Impulsivity and temporal frame: Reducing frequency of snacking by highlighting immediate health benefits

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Abstract

The current study aimed to examine the effect of giving temporally framed health information regarding either the immediate or long-term health consequences of consuming high-calorie snacks, for people with high Negative Urgency (a dimension of impulsivity), and for those primed with impulsivity. We expected that for participants with high Negative Urgency, and those primed with impulsivity, information which detailed the immediate health benefits of avoiding snack consumption would be more effective than information which detailed long-term health benefits. Participants (N=110) completed a measure of Negative Urgency, reported their snacking frequency over the previous seven days, and completed either an impulsivity or neutral prime task. Following this, they read information detailing either the immediate or long-term health benefits of avoiding high-calorie snacks. High-calorie snack consumption was reported 7 days later. The results showed a significant three-way interaction between Negative Urgency, prime task, and temporal frame. Participants who were primed with impulsivity and those high in Negative Urgency showed a greater reduction in snacking frequency after being given information about the immediate vs. long-term health benefits of snacking. The results suggest that the immediacy of health consequences should be considered when designing health information to reduce impulsive snacking behaviour.

Keywords: snacking; impulsivity; health communication; priming; temporal frame; immediate; health information; priming; health promotion; diet.

Recent statistics show that 35% of adults aged 20 or over worldwide are classified as overweight (with a Body Mass Index [BMI] greater than or equal to 25) and 11% are classified as obese (with a BMI greater than or equal to 30) (WHO, 2015). Obesity and overweight is considered to be a prominent risk factor for global mortality, and is associated with numerous health problems such as cardiovascular diseases, diabetes, musculoskeletal disorders, and some cancers (WHO, 2015). The obesity epidemic is increasing (see Goryakin, Lobstein, James, & Suhrcke, 2016), with this increase partly attributed to a rise in the availability, affordability, and advertising of convenient, high-calorie snack foods that are energy-dense, typically high in saturated fats and sugar, and low in nutritional benefit (Anschutz, Engels, van der Zwaluw & Van Strien, 2011; Lobstein & Dibb, 2005; Swinburn et al., 2011).

Traditional socio-cognitive psychological models of health behaviour have tended to focus on planned, reflective components of behaviour such as attitudes, social norms, risk perceptions, and intentions (e.g., the Theory of Planned Behaviour [Ajzen, 1991] and the Health Belief Model [Janz & Becker, 1974]). Whilst these models have been useful in identifying predictors of snacking which may be successfully targeted via intervention and health information (see Branscum & Sharma; 2014; Mesters & Oostveen; 1994, Lally, Bartle, & Wardle; 2011, Robinson, Harris, Thomas, Aveyard, & Higgs, 2013; Shojaeezadeh, 2010), they have tended to neglect aspects of behaviour which are unplanned or non-reflective in nature. For snacking behaviour in particular, it is likely that non-reflective variables play a large role in determining action (Hofmann, Freise, & Strack, 2009; Ohtomo, 2013). Indeed, dual-process models confirm that snacking behaviour is predicted by both reflective and non-reflective processes (Churchill & Jessop, 2011; Honkanen, Olsen, Verplanken, & Tuu, 2012).

Impulsivity is considered to be a multi-dimensional construct which includes the tendency to act without thinking, to take risks, to distort negative consequences, and to

devalue future events (de Wit, Flory, Acheson, McCloskey, & Manuck, 2007; Whiteside & Lynam, 2001). A large body of research has found significant associations between various dimensions of impulsivity and unhealthy dietary behaviours (French, Epstein, Jeffery, Blundell, & Wardle, 2012; Hofmann, Freise, & Strack, 2009; Jasinska et al., 2012; Mullan et al., 2014; Racine, Culbert, Larson, & Klump, 2009; Yeomans, Leitch, & Mobini, 2008). Impulsive buying tendencies have been linked to snacking habits (Honkanen et al., 2012; Verplanken, Heribadi, Perry, & Silvera, 2005), suggesting that impulsivity may play a role in both the purchase and consumption of unhealthy high-calorie snack foods.

