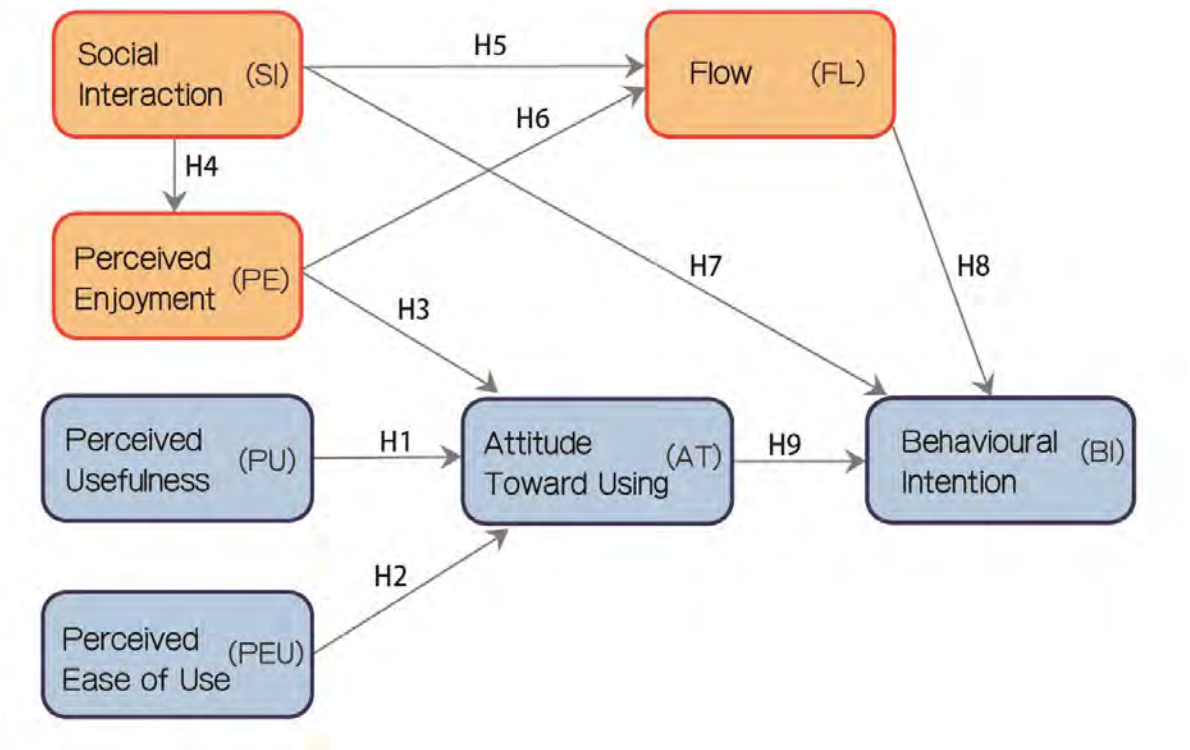


Figure 2. Research framework of this study

Based on relevant research, we developed the following hypotheses for the constructs in this study:

H1: PU significantly and positively influences the AT of Pokémon GO players.

H2: PEU significantly and positively influences the AT of Pokémon GO players.

H3: PE significantly and positively influences the AT of Pokémon GO players.

H4: SI significantly and positively influences the PE of Pokémon GO players.

H5: SI significantly and positively influences the FL of Pokémon GO players.

H6: PE significantly and positively influences the FL of Pokémon GO players.

H7: SI significantly and positively influences the BI of Pokémon GO players.

H8: FL significantly and positively influences the BI of Pokémon GO players.

H9: AT significantly and positively influences the BI of Pokémon GO players.

A questionnaire was conducted. The survey tools referred to domestic and foreign literature and questionnaires, and items were closed questions. The questionnaire was designed to collect demographic information and was also divided into seven perception scales: social interaction (SI), perceived enjoyment (PE), flow (FL), perceived ease of use (PEU), perceived usefulness (PU), attitude toward using (AT), and behavioural intention (BI). A 5-point Likert scale was used to evaluate the degree to which the participants agreed or disagreed with each item, from *strongly disagree* (1) to *strongly agree* (5). The questionnaire content was based on relevant literature. Experts were invited to review the questionnaire and thus increase expert validity.

The research participants were Pokémon GO players in Taiwan. Purposive sampling was used, and all questionnaires were distributed online. A total of 64 questionnaires were returned, 56 of which were valid, yielding a return rate of 87.5%.

3 Research results and discussion References

Regarding the sample (N = 56), men comprised 46.4% (N = 26), and female comprised 53.6% (N = 29). Most players were between 20 and 29 years old (46.4%), and the smallest proportion was 60 years or older (3.6%). Regarding motivation for downloading the game, 46.4% of participants stated that they did so because “my friends or family members were playing it,” followed by “I was curious about it.” Regarding with whom they played the game, 33.9% played it with “no one in particular,” followed by “by myself” (32.1%). The largest proportion of participants (32.1%) reported a usage time of less than 30 minutes each time they played the game, and 60.7% of participants reported playing the game every day. Table 1 presents the detailed results.

After the questionnaire responses were retrieved, we conducted a Cronbach’s α analysis on all constructs to assess their internal consistency. Guielford (1965) maintained that when a Cronbach’s α is greater than 0.7 for constructs to be considered as showing an acceptable level of convergent validity. The results of the present study revealed that the Cronbach’s α of the constructs of PEU, PU, SI, PE, FL, AT, and BI were all 0.812 or greater, as indicated in Table 2, demonstrating that the questionnaire items we revised according to the TAM were of high internal reliability and able to support the results of this study.

Table 1 Descriptive statistics of the sample structure.

Control variables	Questionnaire item	Counts	Percentage (%)	Ranking
Gender	male	26	46.4%	2
	female	30	53.6%	1
Age	20–29	26	46.4%	1
	30–39	8	14.3%	3
	40–49	12	21.4%	2
	50–59	8	14.3%	3
	60–69	2	3.6%	4
Why did you download Pokémon GO?	My friends or family members were playing it.	26	46.4%	1
	It was on the news all the time.	6	10.7%	3
	I was curious about it.	14	25.0%	2
	I like virtual games integrated with reality.	3	5.4%	5
	I play it as a form of exercise.	2	3.6%	6
	Other	5	8.9%	4
With whom do you usually play Pokémon GO?	By myself	18	32.1%	2
	With my family	6	10.7%	4
	With friends	13	23.2%	3
	With no one in particular	19	33.9%	1
How long do you play the game each time?	Less than 30 minutes	18	32.1%	1
	30–60 minutes	12	21.4%	3
	1–2 hours	10	17.9%	4
	2–3 hours	2	3.6%	5
	3 hours or more	14	25.0%	2
How often do you play the game each week?	1–2 days	7	12.5%	3
	3–4 days	9	16.1%	2
	5–6 days	6	10.7%	4
	Every day	34	60.7%	1

Table 2 Reliability analysis of the research variables

Construct	Reliability (Cronbach's α)
Perceived Ease of Use (PEU)	0.854
Perceived Usefulness (PU)	0.933
Social Interaction(SI)	0.939
Perceived Enjoyment(PE)	0.893
Flow(FL)	0.886
Attitude Toward Using (AT)	0.888
Behavioural Intention (BI)	0.812

Note: Cronbach's α > 0.7 indicates high reliability.

This study used the Pearson correlation coefficient to analyse the correlation among the seven constructs, namely Social Interaction (SI), Perceived Enjoyment (PE), Flow (FL), Perceived Ease of Use (PEU), Perceived Usefulness (PU), Attitude Toward Using (AT), and Behavioural Intention (BI). A large coefficient indicated a strong correlation between variables. Table 3 presents the correlations among the variables. We adopted the evaluation standards proposed by Gaski and Nevin (1985), which were that the value of the correlation coefficient between any two variables should be less than 1 and that between any two constructs should be less than the value of the individual Cronbach's α. Table 3 reveals that the Cronbach's α values in the diagonal line of each construct were larger than the correlation coefficient of each construct. Therefore, these test results indicate that the constructs of this study exhibited favourable validity.

Table 3 Discriminant validity analysis

Construct	PEU	PU	SI	PE	FL	AT	BI
PEU	**0.854**						
PU	.698**	**0.933**					
SI	.692**	.881**	**0.939**				
PE	.650**	.798**	.687**	**0.893**			
FL	.581**	.824**	.700**	.808**	**0.886**		
AT	.640**	.883**	.769**	.853**	.853**	**0.888**	
BI	.688**	.793**	.739**	.787**	.788**	.815**	**0.812**

*Note: The diagonal values are the Cronbach's α of each construct, and ** denotes p < .01.*

To determine whether the variables in the research framework could effectively reveal the BI of gamers, we used a path analysis to examine the explanatory power of independent variables on dependent variables. A regression analysis was conducted to determine whether the path coefficients reached the significant level. In each regression analysis, all variance inflation factors were no greater than 10, and the conditional indices were no greater than 30. Therefore, no multicollinearity between variables in the regression was observed. The results of the data analysis are provided in Fig. 3.

First, PEU, PU, and PE were employed as independent variables and AT was set as the dependent variable. The results of the path analysis revealed that only PU ($\beta = 0.569$, $p < .001$) and PE ($\beta = 0.418$, $p < .001$) significantly affected AT. $R2 = 0.841$ ($F = 91.362$, $p < .001$), thus explaining the AT of 84.1% of the participants who played Pokémon GO. However, PEU has no significant impacts on AT in this study.

