A Cross-Sectional Investigation of Impulsivity, Sensitivity to Reward, Eating Attitudes and Mental Habit as Predictors of Snacking Behaviours.

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ABSTRACT

Impulsivity, sensitivity to reward, mental habit strength and eating attitudes have all been found to independently predict the food choices we make. With an urgency to better understand dysfunctional eating behaviours, recent research has highlighted the importance of habit strength and its role in snacking behaviours (Verplanken, 2006). This current research aims to enhance our understanding of the relationship between personality and eating attitudes and how together they may predict snacking behaviour. It also aims to provide a greater insight into mental habit strength and examine the possibility that it may be driven by opposing aspects of our personality. 112 female undergraduate students completed a cross-sectional survey containing four psychometric measures Snacking behaviour was measured using a self-reported food diary over 48 hours. Habit strength was positively associated with uncontrolled and emotional eating (ps < .01). A simple mediation model found habit strength partially mediated the effect of uncontrolled and emotional eating on snacking behaviour. Sobel test indicated that this indirect effect was significant (p < .05). Emotional eating, uncontrolled eating and cognitive restraint independently of each other, predicted snacking behaviour. However, when mental habit strength was accounted for, the effect of uncontrolled eating and emotional eating was reduced. Findings from this research may be used to educate healthcare professionals on areas to focus on when implementing new interventions for the treatment of obesity, bulimia nervosa and compulsive eating disorder.

KEY WORDS: SNACKING, IMPULSIVITY, HABIT, EMOTIONAL EATING, UNCONTROLLED EATING.

INTRODUCTION

Obesity has reached pandemic proportions. The most recently available figures (NHS, 2008) revealed that nearly a quarter of all adults in the UK were classified as clinically obese. In other countries, such as the United States, more than two-thirds of the population is overweight; the equivalent of 19 million people (Sengupta & Zhou, 2007). The adverse health effects associated with obesity such as diabetes and heart disease are widely publicised and have the potential to reduce life expectancy by 7 years. With Statistical forecasts (NHS, 2008) estimating that obesity figures will double by 2050 if no major changes occur in the prevention or treatment of obesity. We must aim to determine what is driving this epidemic, and try to understand why some are more susceptible to the potent obesigenic environment than others.

There are many theories as to why this epidemic has emerged and many proposed contributing factors. Evolutionary theory suggests that humans have evolved to consume more food than is required to gratify basic nutritional needs (Pinel, Assanand, & Lehman, 2000). This behaviour which was once advantageous when future food supply was uncertain is now claimed to be maladaptive due to the abundant availability and easy accessibility of food in the current environment. The human appetite system has not evolved to effectively manage this continuous exposure to foods that offer such high values of reward (Nederkoorn, Guerrieri, Havermans, Roefs, & Jansen, 2009; Van Den Bos & De Ridder, 2006). This adaptive drive for instant gratification provides one explanation for the obesity epidemic and the increase in snacking behaviour. Parallels can be drawn between immediate gratification and the personality trait impulsivity (Lattimore, Fisher, & Malinowski, 2011; Nederkoorn, et al., 2009).

According to Sengupta and Zhou (2007) “impulsive behaviour is experiencing a sudden and unplanned urge to behave in a hedonically appealing manner that is immediately gratifying, and then acting on the impulse without careful deliberation of subsequent negative consequences” (p.297). The role of impulsivity in eating behaviour is widely cited in psychological literature. It is suggested that there are many changeable factors present in any given situation related to eating, yet impulsivity is one of the few factors that remains stable (Lyke & Spinella, 2004). Direct links between impulsivity and eating behaviours have been found in experimental research where women who produced high scores on impulsivity scales were found to consume more food in a laboratory environment than those who produced low impulsivity scores (Guerrieri, Nederkoorn, & Jansen, 2007).

Nederkoorn et al. (2009) suggested that highly impulsive people were more likely to experience daily and recurrent temptations to eat than their less impulsive counterparts. They found that a moderate feeling of hunger in impulsives resulted in the selection of a high calorie snack and a substantial increase in food intake. Overall highly impulsive participants were found to be more vulnerable to the hedonic appeal of snack foods than non-impulsives

even when sated. However, The validity of this research can be questioned as the manipulation of hunger was artificial.

Impulsivity is said to be categorised into two main domains: reward-related and insufficient-inhibitory control (Nederkoorn, et al., 2009). Reward-related impulsivity is concerned with instant gratification and the inability to comprehend the rewards in delaying gratification. Insufficient-inhibitory control refers to the ability impulsivity has to override automatic processes to respond to stimuli.

The construct of impulsivity is a complex interaction of biological and environmental factors (Dougherty et al., 2003), therefore, it is difficult to clearly define its role in eating behaviours. However, research has suggested that impulsivity is a strong causal factor of overeating in both obese and lean women (Guerrieri, Nederkoorn, & Jansen, 2007; Guerrieri et al., 2007; Nederkoorn, et al., 2009) . Where metabolism accounts for only 12% of the variability in weight-gain, and no evidence to show changes in physical activity trends over the past decade (Schrauwen & Westerterp, 2000), one can infer that eating behaviours provide a significant contribution to the current epidemic. The reward-related impulsivity domain supports research that proposes impulsivity determines an individual's sensitivity to rewards in the environment (Franken & Muris, 2005; Loxton & Dawe, 2001; Nederkoorn, et al., 2009).

