REDUCE TEMPTATION OR RESIST IT?

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Reduce temptation or resist it? Experienced temptation mediates the relationship
between implicit evaluations of unhealthy snack foods and subsequent intake

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REDUCE TEMPTATION OR RESIST IT?

Abstract

A more negative implicit evaluation of unhealthy food stimuli and a more positive implicit evaluation of a weight-management goal have been shown to predict lower consumption of unhealthy food. However, the associations between these evaluations, temptation to indulge, and consumption of unhealthy food remain unclear. The current study investigated whether temptation would mediate the relationship between implicit food and goal evaluations and consumption (resembling an antecedent-focused route to self-control of eating), or whether those evaluations would moderate the relationship between temptation and consumption (resembling a response-focused route). A sample of 156 women (17-25 years) who tried to manage their weight through healthy eating completed two implicit association tasks assessing implicit food and goal evaluations, respectively. Intake of four energy-dense snack foods was measured in a task disguised as a taste-test, and participants reported the strength of experienced temptation to indulge in the snacks offered. Negative implicit food evaluation was associated with lower snack intake, and temptation mediated this relationship. Implicit goal evaluation was unrelated to both temptation strength and snack consumption. The findings contribute to an understanding of how negative implicit unhealthy food evaluation relates to lower consumption, namely through the mediation of temptation to indulge in those foods.

Keywords: implicit evaluations; weight-management goal; temptation; desire; food intake

Word count: 5699

REDUCE TEMPTATION OR RESIST IT?

Desires abound in everyday life. However, pursuit of desired stimuli can conflict with longer term interests or goals, posing a self-control dilemma, turning those desires into temptations. Given the increasing prevalence of obesity and associated health problems (World Health Organization, 2011), a self-control dilemma that is particularly pertinent to address is that of maintaining a healthy diet despite the temptation to consume tasty but unhealthy food (Fishbach, Friedman, & Kruglanski, 2003). Many individuals try to limit intake of unhealthy food for the purpose of managing their body weight (Kruger, Galuska, Serdula, & Jones, 2004; Timperio, Cameron-Smith, Burns, & Crawford, 2000). However, it is often difficult to enact eating behaviour consistent with weight management goals due to our evolutionary preference for, and the rewarding properties of, unhealthy foods high in fat, sugar, and salt (Cohen & Farley, 2008). To further an understanding of the processes involved in the self-control of eating behaviour, the current study investigated two possible predictors of temptation to indulge in unhealthy food: implicit evaluations of unhealthy food, and implicit evaluations of weight management goal stimuli, and explored associations between these variables and consumption of unhealthy food.

Recent research has identified desire, or temptation strength, as an important predictor of effective regulation of eating behaviour. For example, Hofmann, Vohs, and Baumeister (2012) asked participants to carry an electronic device for one week which periodically prompted them to report desire-related experiences in the preceding 30 minutes. Participants reported feelings of desire (e.g., to indulge in unhealthy food), conflict with personal goals (e.g., weight-management), attempts to resist (i.e., exertion of self-control), and whether resultant behaviour was goal-consistent. Results revealed that attempts to resist were less likely to result in goal-consistent behaviour when desires were stronger. A similar study found that instances where current dieters lapsed in dietary control by indulging in unhealthy food were preceded by a stronger reported experience of temptation compared with instances

REDUCE TEMPTATION OR RESIST IT?

of successful dietary control (McKee, Ntoumanis, & Taylor, 2014). In fact, the most common reason cited by a sample of overweight and obese individuals for eating unhealthy snacks was that they were perceived as highly tempting (Cleobury & Tapper, 2013). Even individuals who can generally keep behaviour in line with valued goals have trouble resisting strong temptations. This was demonstrated in a recent study, where participants trying to manage weight through healthy eating were asked to complete a lab-based taste-test as a measure of unhealthy snack consumption (Haynes, Kemps, Moffitt, & Mohr, 2014). Participants also rated the extent to which they felt tempted to eat the food offered. Stronger temptation was related to higher snack food intake, which importantly, remained significant when controlling for trait self-control.