The path of SI to PE was significant ($\beta = 0.687$, $p < .001$), and $R2 = 0.471$ ($F = 48.145$, $p < .001$), meaning that SI explained the PE of 47.1% of the participants. Then, PE and SI were employed as independent variables and FL was set as the dependent variable. Both PE and SI significantly affected FL ($\beta = 0.620$, $p < .001$ and $\beta = 0.274$, $p < .05$, respectively), and $R2 = 0.693$ ($F = 59.778$, $p < .001$), meaning that they explained the FL of 69.3% of participants.

Finally, when SI, FL and AT were set as independent variables and PL was the dependent variable. Regarding the effects of SI, FL, and AT on BI, a path analysis revealed that SI ($\beta = 0.244$, $p < .05$), FL ($\beta = 0.302$, $p < .05$), and AT ($\beta = 0.370$, $p < .05$) all had a significant effect on BI; moreover, $R2 = 0.720$ ($F = 44.492$, $p < .001$), revealing that these three

variables explained 72.0% of the BI of participants. Therefore, this study confirmed that multiple factors simultaneously affect each dependent variable.

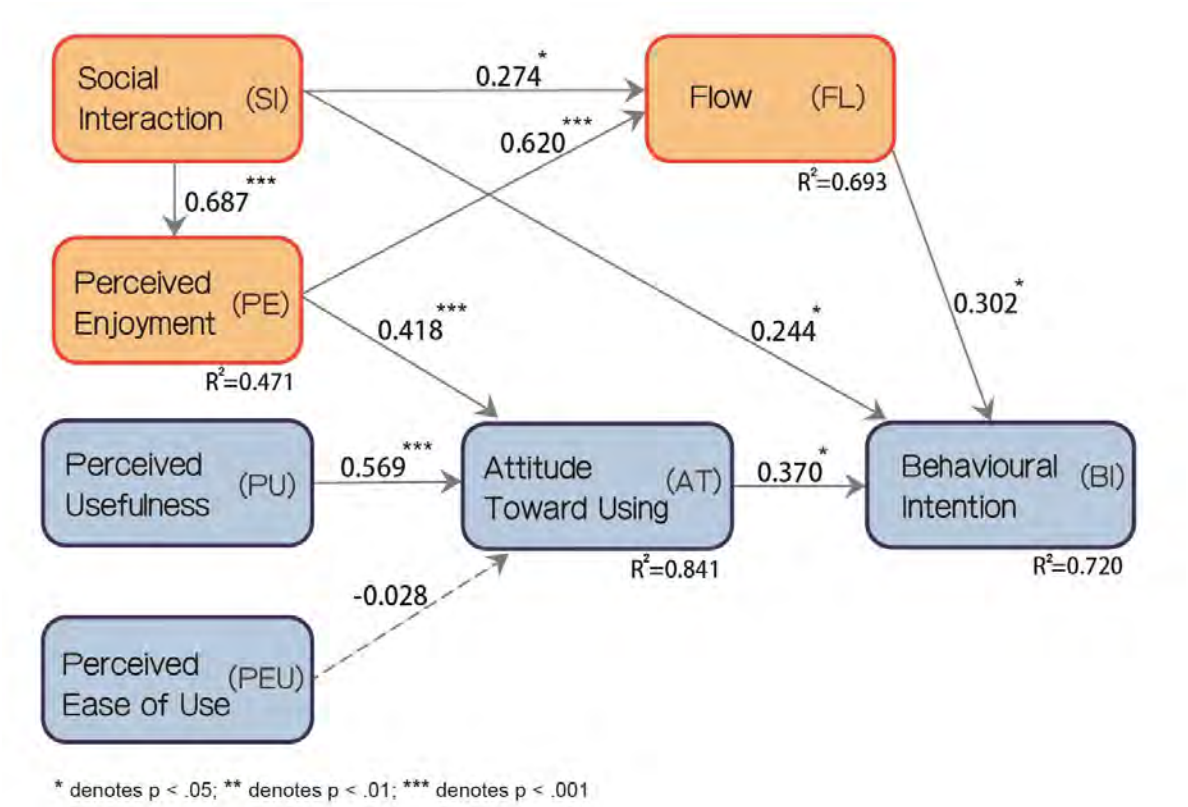


Figure 3. Path analysis of the research framework

Table 4 Research hypotheses and verification results

Research hypothesis	Construct relationship	β coefficient	t value	p value	Verification result
H1	PU→AT	0.569	5.692	<.001	Accepted
H2	PEU→AT	-0.028	-0.355		Rejected
H3	PE→AT	0.418	4.368	<.001	Accepted
H4	SI→PE	0.687	6.939	<.001	Accepted
H5	SI→ FL	0.274	2.615	<.05	Accepted
H6	PE→FL	0.620	5.924	<.001	Accepted
H7	SI→BI	0.244	2.107	<.05	Accepted
H8	FL→BI	0.302	2.128	<.05	Accepted
H9	AT→BI	0.370	2.334	<.05	Accepted

Using path coefficients (β) and the coefficient of determination (R^2), we verified the study hypotheses as well as the predictive power of this model. Figs. 3 and Table 4 present the path analysis results, which indicate that eight out of the nine hypotheses (H2 excluded) reached the significance level $p < .05$ (t value > 1.96).

H1 and H3 were accepted, revealing that PU and PE significantly affected the AT of Pokémon GO players, and their explanatory power for the total model was $R^2 = 0.841$. H4 was accepted, indicating that SI significantly affected the PE of players, and the explanatory power for the total model was $R^2 = 0.471$. H5 and H6 were accepted, suggesting that SI and PE significantly affected the FL of players, and their explanatory power for the total model was $R^2 = 0.693$. H7, H8, and H9 were accepted, revealing that SI, FL, and AT significantly affected the BI of players, and the explanatory power for the total model was $R^2 = 0.720$. The results indicated that the TAM exhibited favourable explanatory power and is worthy of reference.

4 Results and conclusion

Along with the development of technology and mobile devices, social network based mobile gaming has become wildly popular. This study investigated the user attitude and behavioural intention of users of the mobile game Pokémon GO. We used the TAM to identify factors influencing players' behavioural intentions to make practical contributions in the gaming industry. The demographic characteristics of the research participants indicated that most Pokémon GO players are female. This echoed the result from the online surveying company Survey Monkey (2016), which revealed that 63% of Pokémon GO players in the United States were women. This finding suggests that female players in the mobile game market should not be overlooked. The survey results revealed that most players were between 20 and 29 years old, which can be attributed to the fact that most individuals who grew up watching Pokémon on television were in this age group. Many Pokémon Go fans have fond memories of titles dating back to 1996, when the first instalments in the series were released. Even the very fact that people are talking about Pokémon more than usual again has prompted reminiscences among some older fans. The main reason for downloading this game was that family and friends were playing. We can thus infer that the players downloaded the game after discovering that family members or friends were playing in an effort to increase their interaction with others by identifying a topic of common interest. This echoes findings reported in the literature on social games that indicate that players continue to play social games both for entertainment and for socialisation (Choi and Kim, 2004; Baraniuk, 2016). Most users play the game with "no one in particular" because the game has a gym battle mode. Most of the participants reported playing the game daily. This popularity is attributable to the continual improvements that the official company has made to the game for maintaining novelty for the player, such as the additions of new characters and modes. In the contemporary setting in which most people own a mobile phone, playing mobile phone games has become a form of daily entertainment. Their prevalence also demonstrates the attachment players form with such games.

This study used a literature review, empirical data, and statistical analysis to infer and verify the research hypotheses. The results revealed that perceived usefulness and perceived ease of use affect the attitude toward using of players. This means that when users play a mobile game, they open a communication channel with friends and achieve a sense of happiness and satisfaction in the game during their interactions. Playing games is conducive to shaping an active and positive attitude toward using. The main purpose of mobile gaming is for entertainment and relaxation. And it provides a kind of social platform for users to share fun and other experience. The perceived ease of use of operating the game did not demonstrate a positive influence on attitude toward using.

In addition to attitude toward using, social interaction and flow also increased the player's behavioural intention, whereas social interaction and perceived enjoyment exhibited significant effects on flow. This is similar to the findings reported by Choi and Kim (2004) as well as by Su et al. (2016). A game has to remain over time entertaining and fun for the users to continue playing it. When players are engaged in mobile games, they can interact with others and find entertainment, which subsequently generates flow experiences that lead to behavioural intentions for entertainment and recreation and is conducive to users continuing to play the game. What is worth investigating is the fact that social interaction had a positive influence on behavioural intention. As the Internet and mobile devices have increased in popularity, mobile games have become a mainstream form of recreation and entertainment. Pokémon GO not only allows its users to collect Pokémon; it also offers a social platform for players to interact with their families and friends. Challenges at different levels enable the maintenance of relationships and the potential for developing new relationships, which promotes a player's behavioural intention to continue playing the game. Interactions in the game also enable players to discuss topics of mutual interest. These findings explain why social interaction is an indispensable element for social mobile games and can serve as a reference for mobile game producers to formulate marketing strategies.