Sensitivity to reward is a personality trait, controlled by the mesolimbic dopamine (DA) system. Individual differences in the functioning of the dopamine neurotransmission pathway will influence appetite responses to food (Davis, Strachan, & Berkson, 2004). This is an elaboration of the Behavioural Activation System (BAS) (Gray, 1970), where it is proposed that when the BAS encounters a cue associated with reward, the dopaminergic system is activated resulting in motor output in favour of the reward (Kane, Loxton, Staiger, & Dawe, 2004). Previous research found obese children were more sensitive to rewards and were more likely to opt for immediate gratification when compared with lean children (Dougherty, et al., 2003)

Franken et al. (2005) found that young women who were more sensitive to reward reported stronger food cravings and had a higher BMI. Research was carried out on a large sample of healthy women, it found a strong positive relationship between high sensitivity to reward and overeating (Davis et al., 2007). Loxton et al. (2001) found that adolescents who scored significantly high on the sensitivity to reward scale were four times more likely to engage in binge eating that those who produced low sensitivity to reward scores. Similarities can be drawn between impulsivity and sensitivity to reward literature. Both impulsivity and sensitivity to reward can be likened to instant gratification and to the lack of understanding regarding the benefits obtained from delaying that gratification.

Research has suggested that the physical changes that occur as a result of Gastric Bypass surgery do not fully account for the associated post-surgical weight loss (Cummings, Overduin, & Foster-Schubert, 2004; Tadross

& le Roux, 2009). Recent research has drawn our attention to changes in the mesolimbic reward pathway post-gastric bypass surgery. The perceived reward value of external stimuli, including food, is primarily processed in the mesolimbic reward pathway. fMRI images revealed a reduction in brain activation in key areas within the mesolimbic reward pathway. The reduction was significantly more pronounced in response to food cues that were high (vs. low) in caloric density (Ochner et al., 2011). The most pronounced reductions in postsurgical activation were within the pre-frontal cortex, the primary integration site of reward-related processing in the brain. The findings suggest some level of neural mediation of the decreases in caloric intake. This research further supports the role of the mesolimbic reward pathway in appetite regulation and weight management.

Eating is something which the majority of us do every day, most meals consumed are done so at approximately the same time every day, therefore, it may be assumed that the process is habitual (Riet, Sijtsema, Dagevos, & De Bruijn, 2011). It is estimated that approximately one half of all food consumption is a consequence of a mental habit (Naik & Moore, 1996). Mental habits are more than just repeated behaviours. According to Riet et al. (2011) habits are learned sequences of acts that have been reinforced in the past by rewarding experiences and are triggered by environmental cues. Habit strength is said to increase when behaviour is repeatedly reinforced by satisfactory experiences (Wood & Neal, 2007).

Mental habits can be characterised by three pillars: repetition, automaticity and the ability to be triggered by cues in stable contexts. Automaticity is concerned with the lack of conscious awareness whilst engaging in the habitual behaviour and the ability to successfully execute unrelated tasks and processes parallel to the habit. Research has suggested that repetition is the qualifying element of a mental habit (Verplanken & Tangelder, 2011). However, although constant repetition of behaviour is necessary in order for habits to develop, it has been argued that the qualifying quality is the automaticity and efficiency of the behaviour occurring in stable contexts (Verplanken, 2006; Wood, Quinn, & Kashy, 2002; Wood, Tam, & Witt, 2005). An individual is said to be engaged in an habitual mind-set when conscious intentions matter little, and control over behaviour is primarily delegated to environmental stimuli (Verplanken, Aarts, van Knippenberg, & Moonen, 1998).

Previous research has found habit strength to be a predictor of unhealthy snack consumption (Verplanken, 2006) and regular high saturated fat consumption (de Bruijn, Kroeze, Oenema, & Brug, 2008). Between 20% to 80% of our daily energy intake is now provided by snacks (Kant & Graubard, 2006). Snacking behaviours are shifting from our recommended eating pattern of three meals a day to a new continuous grazing consumption of food. Due to the high frequency of snacking and lack of forethought, it can be concluded that snacking is a mental habit because of its habitual response. Although there is a wealth of literature regarding the impact of snacking habits on our eating behaviours and subsequently the harmful effects they can have

on our health, there is little knowledge of the underlying psychological processes and personality traits which drive these mental habits.

This research proposes that it would be beneficial for the healthcare profession to have a better understanding of the driving force of snacking habits, so that existing dysfunctional habits can be replaced by new functional ones. By forming implementation interventions research has found unhealthy eating habits can be moved towards healthier eating habits, but that the negative influence of unhealthy eating habits cannot be broken altogether (Tam, Bagozzi, & Spanjol, 2010; Verplanken & Faes, 1999). Lally et al. (2008) developed the 'Top Ten Tips' intervention which aimed to promote healthy eating and was explicitly underpinned by habit formation theory. This intervention strategy resulted in increased weight-loss when compared to a control group. Their findings provide support for the notion that interventions which take the principles of habit formation into account, can successfully establish healthy eating (Lally, Chipperfield, & Wardle, 2008).

Specific emotions such as anger, fear, sadness and joy have been found to affect our motivation to eat and other affective responses to food (M. Macht & Simons, 2000). It has been reported that on average 30% of people experience an increase in their appetite levels in response to emotional stress (M. Macht, 2008). Research has suggested that emotional eaters do not eat in response to internal signals such as hunger and satiety, but that their appetite system is predominantly driven by their emotional state (Snoek, van Strien, Janssens, & Engels, 2006).

Emotional eating is measured alongside additional eating attitudes; cognitive restraint and uncontrolled eating, using the Three Factor Eating Questionnaire R-18 (TFEQ) (Stunkard & Messick, 1985). The psychometric test was developed using data from severely obese participants, however, recent evidence has supported the notion that this can also be used to characterise eating behaviours in non-obese populations (Cappelleri et al., 2009; Lauzon et al., 2004).

