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Resisting Temptation of Unhealthy Food: Interaction Between Temptation-elicited Goal Activation and Self-control

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Abstract

Counteractive control theory suggests that the cognitive accessibility of a goal in response to a temptation cue predicts self-regulation of behaviour consistent with that goal. The current study provided a novel test of this effect in the eating domain, exploring the moderating role of trait self-control. A sample of 124 women (18-25 years) completed a lexical decision task to assess cognitive accessibility of the weight-management goal after food temptation priming. Eating self-regulation was operationalised as unhealthy snack food intake measured in a task disguised as a taste-test. Participants completed trait self-control and temptation experience intensity measures. Cognitive accessibility predicted lower food intake, but only among high self-control participants. The relationship was mediated by temptation experience intensity: participants with high cognitive accessibility felt less tempted, and subsequently ate less food. Results suggest that changing the processes underlying the temptation experience, rather than the cognitive accessibility of a goal may more effectively enhance self-regulation among low self-control individuals.

Keywords: counteractive control theory; weight-management goal; self-regulation; self-control; food intake

Resisting Temptation of Unhealthy Food: Interaction Between Temptation-elicited Goal Activation and Self-control

Although once assumed a potent influence on behaviour, there is substantial evidence to suggest that between 58 and 95% of variance in dietary behaviour is left unaccounted for by intentions alone (e.g., Armitage & Conner, 1999; Carels et al., 2001; Conner, Norman, & Bell, 2002; Dholakia, 2000; Hall & Fong, 2007; Sheeran, 2002). Understanding the mediators of the relationship between intention and eating behaviour is an important direction for research, and has been the focus of recent theoretical models of health and motivational behaviour.

According to one such theory, counteractive control theory, situational cues can undermine intentions to achieve long-term goals (Trope & Fishbach, 2006). For example, healthy eating intentions can be difficult to follow because eating unhealthy food is immediately rewarding (Cohen & Farley, 2008). Highly palatable, energy dense food offers a temptation for individuals wanting to manage weight through healthy eating, because the immediately rewarding behaviour of eating it conflicts with the longer-term, higher order goal of successful weight management (Fishbach, Friedman, & Kruglanski, 2003). Counteractive control theory proposes that cognitive and behavioural strategies can increase intention-behaviour consistency to serve higher-order weight management goals (Fishbach et al., 2003; Trope & Fishbach, 2006). These counteractive control strategies are enacted in response to temptation cues, which are stimuli offering immediate reward but which threaten longer term goals (Fishbach et al., 2003).

One counteractive control strategy is temptation-elicited goal activation (Fishbach et al., 2003). When an individual is faced with a temptation cue that threatens the attainment of a goal, a mental representation of that goal concept is activated. According to Kruglanski et al. (2002), goals are cognitive – they are represented in conceptual nodes in a semantic network

and can be activated intentionally, or by environmental cues (Bargh & Chartrand, 1999, 2000). Different goals compete for resources to become realised, and the cognitive activation of a goal allows cognitive resources to be concentrated into processes that facilitate pursuit of that goal (e.g., evaluation of objects in the environment in a way that facilitates approach behaviour towards goal-facilitative and avoidance of goal-threatening stimuli, Ferguson & Bargh, 2008; Fishbach et al., 2003; Kruglanski et al., 2002). Literature on goal-priming supports this link between goal activation and goal-consistent behaviour. For example, when individuals are exposed to words associated with a goal (e.g., success), their subsequent behaviour is more likely to be consistent with that goal (i.e., performance on an intellectual task is enhanced; Bargh, Gollwitzer, Lee-Chai, Barndollar, & Troetschel, 2001). Therefore, cognitively associating a temptation cue with an incompatible longer-term goal is thought to facilitate effective self-regulation of behaviour in response to that temptation (Bargh & Chartrand, 1999; Bargh et al., 2001).

Support for the role of temptation-elicited goal activation in successful self-regulation of eating comes from a study by Fishbach et al. (Study 4, 2003). A lexical decision task was used to measure the cognitive accessibility of a weight management goal concept following the presentation of temptation-related words. Each trial of the lexical decision task subliminally presented a prime word, either a temptation word relevant to the goal of weight management (e.g., “cake”), or an irrelevant temptation word (e.g., “sex”). This was quickly followed by a probe word, either related to the goal of weight management (e.g., “diet”), a neutral word (e.g., “card”), or a non-word letter string (e.g., “grov”). Participants completed trials with all possible combinations of prime and probe word types, and were asked to indicate whether the probe was a word or non-word letter string. Shorter response latencies on trials with a food prime (as opposed to an irrelevant prime) followed by a weight-management probe indicated higher cognitive accessibility, and therefore, activation of

weight-management goals in response to temptation word cues. Among participants who rated the goal of weight management as highly important, the relationship between food priming and higher cognitive goal accessibility was moderated by perceived self-regulatory success, that is, participants who reported being successful at weight management showed higher cognitive goal accessibility in response to relevant temptation primes than unsuccessful self-regulators. These results suggest that temptation-elicited goal activation is more prominent among those who perceive themselves as successful at self-regulating their behaviour in line with their goal.

Papies, Stroebe, and Aarts (2008) similarly found that participants with a concern for dieting and high self-reported self-regulatory success identified goal-related concepts quicker when following a temptation-related prime than when they followed a neutral prime word in a lexical decision task. To the contrary, participants with a concern for dieting but low self-regulatory success responded slower to the goal probe when it followed the temptation prime compared to when it followed a neutral prime. This study therefore provides further evidence for the relationship between higher goal accessibility and perceived successful self-regulation.