Similar to other researches, there are several limitations in this study which deserve future effort to address. Regarding the application of new technology, there are still many constructs that may affect actual use behaviours that were not included in the present study. Future studies may include other influential factors for investigation. This study used an online questionnaire to conduct purposive sampling; therefore, the source of sample acquisition may be limited. Future studies can conduct research with samples that are larger in size and more random. They can also consider adopting qualitative methods such as observation methods and interviews to examine the associated topics to further elucidate player perceptions of mobile gaming. Furthermore, to discuss the behavioural intentions of different groups toward mobile games can to make the research results more objective and comprehensive.

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Why designing may help treat psychosis

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The paper presents some initial theoretical insights on why designing may help people with experience of psychosis. The paper reviews how psychosis has been discussed in the literature from a phenomenological point of view, and how it links to designing by looking at the themes of agency and embodiment. These insights are then used to formulate the hypothesis that the experience of designing, and design iteration, may pose a continuous force (and have an indirect effect) towards the coupling, or pulling together, of dimensions of experience such as perception, cognition and action which in psychosis are sometimes experienced as particularly fragmented. The paper contributes to our understanding of design and introduces the idea of design as treatment for the development of design projects to support mental health.

Keywords: psychosis; co-design; schizophrenia: mental health; self; agency; embodiment; phenomenology; experience

1 Introduction

This paper is concerned with making connections between the experience of psychosis and the design process to explore whether designing can contribute to the treatment of psychosis.

Mental health problems represent the largest cause of disability in the UK, and there is a requirement of participatory research and development of new ways to improve the services' productivity (Mental Health Taskforce, 2017). The recovery movement, which broadly focuses on restoring functioning above and beyond symptom reduction and recognizes the ability of people with mental health problems to participate in society (Davidson, 2016), and the patient-oriented treatment plans that acknowledge experiential knowledge have opened up doors to imagine what could constitute treatment, and the exploration for new ways in which recovery is supported more generally.

While some studies exist that use design in mental health contexts, there is no research which explicitly looks at the effects of design thinking in mental health. There is no previous evidence to proof the benefits of designing for mental health problems, although authors experiences through professional practice seem to suggest positive changes. The paper focuses on describing a theoretical framework developed through the preparation of a co-design project with participants with psychosis at a mental health charity. The aim of the theory is to inform the set up of co-design projects and guide data collection, but it is expected that empirical evidence will in turn help re-evaluate and re-formulate the theory, and develop alternative perspectives.

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A variety of arguments can be drafted to support the idea that co-design may be reimagined as a treatment, which does not necessarily focus just on the individual. One such argument is that as powerlessness, loss of credibility and identity, isolation and hopelessness create most suffering to service users (Kaite, Karanikola, Merkouris, & Papathanassoglou, 2015), co-design provides an empowering platform. By respecting participants as experts in their experience and key actors due to their contributions (Sanders, 2000), co-design may be reimagined as a treatment that transcends the individual and focuses on the wider community or context where psychiatric and psychological distress is happening.

Conceptualizing co-design itself as a kind of treatment is a radically different approach to the way co-design and co-creation have been approached and used within health services. Projects tend to focus on using co-design to inform the improvement of services or increase efficiency for instance, rather than using it as a treatment in itself. Some findings from a UK healthcare participatory project suggest participants did not think to be ‘doing’ the designing, and had doubts about the effectiveness of the intervention (Bowen et al., 2013).

Among the projects led by designers specifically within the mental health context, the focus has been on developing appropriate design methods or innovative processes, and describing the design outcomes (Glazzard et al., 2015; Kaasgaard & Lauritsen, 1997; Kettley, Sadkowska, & Lucas, 2016; Nakarada-Kordic, Hayes, Reay, Corbet, & Chan, 2017), leaving the effects of participation on mental health users -aside as general feedback- yet to be explored. Even looking at the wider area of design for health, studies focusing on the effects of co-design on participants themselves appear rare, with the exception of a couple of studies looking at the potential of design thinking to help those affected by long-term physical conditions such as spinal cord injury (Macdonald 2013; Langley et al. ,2013).

Nevertheless, the idea that participating in co-designing may have an impact in some way or another informed some studies which speculated why these changes could occur. With participants from the general population, Corcoran, Marshall, and Walsh (2017) suggest that cooperative place-making workshops supported changes to psychological and community wellbeing by enhancing both a sense of personal growth and a collective sense of place-related optimism. Hendriks, Dreessen, and Schoffelen (2016) describe how participatory design could ‘enable’ increase in perceived quality of life and secondary gains which (as (Albrecht & Devlieger, 1999) describe) occur when a person with a disability (in their case diabetes) finds an enriched meaning secondary to the condition brought on by the disability. Renedo-Illarregi (2018) conceptualizes uncertainty as a potential explanation for changes that could be expected in people with mental health problems who partake in design.

This paper focuses in the experience of psychosis in particular, and how the experience of designing may relate to it, building a hypothesis of why these may impact one another.

1.1 Why focus on experience

The lived experience of designing has been paramount in the study of design. According to Frauenberger, Good, & Keay-Bright (2010) the philosophical discipline of phenomenology provides the designer with a framework for studying user experience by affording an intrinsically contextual view of the way we interact with things around us. They argue that it also plays a critical role in participatory design when it is undertaken as an interpretive and generative process, mindful of end user experience rather than directed toward the specification of outcomes.

On the other hand, psychiatric research and treatment initiatives are moving away from traditional diagnostic categories and focus on transdiagnostic phenomena (Pienkos et al., 2019). Many psychotherapeutic or recovery-focused initiatives within mental health charities are now organized around phenomena and according to experience, and charities rarely use diagnosis in the way they design, organize and provide their services. This is reflected in initiatives such as the service offered by the mental health charity who are collaborating in this study, which provides psychotherapy for people who have experience of psychosis, regardless of the reasons for such experiences.

Increased awareness of the limitations of reductionist approaches that mostly rely on biologically oriented models, has led to alternative conceptualizations more interested in lived experience of psychosis (Hamm, Leonhardt, Ridenour, Lysaker, & Lysaker, 2018b). Indeed, as reviewed by Hamm et al (2018a), both the philosophical phenomenological model of psychosis and the recovery model, focus on the first-hand experience of psychosis, and although they differ on methodology and epistemology, they are both interested in the alterations of subjectivity that occur in psychosis, and both contribute to interventions that are responsive to these alterations.

Most recently, changes that relate to cognition, perception, selfhood and reality, temporality, interpersonal experience, and embodiment were reviewed across the psychiatry literature from a phenomenological point of view (Pienkos et al., 2019) providing a great opportunity to build a shared, interdisciplinary framework to understand the experience of designing alongside the experience of these changes occurring in psychosis.

With a primary interest on lived experience, in this paper we theorize changes that could occur (theoretically) when the experiences of designing and the experiences of psychosis interact.

1.2 The structure of the paper

The first part of the paper, centres around the question of how design may impact psychosis by discussing two main themes, **agency and embodiment,** which are of great relevance to psychiatry and design. The intention is not to provide an extensive literature review, but to provide an overall thematic analysis in order to illustrate insights that informed this project and the theoretical contribution which is presented at the end. The concluding section, presents a hypothesis of how designing could help treating psychosis by conceptually intertwining the themes discussed.

It is important to clarify, nevertheless, that the data collection for this project has just commenced, and this theoretical argument is one of few which may emerge once more data is collected. Following an abductive approach, the aim is to generate a variety of explanations that could account while we are collecting data, continuously checking for alternative theorizations.

2 Could designing treat psychosis?

In order to review the potential of designing to help with the limiting and debilitating aspects of psychosis, we first look at two common themes across the phenomenology of psychosis and design literatures, and organize brief summaries around two main themes, agency and embodiment, which are, paramount to both research agendas.

Arguably, the themes of agency and embodiment are also relevant to the subjective experiences of designing and psychosis.

In the literature in psychosis, we see these themes reflected upon from the point of view of what seems disrupted on the experience (diminished agency, disembodied self, disconnection with the world and others) but they are also seen as relevant for the proposed treatments or interventions to respond to the struggles often associated to psychosis.

2.1 Agency

A diminished sense of agency is a recurrent and common theme in research which deals with understanding the experience of psychosis. It appears central to studies that differ wildly both in epistemology and methodology. For instance Hamm et al (2018b) review the commonalities and differences across two research agendas, that is the phenomenology of psychosis and the recovery models. By philosophical phenomenology they refer to research concerned with structures of consciousness as experienced from the first-person point of view such as perceptual and cognitive aspects of how persons experience the self and its relation to the world around them (e.g. Parnas 2011). Recovery-oriented approaches on the other hand are those which focus on individual definitions of wellness and the processes which promote those (Leonhardt et al., 2017). They specifically focus on the ipseity disturbance conceptual model of schizophrenia, which is well known in phenomenological writings, and recovery writings that generalize from common and diverse experiences of movements towards well-being. Hamm et al (2018b) conclude that treatments following these paradigms need to address experiences of diminished agency and confused or fraught self-experience, primary focusing on helping patients to name, reflect upon, and respond to their experience, as a basis for action – a very familiar process to designers.

On one hand, a diminished sense of agency may refer to the lesser ability to have an impact on the world around oneself. This feeling of disempowerment is something that most people can relate to and may experience at different points in their life. In many cases of psychosis, this particular sensation may indeed reflect the real situation quite accurately, as the power over the environment, others and even oneself can be extremely compromised by some events following breakdown such as being sectioned or treated compulsorily.

