Researching Climate through Design

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This paper explores how design can be used as a process of enquiry in climate research in collaboration with climate scientists. The research discusses the value of design in navigating the complexities of transdisciplinary climate research by engaging with the mess and researching everyday climate actions. The ordinary can be described as the realm of social life where the repetition of daily cycles that we learn is eventually taken for granted. Climate actions that are situated in this ordinary are vital to delivering larger-scale transformations and achieving carbon reductions. However, climate scientists across disciplines often overlook the importance of engaging with the messiness of such climate initiatives – such as understanding how ordinary climate initiatives emerge, impact a place, and move across contexts. As a result, academics and policymakers tend to focus on global and high-tech responses to climate issues. However, by shifting our focus on the mundane, we can research and present situated perspectives of climate actions that are crucial to achieving carbon emission reductions and improving resilience to the impact of climate change at different scales.This paper presents theoretical grounding for design to be used as an integral part of 'ordinary' climate research.

Key words: climate research, design methods, ordinary climate action

Introduction

This paper introduces theoretical grounds for collaborative practices between climate research and design and explores the following question; how might *designerly* thinking offer new inroads to researching climate action? To examine this question, I present design as a method of research enquiry that facilitates interdisciplinary collaborations throughout the research process by focusing on a human-centred approach with considerations for situated knowledge, materialities and dialogic encounters.

To develop my argument, I start by presenting how climate actions and climate governance are defined, as well as what the *ordinary* might

mean in the context of (transdisciplinary) climate research. I also introduce the challenges that are commonly encountered in such research enquiries. In the second section I present how principles and characteristics of design-based methods can contribute to the transdisciplinary research of climate actions by addressing current limitations and gaps in knowledge. Finally, I discuss how climate research tends to already be inherently *situated* and concerned with *materiality*, and I argue that design could reinforce this focus by facilitating mutual understanding in interdisciplinary climate research.

The theoretical foundation presented here serves as a starting point for understanding and engaging in interdisciplinary research to explore ordinary climate actions. I conclude this paper by introducing how this supportive ground for design-based methods in climate research might be carried out in further research. The overall objective is the creation of a framework of design characteristics to create and test methods that combine *a)* biographical accounts collected through qualitative interviewing (including employing design-based methods) to investigate the mechanics of climate actions at a personal level and *b)* deploying (graphic) design processes as data analysis method. The analytical focus is to reveal the role of everyday situations and experiences in shaping climate actions and their research.

Climate issues enacted in the flesh

What are ordinary climate actions?

Climate action can refer to both the acts of *preventing* and *adapting* to conditions and possibilities engendered by climate change (EUR-Lex, 2021). This work of mitigation and adaptation is researched across different disciplines by climate scientists with the aim of understanding what conditions facilitate the development of such initiatives and their transfer and application across contexts. By extension, the role of *climate governance* is to prompt and support climate action by facilitating formal and informal decision-making at different scales, from the local to international level. Urban climate researcher Vanesa Castán Broto (2020, p. 249) presents governance as a 'messy process that depends on multiple random connections between technologies, discourses and actions' and calls for the development of conceptual frameworks that can reflect the *messiness* that is noticeable in specific places and moments of action.

To notice these elusive places and moments of climate actions, we can turn towards the study of the *ordinary*. The *ordinary* can be described as the realm of social life where the repetition of daily cycles we learn is eventually taken for granted (Holmes & Hall, 2020). Climate actions that are situated in this *ordinary* are vital to delivering larger-scale transformations and achieving carbon reductions, yet climate scientists across disciplines often overlook the importance of engaging with the *messiness* of such climate initiatives and as a result, academics and policymakers tend to focus on global and high-tech responses to climate issues (Castán Broto & Westman, 2020). Such local, *ordinary* climate actions are key as they enact effective transformations through more immediate and specific efforts that respond to tangible local issues (Tiratelli, Studderts, & Morgan, 2021). For positive dynamics of change to last, transformations must be supported by deep systemic change at international, national and local levels. Within these strata, the *personal* is political, and as such, is a crucial ground to learn and to foster positive intersectional dynamics towards social and climate justice. Moreover, individual efforts are rarely isolated and contribute to forming *place-based communities* whose efforts are key to 'provide holistic, culturally-grounded, and multi-causal reports of change' (Reyes-García et al., 2024, p. 2). By shifting our focus on the mundane, we can research and present situated perspectives of climate actions that are crucial to achieving carbon emission reductions and improving resilience to the impact of climate change at

different scales, from the hyper local to the international.