Despite evidence attesting to its importance in goal pursuit, the determinants of temptation strength are understudied. Furthermore, the way that temptation and implicit evaluations of food and goal stimuli relate to one another, and to eating behaviour, are unknown. Two paths to resolving self-control dilemmas have been identified in the literature; one involves reducing the temptation to indulge in unhealthy behaviour, and the other requires the individual to overcome or resist that temptation (Hoch & Loewenstein, 1991; Hofmann & Van Dillen, 2012). This distinction parallels one proposed in the emotion regulation literature, between two routes via which undesired emotional states can be regulated (Gross, 1998). The former is an antecedent-focused regulation route involving the prevention of the internal experience of emotion before it arises. In the context of dietary self-control involving implicit food or goal evaluations, this would involve a reduction in the temptation to engage in unhealthy eating behaviour, such that the relationship between implicit evaluations and eating behaviour would be mediated by temptation. The latter route requires response-focused regulation and involves the moderation of the outward, observable expression of internal states. This is similar to resisting an unhealthy temptation or desire

REDUCE TEMPTATION OR RESIST IT?

once it has arisen, such that the strength of the relationship between temptation and eating behaviour would be moderated by implicit evaluations.

The implicit evaluation of food is one variable related to the regulation of eating behaviour. Incentive theory proposes that stimuli or states associated with positive affect become an incentive which an individual will pursue (Bindra, 1974; Bolles, 1972). Accordingly, individuals' implicit evaluations of a stimulus (i.e., the extent to which the stimulus is associated with positive affect) have been found to predict the tendency to approach that stimulus across time and situations (e.g., Chen & Bargh, 1999; Dovidio, Kawakami, Johnson, Johnson, & Howard, 1997; Duckworth, Bargh, Garcia, & Chaiken, 2002; Ferguson & Bargh, 2008). In the area of healthy eating, research has shown a correlation between a more positive implicit evaluation of unhealthy food and lab-based choice and actual purchase of unhealthy over healthy food items, higher intake of unhealthy snack food in lab-based tasks or self-report snack diaries, higher levels of weight gain, and higher BMI (Ayres, Prestwich, Conner, & Smith, 2010; Conner, Perugini, O'Gorman, Ayres, & Prestwich, 2007; Dube, 2007; Friese, Hofmann, & Wanke, 2008; Hofmann, Gschwendner, Friese, Wiers, & Schmitt, 2008; Perugini, 2005; Prestwich, Hurling, & Baker, 2011; Richetin, Perugini, Prestwich, & O'Gorman, 2007). However, not all studies have found this relationship (Czyzewska & Graham, 2008; Karpinski & Hilton, 2001; McKenna, 2010; Nederkoorn, Houben, Hofmann, Roefs, & Jansen, 2010). In fact, one study reported that obese participants showed a more negative implicit evaluation of unhealthy snack food than those in lower BMI categories (Roefs & Jansen, 2002). In addition, Ayres, Conner, Prestwich, and Smith (2012) found that implicit food evaluation no longer predicted choice of unhealthy food after controlling for explicit ratings of palatability (e.g., how pleasant and enjoyable eating the food is). While it has been demonstrated that automatic affective reactions can influence behaviour in the absence of conscious awareness (Winkielman,

REDUCE TEMPTATION OR RESIST IT?

Berridge, & Wilbarger, 2005), Hofmann and Van Dillen (2012) have argued that those automatic positive affective reactions can themselves give rise to conscious desire or temptation to indulge. The experience of temptation may therefore play at least some part in the relationship between implicit evaluations of stimuli and subsequent behaviour toward them in self-control dilemmas. However, to date, the associations between implicit food evaluation, temptation, and consumption, have not been investigated.

In line with incentive theory (Bindra, 1974; Bolles, 1972), just as individuals implicitly evaluate concrete, tangible objects (e.g., chocolate cake), they also implicitly evaluate abstract stimuli, including goal concepts (Ferguson, 2007). While the mental activation of a goal concept leads individuals to prepare the execution of goal-consistent behaviour and has been shown to correlate with lower experienced temptation to engage in goal-inconsistent behaviour (Haynes et al., 2014), the attached positive valence of the goal is responsible for turning that preparation into motivation, and subsequent action toward that goal (Custers & Aarts, 2005a, 2005b). Therefore, individuals will be motivated to enact goal-consistent behaviour to the extent that the goal is associated with positive affect (Custers & Aarts, 2005a; Ferguson, 2007). This link between positive goal valence and goal-consistent behaviour has been demonstrated in both experimental and correlational studies. For example, Custers and Aarts (2005b) manipulated the pairing of a goal of ‘puzzle solving’ with either positive or negative affect in an evaluative conditioning task. Participants for whom the goal was associated with positive affect expended more effort on a task that was instrumental to achieving the goal (Custers & Aarts, 2005b). Similarly, a study measuring the evaluation of a pre-existing goal found a correlation between a more positive implicit evaluation of the goal and motivated behaviour toward that goal (Custers & Aarts, 2007). Participants who were primed with the goal of socialising and evaluated that goal as more positive, expended more effort on a puzzle task that would give them a chance to win tickets