However, from the lived experience of the psychotic, a diminished sense of agency may not only refer to a lesser ability to impact on the environment or what is being done to them; in some cases, the lack of a sense of agency may extend to one's own inner world (e.g. thoughts, feelings, sense of will).

A diminished sense of agency thus extents to the sphere of one's inner world and experience. In these kinds of situations, the person is not only unable to act upon things and events 'out there', but he or she also experiences his or her inner existence as driven by foreign agency or subject to the agency of others.

These various cognitive phenomena have been framed as alterations of thought-agency and ownership (Humpston & Broome, 2015). Examples portrayed in (Pienkos et al., 2019) include 'thought insertion', which is the inward projection of "other" thoughts into one's mental space, and 'audible thoughts' referring to the vocalization of one's own thoughts into an external space. Furthermore, Mayer-Gross (as cited in Sterzer et al. 2016) proposed that thought insertion involves those thoughts to 'become sensory', no longer being experienced as thought but as objects inserted by foreign agency.

One of the most characteristic experiences of psychosis, hallucinations, are considered as self-disturbances to the extent they are perceived as occurring independently from self, and this separation between self and its automatic processing is also often experienced as due to foreign agency. (Pienkos et al., 2019)

Fuchs (2007) suggests that the inhibition of unintended thoughts or actions fails when the essential syntheses that relieve us of the task of actively connecting and building up the perceived objects, situations and habitual patterns of our life are disturbed. Associations or even bodily movements appear ‘out of the blue’ and instead of serving as a medium for the patient’s intentional relation to the world, their thoughts, perceptions or movements may occur as single erratic blocks that stand in the way of their intentional effort. (Fuchs, 2007)

Agency is a fundamental pillar for the activity of designing. In design, the choice for action, is influenced by the perception of the consequences of the action. It is also been conceptualized as emergent from the interaction with design materials, see for instance (Tholander, Normark, & Rossitto, 2012), who describe this process in the context of intensive short-time prototyping.

Let us imagine and speculate what happens when a person with experiences of psychosis is presented with a design brief. The person is confronted paradoxically with 1) having to pay attention to the constraints of what is ‘out there’ therefore becoming aware that their actions will have a potential impact in the external world and 2) the multiplicity of responses that the brief entails, basically by endless choices. The person may make any decision but must also take into account the effects of the decisions and act accordingly. Being confronted with this situation, the psychotic needs to act upon external perception (e.g. brief) as well as personal narratives (e.g. there is many ways to respond appropriately to the same brief). Through this process, dimensions of experience such as perceptions, thoughts, feelings need to somehow coordinate.

2.2 Embodiment

As Hamm et al (2018b) summarize, if attending to subjective experience is addressed principally by promoting agency, treatment should attend to mental phenomena in the context of embodied experience.

The subject of embodiment is also one of the themes Pienkos et al (2019) use to organize their extensive review of the literature on hallucinations, suggesting it is central to the phenomenological study of psychosis.

A review of implications and applications of the subject of embodiment in schizophrenia is discussed in Tschacher et al (2017). They remark how embodiment has become an influential concept in psychology and cognitive neuroscience, and that the embodiment of the mind constitutes the basis of social interaction and communication. Sensorimotor dysfunctions are closely associated with affective and psychotic psychopathology, leading to altered timing in the processing of stimuli and to disordered appraisals of the environment.

Alterations of bodily self-representations have also been suggested to be a core component of schizophrenia, for example changes in size and shape, alterations in body ownership or out of body experiences. (Pienkos et al., 2019).

The idea of disembodied self is central to the existential interpretation of psychosis presented in The divided self (Laing, 1960). In Laing’s thesis, the schizoid person, who may

or not develop psychosis, consists on an unembodied self, and a false self-system who deals with others and the world. He stresses that although most people regard the embodied position as healthy and the unembodied pathological, sometimes an individual should try to disentangle himself from his body, for instance to achieve discarnate spirituality.

On the other hand, the concept of embodiment also takes a central role in design research, often implicitly. As Peter et al (2013) describe, there is a strong view in the literature that any practical activity, and perhaps especially designing, embodies different types of thinking and that these types of thinking can interact with one another in achieving a particular goal. As (Loke & Robertson, 2011) summarize, the thinking is not in words or propositions, but in visual, tactile and somato-sensory forms.

Schön's work on reflection-in-action (e.g. Schön 1983), which guided an extensive research agenda referred to as the reflective paradigm or design as exploration (see Hay et al. 2017 for an extensive review), is highly related to the idea of embodiment, where thinking and doing are experienced as an integrated whole.

From a phenomenological perspective, Poulsen and Thøgersen (2011) argue that embodied engagement of the designers plays a fundamental role both in understanding the problem at hand and in opening up new ideas leading to a new design solution. According to their study, the verbal interaction constantly finds its meaning in reference to a tacit level of embodiment, which remains unspoken. The verbal interaction is also integrated into the designer's tacit use of items in the surroundings and design thinking relies on a more complex and multidimensional interaction, which is based on the pre-linguistic engaged perspective of the lived body.

Now let us again imagine a person with psychosis is presented with a design brief, and/or some tools to design, for instance paper prototyping. Suppose the person experiences the body as separated from self or alien, or even perceives his/her weight in an unusual manner. In responding to the brief, the psychotic is forced to use the body to react to the object of design through feedback (perception) and action. By following the design process, a psychotic person may iteratively reconnect to their self (mind and body) even if only in the specific context of responding to a brief.

3 Summary and discussion

Summarizing, we have described how a sense of agency and embodiment are critical dimensions both in the experience of psychosis and designing.

Our concluding thesis is that the activity of designing and design iteration may act upon this experiential landscape as a continuous force towards the gradual integration of the fragmented dimensions of experience found in psychosis.

This theoretical concept has been developed by immersing in literature in an attempt to empathize with the experience of psychosis and understand the profound ontological differences implied, whilst reflecting on first hand experiences of designing and visualizing how these positions may interact. The theory here described was first articulated in a visual, dynamic form, when trying to understand the experience of psychosis alongside that of designing, and explore the meanings portrayed by authors who looked at the lived

experience of psychosis and even described it in visual forms. The process involved the hacking of existing conceptual diagrams and the development of a new one, which is adopted here to assist in maintaining a conceptual thread and communicate the theory visually. Put it another way, the theory was ‘prototyped’ as in physical form.

The design object, or focus of attention, supposes a continuous demand on both perception and action and the body. For the design concept to move and iterate forward, and the designer to be able to make design decisions (which transcend personal preference and are embedded in the world) all these elements (agency, perception, action, body, object) need to coordinate with one another. As (Tholander et al., 2012) describe, neither technology nor people are the sole performing agents that drive activity forward – but rather the two in interplay.

The psychotic person may begin the task by compensating for this lack of integrated experience and agency with rational thinking (e.g. make conscious connections among things commonly experienced as integrated). But the designing continues and the object moves forward, demanding some coherence in the perceptions and actions that are most relevant to the present situation. Design activity may even encourage redirecting thoughts that are intrusive or dreamy back into the design focus by indirectly informing creative shifts or innovative ideas. By following the design process a psychotic person may slowly begin to pull these fragments of their experience together, which then provide the basis for the gradual emergence and realisation of agency.

In order to visually illustrate this theory and integrate it with earlier summaries, we look first how these fragmented dimensions of experience have been visualized in psychosis literature through two very different examples. Although referring to highly complex phenomena in reality, these diagrams are relatively simple ways to facilitate the comprehension of how radically different the world and oneself is experienced when dealing with psychosis. From the understanding of those diagrams, we build a final diagram which portrays our theory.

This first diagram (Figure 1) is found within the work RD Laing The Divided self (Laing, 1960). In this diagram, we understand how having a divided self may result in perception becoming unreal, and action futile, rather than meaningful. Simply put, when the self is embodied, action and perception are connected in a healthy cycle and the self has direct access to the other, which could be a thing, other people or the world for instance. When the self retracts to some inner dimension and a false self operates within the world, perception is no longer experienced directly, and action is no longer associated with one’s own will. In this diagram, the disconnection or uncoupled action and perception results from a self being displaced. Experience is no longer integrated and embodied.

The main way to normalize this kind of situation according this diagram would be to try to help the inner self gravitate towards the centre to align again within the circle. If we try to visualize the act of designing within this conceptual diagram, we could imagine it as a rotating axis that crosses the centre of the cycle of perception and action represented (Figure 2).