Research suggests that An emotional eater's response is different to that of non-emotional eaters when subjected to emotional stress. Emotional eaters respond by excessively over-eating and consuming large quantities of sweet and high-fat foods (Schneider et al., 2012), whereas, non-emotional eaters recorded a drop in their appetite levels (Oliver, Wardle, & Gibson, 2000). Emotional eating has been viewed as a strategy to improve negative mood, to mask stress or to escape from aversive self-awareness. Restrain-theory suggests that emotional distress weakens dietary restraint and therefore increases food intake (M. Macht, 2008). Previous research reported a significant relationship between emotional eating and personality trait impulsivity (Bekker, van de Meerendonk, & Mollerus, 2004). This relationship may stem from restrain-theory (M. Macht, 2008) which suggests that a slight reduction in restraint may allow impulsivity to overpower the appetite system.

A cross-sectional study aimed to examine the relationship between eating attitudes (defined by the TFEQ) and reported food intake (Lauzon, et

al., 2004). The research found emotional eating and uncontrolled eating positively affected the preference for sweet and high fat foods. High uncontrolled eating scores were positively associated with high energy intake. The effect of cognitive restraint varied between populations, it was predominantly associated with a higher consumption of healthy foods among the adult population but with a lower consumption of fat and sweet foods among the teenage population. These findings support those of previous research (Lähteenmäki & Tuorila, 1995), that proposed that individuals with high scores on the cognitive restraint scale reduced their calorie intake due to overwhelming feelings of guilt.

Cognitive restraint is concerned with a conscious awareness to control food intake in order to manage body weight. Previous research found that highly restrained bulimic females experienced a significantly heightened sensitivity to reward and cue-reactivity. On exposure to food-cue exposure restrained eaters had an increase in saliva levels and increase in heart rate. However, after psychological treatment for bulimia nervosa, on exposure to food-cues participants reported lower levels of cue-reactivity and exhibited reduced biological responses (Carter & Bulik, 2001). Surprisingly, other research reported that high-restrained eaters were less distracted by food than none restrained eaters (Roefs et al., 2008). The uncontrolled eating domain refers to the loss of control over food consumption preceding exposure to food-cues, this domain is similar to that of motor impulsiveness which is defined as acting without thinking about the current situation or possible consequences; strong associations are expected between these two domains in this research.

The existing research draws our attention to the many theories and vast research which attempt to explain our eating behaviours. A current and common goal in health psychology research is to improve the overall healthiness of peoples diets by switching behaviours from unhealthy to healthy snacking (Tam, et al., 2010). This research aims to advance the knowledge in this field by outlining the underlying psychological processes involved in snacking behaviours.

It can be inferred from the reviewed research above that there are many complex factors which contribute to our eating behaviours, yet our understanding of their relationship with one another is relatively vague. Based on previous research, initial predictions for this research are that (1) psychometric measures; impulsivity, sensitivity to reward, habit strength uncontrolled and emotional eating will be positively associated with one another. There will be a negative association between cognitive restraint and all three domains of impulsivity. Subsequently, (2) impulsivity, sensitivity to reward, habit strength, uncontrolled and emotional eating will be positively associated with snacking behaviour. Cognitive restraint will be negatively associated with snacking behaviour.

Previous research has found habit strength to predict snacking behaviours (Verplanken, 2006; Verplanken, Herabadi, Perry, & Silvera, 2005). Therefore, we are aware of the influential role that habit strengths plays in

determining snacking behaviours. Having said this, there is a lack of research regarding the effect habit strength has on other domains of our personality. This research proposes that when (3) habit strength is accounted for there will be a significant reduction between the relationships of snacking behaviour and significantly associated psychometric measures.

METHODS

Design

112 participants completed a cross-sectional survey containing four psychometric measures to assess impulsivity, sensitivity to reward, mental habit and eating attitudes and their impact on snacking behaviours. Snacking behaviour was measured using a self-reported food diary.

Participants

Female undergraduate students were recruited from a private university website in return for partial course credit. Participants were required to complete an online survey which took approximately 12 minutes to complete. The average age of participant was 19 (Range= 18-25, SD=2.1), and the average Body mass Index (BMI) 23.2 (M=17.9-31.5, SD=3.5).

Materials

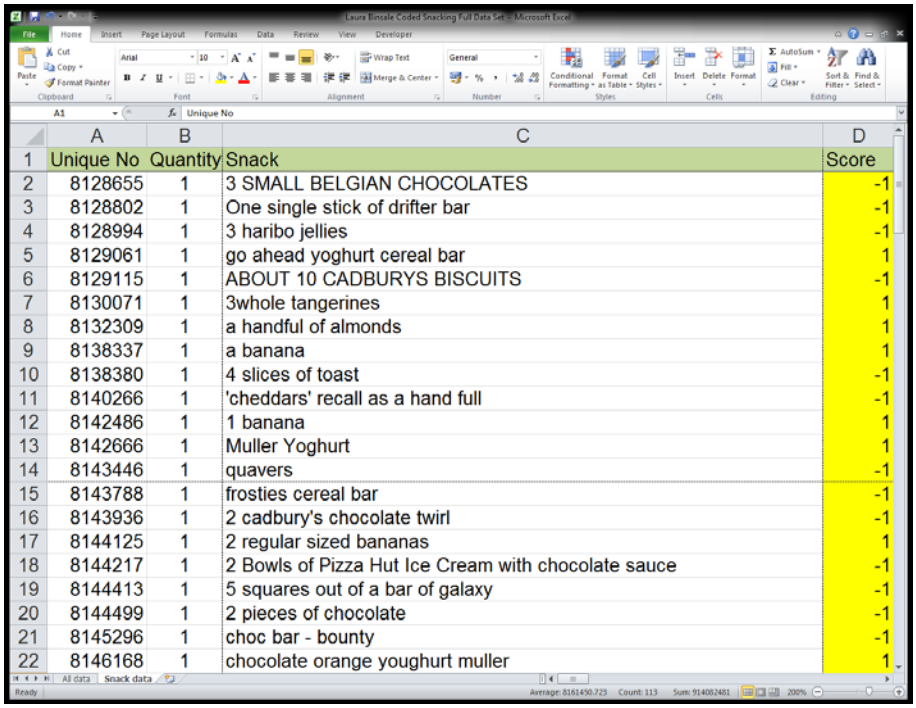
Snacking Behaviour. Participants were asked to recall *all* food items they had consumed over the past 48 hours outside of their three main meals a day (breakfast, lunch and dinner). Participants were asked to provide as much information as they could about each snack, this included recalling the quantity and brand (where relevant). The following is an example which was provided in the instructions; "report some chocolate' as three pieces of a regular plain Cadbury's dairy milk bar". The specific recall was a crucial aspect of the analysis. Participants were given an open ended opportunity to record an unlimited amount of information for a maximum of 20 snacks. Overall 5880 snacks were recalled in the food diary, on average each participant recalled 5 snacks (Range =0-18, SD =3.15).