Engaging with the *everyday* requires methodological innovation; in 'Mundane Methods: innovative ways to research the everyday', Holmes and Hall (2020, p. 1) explain that there is an inherent challenge to studying everyday lives, because there is no single everyday: 'everyday lives are multiple, messy and full of methodological possibilities'. Sociologist John Law (2004) proposes to define the *mess* as encompassing 'textures, ideas, objects, artefacts, places, people and emotions that are difficult to deal with within the traditional confines of social science' (cited by Jungnickel & Hjorth, 2014, p. 137). However blurred out at the edges, this proposition of what the *mess* might be is particularly helpful to illustrate the complex entanglements at the heart of the *ordinary*. It is within this realm of the ordinary, of the messy, that it is key to researching and present situated experiences of climate issues as they are known markers of social inequalities; climate issues are enacted *in the flesh*, in the health of human bodies as well as more-than-human beings.

The extent of the impact of climate change on our body is rooted in social determinants of health and geographical conditions (Magnano San Lio, Favara, Maugeri, Barchitta, & Agodi, 2023). A specific example of the effect of climate issues on health as determined by social conditions is the exposition to air pollution; where the lower socio-economical classes of city residents are limited to living in certain areas, working in certain environments or travelling via certain modes of transport that are disproportionately exposed to and affected by air pollution (Fairburn, 2019). This also exemplifies that, to research and address climate issues we need to work collaboratively across current disciplinary standpoints – common disciplines operating in climate fields expand across humanities and scientific disciplines; biology, microbiology, biochemistry, geography, environmental studies, urban planning, human geography, behavioural psychology, socio-economic studies, public and private finance, governance and geopolitics, to name a few examples.

Transdisciplinary research is a key entry point to untwine and address the heavy knots formed by climate, health, and social issues. In social sciences transdisciplinary modes of co-production are gaining traction as they aim to create new cultures and practices of collaborative research to better address the complexities we are facing by seeking more inclusivity in knowledge creation to addressing real-world problems. The overarching aim of knowledge co-production is to challenge existing knowledge systems whilst producing usable knowledge (Kruijf et al., 2022) and finding new ways to advance climate and social justice in the inter-disciplined borderlands.

Encounters at the edge of transdisciplinary research

Sustainability researchers and designers Gaziulusoy, Ryan, McGrail, Chandler, and Twomey (2016) identify three types of challenges in transdisciplinary climate research; *a)* challenges that are inherent to transdisciplinary research, such as differences in the language and methods employed, *b)* institutional challenges – stemming from the existing structures and procedures of generating and evaluating knowledge in academic institutions – and *c)* teamwork challenges. Such teamwork challenges can emerge from the practical, operational and logistical setbacks that may arise in the working team (Kruijf et al., 2022). These challenges make transdisciplinary climate research projects run the risk of losing their *objectivity* by eliciting unattainable expectations and encountering challenging mediation tasks that may be further complicated by a lack of resources (Kruijf et al., 2022). Simon et al. (2018) found similar challenges in transdisciplinary projects focusing on international comparative research where adhering to a single 'project narrative' is challenging as the research focus might stem from different origins and work towards 'uncertain outcomes', themselves challenging to assess. They also highlight that funding and time constraints add to that complexity by introducing different requirements, timescales and expectations for reporting and impact. Cultural

differences and power dynamics are typically 'intertwined, complex, and often implicit' and can impact communication and decision making. Finally, the expectations and impacts linked to governance are challenging to assess (Simon et al., 2018). Although projects that integrate design-based research methods run similar risks of encountering institutional and organisational challenges, *designerly* researching climate actions creates new inroads to engage with the *situated knowledges* that are located in the messy and the ordinary (Cross, 1982; Jungnickel & Hjorth, 2014; Page & John, 2019). Design approaches can facilitate understanding across disciplines by acting as a *boundary object* – boundary objects are used in knowledge production to establish a shared understanding and to create collaborative, practical means to work across knowledge boundaries (Carlile, 2002; Star & Griesemer, 1989). Star and Griesemer (1989) originally proposed four categories of boundary objects, namely *repositories, standardised forms and methods, objects or models* and *maps of knowledge boundaries*. For Carlile (2002), 'successful' boundary objects establish a shared syntax/language, provide 'concrete means' to engage with complex knowledge boundaries and facilitate knowledge transformation. Still according to Carlile (2002), boundary objects allow for a *pragmatic* view of knowledge by facilitating a research practice that is localised, embedded and working both within and across knowledge boundaries. Such *pragmatic* approach to knowledge highlights the importance of understanding the relations and repercussions between different and interdependent elements; even where a shared syntactic/language has been established and different semantic/interpretations are conceded (Carlile, 2002). The concept of boundary objects can help advance design as a research practice; where, if successfully applied it has the potential to create shared representations, to foster practical research applications, to create actionable outputs and to legitimize other forms of knowledge (Mark, Lyytinen, & Bergman, 2007). Design, as boundary object and as research process, opens to the tackling of *messy*, interconnected issues.