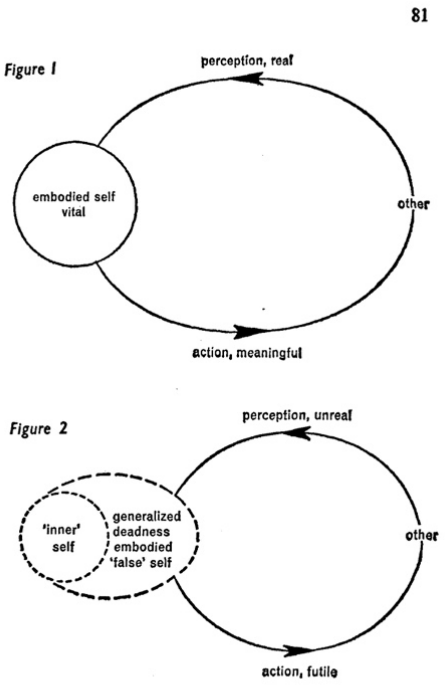


Figure 1. Pag 81 in (Laing, 1960)

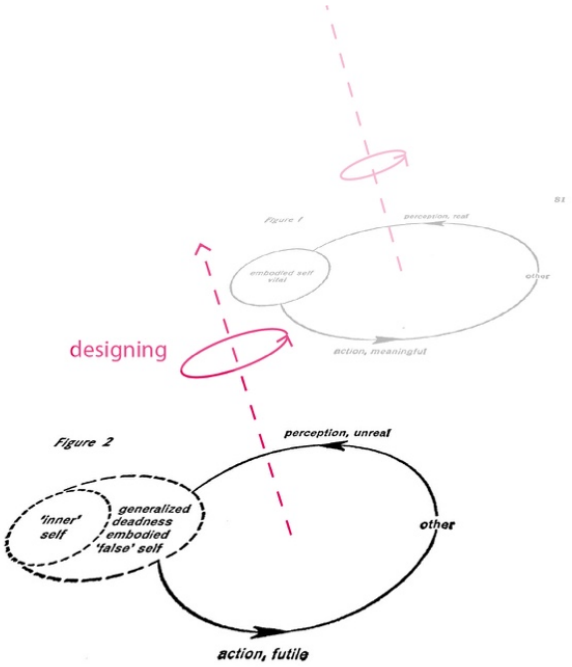


Figure 2. designing in relation to Laing's theory, (1960)

The next diagrams below, by Fuchs (2007), refer to a different phenomenon described earlier in this paper, that of intentionality, which is often disordered in Schizophrenic people who deal with psychosis. According to Fuchs (2007) the basic temporal structure of mental life as an integration of past, present and future could be paralleled, phenomenologically, to Husserl's analysis of the structure of internal time consciousness, consisting of a retentional, presentational and protentional function. These functions operate in the most basic levels of consciousness and are capable of integrating the sequence of single moments into an 'intentional arc', enabling us to direct ourselves towards objects and goals in a meaningful way (Figure 3, (Fuchs, 2007)

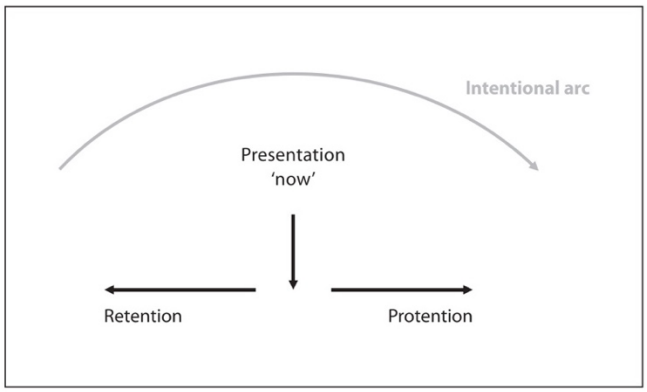


Figure 3. Structure of internal time consciousness, adapted by (Fuchs, 2007) *from* (Husserl, 1966)

The fragmentation of the intentional arc, leaves single elements of perception, action and thought processes unconnected, and they come to explicit awareness as alienated or opaque phenomena. As Fuchs (2007) describes, as a consequence the automatic constitution of reality is dismantled and has to be replaced by active or rational reconstruction, which overburdens the patient's adaptive intentional capacity.

In psychosis, a failure of the continuous intertwining of succeeding moments, and especially of the protentional function (represented in figure 4), leads to a loss of the tacit or operative intentionality that carries the acts of perceiving, thinking and acting.

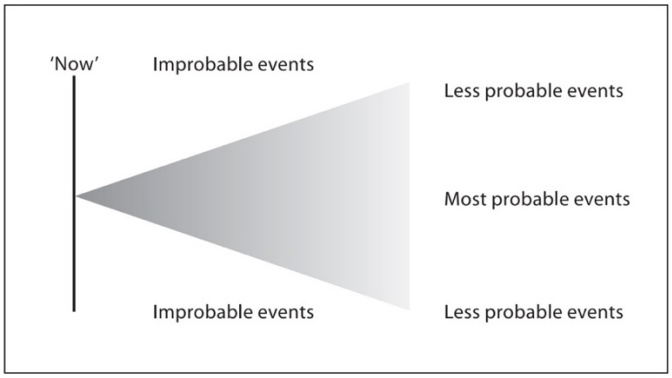


Figure 4. Protentional function (Fuchs, 2007)

In the following diagrams, the protentional function is represented in the cases of focused activity, alongside dilated and retracted protention which happens in creativity and dreaming or drug induced states for instance (Figure 5)

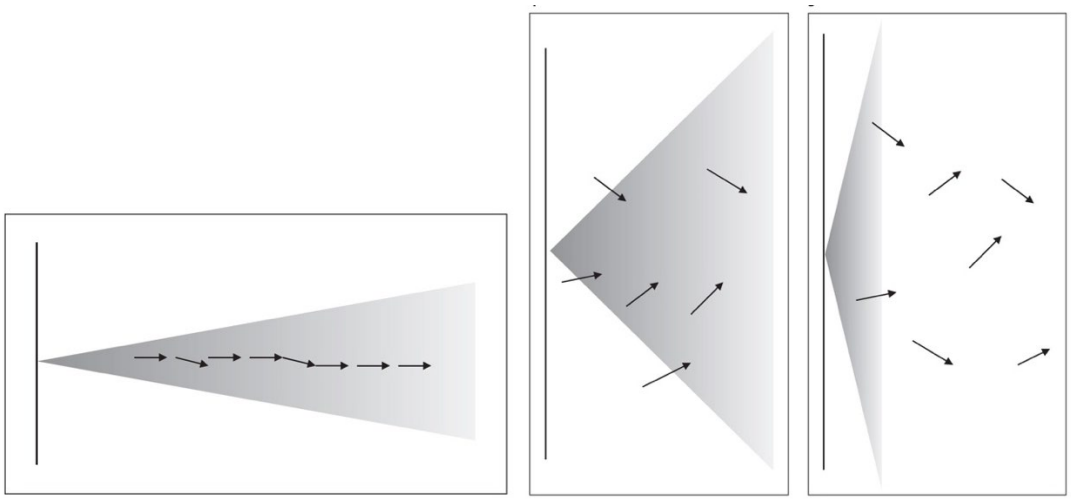


Figure 5. From left to right, focussed protention (e.g. in concentrated thinking or speaking), dilated protention (e.g day-dreaming, free association and creativity) and retracted protention (e.g. in dreaming and drugged states). (Fuchs, 2007)

According to Fuchs, the schizophrenic patient still tries to think actively. Unlike the dreamer, he is not just the passive spectator of his mental experiences. His intentional activity starts, but then it is suddenly thwarted by intruding splinters of thoughts that appear 'out of the blue'. Thus we may say that his protentionality is not only weakened and retracted, but fragmented (Figure 6).(Fuchs, 2007)

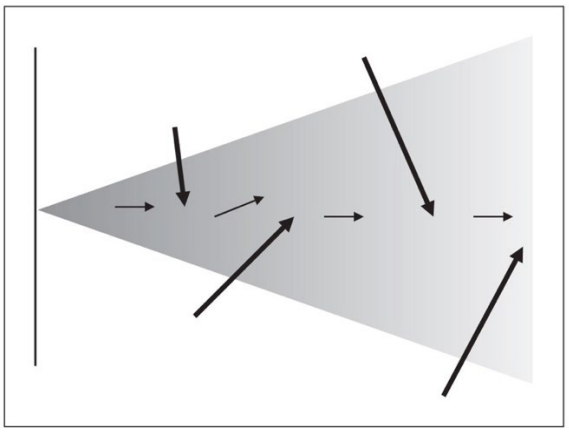


Figure 6. Fragmented protention in schizophrenia. (Fuchs, 2007)

Leading to our final contribution, we create a diagram that aims to integrate, phenomenologically, the two contributions of Laing and Fuchs. In this diagram, agency and intention emerge from this iterative cycle or perceiving, thinking and acting, as if by inertia forward in time, which is why it is represented in a vertical axis (Figure 7). When psychosis happens, however, fragments of perception, action and thought appear to awareness as alien, and thus a sense of agency and intentionality is unlikely to emerge and be sustained.