REDUCE TEMPTATION OR RESIST IT?

to a student party. Similar findings have emerged in the eating and weight-management domain. Individuals with a more positive implicit evaluation of the goal of weight management reported being better able to resist eating tempting food over a one week period, and consumed less unhealthy food in a laboratory-based taste-test (Ferguson, 2007). Notably, the implicit evaluation of the goal concept was a stronger predictor of unhealthy food consumption than implicit evaluation of unhealthy food, which did not correlate with either measure of consumption. While results of this study suggest that a more positive goal evaluation may facilitate overcoming temptation, the strength of experienced temptation itself was not measured. The cognitive accessibility of the goal of weight-management has been shown to correlate with lower temptation to indulge in unhealthy foods (Haynes et al., 2014); however, it is unclear whether implicit goal evaluation correlates with a weaker experience of temptation, or whether it moderates the relationship between experienced temptation to indulge in unhealthy food and intake of unhealthy food.

The current study had two aims. First, we investigated whether a more negative implicit evaluation of unhealthy food and a more positive implicit goal evaluation were related to weaker temptation to indulge in unhealthy snack food. Second, we explored the associations between each of these implicit evaluations, temptation to indulge in unhealthy snack food, and snack food consumption. Specifically, we explored whether temptation would mediate the relationship between both implicit food and goal evaluations and intake of unhealthy snack food (suggesting antecedent-focused self-control), or whether a more negative implicit evaluation of unhealthy food and more negative implicit goal evaluation would moderate the relationship between temptation and snack intake (suggesting response-focused self-control). As some previous research (e.g., Ayres et al., 2012) has suggested that implicit unhealthy food evaluation may no longer predict unhealthy food consumption incrementally over explicit ratings of palatability, we further examined whether temptation

REDUCE TEMPTATION OR RESIST IT?

would still mediate the relationship between implicit unhealthy food evaluation and snack intake after controlling for participants' explicit evaluation of unhealthy foods.

Method

Participants

One hundred and ninety-two women aged 17 to 25 years ($M = 19.60$, $SD = 2.23$) were recruited from Flinders University. Participants were recruited on the basis that they identify themselves as being motivated to manage body weight by avoiding consumption of unhealthy foods and were told the study investigated the relationship between language processing and taste perception. One hundred and thirty first-year psychology student volunteers participated for course credit, and the remaining paid volunteers received a \$15 honorarium. The mean body mass index (BMI) of the sample was 23.10 ($SD = 2.17$), which is classified as in the healthy weight range. Only women were recruited, as they have higher levels of food liking and craving than men (Coelho, Jansen, Roefs, & Nederkoorn, 2009; Fishbach et al., 2003; Harderwijk, 2010; Kroese, Adriaanse, Evers, & De Ridder, 2011; Van den Bos, 2011).

Materials

Implicit evaluation of unhealthy snack food. Implicit evaluation of unhealthy snack foods was measured with a computer-administered single category implicit association task (SC-IAT, Karpinski & Steinman, 2006). The task requires participants to sort stimuli belonging to three categories (positive, negative, and unhealthy food) using two evaluative categories (positive and negative). The two evaluative categories appear at the top left and right corners of the screen, and the word stimuli are presented one by one in the centre of the screen. Participants sort the positive and negative stimuli into positive and negative categories respectively, by pressing a key designated to the position of the evaluative category on the screen (left or right). In the remaining trials, participants are instructed to sort

REDUCE TEMPTATION OR RESIST IT?

the food stimuli into the positive category for half of the trials, and the negative category for the other half. The task is easier when the concept ‘unhealthy food’ and the attribute with which it is paired, are more strongly associated. Therefore, the food + positive pairings are generally made more quickly than the food + negative pairings, which indicates a more positive implicit evaluation of food.