Both Fishbach et al. (2003) and Papies et al. (2008) used the Perceived Self-Regulatory Success Scale to measure self-regulatory success. The scale items ask participants about their perceived progress towards a goal of weight management (e.g., difficulty staying in shape, success at losing weight), but do not refer to self-regulatory behaviours themselves. Thus, although higher scores on this scale are associated with lower body mass index (BMI; Papies et al., 2008), responses to the items may not only reflect an individual's ability to self-regulate behaviour. Instead, responses could be affected by various extraneous factors including personal weight standards, body dissatisfaction, or biology, or could more

accurately reflect self-efficacy regarding weight management than actual self-regulatory success.

More recent studies that have measured actual self-regulatory behaviour, rather than perceived progress toward the goal of weight management provide further evidence for the relationship between temptation-elicited goal activation and successful self-regulation of eating (Kroese, Adriaanse, Evers, & De Ridder, 2011; Van Koningsbruggen, Stroebe, Papies, & Aarts, 2011). These studies operationalized self-regulatory behaviour as the intake of unhealthy food assessed by self-report snack diaries. For example, Van Koningsbruggen et al. (2011) found that training weight-concerned individuals to formulate and practice implementation intentions (i.e., practicing the phrase – "The next time I am tempted to eat chocolate, I will think of dieting"), increased cognitive accessibility of the goal of dieting in response to food temptation cues, and decreased reported unhealthy snack intake. Kroese et al. (2011) found that a similar intervention increased cognitive goal accessibility in response to a temptation cue (i.e., the word 'chocolate'), which in turn predicted lower chocolate intake. These findings build upon previous evidence linking temptation-elicited goal activation and eating self-regulation by assessing behaviour rather than perceived goal progress.

Self-report snack diaries provide ecologically valid information about eating behaviour outside of the laboratory. However, they allow participants to exert deliberate control not only over their food intake, but also over their exposure to unhealthy food stimuli. Therefore, they reflect not only an individual's ability to limit intake when immediately faced with unhealthy food, but also the ability to deliberately limit exposure to certain foods (e.g., choosing not to purchase chips while grocery shopping so it is not available for subsequent consumption). To our knowledge, the relationship between cognitive goal accessibility and intake of unhealthy foods when exposure to those foods is not under personal control has not

been examined. It is nevertheless important to do so, because individuals trying to manage their weight by limiting intake of unhealthy food will inevitably be faced with immediate opportunities to indulge in unhealthy food, either when control over exposure to those foods is not available or is impractical (e.g., unhealthy snacks offered at a social function), or when attempts at limiting exposure has failed (e.g., unhealthy snacks are available for consumption in the pantry at home). The current study therefore aimed to test the relationship between cognitive goal accessibility and intake of unhealthy snack food measured using a laboratory-based taste-test. All participants were offered the same amount of food under the same conditions, and asked to taste and rate the foods on several scales. To minimise demand effects, the true purpose of the task (i.e., measurement of intake) was not revealed.

Previous studies have assessed the cognitive accessibility of goal concepts in response to pictures or words representing food temptations. The current study sought to add to this research by investigating cognitive goal accessibility in response to a more ecologically valid temptation cue. Specifically, participants were told that they would be presented with unhealthy snack foods to taste as part of the experiment. Therefore, they would have anticipated a real temptation that threatened their goal of healthy eating for weight management, and one that would be expected to elicit counteractive control.

Cognitive accessibility is proposed to facilitate goal-consistent behaviour by affecting the processing of relevant environmental stimuli. This mechanism was demonstrated by Ferguson (2008), who found that with enhanced cognitive goal accessibility, individuals systematically evaluate goal-relevant stimuli in a way that facilitates successful goal pursuit. This evaluation pattern is proposed to encourage avoidance of goal-threatening stimuli, and approach of goal-facilitative stimuli (Ferguson & Wojnowicz, 2011). For instance, when the goal of weight management is highly cognitively accessible, individuals should evaluate goal-threatening stimuli (e.g., unhealthy snack food) as less attractive, and goal-facilitative

stimuli (e.g., exercise or healthy food) as more attractive, than when cognitive goal accessibility is low. However, an individual's automatic evaluations of unhealthy food could affect the extent to which they feel tempted to indulge in unhealthy food (Hofmann & Van Dillen, 2012). The current study therefore also assessed participants' ratings of the extent to which they experienced temptation or desire to indulge in the unhealthy snack food presented to them. We expected to find results consistent with Ferguson, namely, that higher cognitive goal accessibility would be associated with lower experienced temptation to indulge in the snack food. As positive evaluations of unhealthy food have been found to predict intake of that food (e.g., Ayres, Prestwich, Conner, & Smith, 2010; Hofmann, Gschwendner, Friese, Wiers, & Schmitt, 2008; Richetin, Perugini, Prestwich, & O'Gorman, 2007), we also expected that the experience of temptation would predict snack food intake. Additionally, based on findings of Ferguson (2008) that cognitive goal accessibility predicted goal-consistent evaluations of stimuli (i.e., more positive evaluations of goal-facilitative stimuli), we predicted that the experience of temptation would mediate the relationship between cognitive accessibility and snack intake.

Ferguson (2008) furthermore found that high cognitive goal accessibility activated goal-facilitative evaluations to a greater extent for individuals with high self-control, or skill, in the relevant behavioural domain than for those with low self-control. For example, when primed with a diet-related goal, only individuals with high skill (i.e., high dietary self-control) evaluated goal-facilitative stimuli (e.g., 'vegetables', 'salad', 'gym') as more positive. Self-control refers to the ability to control behaviour and act in accordance with longer-term intentions (Carver, 2005; De Ridder, Lensvelt-Mulders, Finkenauer, Stok, & Baumeister, 2012; Hoch & Loewenstein, 1991; Tangney, Baumeister, & Boone, 2004). While Ferguson's findings suggest that self-control moderates the relationship between cognitive goal accessibility and goal-consistent evaluation, the role of trait self-control in the

relationship between cognitive goal accessibility and goal consistent behaviour (e.g., snack intake) has yet to be explored. Based on Ferguson's findings regarding the influence of cognitive goal accessibility on evaluative processes related to the successful regulation of eating behaviour, we predicted that cognitive accessibility of the weight-management goal would have a stronger influence both on the experience of temptation to indulge in snack food, and also on the intake of that food, for individuals with high self-control than for those with low self-control.