Initial first order coding of the snack data was done using personal discretion and previous knowledge of the nutritional value of foods. A healthy snack was given a +1 score, an unhealthy a -1 score and where no obvious score could be granted a zero-score. The quality of the information provided varied greatly between participants; this difference in data guided the initial coding methodology.

Second order coding was focused on coding the zero-codes, initially there were 980 snacks scored as zero, many were replications. A supermarket website was used to test the nutritional value of the zero-scored snacks. All snacks with Kcal < 100 and fat and sugar RDA % < 5% were coded as healthy (+1), those that did not meet the criteria were coded as unhealthy (-1).

Three independent judges scored a sample of snack data which included randomly selected data sets from 30 participants. The percentage agreements were as follows; judge 1: 78%, judge 2: 91%, and judge 3: 92%. 91% of the percentage disagreement could be accounted for by snack's awarded zero-scores. An explanation for this is that the independent judges were not provided with the nutritional database tool to enhance the accuracy of their scoring.

Below is an extract taken from the snack data which includes the scores that were subsequently used in the data analysis.



	A	B	C	D
1	Unique No	Quantity	Snack	Score
2	8128655	1	3 SMALL BELGIAN CHOCOLATES	-1
3	8128802	1	One single stick of drifter bar	-1
4	8128994	1	3 haribo jellies	-1
5	8129061	1	go ahead yoghurt cereal bar	1
6	8129115	1	ABOUT 10 CADBURYS BISCUITS	-1
7	8130071	1	3whole tangerines	1
8	8132309	1	a handful of almonds	1
9	8138337	1	a banana	1
10	8138380	1	4 slices of toast	-1
11	8140266	1	'cheddars' recall as a hand full	-1
12	8142486	1	1 banana	1
13	8142666	1	Muller Yoghurt	1
14	8143446	1	quavers	-1
15	8143788	1	frosties cereal bar	-1
16	8143936	1	2 cadbury's chocolate twirl	-1
17	8144125	1	2 regular sized bananas	1
18	8144217	1	2 Bowls of Pizza Hut Ice Cream with chocolate sauce	-1
19	8144413	1	5 squares out of a bar of galaxy	-1
20	8144499	1	2 pieces of chocolate	-1
21	8145296	1	choc bar - bounty	-1
22	8146168	1	chocolate orange youghurt muller	1

The final stage in the coding methodology was to reduce the copious amounts of data provided in the snack diary to a numerical value, which could subsequently be used in the analysis. This was done by formulating a *Snack Ratio.* A Snack Ratio was calculated for each of the participants. This was done by totaling the previously coded positive (healthy) and negative (unhealthy) scores together to produce an overall Snack Ratio.

An example of this coding is provided using a randomly selected participant (Unique No. 8152383) who recorded; a regular Galaxy chocolate bar (-1), 2 packets of walkers crisps (-1) and 1 apple (+1), this participant was given a Snack Ratio score of -1. A negative Snack Ratio indicates unhealthy snacking behaviours, whereas a positive Snack Ratio indicates healthy snacking behaviours. The larger the negative value the unhealthier the participants snacking behaviour, the same principle is true for healthy snacking behaviours where a larger positive value represents healthier snacking behaviours.

Reward Sensitivity. Sensitivity to reward was measured using the Sensitivity to Reward Scale (SR) taken from the Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ;). SR Scale comprises 24 items; participants responded either ‘yes’ (scoring 1 point) or ‘no’ (scoring zero points) to each of the items. A sample item of Sensitivity to Reward scale is “Do you often do things to be praised?” Previous research has reported the scale to have good internal consistency (Tetley, Brunstrom, & Griffiths, 2010). The current research also reported the scale to have good internal consistency with cronbach’s coefficient = 0.72.

Mental Habit. Unhealthy snacking habit strength was measured using the Self-Report Habit Index (SRHI) (Verplanken, 2006). A 12-item measure assessing 4 meta-cognitions; history of repetition, lack of awareness, difficulty to control and mental efficiency. Responses on each of the 12-items were given on a 5-point likert scale; 'disagree completely' (1) to 'agree completely' (5). Participants were told to identify thoughts they have about their healthy and unhealthy snacking habits. Unhealthy snacks were defined as "those high in calories, saturated fat, and low in fibre and nutrients". A sample item of the Self-Report Habit Index scale is "Eating unhealthy snacks is something I do without further thinking". This scale measures the degree to which the behavior has acquired habitual qualities; lack of awareness, lack of control and mental efficiency. The scores from each of the items were totaled together to produce an overall indication of snacking habit strength, high scores indicate a strong snacking habit. Previous research reported high internal reliability and validity for the SRHI (Verplanken & Orbell, 2003). In the current study internal consistency of the SRHI was good with cronbach's coefficient = 0.92.