The task consisted of 24 practice trials, followed by two blocks of 72 experimental trials each, which were each preceded by three buffer trials. The two experimental blocks were presented in counterbalanced order (Nosek, Greenwald, & Banaji, 2007). In the practice block, only positive and negative attribute words were categorised. In the food + positive block, food words and positive words were categorised on one response key, and negative words were categorised on another. In the food + negative block, positive words were categorised on one response key, and food and negative words were categorised on the other. Response bias was minimised by presenting food words, positive words, and negative words at unequal frequency in each block, so that 58% of correct responses were on one key, and 42% on another. This resulted in 30 presentations of food words in each block; 30 presentations of negative words and 12 presentations of positive words in the food + positive block; and 30 presentations of positive words and 12 presentations of negative words in the food + negative block (Nederkoorn et al., 2010; Olson & Fazio, 2004).

As used in previous research, the target category was labelled “food”, and the positive and negative evaluative categories were labelled “I like”, and “I dislike”, respectively (Craeynest, Crombez, Haerens, & De Bourdeaudhuij, 2007; Houben & Wiers, 2007; Nederkoorn et al., 2010; Olson & Fazio, 2004). The target words included six unhealthy food words: chocolate, cake, ice-cream, chips, pizza, and hamburger and are similar to those used in previous studies (e.g., Fishbach, Zhang, & Trope, 2010; Richetin et al., 2007; Roefs,

REDUCE TEMPTATION OR RESIST IT?

Herman, MacLeod, Smulders, & Jansen, 2005; Roefs & Jansen, 2002; Roefs et al., 2006).

The evaluative stimuli for the positive category included romantic, pleasure, rainbow, sunlight, peace and friend; and for the negative category included accident, sickness, abuse, alone, fear, and pain. These stimuli were selected from previous IAT studies (e.g., Karpinski & Steinman, 2006; Olson & Fazio, 2004; Roefs et al., 2005). Between the positive and negative categories, the stimuli were matched on number of syllables, word type (i.e., noun, adjective), frequency, and arousal (Bradley & Lang, 1999). All words were presented in lower case letters.

Each block was preceded by instructions. The category labels remained at the top of the screen on the same side as the appropriate response keys (i.e., ‘z’ for left, ‘/’ for right) throughout the tasks. Each word appeared centred on the screen, and the order of presentation of the words was randomised within each block. The word remained on the screen until the participants responded. The inter-trial interval was 400ms. Accuracy and response times were recorded.

Implicit evaluation of the goal of successful weight management. The weight management SC-IAT was identical to the food SC-IAT except that a “weight management” target category was used. The target words (thin, slim, slender, lean, fit, and healthy) were similar to those used in previous research (e.g., Fishbach et al., 2010; Vartanian, Herman, & Polivy, 2005).

Snack intake. A taste test was used to measure snack intake (e.g., Coelho et al., 2009). Participants were presented with four full bowls of pre-weighed popular energy-dense snack foods. The bowls contained 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). Using a Latin square

REDUCE TEMPTATION OR RESIST IT?

procedure with four orders, the placement position of the four bowls from left to right was counterbalanced across participants. Each bowl was accompanied by one paper-pencil format rating sheet containing six questions about the sensory attributes of the foods (e.g., “How sweet is this product?”). Ratings were completed on 100mm visual analog scales, ranging from “*not at all*” to “*extremely*”. Participants were given 10 minutes to taste as much food as they needed in order to accurately rate the foods while the experimenter was out of the room. To measure food consumption, the pre- and post-taste test weight of each bowl was recorded. Food intake in grams was multiplied by the number of kilojoules (kJ) per gram in each food. Intake in kJ for each food was summed to give total intake in kJ.

Temptation experience. A temptation score was obtained by averaging the responses to the question: “How much were you tempted to eat each of the foods presented in the taste-test?” for each food. Participants responded on 7-point Likert scales, ranging from 1 (*not at all*), to 7 (*extremely*) for each food.

Hunger. Participants’ subjective hunger levels were assessed with a single item: “Please indicate the place on the scale which best reflects your current level of hunger”. Responses were collected on a 7-point Likert scale ranging from 1 (*not hungry at all*), to 7 (*extremely hungry*).

Motivation. The extent to which participants were motivated to regulate eating in order to manage weight was measured using a 4-item self-report scale (e.g., “I choose certain food items to avoid gaining weight”, Sproesser, Strohbach, Schupp, & Renner, 2011). The scale requires participants to indicate how often each item is true for them on 5-point Likert scales, ranging from 1 (*never*), to 5 (*always*). An average motivation score was calculated for each participant, with higher scores indicating higher motivation to regulate eating for weight management. The scale’s internal-consistency coefficient alpha was acceptable in the current

REDUCE TEMPTATION OR RESIST IT?

study, Cronbach's $\alpha = .80$; and comparable with previous research, Cronbach's $\alpha = .89$ (Sproesser et al., 2011).