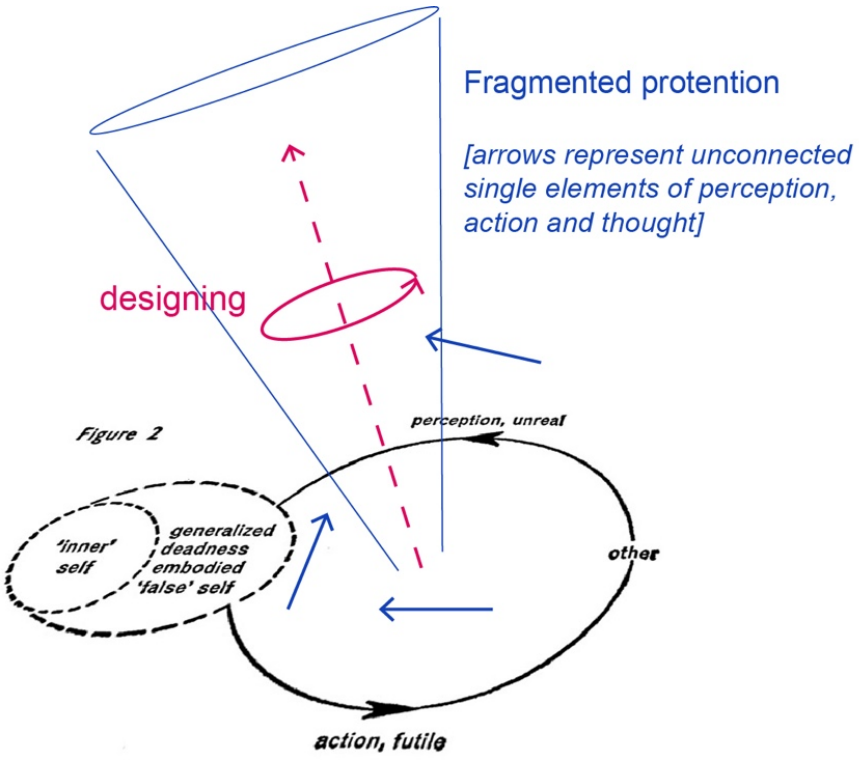


Figure 7. A diagram bringing together Fuchs and Laing's theoretical insights

In the final diagram which illustrates the proposed theory (Figure 8), we have represented the experiences of both the divided self and the unconnected elements of perceptions, thoughts and actions as lines and shapes within the lower layer. These lines and shapes represent dimensions of experiences of psychosis which have been discussed throughout the paper. Actions, thoughts and perceptions, may not be experienced as integrated, and there may be a diminished or lacking sense of self which is embodied and holds the experiences around some more or less stable citadel. There is a lack of sense of agency and intention which could be thought as emerging from, or necessary for, the continuous, coherent process of perceiving, thinking and acting upon the world.

We next invite the psychotic -who is often struggling with these experiences- to engage with designing. The design object, or focus of attention (Figure 8), represents the centre of our design efforts. It can be argued that the design focus of attention in itself holds within it some form of retention (where it came from or what informed it) and protention (what it will be for). Unlike art work, the design object moves forward by constantly pulling actions, thoughts and perceptions into some coherent frameworks which should be embedded in the context of use. Artistic exploration has a very different set of demands and in psychiatry has often had the function of helping express these fragmented and unusual aspects of experience. It is perhaps a brilliant medium to express the often-bizarre nature of one's experience, with tremendous therapeutic value. However, in contrast to design, artistic exploration does not always demand changing aspects of experience.

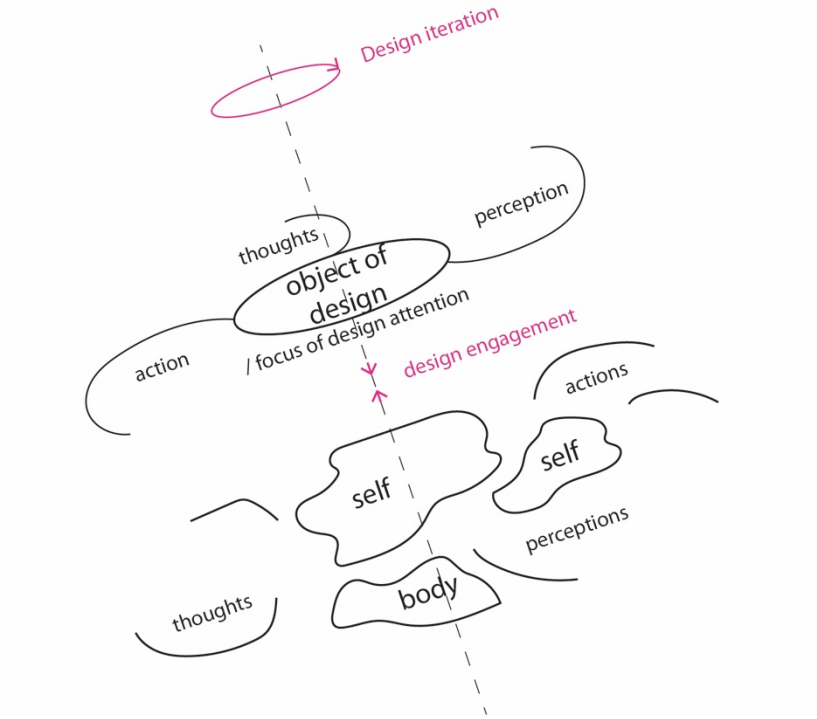


Figure 8. Diagram showing how designing may help treat psychosis by connecting fragmented aspects of experience.

Most actions performed in designing, and the decision making associated with it, demand the integration of perception and action quasi simultaneously. For instance, seeking feedback, testing out prototypes, sketching, making calculations, evaluating shapes or forms, all pull dimensions of experience such as acting and perceiving together. Within a design process, the next action (e.g. sketch) is determined by the previous perception (e.g. scale doesn't work for the user), via the body (e.g. using the body literally to sketch and even imagining our body interacting with the object to make a judgement of the scale).

The diagram shows the fragmented elements of experience, summarizing from earlier descriptions of how it is like to be psychotic, in the lower layer. The central axis, rotates through design iteration, and the object of design, functions as a force or focus of design attention, which continuously demands perception, action and thoughts to be put in relation to one another.

The repetitive, continuous activity of designing which moves forward through iteration, pushes the single elements that are experienced as alienated or fragmented to gravitate towards one another. A design focus may help the psychotic to couple and connect elements of action, perception and thought together in a meaningful way.

Designing and design iteration, may pose some revolving force towards the reintegration of the dimensions of experience, through which agency may, with time, remerge.

3.1 **Next steps**

The above theory was motivated by a co-design project which is currently taking place with patients attending a Psychosis service in a mental health charity. The aim of the project is to experiment with the use of design as a way to help with psychosis. Through this collaboration, participants are being encouraged to engage with and reflect upon designing, and the author is encouraged to reflect upon the experience of psychosis in relation.

In contrast with earlier work reviewed above, the lived experience of participants who go through the design process and the forming of this process from their point of view, is the main focus of this project.

In brief summary, the project recruited participants from an ongoing therapeutic service for people with psychosis, with the support of staff. It consists in one design facilitator, the author, attending the service space every week. The researcher facilitated a semi structured process, which was presented to participants to have three main stages: understanding design, finding and mapping situations and creating design(s). The challenge consisted in providing a space that would accommodate different ways to participate and acknowledge everyone's contribution as unique and valuable.

The theory presented here is based upon phenomenological descriptions of psychosis in relation to design and has been influenced only by the very first interactions with the participants that were recruited. As this project is still ongoing, it is too early to report any project results and mental health changes. The ongoing analysis of data may provide us more concrete evidence on the actual impact on peoples lives, and may lead to different insights about the nature of designing and mental health problems.

The wider research agenda includes generating alternative explanations alongside further data collection and analysis. Following an abductive approach, the intention is to generate plausible explanations by constructing and testing different scenarios in practice (Zamenopoulos & Alexiou, 2018)

The research is expected to contribute to our understanding of design and how co-design projects within mental health, can motivate and influence the development of new treatments.

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IASDR 2019 Author Index

Alphabetical order by family name – First Name Family Name, **Volume**(Page)

Janett Adler, Workshop
Collins Ahorlu, Workshop
Ouail Al Maghraoui, **3**(558)
Jason Alexander, **2**(367)
Katerina Alexiou, **3**(423), **3**(654)
Can Altay, **1**(610)
Ming An, **3**(580)
Mads Andersen, **4**(402)
Paul Anderson, **3**(237)
Toshinori Anzai, **4**(695)
Gifty Arthur, **1**(320)
Mattias Arvola, **1**(162)
Salman Asghar, **3**(156)
Yusuke Ashizawa, **4**(56), **4**(626)
Douglas Atkinson, Workshop
Johnathan Avant, **1**(320)
Sung-Han Bae, **4**(2)
Mark Bailey, **4**(163)
Joe Baldwin, **4**(429), **3**(509)
Nevena Balezdrova, **3**(394)
Shoshi Bar-Eli, Workshop
Betsy Barnhart, **4**(100)
Weston Baxter, **3**(207)
Caoimhe Isha Beaulé, **4**(495)
Remi Bec, Workshop
Begüm Becermen, **4**(68)
Chris Becker, **1**(329)
Eva Beke, **2**(509)
Marguerite Benony, **1**(454)
Estelle Berger, **1**(561)
Richard Bibb, **3**(265)
João Bicker, **4**(503)
Adam Blaney, **2**(367)
Luciënne Blessing, **2**(162)
Daniel Boakye, Workshop
Zoé Bonnardot, **1**(454)
Afonso Borges, **3**(50)
Brooke Brandewie, **1**(62)
Jo Briggs, **2**(547)
Molly Briggs, **4**(218)
Judy Brooks, **4**(240)
Sass Brown, **1**(340)
Priscila Brust-Renck, **3**(455)
Kathryn Burns, **4**(708)
Monika Büscher, **4**(402)
Daniele Busciantella Ricci, **3**(288)
Rebecca Cain, **3**(252)
Stuart Candy, **4**(240)
Azael Jesus Cortes Capetillo, **1**(31)
Juan Manuel Fernández Cárdenas, **1**(31)
Vicky Carr, Workshop
Marta Carrera, **1**(311)
Justine Carrion-Weiss, **4**(163)
Hernan Casakin, **4**(263)
Estelle Chaillat, **1**(634)
Fu-Chieh Chang, **1**(678)
Lung Chieh Chao, **1**(219), **2**(582)
Yan Ting Chen, **4**(612)
Fan Chen, **4**(230)
Chien-hsu Chen, **4**(443)
Zhen Chen, **3**(580)
Hsi-Jen Chen, **3**(85), **4**(612)
Lin-Lin Chen, **1**(553), **1**(678), **2**(604)
Xi Chen, **2**(397)
Yu-Shan Athena Chen, **2**(604)
Pei-Jung Cheng, **1**(514), **3**(643), **4**(688)
Peiyao Cheng, **2**(613)
Vien Cheung, **1**(598)
Alvin Jia Hao Chia, **1**(16)
Ping-Hsuan Chiang, **2**(138)
Kwangmin Cho, **3**(169)
Hayeon Choi, **2**(77)
Kyungah Choi, Workshop
Youngok Choi, **2**(397), **3**(394)
Ya Han Chou, **1**(51)
Wei Chow, **1**(264), **2**(217)
Clifford Choy, **2**(358)
Dongxiao Chu, **2**(653)
Xueman Chu, **2**(653)
Wanjun Chu, **1**(133)