Impulsivity. The measure of impulsivity is more complex than that of the other contributing factors. Barratt (1992) claimed that impulsivity is a multi-faceted construct and therefore strived to develop a multi-faceted way of measuring it (Stanford & Barratt, 1992; Stanford et al., 2009). The Barratt Impulsivity Scale (BIS-11), encompasses three variations of impulsiveness; motor-impulsiveness (acting without thinking about consequences), attentional impulsiveness (the inability to focus attention for long periods of time) and non-planning impulsiveness (a lack of forethought). Responses were self-reported on each of the 30-items on a 4-point likert scale; rarely/never (1), occasionally (2), often (3), always (4). The BIS-11 produces a total score as well as independent scores for each of the domains. Internal consistency was good for the BIS-11 in the current study, cronbachs coefficient = 0.86

*Eating Attitudes.*The Three Factor Eating Questionnaire R-18 (TFEQ R-18) was used to measure uncontrolled eating, emotional eating and cognitive restraint (element of thought or cognition involved in eating behavior). The TFEQ included 18-items 9 items for uncontrolled eating, 6 items for emotional eating and 3 items for cognitive restraint. Responses were given on a 4-point likert scale; "definitely true" (4), mostly true (3), mostly false (2) and definitely false (1). A sample item from each of the three factors are as follows; uncontrolled eating scale "Sometimes when I start eating I just can't seem to stop", emotional eating; "I start to eat when I feel anxious", cognitive restraint "I deliberately choose small helpings to control my weight". Previous research has reported acceptable internal consistency for the model and identified no weak items (Cappelleri, et al., 2009). In this research, internal consistency was good for the 18-item three-factor model with Cronbach's coefficient is 0.86 for the uncontrolled eating domain, 0.92 for the emotional eating domain and 0.87 for the cognitive restraint domain.

Ethical Issues

Ethical approval for the study was obtained from the University Ethics Committee. There were no previously outlined ethical issues. Participants were required to give full informed consent and their anonymity was guaranteed. A full debrief sheet was provided on completion.

Data Analysis

All 112 cases met requirements for correlation and multiple regression analysis. A simple mediation analysis was performed according to the original procedure (Baron & Kenny, 1986). Mediation analysis provides a functional understanding of the relationships between the variables. Where indirect effects were identified a Sobel Test was conducted to compare the strength of the indirect effect.

RESULTS

Data Screening (Table 1.1) revealed that three cases included outliers (Z-Score > 2.5, Z-Score < -2.5). These were removed and analysis repeated, however, magnitude of correlations did not change substantially and therefore they are retained. Descriptive statistics for psychometric and snacking measures are displayed in Table 1.1.

Table 1.1
Descriptive Statistics of Psychometric and Snacking Measures.

	N	M	SD	Skew	Kurtosis	Z-Score Range
BIS11tot	111	67.42	11.14	0.53	0.49	-2.10 - 3.01
BIS_attention	112	17.83	3.90	0.49	0.50	-2.52 - 2.86
BIS_motor	112	23.05	4.23	0.87	1.02	-2.14 - 3.29
BIS_nonplan	111	26.53	5.19	0.05	-0.36	-2.42 - 2.02
TFEQ_UE	112	21.79	5.27	0.11	-0.30	-2.05 - 2.70
TFEQ_CR	112	6.71	2.48	0.34	-0.62	-1.49 - 2.13
TFEQ_EE	112	13.19	4.87	0.36	-0.58	-1.48 - 2.22
SRHI	112	36.95	10.14	0.05	-0.27	-2.46 - 2.27
SReward	112	12.14	3.87	0.15	-0.25	-2.62 - 2.29
Snack Ratio	111	-1.80	2.80	-0.55	1.40	-3.68 - 2.82
Snack Freq	112	5.25	3.15	1.52	3.38	-1.67 - 4.05

NOTE: BIS11tot: total score for the Barrett Impulsivity Scale (BIS), BIS_attention: Attentional impulsivity domain of the BIS, BIS_motor: Motor impulsivity domain of the BIS, BIS_nonplan: Non-Planning impulsivity domain of the BIS, TFEQ_UE: Uncontrolled Eating domain of the Three Factor Eating Questionnaire (TFEQ), TFEQ_CR: Cognitive Restraint domain of the TFEQ, TFEQ_EE: Emotional Eating domain of the TFEQ, SRHI: Self-Report Habit Index Quetionnaire, Sreward: Sensitivity to Reward Scale, Snack Ratio: proportion of healthy vs. unhealthy snacks consumed (see materials section: snacking behaviour, Snack Freq: Number of snacks consumed.

Pearson's correlations between psychometric measures are displayed in table 1.2. BIS-Total correlated with all three domains of the BIS-11 and with the Emotional Eating and Uncontrolled eating domains of the TFEQ. BIS-Attention is positively associated with TFEQ-EE and TFEQ-UE, this finding is as predicted in the original hypotheses. BIS-Motor is positively associated with SReward and TFEQ-EE, the positive association between BIS-Motor and SReward suggests that when exposed to hedonically appealing foods individuals with higher levels of sensitivity to reward consume the hedonic food not only because of their sensitivity to reward but also because of their high motor-impulsivity levels causing them to act without thinking of the consequences. SReward is also positively associated with TFEQ-UE as predicted in the original hypotheses. Habit strength (SRHI) is negatively associated with TFEQ-CR and positively associated with TFEQ-EE and TFEQ-UE.

Table 1.2
Pearson Correlations of Psychometric Tests.