Method

Participants

One hundred and twenty-four women between the ages of 18 and 25 years (M = 20.45, SD = 2.29) were recruited from Flinders University. Forty-eight first-year psychology student volunteers participated for course credit, and the remaining paid volunteers received a $15 honorarium. The mean BMI of the sample was 22.81 (SD = 3.64), which is classified as in the healthy weight range. The study advertised for individuals motivated to manage their body weight by avoiding unhealthy foods, as Fishbach et al. (2003) suggest that motivation is necessary for individuals to enact counteractive control processes. Also, only women were recruited into the study, as they have higher levels of liking and craving for food than men (Coelho, Jansen, Roefs, & Nederkoorn, 2009; Fishbach et al., 2003; Harderwijk, 2010; Kroese et al., 2011; Van den Bos, 2011).

Materials

Cognitive accessibility of the weight management goal. Following previous research (Fishbach et al., 2003; Kroese et al., 2011; Papies et al., 2008), a computer-administered lexical decision task was used to test the cognitive accessibility of the weight management goal-related concept. Trials consisted of a fixation point (+) that remained on the screen for 2 seconds, followed by a target letter string. Participants were asked to indicate

as quickly and accurately as possible whether the preceding letter string was a word (by pressing the ‘z’ key) or non-word (by pressing the ‘/’ key). The word types included goal-related words, neutral words, and non-words. The keys designated to ‘word’ and ‘non-word’ responses were counterbalanced between participants. Following Fishbach et al. (2003), the task began with 10 practice trials consisting of an equal number of words and non-words, followed by 3 buffer trials, and then the experimental task consisting of 192 trials. Only reaction times to the words in the experimental trials were analysed.

The experimental stimuli consisted of four goal-related words (i.e., diet, slim, thin, and weight) repeated four times each and selected from those used in previous studies of a similar nature (e.g., Fishbach et al., 2003; Kroese et al., 2011; Papies et al., 2008). Neutral words were matched with goal-related words on word type (i.e., noun, adjective), and number of letters, phonemes, and syllables using the MRC Psycholinguistic Database (Coltheart, 1981). Five words that were closest to each goal-related word in relation to indices of frequency, concreteness, familiarity, imageability, and meaningfulness (where available) were identified for use as neutral words. For each group made up of one goal-related and five neutral words, six non-words of equivalent letters and phonemes were selected from the ARC Nonword Database (Rastle, Harrington, & Coltheart, 2002). This resulted in a set of 24 words, and 24 non-words. To replicate Fishbach et al.’s (2003) methodology, each goal-related word trial was repeated four times, to make up the total of 192 trials.

Only correct responses with a reaction-time greater than 300ms and less than 3000ms were included in the final analysis, which resulted in the exclusion of 0.7% of responses (Bargh & Chartrand, 2000). Trimmed scores were also subject to a natural log transformation to reduce positive skew typical of reaction time data (Bargh & Chartrand, 2000). The cognitive accessibility of the goal-related concept for each participant was operationalised as their response time (RT) to goal-related words relative to neutral words (cognitive

accessibility = *M* RT neutral – *M* RT goal-related), with higher values indicating greater accessibility of goal concepts relative to neutral.

Snack intake. Snack intake was measured using a taste test (e.g., Coelho et al., 2009). Four bowls were filled with pre-weighed popular energy-dense snack foods, so that they each appeared equally full. The foods included 80g of M&Ms (Mars, 2050 kilojoules [kJ]/100g), 30g of original salted chips (Smiths, 2190kJ/100g), 30g of Cheese Twisties (Smiths, 2080kJ/100g), and 80g of mini choc-chip cookies (White Wings, 1959kJ/100g). The placement order of the food bowls from left to right was counterbalanced across participants using a Latin square procedure with four orders. Accompanying each bowl was a 6-item paper-pencil format rating sheet asking participants to rate various sensory attributes of the foods (e.g., "How sweet is this product?"). Ratings were recorded on a 100mm visual analog scale, with anchors labelled as "*not at all*" and "*extremely*". Participants were given 10 minutes to taste as much of the food as they needed to rate the foods accurately while the experimenter was out of the room. The weight of each bowl was recorded after the taste test and compared to the pre-test weight to determine intake of each food in grams. Intake is reported in kilojoules (kJ), derived from multiplying intake in grams by the number of kJ per gram for each food.

Temptation to indulge in unhealthy snacks. Participants were asked: "How much were you tempted to eat the [Twisties/chips/cookies/M&Ms] presented in the taste-test?" Responses were collected on a 7-point Likert scale ranging from 1 (*not at all*), to 7 (*extremely*) for each of the four foods. A 'temptation' score was obtained by averaging the responses to each of the four foods.

Trait self-control. The 36-item Self-control Scale (SCS) assesses the domain-general ability to interrupt or override a dominant behavioural tendency in order to serve a higher-order goal (e.g., "I refuse things that are bad for me", Tangney et al., 2004). Participants

indicate the extent to which each statement represents them, on 5-point Likert scales ranging from 1 (*not at all like me*), to 5 (*very much like me*). Higher scores indicated higher levels of trait self-control. Internal consistency coefficient alpha for the SCS was acceptable in the current study, Cronbach's *a* = .78; and similar to that reported in previous research, Cronbach's *a* = .89 (Tangney et al., 2004).