Erik Chua, **1**(253)
Theresa Coburn, **3**(70)
Fabrizio Cocchiarella, **1**(643)
Loura Conerney, **1**(280)
Rachel Cooper, **3**(237)
Jillian Coorey, **4**(43)
Henriette Cornet, **3**(558)
Aykut Coşkun, **3**(278), **3**(360), **4**(482)
Paul Coulton, **4**(571)
Samantha Creeger, **4**(657)
Emily Crompton, **3**(138)
Alma Leora Culén, **1**(177)
Aziza Cyamani, **4**(100)
Aurélie Daanen, **1**(454)
Andy Darby, Workshop
Francielle Daudt, **3**(455)
Carlos Araujo de Aguiar, **2**(129)
Cees de Bont, **2**(613)
John Mathew Deepak, **2**(64)
Alejandra Díaz de León Lastras, **1**(31)
Verena de Lima, **1**(430)
Dziedzom De Souza, Workshop
Clara Dewey, **2**(129)
Jun Ding, **1**(415), **2**(484)
Fangzhou Dong, **3**(108),
Michelle Douglas, Workshop
Ken Drinkwater, **1**(643)
Qin Du, **2**(50)
Alex Duffy, **1**(688)
Rose Dumesny, **1**(454)
Nick Dunn, **1**(205), **2**(367), **4**(290)
Deniz Ekmekçioğlu, **1**(148)
Stuart English, **1**(296)
Ilgım Eroğlu, **1**(148)
Terry Eskenazi, **3**(278)
Parisa Eslambolchilar, **4**(460)
Susan Evans, **1**(99)
Kuo-Kuang Fan, **4**(18)
Ya-Fen Fan, **3**(643)
Shu Hsuan Feng, **1**(228)
Laura Ferrarello, **3**(237)
Bruna Ferreira Montuori, **1**(430)
Emily Flannery, **1**(62)
Luiza Leal Fontanella, **3**(455)
Chelsea Franklin, Workshop
Fritz Frenkler, **3**(558)
Xuan Fu, **4**(192)
Zhiyong Fu, **4**(178), **4**(206)
Noriki Fukatsu, **2**(466)
Fernando Galdon, **4**(516)
Cathy Gale, **1**(364)
Francesco Galli, **1**(196)
Silvia Gasparotto, **1**(467)
Annie Gentes, **1**(634)
Freddie Gibbons, **4**(163)
Steve Gill, 3(509), **4**(429)
Fanny Giordano, **1**(83)
Wiktoria Glad, **1**(133)
Ying Gong, **1**(505)
Noé Abraham González Nieto, **1**(31)
Bethan Gordon, **3**(509)
Raghavendra Reddy Gudur, **3**(15)
Weimin Guo, **1**(415), **1**(505), **2**(484)
Qing Guo, **3**(41)
Laurent Gutierrez, **1**(505)
Satoshi Hachima, **4**(56)
Young-ae Hahn, **2**(148)
Kirsi Hakio, **4**(144)
Ashley Hall, **3**(237), **4**(516),
Barron Han, **4**(324)
Jia-Xuan Han, **4**(592)
Tong Han, **3**(608)
David Hands, **3**(2)
Michael Hann, **1**(488)
Yasushi Harada, **3**(521)
Robert Harland, **2**(50), **3**(156)
Simon Hayhoe, **1**(31)
Jeongcheol Heo, **2**(303), Workshop
Deniz Hepdoğan, **4**(482)
Bianca Herlo, **3**(185)
Richard Herriott, **1**(699)
Hajime Hirako, **2**(523)
Jonathan Hitchen, Workshop
Amic Ho, **3**(304)

Meng-xun Ho, **3**(85)
Stefan Holmlid, **1**(162)
Nur Horsanalı, **1**(610)
Shih-Wen Hsiao, **2**(217)
Eric Chen-F Hsieh, **3**(332), **4**(592)
Chia Hsuan Hsien, **2**(315)
Jie Hu, **2**(339)
Jinghua Huang, **3**(580)
Wei-Ken Hung, **1**(553), **1**(678), **2**(604)
Alis Iacob, **4**(37)
Hassan Iftikhar, **3**(156)
Minako Ikeda, **2**(116), **4**(646)
Tiffany Imron, **1**(688)
Mikihiro Ishii, **3**(496)
Yoshimune Ishikawa, **1**(122)
Kazunari Ito, **3**(496)
Brian James, **4**(156)
Kyeong Ah Jeong, **2**(209), **2**(252), Workshop
Wondo Jeong, **4**(76)
Banhi Jha, **2**(474)
Zhonggang Jiang, **1**(586)
Song Jiao, **1**(553)
Nicholas Johnson, **2**(665)
Sarah Johnson, **4**(27)
Jaewoo Joo, **2**(628)
Gesche Joost, **3**(185)
Jiwon Jung, **1**(238)
Eui Chul Jung, **2**(303), Workshop
Heekyoung Jung, **4**(114)
Zachary Kaan, **1**(661)
Kyo Kageura, **4**(532)
Heimin Kang, **3**(374)
Namgyu Kang, **2**(466)
Sunghyun Kang, **3**(41)
Yosuke Kanno, **2**(596)
Takeo Kato, **4**(626)
Wendy Keay-Bright, **4**(460)
Rachel Kelly, **1**(395)
Louise Kiernan, Workshop
Yujin Kim, **3**(630)
Chajoong Kim, **2**(77), **2**(262), **3**(169), **3**(374), **3**(465), **4**(634)
Gaee Kim, **2**(262)
Han-Jong Kim, **4**(558)
Hankyung Kim, **4**(370)
Juhee Kim, **1**(2), **2**(209), **3**(408)
Juyeon Kim, **3**(408)
KwanMyung Kim, **3**(545)
Kyulee Kim, **2**(535)
Miso Kim, **2**(496)
Kyungmin Kim, **2**(303), Workshop
Soyoung Kim, **3**(465)
Maaike Kleinsmann, **1**(238), **4**(354)
Dong Yoon Koh, **4**(370)
Jio Koike, **4**(626)
Hiroshi Komada, **3**(7)
Akira Kondo, **2**(192)
Naoko Kondo, **2**(192)
Penny Kong, **3**(558)
Hisaka Konish, **4**(56)
Georgios Koronis, **4**(263)
Elizete Kreutz, **3**(437)
Thierry Lagrange, **2**(509)
Aulikki Laitinen-Tolonen, **4**(495)
Vali Lalioti, **4**(546)
Busayawan Lam, **2**(397), **3**(394)
Mei Seung Lam, **2**(34)
Kate Lampitt Adey, **4**(163)
Newman Lau, **3**(92), **3**(126)
Abbie Lawrence, **4**(429)
Gaeun Lee, **4**(370)
Hui Sung Lee, **4**(76)
Jung-Joo Lee, **1**(16), **1**(253)
James Lee, **1**(320)
Chang-Franw Lee, **3**(568)
Yi-Chang Lee, **1**(109)
Youngsoo Lee, **2**(496)
Kate Sangwon Lee, **3**(222)
Ki Ho Lee, **4**(2)
Kyung-Ryong Lee, **2**(77)
Sang Won Lee, **3**(118)
Sooyeon Leem, **3**(118)
Catarina Lelis, **3**(437), Workshop
Sao Fan Leong, **1**(514)
Pierre Lévy, **2**(91)

