Snack Intake is Reduced Using an Implicit, High-Level Construal Level Cue

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Running title: Construal-level cue and snack intake

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Abstract

Objectives: Priming a high level construal has been shown to enhance self-control and reduce preference for indulgent food. Subtle visual cues have been shown to enhance the effects of a priming procedure. The current study therefore examined the combined impact of construal level and a visual cue reminder on the consumption of energy-dense snacks. *Methods:* A student and community-based adult sample with a wide age and BMI range (N = 176) were randomly assigned to a high or low construal condition in which a novel symbol was embedded (or not). Afterwards participants completed a taste test of ad libitum snack foods in the presence or absence of the symbol. *Results:* The high (versus the low) construal level prime successfully generated more abstract responses ($p < .0001$) and reduced intake when the cue-reminder was present ($p = .02$) but not when it was absent ($p = .40$). *Conclusions:* Priming high construal level thinking reduces consumption of high energy dense snacks in the presence of a visual cue-reminder. This may be a practical technique for reducing overeating and has the potential to be extended to other unhealthy behaviours.

Keywords: Priming, implicit cues, construal-level, overeating

Snack Intake is Reduced Using an Implicit, High-Level Construal Cue

Health behaviours are not necessarily the result of conscious processes and are often influenced by the unconscious processing of cues in the environment (Sheeran, Gollwitzer and Bargh, 2013). Research has shown that cues related to tasty food can increase consumption of energy dense snacks without participants realizing the impact of the cue (Hall, Tran, Lowe, Vincent, Mourtzakis, Liu-Ambrose, Prapavessis, and Gidron, 2015). However, priming can also work in favour of healthful choices as activating dietary goals can reduce intake (Papies and Hamstra, 2010).

Construal level theory (Trope and Liberman, 2003) maintains that people can construe a tempting situation using either higher or lower construal level thinking (CLT). High CLT is defined as abstract, superordinate consideration of the current situation within a broader framework of overarching goals (e.g., considering the healthful qualities of a particular food), whereas lower CLT is defined as concrete, subordinate attention to the immediate environment (e.g., considering the rewarding taste of a particular food). The self-control dilemma between consuming tasty foods now versus obtaining health benefits later is captured by delay discounting tasks, and performance on such tasks is related to overeating (Appelhans, Waring, Schneider, Pagoto, DeBiasse, Whited et al., 2012). Studies have shown that priming high versus low level CLT can reduce present-bias preferences (Malkoc, Zauberman and Bettman, 2010; Fujita, Trope, Liberman and Levin-Sagi, 2006), reduce cigarette smoking (Chiou, Wu and Chang, 2013) and increase physical exercise (Sweeney and Freitas, 2014). Fujita and Han (2009) showed that high CLT increased negative associations with tempting food and enhanced preference for an apple over a candy bar. Sullivan, Hutcherson, Harris and Rangel (2015) have recently shown that the faster participants directed attention towards healthful (higher construal) stimuli, the more likely

they were to choose healthy foods. However, these studies examined self-reported behavior; whether construal level would affect a real opportunity to eat is currently untested.

The effects of a construal prime may show temporal degradation or be attenuated through cognitive load (Wan and Agrawal, 2011) and therefore effective methods for maintaining the high CLT are vital. Explicit auditory reminders of personal future events have been shown to reduce delay discounting and snack intake (Daniel, Stanton and Epstein, 2014). However, the delivery of audio reminders may prove difficult to translate to everyday settings. An alternative method emerging from health psychology focuses on the use of implicit cues that instigate healthful choices. Implicit reminders of long-term goals (e.g., low-fat recipe posters) have been shown to reduce food intake in naturalistic settings, especially for participants who have a strong goal to diet (Papies and Hamstra, 2010). Incidental cues in the environment can therefore 'nudge' people towards making more healthful food choices. There is also evidence that cue-reminder symbols can promote healthful behaviors. Kleinjan, Strick, Lemmers and Engels (2012) embedded a power button symbol in a video on 'empowerment and refusal' of alcohol consumption. One day later, participants were exposed to a natural drinking situation with or without the implicit presence of the symbol in the environment (on beer mats). Alcohol consumption was significantly reduced in frequent drinkers but only when the cue was present. If cue reminders can enhance control over drinking behaviour, this practical technique could also be applied to eating behaviour.

The aim of the current study was to test the effect of a construal level cue-reminder on snack intake. It was hypothesised that participants exposed to a high- versus a low-level construal prime would afterwards show reduced consumption of energy dense snacks, but that this effect would be greater in the presence of the cue-reminder symbol, and among participants with a strong goal to diet. In addition, delay discounting, and perceived healthiness of the snack foods were measured as potential mediating mechanisms.

Method

One hundred and seventy six adults (mean age = 27.79 years, *SD* = 10.54; mean BMI = 24.02, *SD* = 4.38; 59% female) were randomly allocated to a 2 (Construal level: high vs. low) x 2 (Cue: present vs. absent) factorial design, and received £7 for participation. All participants were tested individually.