Explicit evaluation of unhealthy food. To assess explicit food evaluation, participants were asked to rate how much they liked eating six unhealthy foods (i.e., chocolate, cake, ice-cream, chips, pizza, and hamburger) on a 7-point Likert scale ranging from 1 (*not at all*), to 7 (*extremely*) (Hoefling & Strack, 2008).

Awareness of purpose of taste-test. Participants were asked to respond to the question "What do you think was the purpose of the taste-test?" using an open-ended response format. Participants were categorised as being aware of the taste-test's purpose if their response referred to the assessment of food intake, the self-control of eating, or resisting temptation.

Procedure

Testing was conducted in a quiet room in the Applied Cognitive Psychology Laboratory. Participants were tested individually, with each session running for approximately 30 minutes. Participants were asked to eat something 2 hours before the scheduled time of the study, and to refrain from eating again until the study to equalise hunger levels across participants. The hunger scale was completed first, followed by the two implicit association tasks presented in counterbalanced order, and then the taste test. Participants were then asked to complete the temptation, motivation, explicit food evaluation, and taste-test awareness questions, and to disclose background information (i.e., age, height and weight).

REDUCE TEMPTATION OR RESIST IT?

Data analysis

Computing implicit food and goal evaluation. Scores were calculated using the D600 algorithm (Greenwald, Nosek, & Banaji, 2003) modified for application to single-category IATs (Karpinski & Steinman, 2006). Participants with an error rate greater than 20% in either food + positive or food + negative trials were excluded from food SC-IAT analyses ($n = 20$); and participants with an error rate greater than 20% in either goal + positive or goal + negative trials were excluded from goal SC-IAT analyses ($n = 33$) (Karpinski & Steinman, 2006). A total of 48 participants had an error rate greater than 20% on either the food or the goal SC-IAT. Trials with response times of less than 350ms or more than 10000ms were also discarded (Karpinski & Steinman, 2006), which accounted for 4.96% and 5.01% of the food and goal data respectively. Incorrect responses on the remaining trials were replaced with the mean of response times from that block plus an error penalty of 400ms (Karpinski & Steinman, 2006). Error trials made up 10.1% of the food data and 13.2% of the goal data. Mean response times on positive trials (food or goal paired with positive) were subtracted from the mean response times on negative trials (food or goal paired with negative). The difference between response times on positive and negative trials was divided by the standard deviation of all correct response times on food trials for the food SC-IAT, and goal trials for the goal SC-IAT (Karpinski & Steinman, 2006). Higher scores indicate a more positive implicit evaluation of the target stimuli of the respective SC-IAT.

Statistical analyses. An independent-samples t-test was conducted to compare snack intake between participants who indicated awareness of the purpose of the taste-test and those who did not. Simple correlations were used to explore relationships between the variables of implicit food and goal evaluations, snack intake, temptation, hunger, BMI, motivation, and explicit food evaluation. To test whether temptation mediated the relationship between

REDUCE TEMPTATION OR RESIST IT?

implicit evaluation and intake, several hierarchical regression analyses were conducted: firstly, to establish a relationship between the predictor (implicit evaluation) and mediator (temptation), secondly, between the predictor and the outcome (food consumption), and finally, to explore whether the predictor was related to the outcome with the mediator variable in the model. A second set of regression analyses with implicit food evaluation was then run identical to the first, but including explicit food evaluation as a covariate. To investigate whether the relationships between implicit evaluations and snack intake were moderated by temptation, a hierarchical regression analysis was conducted. The predictors (implicit evaluation and temptation) were centred, from which an interaction term was computed (product of predictors) (Cohen, Cohen, West, & Aiken, 2003). The predictors were first regressed on intake, and then the interaction term was added to the model.

Results

Relationships between variables

Effect of awareness on snack intake. An independent-samples t-test (corrected for unequal variances) revealed that participants who were aware of the purpose of the taste-test did not consume significantly more kilojoules ($n = 31$, $m = 1065.11$, $sd = 820.85$) than participants who were not aware ($n = 161$, $m = 894.54$, $sd = 820.85$), $t(34.32) = 1.12$, $p = .27$.