Motivation. In addition to recruiting only those motivated to manage weight through healthy eating, the extent to which participants were motivated to do this was measured using a 4-item self-report scale (e.g., "I choose certain food items to avoid gaining weight", Sproesser et al., 2011). The scale requires participants to indicate the frequency of each behavioural statement on 5-point Likert scales, ranging from 1 (*never*), to 5 (*always*). An average motivation score was calculated, with higher scores indicating higher motivation to regulate eating for weight management. The scale's internal-consistency coefficient alpha was acceptable in the current study, Cronbach's *a* = .89; and consistent with previous research, Cronbach's *a* = .89 (Sproesser, Strohbach, Schupp, & Renner, 2011).

Hunger. Participants were asked: "Please indicate the place on the scale which best reflects your current level of hunger". Responses were measured on a 7-point Likert scale ranging from 1 (*not hungry at all*), to 7 (*extremely hungry*).

Procedure

Participants completed the experiment individually in a quiet room in the Applied Cognitive Psychology Laboratory. Each session ran for approximately 30 minutes. Participants were informed that the experiment was investigating the relationship between eating styles and sensory perception. As a temptation prime, participants were informed that the tasks included tasting and rating different unhealthy snack foods. Thus, they were made aware that they would be faced with a food temptation. To control for hunger levels, participants were asked to eat something 2 hours before their scheduled session, and to

refrain from eating again until the experiment. On arrival, participants reported their hunger and then completed the lexical decision task and taste test. They were then asked to complete measures of temptation to indulge in unhealthy snacks, trait self-control, and motivation; and to disclose background information, including age, height and weight.

Results

Correlations Between Cognitive Accessibility, Snack Intake, Temptation Experience, Self-Control, Motivation, and Hunger

Correlation analyses explored the relationships between variables. Descriptive statistics are presented in Table 1. As predicted, higher temptation to indulge was significantly correlated with lower cognitive accessibility, r = -.22, p =.02, and significantly correlated with higher snack intake, r = .41, p <.001. However, contrary to predictions, cognitive accessibility and intake were not significantly correlated, r = -.14, p = .12, and neither were cognitive accessibility and self-control, r = .04, p =.66. Hunger was significantly positively correlated with intake, r = .21, p =.02, and with temptation, r = .33, p <.001[1]. Finally, motivation was not significantly correlated with either self-control, r = -.02, p =.84, or cognitive accessibility, r = -.02, p =.81, indicating that neither trait self-control nor cognitive accessibility simply reflected motivation to manage weight through healthy eating or importance of the goal of weight management. No other correlations were significant.

Moderation Analyses

The SPSS macro PROCESS (Hayes, 2012) was used to test whether self-control moderated the effect of cognitive accessibility on both snack intake and temptation to indulge in unhealthy snack foods. The predictors (cognitive accessibility and self-control) were first regressed on the outcome variable (snack intake or temptation to indulge), and then the interaction term (product of the predictors) was added to the model. If the interaction term

[1] Controlling for hunger did not change the statistical significance of any of the analyses in the Results section. Therefore, results of analyses without controlling for hunger are reported.

resulted in a significant increase in variance explained, this indicated a significant moderation effect. To further explore significant moderation models, simple slopes were estimated at plus ("high") and minus ("low") one standard deviation from the sample mean for self-control. These values showed the estimated strength of the effect of cognitive accessibility on snack intake and temptation to indulge at each level of self-control.

Moderating role of trait self-control in the cognitive accessibility – snack intake relationship. Cognitive accessibility was a significant predictor of snack intake, B = -1228.52, $t(120)$ = -2.49, p = .02, but self-control did not significantly predict intake, B = 4.72, $t(120)$ = 0.89, p = .38. In addition, the relationship between cognitive accessibility and snack intake differed according to levels of trait self-control. This is based on the observation that the interaction term (product of cognitive accessibility and self-control) emerged as a significant predictor of snack intake, B = -108.07, $t(120)$ = -2.49, p = .01, and resulted in a significant increase in snack intake variance explained with the predictors already in the model, R^2 *change* = .05, *F change* (1, 120) = 6.22, p = .01. As displayed in Figure 1, the relationship between cognitive accessibility and intake was significant and negative when self-control was high, B = -2731.60, $t(120)$ = -2.99, p = .003. However, there was no significant relationship between cognitive accessibility and intake for participants with low self-control, B = 274.57, $t(120)$ = .40, p = .69.

Moderating role of trait self-control in the cognitive accessibility – temptation to indulge relationship. Likewise, temptation to indulge was significantly predicted by cognitive accessibility, B = -2.58, $t(116)$ = -2.97, p = .003, but not by self-control, B = .002, $t(116)$ = 0.14, p = .89. Self-control also moderated the relationship between cognitive accessibility and temptation to indulge. Temptation to indulge was significantly predicted by the interaction term alone, B = -.15, $t(116)$ = -2.10, p = .04, and adding the interaction term to the model already containing the predictors resulted in a significant increase in variance

explained, R^2 *change* = .03, *F change* (1, 116) = 4.42, p = .04. As can be seen in Figure 2, cognitive accessibility and temptation to indulge were significantly negatively correlated among participants with high self-control, B = -4.63, t(116) = -3.12, p = .002, but not among those with low self-control, B = -14.09, t(116) = .47, p = .64.

Moderating role of trait self-control in the temptation to indulge – snack intake relationship. Intake was significantly predicted by temptation, B = 248.17, t(116) = 4.60, p < .001, but not by self-control, B = 4.84, t(116) = 0.96, p = .34. Self-control did not moderate the relationship between the experience of temptation to indulge and snack intake, as the interaction term (product of temptation and self-control) did not significantly predict intake, B = 3.17, t(116) = .84, p = .40, and the interaction term did not significantly increase the amount of variance explained, R^2 *change* = .01, *F change* (1, 116) = .70, p = .40.

Effect of cognitive accessibility on snack intake via temptation at different self-control levels.