As such, design as a medium for research enquiry can contribute to creating a framework for **situated**, **material** and **dialogical** enquiries. In the next section, I discuss how design-based methods can be characterised and how they can be applied to respond to the current limitations and gaps in knowledge in interdisciplinary climate research.

Characterising a design framework for ordinary climate action research

To set a theoretical framework for design-based methods in climate research we ought to start by acknowledging that the history and early definition of *design* (as a noun, a verb, and as a discipline) are intrinsically linked to the industrial revolution and its systems of exploitation and oppression. It is key to consider how *design* theories, processes and applications are rooted in the very dynamics that led to – and still produce – climate, health and social injustice.

Although we can consider design to be facilitating desirable pathways to creating and supporting climate actions, it is crucial to encompass intersectional values of research, education and action – including actions of *reparation* – in processes of both decarbonisation and decolonisation. In 'Decolonizing Design: A Cultural Justice Guidebook', Elisabeth (Dori) Tunstall (2023) presents principles for decolonising design that necessitate to learn and acknowledge our own privileges rooted in colonial exploitations and exacerbated by European modernism and *Tech Bias*. 'Decolonization is about the land' (Tunstall, 2023, p. 36) just as much as efforts of climate research in the pursuit of decarbonisation.
The ongoing work of decolonising design is essential especially when looking at addressing climate and social issues whose roots are deeply intertwined with colonial histories that still impact a global majority of *ordinary* experiences today. To consider design an inclusive and socially progressive *way of researching* climate, we must reckon with its history of extraction and oppression so we don't feed on and perpetuate

the same dynamics. So as to outgrow its habits of over-production and -consumption, design must carry on learning from neighbouring theories of intersectional feminism and decolonisation when reasserting the key characteristics that make it compelling to research climate actions; its **situatedness**, its concern for **realising just materialities** and its **discursive** nature.

Situated: to design is to make for in context interrogations

In the 'Designerly Way of Knowing', Nigel Cross (2007) quotes the outcome of the RCA research project 'Design in General Education' that defines design as primarily concerned with 'the conception and realisation of new things', 'the application of the arts of planning' and 'inventing, making and doing'. This definition is specifically concerned with materiality, in which modelling is a language that can be practiced and learned. Cross (1982, pp. 221–222) contrasts design with the sciences and humanities to highlight how design education might expand on it:

The phenomenon of study in each culture is

- *in the sciences: the natural world*
- *in the humanities: human experience*
- *in design: the artificial world*

The appropriate methods in each culture are

- *in the sciences: controlled experiment, classification, analysis*
- *in the humanities: analogy, metaphor, evaluation*
- *in design: modelling, pattern-formation, synthesis*

The values of each culture are

- *in the sciences: objectivity, rationality, neutrality, and a concern for 'truth'*
- *in the humanities: subjectivity, imagination, commitment, and a concern for 'justice'*
- *in design: practicality, ingenuity, empathy, and a concern for 'appropriateness'*

Though defining cultures of education through their subjects, methods and values is useful to understand how the sciences and humanities prevail in education and how design is seemingly still largely missing, in practice these cultures are more permeable. Design navigates across them and can contribute to connect the sciences and humanities and there are (long) established practices that encompass the concerns, methods and values of all fields. For instance, the architecture practice 'Forensic Architecture' investigates state violence through interdisciplinary lenses. It equally seeks objectivity and rationality to address justice issues through controlled processes (Fuller & Weizman, 2021) and employ methods that span the scientific, humanities and design fields. Cross (2007) argues that sciences and humanities are typically contrasted as respectively *objective* and *subjective*, suggesting that arguments are either based on experiments (objective) or analogies (subjective) but where identifying a 'suitable comparable' in design reasoning may not be as evident. But if *subjectivity* and *objectivity* are the extents that respectively outline arguments of scientific and humanities research, the specific scope of design could be its *situativity* as design ought to propose solutions in direct relation to interrogations in specific contexts.