Correlations between implicit food and goal evaluation, temptation, and intake of unhealthy food. Correlation analyses revealed that hunger was positively correlated with both snack intake and temptation (Table 1), and was therefore entered as a covariate in subsequent analyses. Snack intake was positively correlated with temptation. Implicit food evaluation was positively correlated with implicit goal evaluation, snack intake, temptation, and explicit food evaluation. Implicit goal evaluation was positively correlated with BMI and motivation, but by contrast was not correlated with either snack intake, or temptation.

REDUCE TEMPTATION OR RESIST IT?

Consequently, no further analyses were conducted on the relationships between implicit goal evaluation and outcome variables.

Mediation analysis: effect of implicit food evaluation on snack intake via temptation

To investigate whether the relationship between a more negative implicit food evaluation and lower snack intake was mediated by temptation strength (i.e., resembling antecedent-focused self-control [Figure 1]), a series of hierarchical regression analyses were conducted. Hunger was entered as a control variable at Step 1 in each model. To estimate pathway *a*, implicit food evaluation was regressed on snack intake. A more negative implicit food evaluation emerged as a significant predictor of lower food intake, $\beta = .15$, $t(171) = 1.99$, $p = .05$, $R^2 \text{ change} = .02$. A separate regression equation was estimated to test pathway *b*, regressing implicit food evaluation on temptation. Results showed that participants with a more negative implicit food evaluation reported feeling less tempted by the food, $\beta = .14$, $t(171) = 2.11$, $p = .04$, $R^2 \text{ change} = .03$. Finally, a regression model was estimated with snack intake as the dependent variable, and temptation and implicit food evaluation entered simultaneously as predictors, $R^2 \text{ change} = .07$, $F \text{ change} (2, 168) = 6.60$, $p = .002$. Temptation was a significant predictor of intake, $\beta = .25$, $t(171) = .25$, $p = .003$. However, implicit food evaluation no longer significantly predicted snack intake, $\beta = .11$, $t(171) = 1.53$, $p = .13$. These analyses show that variations in the experience of temptation account for the relationship between implicit snack food evaluation and snack intake. A Sobel test showed that the overall indirect effect of implicit food evaluation on intake approached significance, $z = 1.67$, $p = .09$.

We subsequently investigated whether temptation still mediated the relationship between implicit food evaluation and intake when explicit food evaluation was included as an additional covariate in the analysis. A similar pattern of results was found. When we

REDUCE TEMPTATION OR RESIST IT?

controlled for explicit food evaluation, a more negative implicit food evaluation was still a marginally significant predictor of lower food intake, $\beta = .14$, $t(171) = 1.85$, $p = .07$, R^2 change = .02, but explicit food evaluation was not, $\beta = .11$, $t(171) = 1.40$, $p = .16$. Results of a separate equation showed that both a more negative implicit, and explicit food evaluation contributed to participants reporting feeling less tempted by the food (implicit: $\beta = .10$, $t(171) = 1.68$, $p = .09$, R^2 change = .01; explicit: $\beta = .46$, $t(171) = 7.46$, $p = <.001$). Finally, when temptation and implicit food evaluation were entered simultaneously as predictors of snack food intake in a separate regression model, R^2 change = .06, F change (2, 167) = 5.25, $p = .001$, temptation significantly predicted intake, $\beta = .25$, $t(171) = 2.64$, $p = .01$, but implicit food evaluation, $\beta = .11$, $t(171) = 1.52$, $p = .13$, and explicit food evaluation, $\beta = -.01$, $t(171) = -.08$, $p = .93$, did not. Importantly, temptation still predicted snack intake when controlling for explicit food evaluation alone, $\beta = .27$, $t(171) = 2.85$, $p = .01$, R^2 change = .04. Thus, even after controlling for explicit evaluation of unhealthy food, variations in the experience of temptation still accounted for the relationship between implicit snack food evaluation and snack intake. However, results of a Sobel test showed that the indirect effect of implicit food evaluation on intake controlling for both hunger and explicit food evaluation was not significant, $z = 1.35$, $p = .18$.

Moderation analysis: effect of implicit food evaluation on snack intake via temptation

To test whether implicit food evaluation moderated the relationship between temptation and snack intake, a hierarchical regression analysis was conducted. The covariate (hunger) and predictors (implicit food evaluation and temptation) were first regressed on the outcome variable (snack intake), and then the interaction term (product of the predictors) was added to the model. Temptation was a significant predictor of snack intake, $B = 113.89$, $t(167) = 3.01$, $p = .003$, but implicit food evaluation did not significantly predict intake, $B =$

REDUCE TEMPTATION OR RESIST IT?