Moderation of the mediation model pathways by trait self-control. PROCESS was also used to investigate whether cognitive accessibility had an indirect effect on snack intake via experienced temptation to indulge for people with different levels of trait self-control. 5,000 bootstrap samples were used to estimate the pathways shown in Figure 3. The same procedure used for the simple moderation analyses was used to determine moderation of the mediation model pathways. In the analysis of pathway *a*, the interaction term emerged as a significant predictor of temptation, B = -.15, t(116) = -2.10, p = .04. This indicates that cognitive accessibility has a different effect on temptation to indulge for people with different levels of self-control, mirroring results of the previous analysis. To estimate pathways *b* and *c*, a separate regression equation was estimated with snack intake as the dependent variable. As mentioned previously, simple moderation analysis showed that the interaction between self-control and temptation to indulge did not significantly predict intake, therefore self-

control was not included as a moderator of pathway *b*. Temptation to indulge alone had a significant effect on intake (pathway *b*), $B = 229.68$, $t(115) = 4.20$, $p < .001$. With all variables in the model (i.e., self-control, cognitive accessibility, and the interaction term of these two variables), the self-control – cognitive accessibility interaction term no longer significantly predicted snack intake, $B = -75.00$, $t(115) = -1.81$, $p = .07$. This indicated that the strength of the direct relationship between cognitive accessibility and snack intake at pathway *c* did not significantly vary at different levels of trait self-control. Therefore, by including a mediating variable (experience of temptation to indulge in unhealthy snacks), the direct relationship between cognitive accessibility and intake was no longer significant, even for those with high self-control. This suggests that the experience of temptation accounts for the effect of cognitive accessibility on snack intake for those with high self-control.

Estimation of overall direct and indirect effects at high and low self-control levels. PROCESS produced estimates of the overall direct and indirect effects of cognitive accessibility on snack intake at high and low levels of self-control, and bias-corrected 95% confidence intervals as statistical tests of those coefficients. These pathways are illustrated in Figure 3, and coefficient estimates and confidence intervals are reported in Table 2. As reported in the table, only among participants high in self-control did cognitive accessibility have a significant indirect effect on snack intake via the experience of temptation to indulge. For those with low self-control, this indirect effect was not significantly different from zero. However, tests of the direct effect of cognitive accessibility on snack intake revealed that when temptation to indulge was included in the model, cognitive accessibility did not directly affect intake for participants either high or low in self-control. The relationship between temptation to indulge and intake was significant across all participants. This supports that for those with high self-control, the experience of temptation to indulge in unhealthy snacks accounts for the effect of cognitive accessibility on snack intake.

Discussion

Temptation-elicited goal activation is a counteractive control process that has previously been found to predict successful self-regulation in the domain of healthy eating and weight-management. The current study contributes to our understanding of the relationship between cognitive accessibility of the weight-management goal and unhealthy snack intake by using a controlled, lab-based measure of intake, and exploring the moderating role of trait self-control. We also explored whether higher cognitive accessibility was related to the extent to which participants reported feeling tempted to indulge in unhealthy foods offered to them, and whether this self-reported temptation would mediate the relationship between cognitive goal accessibility and intake.

Cognitive accessibility was not significantly correlated with the amount of snack food eaten in the taste test across all participants. However, results of moderation analyses revealed that higher cognitive accessibility of the weight-management goal was associated with lower food intake for those high in trait self-control. The relationship was not significant for individuals with low self-control. This finding cannot be explained by differences in motivation to eat healthily or manage weight, as self-control and motivation were not significantly correlated. Therefore, contrary to previous studies that have found an association between higher cognitive accessibility and perceived self-regulatory success in the weight-management domain (e.g., Fishbach et al., 2003; Papies et al., 2008), or with self-reported chocolate intake (e.g., Kroese et al., 2011; Van Koningsbruggen et al., 2011), the current findings suggest that this may only be true for those who are adept at translating intentions into actions. This is consistent with Ferguson (2008), who found that when cognitive goal accessibility was high, only those with high self-control evaluated goal-facilitative stimuli as more positive.

Perhaps a surprising finding regarding the relationship between self-control and intake was that when cognitive goal accessibility was low, individuals with high trait self-control ate more than those with low trait self-control. Self-control is namely the ability to translate intentions into actions, and scores on the Self-Control Scale have been associated with lower BMI and higher dietary healthiness (Sproesser et al., 2011; Tangney et al., 2004). The current finding is inconsistent with evidence suggesting that decreased cognitive goal accessibility contributes to overeating among unsuccessful restrained eaters (Stroebe, Van Koningsbruggen, Papies, & Aarts, 2013). It also runs counter to goal priming literature more generally, which has shown that priming individuals with goal concepts (i.e., enhancing their accessibility) makes subsequent behaviour more consistent with that goal (Bargh et al., 2001). However, our finding is consistent with Ferguson's (2008) observation that when cognitive accessibility of the weight management goal was high, those with high skill at that goal evaluated goal-facilitative stimuli more positively than those with low skill, but at low goal accessibility, they evaluated goal-facilitative stimuli more negatively. Although evaluations of goal-relevant stimuli are not the same as actual behaviour, they do represent 'evaluative readiness', which Ferguson argues promotes goal-consistent behaviour by influencing approach or avoid motivations toward goal relevant objects (e.g., approach 'vegetables'). These results and our own suggest that the evaluative and behavioural responses to goal-relevant stimuli among individuals with high self-control, or skill at a goal, could be characterised by an increased sensitivity or responsiveness to the activation of personal goals, rather than higher activation or accessibility of goals. When the goal is not activated, those with high self-control may not be able to as effectively regulate their behaviour as when the goal is highly accessible. In contrast, intake for those with low self-control was not related to goal accessibility, suggesting they may be generally less responsive to activation of those goals.