Landmark essay 'Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective' by Donna Haraway (1988, p. 579) presents *situated knowledge* as a research focus that reflects 'a more adequate, richer, better account of a world, in order to live in it well and in critical, reflexive relation to our own as well as others' practices of domination and the unequal parts of privilege and oppression that make up all positions'. Beyond situating the object/subject of a research by distancing ourselves from it, Haraway (1988) pushes us to question the power imbalances of *vision* as an embodied and partial querying that ought to be accountable for its positionality.

> *How to see? Where to see from? What limits to vision? What to see for? Whom to see with? Who gets to have more than one point of view? Who gets blinded? Who wears blinders? Who interprets the visual field? What other sensory powers do we wish to cultivate besides vision? (Haraway, 1988, p. 587)*

As intrinsically subjective, *situated perspectives* can be challenging to engage with within academic research contexts as we are trained to look for 'objective' conclusions with replicable solutions; likewise, design practices seek to propose solutions that are problem- and context-specific. To design is to research to inform responses in the form of situated actions that are fully embedded in context rather than abstracted away from their situations (Suchman, 2006). This is a key challenge for climate research where no actions of mitigation is 'labourless' but rather climate actions are *embedded*, *mundane*, *incremental* and *relational* (Bouzarovski, 2022).

Learning scientist Greeno (1998, p. 23) presents situated perspectives as focusing 'on systems in which people interact with each other and with material, informational, and conceptual resources in their environments'. Design can be described with similar inherent qualities as it is concerned with processes, materialities and the affordances for relations and actions it creates by engaging with the *messiness* of the *ordinary*. As such, in a research context, design provides ways to go beyond polished, linear objective academic assertions that otherwise risk missing key elements (Jungnickel & Hjorth, 2014). By engaging in research pursuits of situated perspectives, we can begin to map out the *material-semiotic nodes* that present embodied knowledge and power dynamics (Haraway, 1988). As a field that is characterised by its concern for materiality and making as a way of knowing, design is particularly suited to research situated perspectives within ordinary climate actions.

Materialised: to design is to make visible

Finding innovative ways to look into the materiality of *everyday* life* has been identified as a gap in climate research and governance, where further methodological innovation is needed (Castán Broto & Westman, 2020). Engaging with *situated knowledges* is especially important when looking at climate issues as ongoing effects reflect social dynamics and power imbalances are felt and dealt with in the flesh. According to Haraway (1988) the effects on bodies materialise the shifting boundaries of social interactions – bodies which she further describes as objects of knowledge in the form of 'material-semiotic nodes'. Materiality – as embedded in context and embodied by those who live it – can be mediated by the act of *making* in an effort to make those experiences visible.

In 'Material and Mind' architect Christopher Bardt (2019) presents hands as material-like extensions of the material properties of the body, through which we think. According to Bardt (2019, p. 9), 'thoughts continuously emerge from action and physical work' and in this interaction it isn't the material that directly affects our thoughts but rather what we decide to make with that material in the progress of making. This ongoing suite of decisions is shaped by the materials properties; the process of designing can be seen as a 'reflective 'conversation' between makers and their materials' (Bamberger & Schön, 1983, p. 69; Christenson, 2017). As a process of *knowing-in-action* (Schön, 1995), to design is to mobilise different kinds of knowing (i.e experiential, reflexive, substantiated) in a circularity of thinking that 'examine and re-examine ideas' (Chon & Sim, 2019). This *open-endedness* of knowledge made in action calls for foresight and flexibility; the foresight to create with intent and the flexibility to navigate uncertainties (Ingold & Gatt, 2013). This embodiment of a thinking process through *materiality* – via the functions of *making*, *images* and *language* as defined by Bardt (2019) – gives a fuller sense of Cross' concept of a *Designerly Way of Knowing*. To design is to think through making. To design is to 'code' abstract concepts into concrete objects (Cross, 1982).

To make is a way to engage with forms of materiality that are mediated by tools, techniques, and properties, creating their own forms of knowledge that may be a combination of explicit, tacit, and imbued with serendipity. These acts of making, of materialising, open the opportunity for presenting *situated knowledges* in one's own terms.