Chen Li, **3**(568), **4**(18)
Elena Li, **4**(277)
Yun-fei Li, **2**(230)
Shih-Chieh Liao, **1**(228)
Claudia Libânio, **3**(455)
Youn-kyung Lim, **4**(342), **4**(370)
Chia-Hua Lin, **2**(138)
Chun Yu Lin, **1**(109)
Fang-Suey Lin, **2**(230), **3**(30)
Joseph Lindley, **4**(571)
Zhenyuan Liu, **4**(417)
Yuqi Liu, **2**(243)
Wei Liu, **3**(326)
Doji Lokku, **2**(64)
Maria Lonsdale, **1**(598)
Fabio López, **1**(31)
Maria Cecilia Loschiavo dos Santos, **1**(430)
Nicole Lotz, **1**(31)
Yongqi Lou, **2**(50)
Gareth Loudon, **3**(509), **4**(429)
Han Lu, **1**(586)
Peng Lu, **1**(264), **2**(217)
Hsiu Ching Lu, **4**(443)
Maria Luján Escalante, **4**(402)
Lucia Lupi, **4**(308)
Henry Ma, **3**(126)
Min-yuan Ma, **3**(332), **4**(592)
Sanghyun Ma, **3**(169)
Rafael Machado, **1**(31)
Penousal Machado, **4**(503)
Khushbu Maheshwary, **2**(162)
Peter Mandeno, **3**(207)
Neha Mann, **1**(320)
Valentina Marques da Rosa, **3**(455)
Tiago Martins, **4**(503)
Kubo Masayoshi, **3**(621)
Tuuli Mattelmäki, **4**(144)
Francesca Mattioli, **3**(150)
Nolwenn Maudet, **1**(454), **1**(572)
Francesco Mazzarella, **1**(280)
Erin McCabe, **1**(320)
Seda McKilligan, **4**(657)
Sam Meech, Workshop
Ana Julia Melo Almeida, **1**(430)
Rui Mendonça, **3**(50)
Lisa Mercer, **4**(218)
Tonya Meyrick, **1**(527)
Enza Migliore, **1**(538)
Kyoung Wook Min, **3**(465)
Jusaku Minari, **2**(641)
Yoshiro Miyata, **3**(521)
Luke Moffat, **4**(402)
YangGyu Moon, **3**(545)
Tina Moor, **2**(446)
Tom Morton, **3**(530)
Tamaki Motoki, **3**(521)
Celine Mougenot, **1**(572)
Siân Moxon, **2**(100)
Isabel Rosa Müggler Zumstein, **2**(291)
Louise Mullagh, **2**(326)
Noor Murteza, **2**(200)
Yutaka Nagami, **3**(594)
Toru Nagao, **4**(56)
Ki-Young Nam, **1**(2)
Tek-Jin Nam, **4**(558)
Callum Nash, **2**(547)
Viviane Nicoletti, **1**(430)
Laura Lynggaard Nielsen, **4**(402)
Koichi Nishio, **3**(476)
Ian Oakley, **4**(76)
Byoungkwan Oh, **2**(148)
Kuniko Otomo, **1**(189)
Gizem Öz, **1**(610)
Verena Paepcke-Hjeltness, **4**(100)
Valeria Pannunzio, **4**(354)
Meg Parivar, **2**(566)
Jung-Mi Park, **4**(370)
Yong Jun Park, **4**(634)
Sunjeong Park, **4**(342)
Young-Woo Park, **2**(77)
David Parkinson, **3**(315)
Abby M. J. Paterson, **3**(265)
Catharine Patha, **1**(205)
Jakob Persson, **1**(162)

Pier Paolo Peruccio, **2**(277)
Roger Pickup, Workshop
Louis Shek Wing Poon, **2**(2)
C. Samantha Porter, **3**(265)
Susan Postlethwaite, Workshop
Gemma Potter, Workshop
Annabel Pretty, **2**(177)
Katelijn Quartier, **2**(686)
María Laura Ramírez Galleguillos, **3**(278), **3**(360)
Özge Raudanjoki, **4**(495)
Lesley Raven, Workshop
Sérgio Rebelo, **4**(503)
Erika Renedo Illarregi, **3**(654)
Cristina Gehibie Reynaga Peña, **1**(31)
Joomyung Rhi, **1**(444)
Daniel Richards, **2**(367)
Gretchen Rinnert, **4**(43)
Emma Roberts, **3**(382)
Jessica Robins, **2**(20), **4**(402), Workshop
Paul Rodgers, **1**(280), **2**(566), **4**(290)
Chris Ross, **3**(237)
Tracy Ross, **3**(252)
Aissa Sabbagh Gomez, **3**(351)
Juan Salamanca, **4**(218)
Elizabeth B.-N. Sanders, **4**(9)
Daniela Sangiorgi, **1**(311)
David Santamaría-Cid de León, **1**(31)
Teresa Sarmento, **3**(50)
Carla Sartori do Amaral, **4**(386)
Alessandra Savina, **2**(277)
Pam Schenk, **3**(70), **4**(129)
Laura Scherling, Workshop
Simon Scott-Harden, **1**(296)
Peter Scupelli, **4**(240)
Colleen Seifert, **4**(657)
Ece Şekerli, **3**(360)
Andrew Selby, **2**(50)
James Self, **2**(262), **4**(76)
Paris Selinas, **4**(402)
Elisa Servais, **2**(686)
Chris Shearston, Workshop
Yvette Shen, **3**(196)
Hong-Chun Shi, **3**(30)
Satoshi Shibata, **2**(596)
Meng-Dar Shieh, **1**(264)
Yooncheol Shin, **2**(628)
Fumihiro Shutoh, **3**(7)
Arlindo Silva, **4**(263)
Luca Simeone, **4**(68)
Kin Wai Michael Siu, **1**(505), **2**(34)
Harald Skulberg, **2**(424)
Dirk Snelders, **1**(238), **4**(354)
Gahyung Song, **2**(303), Workshop
Ana Isabel Sousa, **3**(50)
Jon Spruce, **3**(382), Workshop
Swati Srivastava, **1**(177)
Michael Stead, **4**(571)
Michelle Stephens, **1**(395)
Sara Sterling, **3**(108)
Ian Storer, **2**(665)
Rui (Suri) Su, **2**(177)
Hyeon-Jeong Suk, **2**(209), **2**(252), **3**(408), Workshop
Tung-Jung Sung, **1**(553)
Mari Suoheimo, **4**(495)
Pornpan Sutas, **3**(476)
Irina Suteu, **1**(196)
Simone Taffe, **1**(527)
Hideki Takahashi, **3**(594)
Masahito Takizawa, **3**(594)
Ryoichi Tamura, **2**(243)
Kat Thiel, Workshop
Briony Thomas, **1**(31)
Tian Tian, **1**(598)
Deng Tianren, **4**(417)
Leandro Miletto Tonetto, **3**(455)
George Torrens, **2**(665), **3**(156)
Emmanuel Tsekleves, **4**(402), Workshop
Muhammad Tufail, **3**(545)
Fang-Wu Tung, **1**(51)
Tomohiro Ueshiba, **3**(521)
Margot Vaaderpass, Workshop
Sander Välk, **1**(572)
Flore Vallet, **3**(558)
Jo Van Den Berghe, **2**(509)

Jan Vanrie, **2**(686)
Michela Ventin, **3**(288)
Emilija Veselova, **4**(144)
Massimiliano Viglioglia, **2**(277)
Amil Vira, **2**(129)
Anna Vlachaki, **3**(265)
Stuart Walker, **2**(326), **2**(339)
Kellie Walters, **4**(100)
Chaoran Wang, **1**(488)
Yueyi Wang, **3**(2)
Tao Wang, **3**(326)
Laura Wareing, **4**(290), Workshop
Laura Warwick, **3**(315)
Andrea Weber Marin, **2**(291)
Huaxin Wei, **3**(222)
Paul Wells, **2**(50)
Renee Wever, **1**(133)
Lisa Winstanley, **1**(348)
Matthew Wizinsky, **1**(320), **1**(378), **3**(608)
Yi Lin Wong, **2**(34)
Eunji Woo, **1**(2)
Jae Yong Woo, **1**(122)
Dave Wood, **4**(676)
Kuan-Hua Wu, **1**(678)
Fong-Gong Wu, **1**(228), **4**(443)
Hoi San Wu, **1**(2)
Hsien-Jung Wu, **2**(315)
Shi-Chi Wu, **4**(277)
Qing Xia, **4**(178)
Song Xu, **3**(568), **4**(18)
Jingyu Xu, **1**(586)
Johnny Xu, **2**(50)
Tong Xu, **2**(129)
Jiang Xu, **1**(586)
Zhang Xueqing, **2**(50)
Toshimasa Yamanaka, **3**(7)
Danying Yang, **4**(474)
Aria Chien-Hui Yang, **3**(126)
Kit-lun Yick, **3**(92)
Mert Yıldız, **4**(482)
Joanne Yip, **3**(92)
Ken Yokomizo, **3**(521)
Jungkyoon Yoon, **2**(129), **3**(169), **3**(465), **4**(634)
So-Yeon Yoon, **1**(661)
Takashi Yoshimatsu, **2**(116)
Kiyomi Yoshioka, **3**(59)
Go Yoshizawa, **2**(641)
Chanyang You, **2**(252)
Winnie Yu, **3**(92)
Shasha Yu, **3**(196), 4(9)
Theodore Zamenopoulos, **3**(423), **3**(654)
Gabriela Zapata-Lancaster, **1**(628)
Xiaofang Zhan, **2**(339)
Jun Zhang, **3**(92)
Shichen Zhang, **3**(92)
Lanyun Zhang, **3**(252)
Wanlin Zhang, **2**(326)
Linghao Zhang, **1**(505)
Duoduo Zhang, **4**(192)
Chen Zhou, **3**(7)
Jie Zhou, **3**(92)
Qiyang Zhou, **4**(114)
Yuyao Zhou, **4**(206)
Jianchun Zhu, **1**(71)
Xinru Zhu, **4**(532)

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IASDR 2019 CONFERENCE PROCEEDINGS | **VOLUME 3**



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