		2	3	4	5	6	7	8	9
1	BIS-Total	.79**	.83**	.86**	.15	.19	.07	.25**	.20*
2	BIS-Attention		.51**	.52**	.11	.17	.11	.19*	.21*
3	BIS-Motor			.57**	.16	.20*	.14	.27**	.14
4	BIS-Non Planning				.10	.10	-.04	.17	.17
5	SRHI					.18	-.41**	.44**	.42**
6	Sreward						.04	.14	.27**
7	TFEQ_CR							-.28**	-.29**
8	TFEQ_EE								.61**
9	TFEQ_UE								

**p<.05, **p<.01*
NOTE: BIS11tot: total score for the Barrett Impulsivity Scale (BIS), BIS_attention: Attentional impulsivity domain of the BIS, BIS_motor: Motor impulsivity domain of the BIS, BIS_nonplan: Non-Planning impulsivity domain of the BIS, TFEQ_UE: Uncontrolled Eating domain of the Three Factor Eating Questionnaire (TFEQ), TFEQ_CR: Cognitive Restraint domain of the TFEQ, TFEQ_EE: Emotional Eating domain of the TFEQ, SRHI: Self-Report Habit Index Quetionnaire, Sreward: Sensitivity to Reward Scale, Snack Ratio: proportion of healthy vs. unhealthy snacks consumed (see materials section: snacking behaviour, Snack Freq: Number of snacks consumed.

The Pearson's correlations between the psychometric and snacking measures are displayed in table 1.3. The second hypothesis was partially supported by Pearson's correlations; snack ratio correlated with four of the six psychometric measures. There is a negative association between snack ratio and habit strength. This association suggests that as the snacking behaviour becomes increasingly unhealthier mental habit strength is stronger.

An interesting significant positive correlation between Snack Ratio and TFEQ-CR suggests that the higher the levels of cognitive restraint the healthier the snack. The negative association between Snack Ratio and TFEQ-EE suggests that emotional eaters require the high fat and sugar content of food supporting previous research by Oliver et al. (2000). Whereas, Snack Ratio positively correlates with TFEQ-UE, suggesting that unlike emotional eaters, uncontrolled eaters need quantity rather than the high reward value of food. There are no significant associations between Sensitivity to Reward or Impulsivity and Snack Ratio.

Table 1.3
Pearson Correlations of Psychometric and Snacking Measures

		2	3	4	5	6	7	8
1	Snack Ratio	-.34**	-.27**	.39**	-.28**	-.33**	-.06	.00
2	Snack Freq		.10	-.04	.18	.14	.06	.07
3	TFEQ_UE			-.29**	.61**	.43**	.28**	.21*
4	TFEQ_CR				-.28**	-.41**	.04	.07
5	TFEQ_EE					.45**	.14	.25**
6	SRHI						.18	.15
7	Sreward							.19
8	BIS-Total							

**p<.05, **p<.01*

NOTE: BIS11tot: total score for the Barrett Impulsivity Scale (BIS), BIS_attention: Attentional impulsivity domain of the BIS, BIS_motor: Motor impulsivity domain of the BIS, BIS_nonplan: Non-Planning impulsivity domain of the BIS, TFEQ_UE: Uncontrolled Eating domain of the Three Factor Eating Questionnaire (TFEQ), TFEQ_CR: Cognitive Restraint domain of the TFEQ, TFEQ_EE: Emotional Eating domain of the TFEQ, SRHI: Self-Report Habit Index Quetionnaire, Sreward: Sensitivity to Reward Scale, Snack Ratio: proportion of healthy vs. unhealthy snacks consumed (see materials section: snacking behaviour, Snack Freq: Number of snacks consumed.

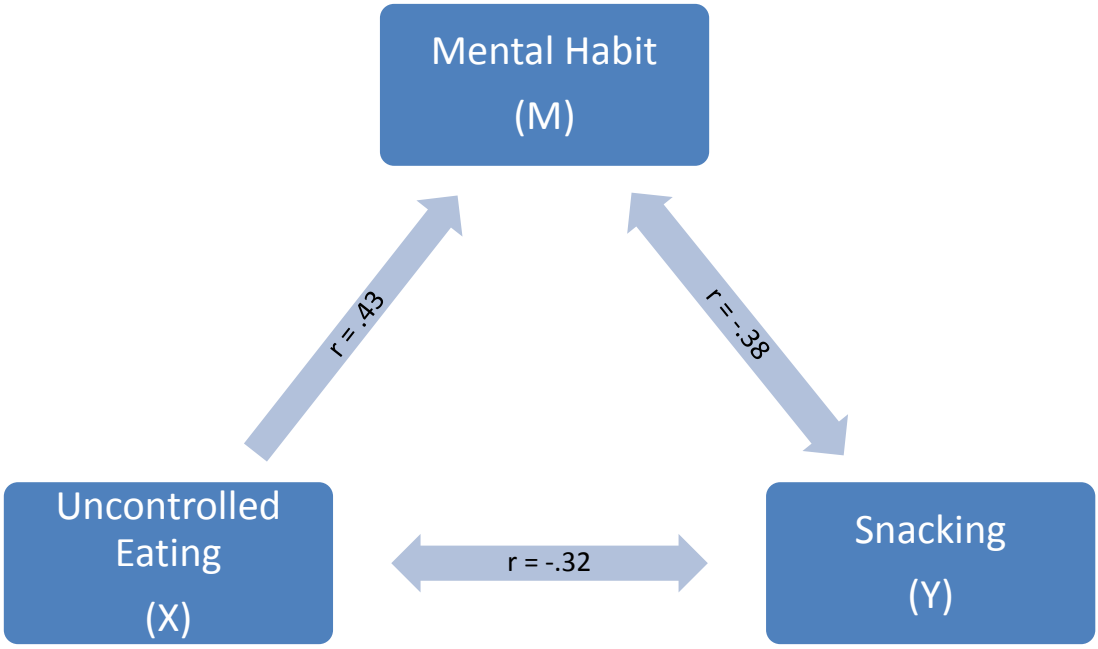
The significance of correlations meets the assumptions for mediation analysis according to Baron and Kenny (1986). To test the two propositions that (1) habit strength mediates the relationship between uncontrolled eating and snack ratio and (2) habit strength mediates the relationship between emotional eating and snack ratio a series of hierarchical regressions were performed. The unstandardised regression coefficients and related mediation model statistics are displayed in Tables 1.4 and 1.5.