*Another way to refer to the *ordinary* realm

According to climate researchers Krauß and Bremer (2020, p. 2) 'in daily life and actual practice, the physical climate and the social climate, the material and the semiotic nature of climate are inseparably intertwined'; they suggest that it is at this intersection that we can link scientific climate research with the more hidden narratives to enable participatory climate action (Krauß & Bremer, 2020). Participatory Action Research (PAR) is typically defined as a research approach focusing on experiential knowledge with the aim of tackling issues caused by 'unequal and harmful social systems' and enabling a redistribution of knowledge, wealth and power (Cornish et al., 2023, p. 1). As such, PAR has been considered a valuable incursion to governance, as a practical opportunity to achieve radical change by focusing on relationships, interactions and the power imbalances that result from institutional decision making processes (Mason, 2015). Examining the multiple effects of situatedness, of messiness from within the power relations that govern our material realities and by extension our health and bodies, is key to progress and enacting climate justice. In 'Climate change politics and the urban contexts of messy governmentalities', Castán Broto (2020, pp. 252–253) proposes the following:

> *Messiness reimagines alternatives to hegemonic governmentalities by opening the climate change sphere as a governing arena that can also be appropriated to contest the structures of power and forms of domination that emerge in a postcolonial context. Mess challenges that thing that Bhabha beautifully calls 'the transparency between legibility and legitimate rule' (2004, p. 134). It challenges not only strategies, knowledges and bodies but also how the three are brought together in attempts to build authority. (Castán Broto, 2020)*

By engaging with the *messy* aspects of climate research – such as the textures, ideas, objects, artefacts, places, people and emotions (Jungnickel & Hjorth, 2014; Law, 2004) located in the *everyday* (Holmes & Hall, 2020) – and by seeking to 'code' those abstract concepts into processes and objects *through* design, we can contribute to the emergence of *messy* climate research governance as alternatives to the assumptions currently shaping the climate change debate (Castán Broto, 2020). Understanding the *symbolic* dimensions of social change is key; the symbolic realm is built beyond the control of people but holds within it multiple degrees of freedom in which we can act (Castán Broto, Olazabal, & Ziervogel, 2024). For instance, language is a powerful tool that both represents and creates social change – language feeds our imaginaries and what we imagine doesn't need to be real to be distilled into what can actually be done; climate practitioners and elected representatives can turn social imaginaries into specific actions that enact the values and symbols they emerge from (Castán Broto et al., 2024). As a material language and through conversations, design has a role to play in decoding the lived realities and messier imaginaries to code them into more just political frameworks and concrete ground actions.

Dialogical: to design is to be in conversation to realise a more desirable future

Anthropologists Ingold and Gatt (2013, p. 142) propose to use *design anthropology* as an engine of enquiry that views design as a 'material embodiment of a generative process' that carries with it a history of relations that are projected in the future. Reflecting on the (auto) ethnographic turn in design, Schouwenberg (2021, p. 27) theorises that there is an 'inextricable, reciprocal relationships of things and humans that make design of paramount importance—it gives shape to our world and to ourselves'. Meaning that it is by researching the objects and systems materialised in specific places, moments and *in the flesh* that ultimately, we can address climate, health and social injustices. It is by *researching through design* that we might uncover such situated knowledges of material-semiotic climate actions. Conversely, it is precisely why it is key to pay close attention not to reinforce inherited inequalities and systems of oppression. Accountability, reflexivity, and criticality are key in the exercise of design, especially when

seeking to achieve reparation for climate adaptation. *Reparative justice* is not a straightforward process; it requires understanding practical experiences through conversation and experimentation, by engaging with different methods so as to shape a reparative justice processes where responsibility must be widespread (Castán Broto, Westman, & Huang, 2021). Ingold and Gatt (2013) describe the *design anthropology* approach as an open-ended *correspondence* that should be continually answerable. They argue for a conception of design that 'makes allowance for hopes and dreams' and that is attuned to the dynamic and improvisatory nature of the everyday so as to engage in research enquiries that are open to speculative enquiries on the conditions and possibilities of human life.

Multiple ways of framing and developing design as a research enquiry have been developed throughout the years, of which Research through Design (RtD) progressively stood out.