Although the finding that cognitive goal accessibility was related to intake only among those with high self-control is consistent with Ferguson (2008), it is contrary to other findings suggesting that cognitive goal accessibility predicts successful self-regulation for all individuals (Fishbach et al., 2003; Kroese et al., 2011; Papies et al., 2008; Van Koningsbruggen et al., 2011). These divergent results may be due to methodological differences in the priming of temptation. Specifically, previous studies of temptation-elicited goal activation in eating behaviour have presented food pictures or words as temptation primes immediately before the goal words within the same tasks designed to assess cognitive goal activation (Fishbach et al., 2003; Kroese et al., 2011; Papies et al., 2008; Van Koningsbruggen et al., 2011). In contrast, prior to completing the lexical decision task, participants in the current study were told that they would be presented with unhealthy snack foods to taste as part of the experiment. This was intended to provide a more ecologically valid temptation prime in comparison to the word or picture cues presented previously, as participants would have anticipated a real temptation that threatened their goal of healthy eating for weight management. However, while most previous studies presented temptation primes (food pictures or words) subliminally, participants here were made explicitly aware of the temptation prime, which would have permitted conscious activation of the dieting goal. Thus, our measure of cognitive accessibility could reflect participants' importance of the dieting goal rather than temptation-elicited goal activation. The lack of a control condition cannot rule out this possibility. Specifically, while previous studies compared cognitive accessibility in response to food primes with that to neutral control primes, the current study exposed all participants to one and the same temptation food prime. However, this interpretation is unlikely as cognitive goal accessibility was not related to motivation to regulate eating for weight management. Nevertheless, future research could usefully compare the current temptation prime to a control condition with no temptation priming.

Alternatively, the discrepancy between the current and previous findings regarding the relationship between cognitive goal accessibility and unhealthy snack intake could be attributed to differences in the measurement of eating self-regulation. Unlike other previous studies, the current taste test methodology enabled us to exert control over participants' exposure to unhealthy food during measurement of intake. Specifically, previous studies have used self-report diaries which allow participants to make deliberate decisions regarding their exposure to unhealthy foods (Kroese et al., 2011; Van Koningsbruggen et al., 2011). In comparison, the current methodology assessed participants' immediate behavioural responses when faced with the unhealthy food temptation. Future research should further explore the influence of having control over one's exposure to unhealthy food stimuli on the relationship between cognitive goal accessibility and food intake.

Consistent with predictions, higher cognitive accessibility was related to a lower experience of temptation to indulge in the snack food offered. This is in line with Ferguson's (2008) finding that cognitive goal accessibility influenced evaluations of goal-relevant stimuli, as temptation to indulge in snack food could reflect participants' positive evaluation of that food. It also supports the idea that evaluation of goal-relevant stimuli in the environment may be part of the mechanism behind the effect of cognitive goal activation on goal-consistent behaviour (Ferguson & Bargh, 2008). Furthermore, and in line with Ferguson's (2008) observation that the relationship between cognitive goal accessibility and evaluation of goal-relevant stimuli was moderated by self-control, the current study similarly found that the relationship between cognitive goal accessibility and temptation was stronger for those with high self-control.

The current study also predicted that the reported temptation to indulge in snack foods offered would mediate the relationship between cognitive accessibility and snack intake. However, the relationships between cognitive goal accessibility and both snack intake and

experienced temptation were moderated by self-control. Therefore, self-control was included as a moderator of these pathways in the mediation analysis. We found that, when self-reported temptation to indulge was controlled for, cognitive accessibility was no longer associated with snack intake among individuals high in self-control. This suggests that among participants with high self-control, those with higher cognitive accessibility of the weight-management goal felt less tempted to eat the snack food presented, and in turn, ate less.

These results are consistent with Ferguson's (2008) finding that success at weight management predicted counteractive evaluation of goal-relevant objects when the goal of dieting was made cognitively accessible. Specifically, she found that when the goal of dieting or weight management was made more salient, people more skilled at achieving that goal tended to evaluate goal-facilitative objects more positively than those less skilled. Although Ferguson (2008) only assessed the evaluation of goal-facilitative objects (e.g., gym, vegetables), evaluations of goal-threatening objects (i.e., unhealthy snacks) may follow a similar pattern. The measure of temptation to indulge in unhealthy snacks in the current study could reflect individuals' evaluations of those unhealthy snacks. Among individuals high in self-control, higher cognitive goal accessibility could lead to a devaluing of the food stimuli, which may manifest in a less intense temptation to indulge in it, facilitating goal-consistent behaviour (i.e., limiting intake of that food). This process may explain why higher cognitive accessibility was only associated with lower intake among participants with high self-control.

The current findings are broadly consistent with counteractive control theory (Fishbach et al., 2003; Trope & Fishbach, 2006). Cognitive goal accessibility in response to temptation affects subsequent goal-consistent behaviour; however, this was only supported among individuals high in self-control. This latter result is nevertheless consistent with research that has shown that individuals with greater skill at achieving a goal show a stronger relationship between goal accessibility and goal-facilitative evaluations of environmental

stimuli (Ferguson, 2008). Moreover, the finding that the experience of temptation to indulge mediated the relationship between cognitive goal accessibility and intake among individuals with high self-control fits with previous research suggesting that the evaluation of goal-relevant stimuli may mediate the effect of increased cognitive goal accessibility on goal-consistent behaviour (Ferguson, 2008).