107.23, $t(167) = 1.53$, $p = .13$. The interaction term (product of temptation and implicit food evaluation) was not a significant predictor of snack intake, $B = 13.05$, $t(167) = .26$, $p = .80$, and did not result in a significant increase in snack intake variance explained with the predictors already in the model, $R^2 \text{ change} = .00$, $F \text{ change} (1, 167) = .07$, $p = .80$. Therefore, individuals' implicit food evaluation did not moderate the relationship between temptation and consumption of snack food.

Discussion

Many individuals experience a conflict between the temptation to indulge in unhealthy but tasty snack food, and the goal of healthy weight management. Implicit evaluations of unhealthy food and the weight-management goal-concept have previously been found to be related to indices of unhealthy eating behaviour, including self-reported and lab-based measures of food intake, self-reported resistance of unhealthy food temptations, weight gain, and BMI (Ayres et al., 2010; Conner et al., 2007; Dube, 2007; Friese et al., 2008; Hofmann et al., 2008; Perugini, 2005; Prestwich et al., 2011; Richetin et al., 2007). The current study contributed to an understanding of the relationship between these implicit evaluations and both the experienced temptation to consume, and the consumption of unhealthy snack food in a sample of young women motivated to manage weight through healthy eating.

Results suggest that the implicit evaluation of unhealthy food resembles an antecedent-focused route to self-control of eating: its relationship with snack consumption was accounted for by experienced temptation or desire to indulge in unhealthy food (Gross, 1998; Hoch & Loewenstein, 1991; Hofmann & Van Dillen, 2012). Consistent with previous research (Ayres et al., 2010; Conner et al., 2007; Dube, 2007; Friese et al., 2008; Hofmann et al., 2008; Perugini, 2005; Prestwich et al., 2011; Richetin et al., 2007), individuals who

REDUCE TEMPTATION OR RESIST IT?

implicitly evaluated unhealthy food stimuli more negatively tended to report being less tempted by the snack food offered, and also consumed less of it. Results suggest that the relationship between a more negative implicit evaluation of unhealthy snack food and lower snack consumption is mediated by the strength of temptation to indulge in unhealthy snacks. Like implicit food evaluation, explicit food evaluation was related to a higher reported experience of temptation. Nevertheless, temptation still predicted snack intake over and above the explicit evaluation of snack food. Furthermore, the relationship between a more positive implicit food evaluation and higher snack intake was also still accounted for by temptation, even after controlling for explicit food evaluation. Thus, in contrast to Ayres et al. (2012), we found that implicit food evaluation predicted snack intake incrementally over explicit food evaluation. This discrepancy could be attributable to differences in the explicit unhealthy food evaluation measures used. In particular, Ayres et al. (2012) suggest that their explicit measure of palatability reflects affective properties, and hence, likely shares more variance with implicit food evaluation than liking measures such as the one used here, which also include cognitive components. Further research into the mediation of the implicit food evaluation – intake relationship by temptation which takes affect versus cognitive laden explicit food evaluations into account would be valuable.

Results of a moderation analysis however, showed that the relationship between temptation to indulge and subsequent snack consumption does not vary according to individuals' implicit evaluation of food. Together, these findings suggest that the relationships between implicit food evaluation, temptation, and snack consumption resemble antecedent-focused regulation. The current study was correlational, and therefore, does not evidence causality. Experimental manipulation of implicit food evaluation is needed to confirm whether implicit negativity toward unhealthy snack food can prevent the experience of strong temptation to indulge, and subsequently lead to lower snack consumption.

REDUCE TEMPTATION OR RESIST IT?