> *Research through Design (RtD) is an approach to scientific inquiry that takes advantage of the unique insights gained through design practice to provide a better understanding of complex and future-oriented issues in the design field. (Godin & Zahedi, 2014, p. 1)*

In a review of the literature on the *Research through Design* methodology developed by Frayling in 1993, Godin and Zahedi (2014) highlight that design is often presented as providing adaptation to individual system with the aim of 'changing existing situations into preferred ones' (Godin & Zahedi, 2014; quoting Simon, 1996, p. 111). This joins the goals of researching climate action and climate governance and suggests again that humanities, scientific and design fields can reinforce one another. If we successfully integrate design in participatory climate research, it could simultaneously advance the fields of design and research for climate justice; as it is only through participatory and critical approaches that we can examine and address how intersectional structural inequalities lead to discriminatory design conditions (Costanza-Chock, 2020). The context-based, sensory and participatory qualities afforded by design activities allow to render visible the 'dynamic interrelation' (Jungnickel & Hjorth, 2014) within participatory research processes; including those in between researchers and 'participants'.

As climate researchers Castán Broto and Westman (2020, p. 11) point towards an 'evident need for a systematic body of work that engages with the material conditions and experiences of climate change action', the inherent situatedness, materiality and correspondence enabled by *design* approaches seem particularly suited to uncover such hidden narratives. Beyond facilitating processes of research between researchers and 'participants', the same inherent characteristics can mediate the barriers inherent to transdisciplinary enquiries and contribute to form mutual understanding. To forge these collaborations and foster the uncovering of new forms of knowledge, I argue that design methods should be weaved into the research process – from its conception, ethics, strategies of data collection and data analysis, to its dissemination and translation into *real world* applications.

Discussion on advancing climate research as a material practice

Design is already practiced in everyday climate research

Existing literatures on the different waves of climate research indicate that there is a strong interest in materiality (Castán Broto & Westman, 2020) and this paper sets out to discuss a theoretical grounding to embed design-based methods in climate research. In addition to the characteristics specific to design, it can be helpful to acknowledge that climate research practices – whether they are traditional or experimental – already tend to be inherently *material*, and as such, design theories could support the development of methods that fully embrace this situatedness.

Materiality is inherent to climate mitigation and adaptation; the aim of climate research and governance is ultimately to positively impact this material reality. Collecting data, be it qualitative or quantitative, often involve some form of studying *on site*.

Yet, across the fields, climate research tends to be guided by principles more commonly found in humanities and scientific disciplines. Researching climate (and by extension social issues) requires a form of engagement, of embodiment that is enacted through collaborating with people to 'collect' data,† navigating pragmatic requirements, considering ethical framework and building human relations. Ultimately, the same applies to facilitating cooperation within transdisciplinary teams. All these interactions are embedded in the material fabric of the *ordinary*. Even secondary data analysis can involve *designerly* reasoning. Facilitating the dissemination and application of research outcomes, including attempting to consolidate them through governance, is already an attempt at creating a dialogue, a 'correspondence' with others. This dialogue is already part of an effort to research and materialise the conditions (past and present) and possibilities (future or even speculative) of human life through work of climate mitigation and adaptation.

Based on the conditions identified by Page and John (2019), translating academic research into practical applications‡ requires *1)* to work with uncertainties and challenges that may be ill-defined, *2)* revisiting hypothesis in enquiries that may be iterative, *3)* working across and with different disciplines that each come with their own language and technicalities, *4)* synthetising and communicating research outputs in ways that make them accessible and actionable, and *5)* navigating the expectations of pure research goals and practical applications (with a potential commercial benefits depending on the specifics of the project) (Page & John, 2019).

Designers tend to work with these challenges, with *1)* design enquiries that may not have a clearly defined goal, method or application, *2)* in a iterative process (which may be open-ended), *3)* by collaborating with different disciplines (where such collaborations tend to bring out aspects of each fields that emulates one another), *4)* by creating artefacts to convey meaning and facilitate understanding (as potential *boundary objects*) and *5)* where the application and purpose direct the design development.

Engaging in design enquiries that are situated, tangible and in a continuous dialogue whilst prompting accountability, reflexivity, and criticality throughout research enquiries creates opportunities for addressing the challenges encountered in interdisciplinary climate collaborations and in research translation.