The findings of the current study have implications for the design of cognitive interventions for facilitating self-regulatory behaviour. Intervention studies attempting to 'train' individuals to cognitively activate the goal of weight management in response to temptation cues as a way of facilitating self-regulation have achieved variable success (e.g., Harderwijk, 2010; Kroese et al., 2011; Van den Bos, 2011; Van Koningsbruggen et al., 2011; Webb & Sheeran, 2008). Several studies have used implementation intentions, which involve participants practicing "*If…, then…*" style plans to facilitate goal-consistent behaviour in response to temptation cues (Webb & Sheeran, 2008). For example, participants may practice the implementation intention of: "*If* I am offered chocolate cake at morning tea, *then* I will think about my weight management goal". By repeatedly reading or rehearsing this phrase, the individual may create a link between a temptation cue and the concept of the overarching goal which it threatens, therefore enhancing cognitive goal accessibility when faced with a food temptation (Webb & Sheeran, 2008). This link, according to counteractive control theory, is expected to facilitate resisting the temptation (Trope & Fishbach, 2006). Some studies have found these implementation intentions effective in reducing consumption of energy-dense foods (Kroese et al., 2011; Van Koningsbruggen et al., 2011). However, other studies have not corroborated these findings. For example, implementation intentions were found not to affect the healthiness of lab-based snack choice, or self-reported snack consumption (Harderwijk, 2010; Van den Bos, 2011). The variable success achieved with

implementation intentions may be due to the samples including a combination of individuals with low and high trait self-control.

The current study's findings suggest that interventions aimed at increasing cognitive goal accessibility may not affect food intake across all individuals. An alternative strategy could be to increase the cognitive control abilities which would enable individuals to override the temptation to indulge in unhealthy foods. In support, recent studies have found that training individuals to inhibit responses to tempting cues such as food or alcoholic beverages reduced their subsequent consumption (Houben, 2011; Houben, Havermans, Nederkoorn, & Jansen, 2012; Houben, Nederkoorn, Wiers, & Jansen, 2011; Houben, Wiers, & Jansen, 2011). However, one of these studies found that the reduction in alcohol consumption after response inhibition training was not due to an increase in inhibitory control, but rather to an increased negative implicit evaluation of alcohol-related stimuli (Houben et al., 2012). This suggests that modifying the way individuals evaluate tempting stimuli could be a more direct and potent strategy for facilitating behaviour consistent with longer term goals. The results of the current study similarly suggest that the evaluative processes underlying the experience of temptation to indulge in snack food may be an effective target for intervention, as temptation was related to intake for *all* individuals (not just those with high self-control). Such an intervention may be particularly beneficial for unsuccessful restrained eaters, as their eating behaviour is mainly driven by enjoyment associated with eating unhealthy food (Stroebe et al., 2013). This idea is echoed by Hofmann and Van Dillen (2012), who advocate the use of strategies designed to change the way individuals evaluate potentially tempting stimuli (e.g., unhealthy snack food) to prevent strong desires or temptations from arising. Such strategies may indeed be preferable to ones which seek to strengthen the ability to restrain or overcome strong desires once they have arisen.

A number of limitations of the current study should be taken into consideration. First, the study was purely correlational. Therefore we cannot conclude a causal link between cognitive accessibility of the weight management goal following unhealthy food temptation and subsequent snack consumption. The direction of this relationship will need to be examined in a well-controlled experimental design. Second, the self-report measure of experienced temptation to indulge in the snacks offered in the taste test was taken retrospectively, after consumption. This was done deliberately to prevent participants' perceived temptation from inadvertently affecting their food intake. However, participants could have adjusted their reports of experienced temptation to be in line with their snack intake. Moreover, participants were instructed to taste each food, which in itself could have affected their experience of temptation. Future research could seek to address these challenges by testing the effect of cognitive accessibility on temptation to indulge, and on snack intake, in separate testing sessions.

Despite these limitations, this study has contributed to our understanding of the processes of counteractive control. In particular, the results add to a growing body of evidence on the relationship between cognitive goal activation in response to temptation cues and subsequent goal-consistent behaviour in the domain of healthy eating for weight management.

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Table 1.

Descriptive Statistics for Lexical Decision Task Data, Snack Intake, Experience of Temptation to Indulge, Self-Control, Motivation, and Hunger

Variable	*M*	*SD*
Lexical decision task (RT in ms) [a]		
Goal words	519.75	123.41
Neutral words	560.49	174.59
Difference: neutral – goal	42.40	44.21
Snack intake (kj)	1048.76	839.98
Temptation experience	4.38	1.35
Self-control	2.97	0.39
Motivation	3.30	0.97
Hunger	3.66	1.60

[a] Descriptive statistics for lexical decision task data calculated after trimming extreme scores but prior to natural log transformation.

Table 2

Overall Direct and Indirect Effects of Cognitive Accessibility on Snack Intake at Different Levels of Self-control

	Indirect effect (*ab*)		Direct effect (*c*)	
Self-control	Coefficient estimate	95% CI	Coefficient estimate	95% CI
Low	-103.12	-567.32 to 240.77	372.21	-919.95 to 1664.38
High	-1173.15[a]	-2305.87 to -406.41	-1654.67	-3494.97 to 185.63

[a] point estimate significantly different from zero, as 95% CI does not contain zero.

Figure Captions

Figure 1. Moderation of the effect of cognitive goal accessibility on snack intake (centred) by trait self-control.

Figure 2. Moderation of the effect of cognitive goal accessibility on temptation (centred) by trait self-control.

Figure 3. Moderated mediation model: Indirect effect of cognitive accessibility on intake via temptation, moderated by trait self-control. *Note:* Bold arrows denote significant relationships. Bold dashed arrows denote moderation of adjoining relationships by self-control.