Priming methods have been extensively used in social cognition research, and brief implicit priming tasks targeting attitudes, traits, constructs, and stereotypes have been shown to have wide ranging effects on behaviour (Bargh, Chen, and Burrows, 1996; Bargh, Gollwitzer, Lee-Chai, Barndollar, & Trotschel, 2001). One of the methodological benefits of priming is that with random assignment to prime condition, researchers can better clarify the causal relationship between a particular construct and behaviour, without the potential confound of extraneous variables inherent in measured variables. In addition, demand characteristics may be minimized due to the participant being unaware of the particular construct being primed. To elucidate the causal link between impulsivity and eating behaviour, several studies have successfully induced impulsivity, showing that priming impulsivity leads to increased calorie intake in laboratory conditions (Guerrieri, Nederkoorn, Schrooten, Martijn, & Jansen, 2009, Guerrieri, Nederkoorn, & Jansen, 2012).

Impulsivity in relation to snack food consumption and unhealthy dietary patterns has been associated with the motivation to regulate negative affectivity (Sproesser, Strohbach, Schupp, & Renner, 2011), and emotional eating is highly associated with BMI (Clum, Rice, Broussard, Johnson, & Webber, 2013). In two studies predicting snack food consumption, the impulsivity dimension of Negative Urgency - referring to the tendency to act on impulse

when distressed or under intense negative emotional affectivity - predicted snack food consumption over and above the other Theory of Planned Behaviour variables, whereas the impulsivity dimensions of lack of Premeditation, Sensation Seeking, and lack of Perseverance, did not (Churchill & Jessop, 2008; 2011). Negative Urgency is suggested to play a key role in the prediction of binge-eating disorders (Cyders et al., 2007), and interventions which aim to improve self-regulation by introducing planning strategies to avoid eating high-calorie snacks have been found to be ineffective for those with high levels of Negative Urgency (Churchill & Jessop, 2010), particularly when emotional activation is high (Burkard, Rochat, & Van der Linden, 2013).

Impulsivity has been closely linked to temporal discounting, described as the tendency to discount the value of an outcome due to a delay in its occurrence (de Wit et al., 2007; Mobini et al., 2007; McLeish & Oxoby, 2007). Assessments of temporal discounting often require participants to choose between a smaller, immediate reward, and a larger reward gained after a specified delay (e.g., £1 now or £5 after two weeks). Although a large amount of research reports a general tendency for diminished value to be placed on distant-future reward as oppose to near-future reward (see Trope & Liberman, 2010), individuals high in impulsivity have been shown to display greater temporal discounting than individuals low in impulsivity, and have a greater preference for immediate rewards rather than larger delayed rewards (de Wit et al., 2007). Temporal discounting has been found to be associated with a wide range of behaviours including unhealthy eating habits (Appelhans et al., 2012; Daugherty & Brase, 2010) and has been found to be more prevalent in obese individuals (Weller, Cook, Avsar, & Cox, 2008). This poses a challenge for health promotion strategies which focus on educating people about the consequences of their lifestyle choices, as people with greater temporal discounting may prefer the immediate reward gained from eating a tasty snack over the long term benefit of weight management (see Hall & Fong, 2010).

Given that impulsive individuals display temporal discounting, health promotion information which details long term health consequences is unlikely to be persuasive. For impulsive individuals, immediate reward is likely to be more tempting than long-term consequence. Temporal framing, which changes the context of information to specify the time frame in which a consequence is likely to occur, has been suggested to be one method to counter the effects of temporal discounting (see Trope & Liberman, 2010). Temporal framing effects have been found to be moderated by trait measures of time perspective. For example, research has found that individuals with low consideration of future consequences are more persuaded to engage in screening behaviour by a message detailing positive outcomes occurring in the short-term vs. the long term (Orbell, Perugini, & Rakow, 2004). It is likely that this effect is similar for people with high levels of impulsivity, given the negative association between these two characteristics (Joireman, Andreson, & Strathman, 2003; Joireman, Sprott, & Spangenberg, 2005). Although temporal framing effects have been found for health screening behaviours (Orbell & Hagger, 2006; Orbell, Perugini, & Rakow, 2004), sunscreen use (Orbell & Kyriakaki, 2008), binge drinking (Gerend & Cullen, 2008, Churchill, Pavey, Jessop, & Sparks), and fruit and vegetable consumption (Lo et al., 2012) no research to date has examined the moderating role of impulsivity on temporal frame in a health promotion context or for eating behaviour.