A full account of the procedure and measures is presented in the Supplementary Materials. Briefly, participants first rated their baseline hunger using a visual analogue scale. They then completed the priming task in which a novel, visual cue-symbol was embedded. The 'How/Why?' task (Freitas et al, 2004) presents participants with a common goal (in this case 'Achieve at work/study') and a series of blank boxes connected by arrows. For the 'Why' (high construal) condition participants were asked to think about why this goal is important in four successive steps (e.g., 'to get a good job'). For those in the 'How' (low construal) condition the task was identical, except that the participants were asked to think about how they would achieve the goal (e.g. 'go to the library'). After completion of the 'How/Why?' task, imagery measures were taken using a Likert response scale (1-10) to assess how 'easy' the task was to complete and assess the clarity of the imagery for the responses. Imagery scores have been reported to moderate the effect of a prime and should be controlled for in analyses (Daniel, Stanton and Epstein, 2013). Participants then completed the Behaviour Identification Form (BIF; Vallacher and Wegner, 1989), which served as manipulation check. This is a 25-item questionnaire that measures an individuals' trait construal level. The BIF is primarily a trait measure and for this reason 'abstractness' scores were also obtained (see Fujita et al., 2006). Participants' responses were coded for higher- or lower-level construal content. Higher scores on both measures indicate more abstract (high-level construal) responses.

Participants then moved to an adjacent room to complete the delay discounting task and the 'taste-test'. The cue symbol was either present or absent on the bottom of the monitor for the discounting task and on food labels for the taste-test. The delay discounting task (McHugh and Wood, 2008) was administered first. Participants were presented with hypothetical choices between obtaining a larger amount of money later versus a smaller amount now. An indifference point was calculated for each delay, ranging from one day to one year, which was used to calculate Area Under the Curve (AUC), with smaller values indicating greater impulsivity for short-term rewards. The taste test comprised six different snack foods presented in identical white containers, labelled A-F. The snacks were 21g Bitsa Wispa (Cadbury, Mondelez, Birmingham, UK), 17g Minstrels (Mars, UK), 32g Haribo star mix (HARIBO Dunhills, Pontefract, UK), 12.5g Pringles Original (Wimble Manufacturing Belgium, Mechelen, Belgium), 10g Ritz Mini Cheddars (Jacob's Bakery, Leicestershire, UK), and 4g Salted popcorn (Tesco Stores Ltd., Cheshunt, U.K)). Participants were asked to sample each of the snacks while watching a television clip. They were informed that there would be some questions about both the clip and snacks afterwards. After viewing the clip and sampling the snacks, each participant (among other 'filler' questions) indicated on a Likert scale how healthy they believed each snack to be (1 = very unhealthy, 10 = very healthy). They were then asked to complete the Dutch Eating Behaviour Questionnaire (DEBQ; van Strien, Frijter, Bergers and Defares, 1986); the restraint scale was used to index the goal of restricting food intake. Before being debriefed about the aims of the study, participants were asked what they thought the study was about to test for awareness of the study hypotheses. None of the participants indicated that they were aware of the cue symbol or of its purpose. All snacks were weighed covertly before and after the session and grams (g) consumed were calculated.

Results

Manipulation Checks

BIF scores for the high and low construal prime groups were compared using ANCOVA, using self-reported 'clarity of imagery' and 'ease of task completion' as covariates. Results indicated that BIF scores in the high construal group (M = 16.41, SD = 5.58) were significantly higher than for those in the low construal group (M = 14.94, SD = 5.25), $F(1, 169) = 4.06$, p = 0.046; f =.22). Abstractness scores were also calculated by two independent judges blind to priming condition. The judges' ratings were highly correlated (r = .94). Participants in the high level construal group had significantly higher (M = 3.52, SD = .77) scores than those in the low construal group (M= -3.56 SD = .62), $F(1,167) = 4358.12$, p < .0001; f = .37).

Delay Discounting

A 2 (construal group) x 2 (cue presence) ANOVA, showed no main effect of construal group, $F(1, 132) = .13$, p = .72), or cue presence, $F(1, 132) = .09$; p = .76, on AUC scores and the interaction was not significant, $F(1,132) = 2.51$, p = .12.

Health Ratings

A 2 x 2 ANOVA showed no main effect of construal group, $F(1, 169) = .26$, p = .61, cue presence, $F(1,169) = .15$, p = .70, and no significant interaction on health ratings, $F(1,169) = .02$, p =.90.

Snack Intake

A 2 (construal group) x 2 (cue presence) x 2 (median split on dietary restraint) ANOVA (controlling for baseline hunger) showed no main effects of construal group (p = .27), cue presence (p = .89), or dietary restraint (p = .24). The three-way interaction was not significant, $F(1,166) = .26$, p=.61, but there was a significant two-way interaction between construal group and cue presence, $F(1, 166) = 5.44$, p = .02; f = .22. Post-hoc tests confirmed that when the cue was present, participants in the higher-level construal group consumed

significantly fewer snacks (M = 54.07g, SD =19.88) than participants in the lower-level construal group (M = 65.37g, SD =22.85), $t(84) = 2.45$, $p = .02$ (17.3% reduction in intake). There was no group difference in intake when the cue was absent, $t(82) = .85$, $p = .39$ (see Figure 1). Finally, planned comparisons showed that participants in the high-level construal/cue present condition consumed fewer snacks than each of the other conditions combined (M = 61.82, SD = 22.11), $t(166) = 2.02$, $p = .02$.