Table 1.4
Unstandardised Beta Coefficients For The Test Of Mediation For Uncontrolled Eating

	Path	B	S.E.	t	p
	YX	-0.04	0.01	-2.95	0.00
	MX	0.22	0.05	4.94	0.00
	YM.X	-0.07	0.27	-2.59	0.01
	YX.M	-0.02	0.01	-1.63	1.07

Note: Y = Snack Ratio; X = Uncontrolled Eating; M = SRHI.

Figure 1.1
Simple model of mediation predicting snack ratio controlling for habit strength



NOTE: Y = Snack Ratio (SR), X = Uncontrolled Eating (UE), M = Self Report Habit Index (SRHI). Refer to Table 1.4 for the unstandardised beta coefficients for the mediation analysis for uncontrolled eating.

The test of mediation for uncontrolled eating indicates that the size of relationship between snack ratio and uncontrolled eating is reduced and is no longer significant when mediator habit strength is accounted for (see figure 1.1). This is also true for emotional eating; when mediator habit strength is accounted for the size of the relationship between snack ratio and emotional eating is reduced. The sobel test indicated that the indirect effect was significant for emotional eating ($Z=2.22$, $p < .05$) and uncontrolled eating ($Z=2.25$, $p < .05$). The relationship between emotional eating/uncontrolled eating and snack ratio is only partially mediated by habit strength as the coefficient for the indirect effect does not reduce to zero. It was tested whether UE or EE would act as mediators with the SRHI as the independent variable, but both indirect effects were not present (ps > .05).

Table 1.5
Unstandardised Beta Coefficients for the Test of Mediation for Emotional Eating

Path	B	S.E.	t	p
YX	-0.29	0.01	-3.04	0.00
MX	0.17	0.03	5.22	0.00
YM.X	-0.07	0.03	-2.50	0.01
YX.M	-0.02	0.01	-1.67	0.01

Note: Y = Snack Ratio; X = Emotional Eating; M = SHRI

DISCUSSION

The aim of this research was to develop our understanding of factors outlined by previous research as predictors of appetitive drive and food choices. An online survey used psychometric measures to assess impulsivity, sensitivity to reward, habit strength and eating attitudes (TFEQ). Initial hypotheses were concerned with the interaction between these psychometric measures. The second-part of the online survey required participants to complete an online snack diary over the course of 48 hours. The information provided in the snack diary was coded. This coding process enabled the reduction of 588 qualitative sets of data to 112 numerical values. Thus providing participants with a numerical snack ratio which represented the frequency and type of snacks they consumed.

Personality trait impulsivity was found to be positively associated with two domains of the TFEQ: emotional eating and uncontrolled eating. This finding supports previous presumptions by Bekker et al. (2004). However, not all facets of impulsivity yielded a significant positive association with emotional or uncontrolled eating. Attentional-impulsivity was positively associated with both of the above factors. Attentional-impulsivity is defined as the inability to focus attention and incapability of maintaining attention for long periods of time (Lattimore, et al., 2011). Therefore, its positive association with uncontrolled eating may be a consequence of the failure to moderate eating behaviours due to it an inability to maintain attention for long periods of time. As attentional-impulsivity is associated with the quick and unconscious shift in attention, its positive association with emotional eating suggests that when emotions are heightened there is an increased inability to focus attention. Therefore, similar to the explanation above, high attentional-impulsivity scores directly impact on eating behaviours due to the lack of mental control which occurs as a result.

Uncontrolled eating is concerned with the lack of control over food consumption and the inability to stop eating. Uncontrolled eating was found to be positively associated with motor-impulsivity. This provides a new insight into uncontrolled eating, as it suggests that uncontrolled eaters act without the forethought of possible consequences. Therefore, it may be that they cannot see the negative consequences associated with over-eating, such as obesity, and are primarily focused on the instant gratification that is provided by food. This explanation was further supported by the significant positive correlation between uncontrolled eating and sensitivity to reward in this research. This finding is supported by previous research which found adolescents who reported a heightened sensitivity to reward were four times more likely to engage in binge eating behaviour (Loxton & Dawe, 2001). Franken and Muris (2005), proposed that the underlying driving force behind reward sensitivity is the need for instant gratification, and that when an individual is highly sensitised to rewards in the environment, food is then consumed without forethought and with only the rewards obtainable as the focus. Franken and Muris's (2005) findings can be used to explain the significant association

between sensitivity to reward and uncontrolled eating found in the current research.

Initial hypotheses stated that reward sensitivity would be positively associated with snacking behaviours. However, the findings from this research found no significant associations with snack frequency or snack ratio. This is surprising as the role of the reward sensitivity in appetite is widely cited in psychological research. Recent research provided us with a new perspective on the reward pathways role in our appetite system. A significant reduction in the corticolimbic areas within the mesolimbic reward pathway was found post-gastric bypass surgery (Ochner, et al., 2011). This research was prompted by earlier research which highlighted that the physical changes which occur as a result of gastric bypass surgery do not fully account for the recorded weight loss (Cummings, et al., 2004). The underlying processes responsible for these changes in neural activity are yet to be clearly understood, therefore, further investigation is needed. However, although the research in this field is relatively novel and limited, its findings have been consistent. Therefore, suggestions for future research should include an elaboration of the role of the mesolimbic reward pathway in appetite control.