The current study aimed to determine whether both Negative Urgency and primed impulsivity moderates the effect of temporal framed information about the health consequences of snack food consumption. We predicted that for participants with a higher level of Negative Urgency, or for those who were primed with impulsivity, information about the immediate outcomes of avoiding high-calorie snack consumption would be more effective in reducing snacking behaviour, compared to information detailing long-term consequences. The current study utilized an experimental manipulation of impulsivity (a

priming task), in addition to a self-reported measure of Negative Urgency (Whiteside & Lynam, 2001).

Method

Design

The study employed a quasi-experimental, prospective design with data collected over two time points. There were three independent variables: one measured (Negative Urgency) and two manipulated (Prime: Impulsivity vs. Neutral; Frame: Immediate vs. Long-term health consequences). Participants were randomly allocated to one of the four experimental conditions using an online randomization procedure. The dependent variable was participants' self-reported frequency of snack consumption over seven days.

Participants

Participants were 164 psychology undergraduate students (135 females) aged between 18 and 47 (M = 19.81, SD = 3.75) who participated in the research as part of their course requirements. Of the 164 participants who completed the baseline measures, 110 participants completed the time 2 questionnaire (representing a 32.92% drop out rate). There were no significant differences in baseline snacking, Negative Urgency, age, or gender between those who completed the baseline measures and those who completed both parts of the study (all ps > .10).

Materials

Baseline snacking behavior. Following Churchill, Good, and Pavey (2014), snacking behavior was measured with the single-item: "How many high-calorie snacks have you eaten in the past 7 days? This can include chocolate, crisps, cake, pastries, biscuits, and other unhealthy sweet or savoury snacks."

Negative Urgency. Negative Urgency was measured using the Negative urgency subscale of the UPPS Impulsive Behavior scale (Whiteside & Lynam, 2001). This consisted of 12 items

(e.g., "I have trouble controlling my impulses") with responses on a 1-4 scale from 'strongly disagree' to 'strongly agree' (α = .85).

Impulsivity Prime

Impulsivity was primed using a sentence unscrambling task. In both the Impulsivity Prime and Neutral Prime conditions, participants were given a list of 15 sets of five words, and for each set were asked to make a sentence out of four of the five words (e.g., I door act impulse on = I act on impulse). In the Impulsivity Prime condition, 8 of the 15 sentences contained words related to impulsivity (e.g., impulsive, spontaneous, and hasty). In the Neutral Prime condition all words were unrelated to impulsivity (e.g., book, table, and coffee).[1]

Temporal Frame

Participants were presented with information about either the immediate (or long-term) health benefits of avoiding eating high-calorie snacks: "*Evidence suggests that people who avoid eating high calorie snacks, compared to those that do not, are at lower immediate (long-term) risk of many serious life-threatening diseases. For example, research shows that if you avoid eating high calorie snacks, you can lower your immediate (long-term) risk of: heart disease and stroke; high blood pressure; high cholesterol; type 2 diabetes; and cancers (e.g., bowel cancer). You can also gain potential immediate (long-term) health benefits by avoiding eating high calorie snacks, for example: healthy looking skin and hair; healthy weight; increased energy and vitality; improved physical stamina; and improved concentration on mental tasks. Avoiding eating high calorie snacks can improve your health today (in the future)!*"

Time 2 snacking behavior

Time 2 snacking behavior was measured using the same item as at baseline.

Procedure

At Time 1, participants completed an online questionnaire with measures of age, gender,

baseline snacking behavior, and Negative Urgency during a scheduled class in groups of 15-20. Following these measures, the online questionnaire randomly assigned participants to complete the impulsivity prime or neutral prime task, and read the information about immediate or long term health risks of excessive high calorie snack consumption. One week later during the same class, participants were asked to complete the second questionnaire which asked participants to record their snacking behavior over the previous 7 days. Informed consent was obtained prior to participation.