Discussion

In the current study, we found that, priming a high level (versus a low level) construal reduced subsequent intake of snacks in the presence of a cue-reminder, but not in the absence of that cue. Furthermore, this interaction was observed across the whole sample and was not restricted to participants with high dietary restraint goals. Construal level and cue-reminder did not affect delay discounting or health ratings.

The present results extend previous reports that higher-level construals promote healthier food choices by showing effects on actual food intake. The effect of construal condition on intake in the current study depended upon the cue being present, whereas other researchers have reported a main effect of construal in the absence of a cue reminder (Fujita and Han, 2009; Sullivan et al., 2015). These contrasting results may be explained by methodological differences. In the present study and Kleinjan and colleagues' (2012) study, the context changed between priming and outcome measures, whereas in studies that reported a main effect of priming (Fujita & Han, 2009) participants were tested in the same context. It may be the case that the context itself served as a cue to trigger the primed construal, and that a cue reminder is needed if the context changes.

The prediction that delay discounting would mediate the effect of the construal cue was not supported. Previous studies have shown that higher-level construal primes reduce delay discounting (Fujita et al, 2006; Malkoc et al., 2010). However, these studies used the

devaluation of products as a function of delay to measure discounting behaviour, whereas we used a hypothetical monetary discounting task which has previously been related to overeating (e.g. Appelhans et al., 2012). The commodities and framing of discounting tasks have a profound effect on discounting behaviour (Weatherly and Terrell, 2010) and so these task differences are a plausible explanation of differences in findings. Future research would benefit from examining the effects of construal priming on different discounting paradigms.

The prediction that health ratings would mediate the effect of the high construal cue on intake also was not supported. This may be because the ratings were taken after consumption and did not capture the 'period of cognitive activity' prior to consumption that influences decisions about intake (Brunstrom & Shakeshaft, 2009). Future research would benefit from measuring health ratings prior to consumption. Previous research has presented both healthy and unhealthy food (e.g., Sullivan et al., 2015) and it would be interesting to add healthy food options to examine if construal cues not only reduce unhealthy snack intake but could also enhance healthy snack intake. We also predicted that construal level effects would be stronger for participants with dietary restraint goals. However, this was not the case, perhaps because most people value the goal of healthy eating regardless of whether or not they are trying to lose weight (Salmon, Fennis, de Ridder, Adriaanse & de Vet, 2014).

Limitations of the present study should be acknowledged. First, although we recruited participants from a student body and the community, it was a convenience sample, and further research looking at specific groups (e.g., people who are obese) or wider populations (e.g., low socio-economic status groups) is recommended. Second, only a small to moderate effect size was observed for the effect on intake. However, a 17% reduction in energy dense snack consumption might result in significant clinical benefits over time (Mozaffarian, Hao, Rimm, Willett and Hu, 2011). Finally, while the manipulation check confirmed that the construal prime was effective, there is no direct evidence that the cue-

reminder was activating a high level construal during snack intake. It is plausible that the cue simply signalled the relevance of a high-level construal during the eating task. Although this is a subtle difference, there may be implications for the durability of the cue-reminder effect because the latter explanation requires task contiguity and extended delays could result in reduced effects. It is important now to determine the exact mechanism for the effect of the cue-reminder on food intake and to investigate the durability of the effect.

In conclusion, the present study showed that priming a high construal level reduced snack consumption in the presence of a visual cue-reminder. This finding affords new avenues for research and practice in developing obesity and other health-related interventions.

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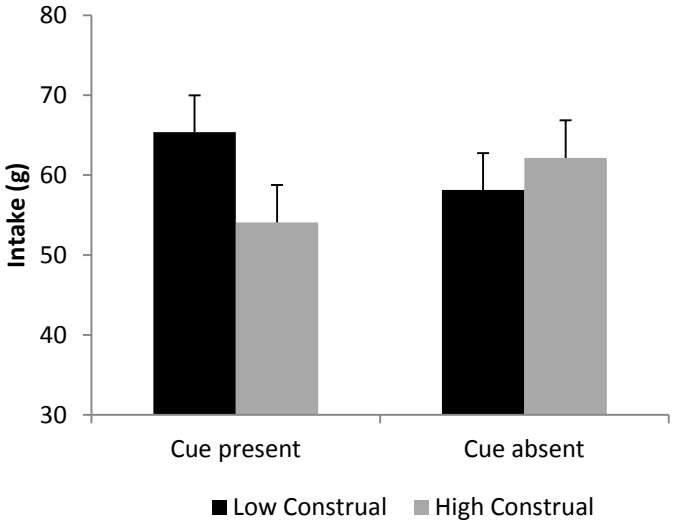

Figure 1

Mean Snack Consumption (*g*) by Construal Level and Implicit Cue

Note. Error bars are standard errors.