Cognitive restraint was negatively associated with habit strength; this finding suggests that future implementations should not solely focus on the formulation of new habits, but on increasing the levels of cognitive restraint, which could potentially overpower existing mental habits. The high levels of cognitive restraint in the current research must be approached with caution as the sample consisted of females who were aged 18-25. There is a greater social emphasis on women to maintain a low weight with young females being subjected to a constant projection of the ‘ideal’ body image by the mass media. Therefore, there is an increased likelihood that the current sample may have been monitoring or controlling their food intake at the time of this research. This explanation would account for the relatively high cognitive restraint scores, and the lack of significant associations between cognitive restraint and other psychometric measures in the current research.

The original hypotheses stated that there would be a negative association between TFEQ-CR and impulsivity. The findings do not support the hypothesis as there was no significant correlation between cognitive restraint and any facet of impulsivity. This finding was unanticipated as cognitive restraint is a construct which involves the conscious control of food consumption, whereas, impulsivity encompasses opposing traits, and foods are said to be consumed without forethought and with lack of control. Having said this, previous research found that emotional distress reduced levels of cognitive restraint, and that this reduction then allows impulsivity to override restraint, resulting in increased food consumption (M. Macht, 2008). Macht’s (2008) research provides one explanation for the lack of association present between cognitive restraint and impulsivity in the current research. There was no manipulation of the emotional state of the participants, which Macht (2008) proposes is a crucial element in order for there to be significant association between impulsivity and cognitive restraint.

Impulsivity did not correlate with habit strength or snack ratio; this finding was not predicted in the hypotheses. To explain this finding we can draw upon research by Nederkoorn et al. (2009) who concluded that hunger levels where the mediating factor in food consumption and that only when hunger levels were heightened would impulsivity impact on predicting eating behaviours. Once the appetite system releases hunger signals, personality trait impulsivity appears to exacerbate those feelings of hunger, resulting in large quantities of food being consumed which are disproportionate to the levels of hunger. The incorporation of hunger measures into future research would be advantageous.

The current research found that as the healthiness of the snacking behaviour increased so did the levels of cognitive restraint. This finding suggests that cognitive restraint does not impact on the frequency of snacking but on the type of snacking. This finding is supported by the work of Lauzon et al. (2004) who found that high levels of cognitive restraint were associated with a higher consumption of healthy foods. There was a negative association between uncontrolled/emotional eating and snack ratio. As uncontrolled and emotional eating scores increased there was an incline in the frequency of snacks recorded and a significant shift to higher calorie and sweet foods. This finding supports previous research (Lauzon, et al., 2004; Schneider, et al., 2012) and the initial predictions made in the hypothesis of the current research.

Stronger habit strength was negatively associated with snack ratio, therefore the frequency of the snacking increased and high calorie snacks became the preference. Habit strength was measured by assessing 4 meta-cognitions: history of repetition, lack of awareness, difficulty to control and mental efficiency. Therefore, this finding suggests that unhealthy snacking (vs. healthy snacking) is more difficult to control and more likely to occur without any conscious awareness. This finding suggests that there is a different underlying process involved when consuming unhealthy snacks in comparison to healthy snacks. Previous research has reported promising results for the use of implementation interventions to replace unhealthy snacking habits with healthy snacking habits (Tam, et al., 2010; Verplanken & Faes, 1999). Snack ratio might not be a true reflection of the snacking habits of the participants, as it could be argued that the food diary made participants more aware of their eating behaviour and therefore, they avoided or underreported their snack consumption.

The most significant finding within this research was the mediating role of habit strength in the relationship between (1) uncontrolled eating and snack ratio and (2) emotional eating and snack ratio. Pearson's correlation showed emotional and uncontrolled eating to have significant associations with snack ratio. However, in the mediation analysis when habit strength was accounted for there was no significant effect of emotional eating or uncontrolled eating on snack ratio. This finding does not propose that without the mediating role of habit strength, uncontrolled or emotional eating would not predict snacking behaviour, but that the strength of the relationship between uncontrolled or

emotional eating and snacking behaviour is partly dependent upon habit strength. While keeping in mind that the study was correlational and thus did not allow causal conclusions, this finding is in line with the notion that habit strength can be the driving force in frequent unhealthy snacking behaviour.

The TFEQ is used widely in experimental research to enhance the understanding of eating behaviours and to generate ideas for new interventions and treatments for those suffering with eating disorders. This research has produced findings which suggest that constructs within the TFEQ may not independently predict eating behaviour as had been previously suggested, and that habit strength may be the determining factor. The finding that habit strength mediated the relationship between emotional eating and uncontrolled eating provides us with a new perspective, and supports previous proposals that more research is needed on intervention strategies which are based on habit theory and designed to change unhealthy eating habits and create new healthy ones. According to Riet et al. (2011) an educational approach is insufficient if habitual eating behaviours are to be changed. They suggest that a different approach focusing on situational factors and self-regulation skills may be needed to effectively target habitual eating behaviours. The ‘Top Ten Tips’ intervention was explicitly underpinned by habit formation theory and was found to successfully facilitate weight loss (Lally, et al., 2008). The limited research available concerned with the formulation of new interventions, which are based on habit formation theory provides promising results. A greater understanding of the determinants of appetite and particularly the role of mental habit strength could help persons and clinicians develop a more informed approach to achieving healthy weight and healthy eating behaviours.

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