Results

Random assignment to condition was shown to be successful, with no differences in baseline snacking, age, or gender between conditions (all *p*s > .10). Means, standard deviations, and bivariate correlations for all measured variables are shown in Table 1. Of note, there was a marginally significant bivariate correlation between Negative Urgency and baseline snacking behaviour, $r(165) = .15$, $p = .060$, suggesting that higher Negative Urgency was associated with greater snacking frequency at baseline.

Table 1. Means, standard deviations, and bivariate correlations for all measured variables (N = 96).

	Mean	SD	2	3	4
1. Negative Urgency	2.46	0.43	.15ǂ	.15	.04
2. Baseline Snacking	7.04	5.23	-	.55**	-.17*
3. Time 2 Snacking	5.13	3.89		-	-.14
4. Age	20.02	4.07			-

ǂ p = .06, * $p < .05$, ** $p < .01$

To test our main hypotheses, the data were analysed using a three-way moderated regression analyses with continuous and categorical predictor variables (Aiken & West, 1991). All variables were standardized prior to data analysis and interactions formed from the standardized variables, to ensure the correct standardized solution was obtained (Friedrich, 1982). Participants' age, gender and baseline snacking behaviour were entered as covariates at Step 1. At Step 2, the three predictor variables of Prime (Impulsivity vs. Neutral), Frame (Immediate vs Long-term), and Negative Urgency (continuous) were entered. At Step 3, the three two-way interactions were entered, and at Step 4, the three-way interaction was entered. The dependent variable was participants' self-reported snacking at Time 2. Interactions were analysed using the simple slopes procedure detailed by Aiken and West (1991), with high and low levels of Negative Urgency referring to +1 and -1 SD from the mean respectively.

Estimated Mean values of Time 2 snacking in each condition for high and low Negative Urgency participants are displayed in Figure 1. The results of the regression analysis are displayed in Table 2. There were no significant main effects of the predictor variables on snacking behaviour (Step 2). However, all two-way interactions were significant (Step 3). These two-way interactions were further qualified with a significant three-way interaction (Step 4). The final model accounted for 42% of the variance in snacking behaviour (adjusted $r^2 = .42$).

Figure 1. Estimated Means of Time 2 snacking behaviour in each condition for participants with high (+1SD) and low (-1SD) levels of Negative Urgency, controlling for age, gender, and baseline snacking behaviour.