Creating mutual understanding

Beyond the more common perception of design as object/medium or system/strategy (i.e for users, for experiences), design can be employed as a *pragmatic approach* to knowledge and address complex interdependent issues as presented by Carlile (2002), who defines them as *cross-boundary challenges*. But design as a research practice, or as a practice supporting research, is often misperceived. Design may fall short in its aesthetic qualities, especially when it seeks to become part of a research process – or it might not clearly display its intention and potential for applications beyond speculative practices. Both climate and design research may face challenges commonly elicited by transdisciplinary encounters (such as institutional and organisational challenges). However, working collaboratively across disciplines by integrating *designerly* ways of researching could be a way to forward the research of climate action. Climate research is already inherently situated, embodied, and interconnected. By bringing design theories and practices within spaces and processes of climate research we could reinforce and support these characteristics where they are most needed. Design, as a process of decoding values to encode them in material/objects, allows us to engage with everyday climate actions in a different way as we would through literacy and numeracy. Ultimately, the point I would like to make is that climate research could benefit from incorporating design methods as an integral part of its approach and throughout the research enquiry

†Preferably 'with' rather than 'from'

‡The article 'Commercializing Academic Medical Research: The Role of the Translational Designer' (2019) focuses on *research translation* in medical research, however the challenges they identify could describe similar issues across academic disciplines

where design is typically used as a punctual mediation (i.e through 'participatory' workshops) or to communicate research outcomes (i.e in dissemination activities). Although it comes with additional layers of challenges that we are to test out and untangle, climate research could benefit from integrating design methods as inherent research characteristics that can facilitate understanding across disciplinary boundaries by engaging with the *messy* and the *ordinary* that otherwise tend to be left out. But to achieve meaningful change, design, must be more than a performative exercise; it must be an ethos of research. Although there are promising grounds for climate research and design to reinforce one another's positives whilst addressing some of their limits, it's important to recognise that design alone is not enough; isolated cavities of design-based research are unlikely to produce durable change. However, if fully embedded in research processes – from conception, data collection, analysis, to translation into practical applications supported by political decisions, design-based methods in research offer new inroads to researching climate actions.

Conclusions and applications

A general limitation of traditional academic research is its tendency to simplify the *mess* to extract polished and linear assertions, thus risking to lose crucial aspects of the study (Jungnickel & Hjorth, 2014). The use of design in collaborative climate research is sure to elicit new questions and requires further testing in transdisciplinary contexts. Existing *corpuses* show that design has the potential to complicate and address pressing issues in the research of climate action. More specifically, design ought to be tested as a fully embedded research approach and set of methods, rather than as punctual tick boxing exercise that emulates participation and co-creation. Building on the literature and practices presented in this paper, I seek to create and test a set of design-based research methods based on the following characteristics:

- to *design* is to be in context; to be embedded in situated knowledge
- to *design* is to work with flexibility and foresight; the foresight to create with intent and the flexibility to navigate uncertainties
- to *design* is to work iteratively; to test and reflect in a circularity of thinking, to examine and re-examine ideas
- to *design* is to engage with complexities at the concurrent boundaries of knowledges
- to *design* is to engage with the *mess*
- to *design* is to make complex ideas more explicit and abstract concept more tangible
- to *design* is to think through an open-ended process, concerned with the realisation of better conditions for the future
- to *design* is to be in dialogue, to research *with*; to set up a *correspondence* that is continually answerable and actionable
- to *design* is to question what and who it is for; to make critically, to hold accountable, to repair ethically

This is what I set out to explore further in the research with *life bio-graphics*. I am developing *life bio-graphics* as a design-based research method to communicate situated accounts of climate change experiences by combining the collection and analysis of qualitative data with a *designerly* way of knowing to create and visualise narratives of situated experiences. The process is to reveal how the recursive relationship between place, materiality and personal experiences can contribute to research and understand climate issues. The specific objectives of the study are *a)* to develop a design-based method of qualitative data analysis which uses visual narrative making to research situated account of climate action; *b)* to test this design-based method in collaboration with climate researchers, in a dialogic and interdisciplinary context; and *c)* to co-produce outputs that represent lived experiences and that contribute to researching knowledge in specific climate research knowledge gaps. The overarching aim of the study is to furthering the use of design as a research tool by legitimising its application in climate research.

Acknowledgments

I would like to thank my supervisors Jea Na, Ray Lucas and Julia Udall for their guidance and support, and the DMI: ADMC 2024 anonymous reviewers for their insights and feedback on this paper.

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