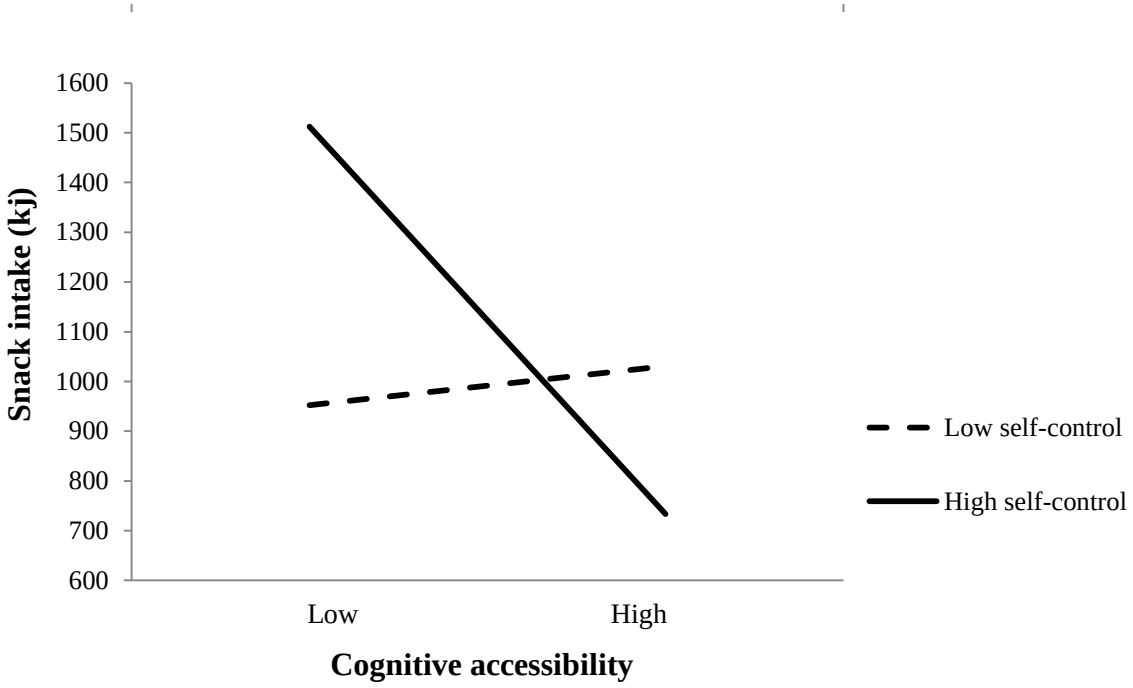
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
Snack intake (kj)
Low
High
Cognitive accessibility
Low self-control
High self-control

Figure 1.

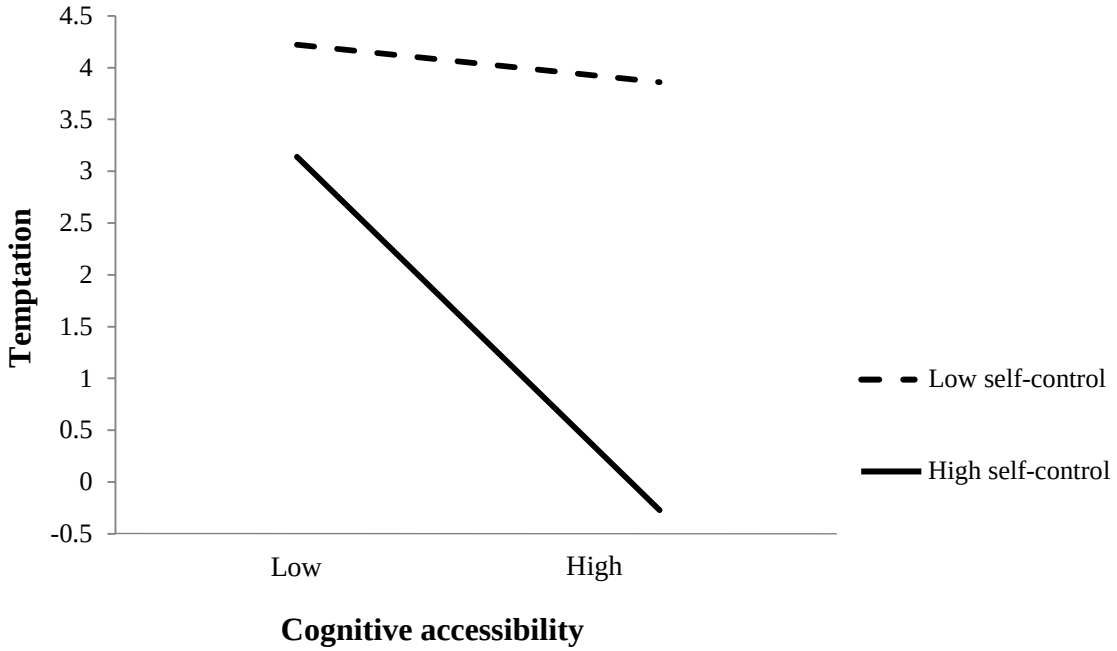
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
Temptation
Low
High
Cognitive accessibility
Low self-control
High self-control

Figure 2.

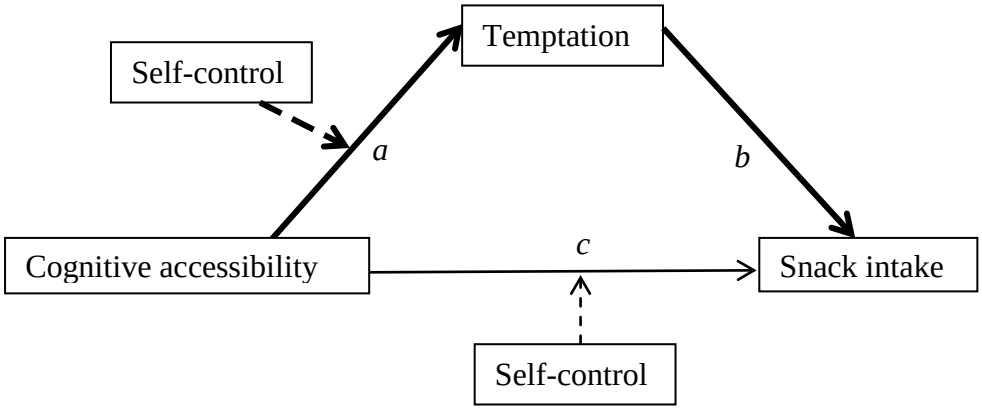
Temptation
Self-control
a
b
Cognitive accessibility
c
Snack intake
Self-control

Figure 3.