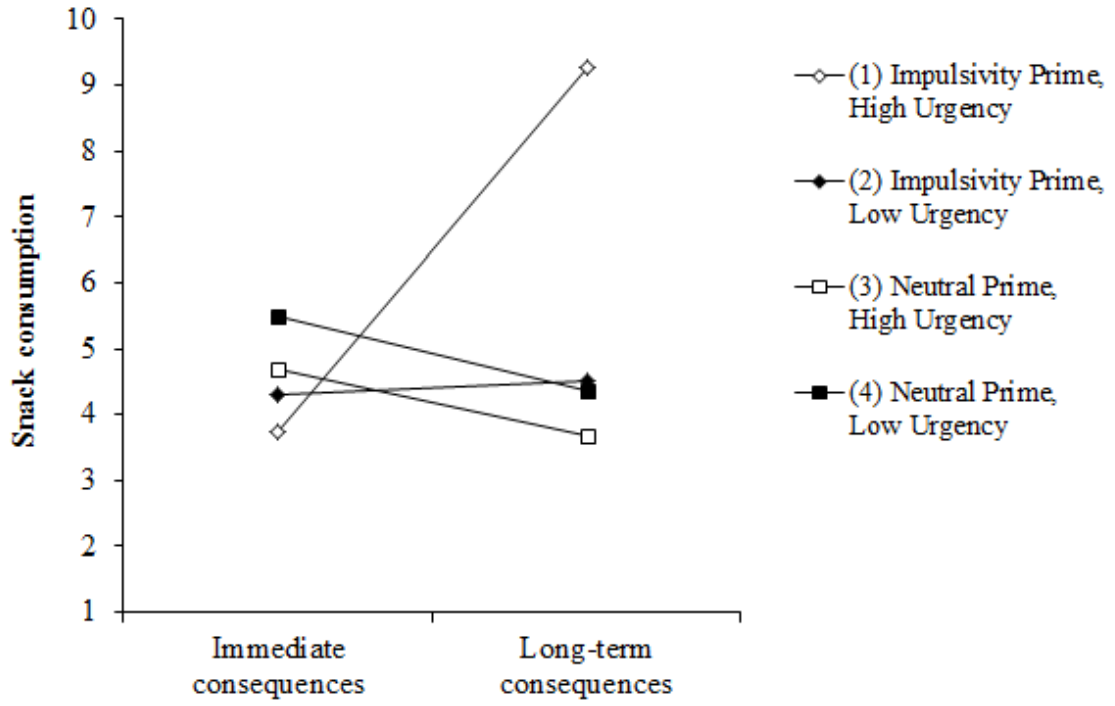

Table 2. Moderated regression analysis predicting the frequency of high-calorie snack consumption at Time 2, with standardized Beta coefficients.

	Step 1		Step 2		Step 3		Step 4	
	B	*t*	*B*	*t*	*B*	*t*	*B*	*t*
Age	-.09	-1.03	-.10	-1.07	-.08	-.90	-.10	-1.21
Gender	.03	0.30	.02	0.21	-.02	-.25	-.03	-0.34
Time 1 Snacking Behaviour	.55	6.64**	.54	6.43**	.54	6.68**	.53	6.65**
Negative Urgency			.09	1.02	.08	.93	.12	1.45
Frame			.12	1.41	.13	1.71	.12	1.61
Prime			.12	1.41	.13	1.64	.13	1.72
Negative Urgency x Frame					.18	2.13*	.15	1.88
Prime x Frame					.25	3.25**	.26	3.43**
Negative Urgency x Prime					.18	2.11*	.16	1.89
Negative Urgency x Prime x Frame							.17	2.00*
Change R^2	.29**		.31		.40**		.42*	

* $p < .01$ ** $p < .001$

Investigation of the Frame x Prime interaction revealed a significant effect of Frame among participants primed with impulsivity (B = 0.34, t = 3.35, p = .001) such that those in the immediate health consequences condition ate fewer snacks than those in the long-term health consequences condition. There was no significant effect of Frame for those in the neutral prime condition (B = -0.17, t = -1.41, p = .162). Investigation of the Frame x Negative Urgency interaction revealed a significant effect of Frame for participants high in Negative Urgency (B = 0.31, t = 2.66, p = .009), such that those given the information about immediate health consequences ate fewer snacks than those given information about long-term health consequences. There was no significant effect of frame for those with low levels of Negative Urgency (B = -0.04, t = -0.39, p = .696). Investigation of the Prime x Negative Urgency interaction showed a significant effect of Prime for those high in Negative Urgency (B = 0.31, t = 2.62, p = .010), such that those participants primed with impulsivity ate a greater number of snacks than those given the neutral prime. There was no effect of Prime for those low in Negative Urgency (B = -0.06, t = -0.50, p = .620).

Analysis of the three-way interaction showed that the Frame x Prime interaction was significant for participants high in Negative Urgency (B = 0.43, t = 3.66, p < .001) but not for those low in Negative Urgency (B = 0.09, t = 0.86, p = .391). Further investigation revealed a significant effect of Frame among high Negative Urgency participants primed with impulsivity (B = 0.51, t = 3.91, p < .001) such that those in the immediate health consequences condition ate fewer snacks than those in the long-term health consequences condition. There was no significant effect of Frame for those in the neutral prime condition (B = -0.17, t = -1.41, p = .162).

Discussion

The results revealed that participants who were primed with impulsivity, and/or those with high individual levels of Negative Urgency, tended to consume fewer snacks when

given health information about immediate consequences of snacking compared to when long-term health consequences of snacking behaviour were made salient. The findings suggest that highlighting immediate health consequences may be a useful strategy for reducing the frequency of snack consumption among highly impulsive individuals. Further to this, the research found that both individual differences in Negative Urgency and experimentally manipulated impulsivity interacted to result in greater snacking behaviour when long-term consequences were highlighted.

Traditional models of health behaviour have tended to use reflective variables such as attitudes, social norms, and intentions to predict action (e.g., Branscum & Sharma; 2014; Mesters & Oostveen; 1994). Following these models, health promotion information often attempts to change attitudes and social norms, or use strategies aimed bolstering the link between intentions and behaviour (e.g., Robinson et al., 2013). However, for some health behaviours (such as the frequency of snack food consumption), non-reflective components such as Negative Urgency are likely to play a large role in determining action (Churchill & Jessop, 2011; Honkanen et al., 2012). Previous research confirms a link between impulsivity and unhealthy eating patterns (French et al., 2012; Guerrieri, et al., 2009; Guerrieri et al., 2012, Jasinska et al., 2012) and in particular, has shown Negative Urgency to be predictive of snack food consumption over and above variables such as attitudes, subjective norms, and intentions (Churchill et al., 2008; Churchill & Jessop, 2011). The current research builds on these findings, and suggests that those most likely to engage in snacking behaviour (and least likely to reduce snack consumption) are those who both have high dispositional levels of Negative Urgency and who are primed with impulsivity (i.e., who have impulsivity made cognitively salient).

Further to this, the research suggests that emphasizing the long-term consequences of snacking behaviour is ineffective for individuals who have high levels of Negative Urgency

or who are primed with impulsivity, and that by highlighting the immediate consequences of consuming high-calorie snacks, frequency of consumption can be reduced. This supports previous literature which has found that temporal framing can influence the effectiveness of information about other health behaviours (e.g., Orbell & Hagger, 2006; Orbell & Kyriakaki, 2008; Orbell, et al., 2004; Trope & Liberman, 2010), and suggests that making health consequences more temporally proximal to individuals is particularly important for those high in Negative Urgency. This is likely due to the delay-discounting tendencies characterized by impulsive individuals (de Wit et al., 2007; McLeish & Oxoby, 2007; Mobini et al., 2007).

Although the research shows promising results, and suggests that temporal framing may be one method for increasing information effectiveness for highly impulsive individuals, there are some limitations to consider. For example, the current sample consisted of undergraduate student participants who were mostly female. Further research is needed to replicate the results with a non-student sample, and to examine whether the results were similar depending on BMI, a variable that was not measured in this study. The study also only examined a single item, self-reported measure of snacking behaviour, and change was only assessed over a seven day period. Although the single item dependent measure has been used in previous research (e.g., Churchill et al., 2014), the measure has not been specifically tested in terms of reliability and validity. Further research could usefully include other measures of snacking behaviour (for example, a diary method) to ensure the reliability of results, and assess behaviour change over a longer period. There is also the potential for the self-report measure to be effected by demand characteristics, particularly as snacking may be deemed as an undesirable behaviour. However, participants were asked to respond to all questions honestly and were assured that their data would remain confidential, in an attempt

to reduce these effects. In addition, any effects would have influenced participants in all conditions equally and are unlikely to have influenced the results of our analysis.

The research used an experimental manipulation of impulsivity, important for elucidating causal effects. In addition to the methodological benefits of using an experimental task, priming impulsivity may mimic environmental cues that encourage impulsive purchase and consumption, or activate innate impulsive tendencies leading to greater snack food consumption. Further exploration of the effects of priming impulsivity could be usefully explored in further research. Despite limitations, the research is the first to show that information highlighting the immediate benefits of avoiding snacking is more effective than information detailing long-term benefits when individuals have high levels of Negative Urgency or when impulsivity is made salient. This is of particular importance, given that impulsivity has been found to be associated with greater snacking behaviour, unhealthy eating habits, and obesity (see French et al., 2012). If health promotion information to reduce unhealthy snacking is to be effective, the influence of impulsivity on snacking behaviour should be acknowledged, and the design of health information adapted accordingly.

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1. The impulsivity prime was piloted in an earlier study ($N = 22$). Student participants completed either the Impulsivity Prime or Neutral task, and were asked to complete a stem-completion task with 8 partially formed words of which 4 could be completed to give a word related to impulsivity. Participants in the Impulsivity Prime condition completed a greater number of words related to impulsivity ($M = 2.55$) than Neutral condition participants ($M = 1.45$), $t(20) = 2.36$, $p = .028$, suggesting that the manipulation was successful