Implicit evaluation of the goal of weight management was found not to correlate with either temptation or unhealthy snack intake. This result contrasts with previous findings revealing that a more positive implicit evaluation of a goal concept was a stronger predictor of both lower unhealthy snack intake, and higher self-reported frequency of ‘resisting tempting foods’, than the implicit evaluation of food stimuli (Ferguson, 2007). A critical difference between the current study and that of Ferguson (2007), is that we specifically recruited individuals who were motivated to manage their weight through healthy eating. We specified this inclusion criterion because we were interested in presenting a self-control conflict to participants – one between indulging in unhealthy but tasty snack food, and the longer term goal of healthy weight management (Hofmann & Kotabe, 2012). The current results show a positive relationship between motivation to manage weight through healthy eating and implicit evaluation of the goal of weight-management, suggesting that sampling from the higher end of motivation may yield more positive implicit goal evaluation. The sampling differences between the current study and that of Ferguson (2007) may be responsible for the divergent results regarding the relationship between implicit goal evaluation and food intake. The current sample may likely have a more limited range of implicit goal evaluations.

Interestingly, BMI was positively correlated with implicit goal evaluation, but not with implicit food evaluation. Thus, individuals with a higher BMI evaluated the goal of weight management more positively. However, as the current study was correlational, the direction of this relationship cannot be determined. Future research could usefully determine whether having a higher BMI affects the implicit evaluation of the goal of weight management, or vice versa.

REDUCE TEMPTATION OR RESIST IT?

The results of the current study have implications for the design of interventions which modify aspects of implicit cognition to enhance healthy regulation of eating behaviour. Modification of implicit cognitive processes like implicit food evaluation to facilitate healthy behaviour, offers benefits over the training of conscious strategies. Implicit processing, by definition, occurs without cognitive control or awareness (Bargh, 1997; Wilson, Lindsey, & Schooler, 2000). Therefore, modifying implicit processes offers a potential way of facilitating healthy behaviour while preserving limited cognitive resources for more cognitively effortful processes, such as the effortful inhibition of unhealthy behavioural impulses and the initiation of healthy alternatives (Carver, 2005; Muraven, 2000). Our finding that participants' implicit evaluation of snack food predicted their snack intake, is consistent with a body of research which suggests that changing people's implicit evaluation of unhealthy food from positive to negative may enhance successful regulation of eating behaviour (e.g., Ayres et al., 2010; Conner et al., 2007; Dube, 2007; Friese et al., 2008; Hofmann et al., 2008; Perugini, 2005; Prestwich et al., 2011; Richetin et al., 2007). Several studies have employed an evaluative conditioning procedure to modify implicit evaluation of unhealthy food. By presenting a stream of pictures or words on a computer screen, in which the unhealthy food stimuli are repeatedly paired with negatively valenced affective stimuli (e.g., obese body shapes, heart disease, etc.), and healthy or neutral stimuli are paired with positive or neutral affective stimuli, participants acquire a more negative implicit evaluation of unhealthy snacks (Hollands, Prestwich, & Marteau, 2011; Lebens et al., 2011). Subsequent effects on choice of fruit over unhealthy snacks have, however, varied: while Hollands et al. (2011) demonstrated that evaluative conditioning training promoted choice of fruit over unhealthy snacks, Lebens et al. (2011) did not. Previous research has not, however, examined the effect of modification of implicit food evaluation on individuals' temptation to indulge in unhealthy food. Although correlational in nature, the current study nevertheless suggests that changing implicit food

REDUCE TEMPTATION OR RESIST IT?

evaluation to become more negative may reduce consumption of unhealthy foods by reducing the extent to which individuals feel tempted by it. Further studies into the modification of implicit food evaluation are needed to validate this causal hypothesis.

Examining the ways in which other modifiable implicit cognitive processes relate to both temptation and eating behaviour may help to identify targets for a program of cognitive modification tasks which simultaneously enhance both antecedent- and response-focused regulation strategies. For example, attentional biases have been successfully retrained toward healthy foods to increase consumption of healthy foods relative to unhealthy options (Kakoschke, Kemps, & Tiggemann, 2014), and away from chocolate stimuli to decrease both subjective craving (an intense, specific desire) for, and consumption of, chocolate (Kemps, Tiggemann, Orr, & Gear, 2014). It is unclear, however, whether the effect of attentional bias modification on consumption can be primarily accounted for by its effect on craving or desire – therefore representing an antecedent-focused strategy of regulation; or whether it affects behaviour at a response-focused level, moderating the effect of craving or desire on subsequent consumption. Classifying implicit modifiable cognitive factors as resembling antecedent- or response-focused pathways to behavioural regulation could inform the development of a program of cognitive modification tasks which simultaneously reduce the strength of, and enhance the ability to overcome, the temptation to indulge in unhealthy behaviour.

Like all studies, the current study has a number of limitations. First, the temptation measure was administered after the taste-test, and thus prompted participants to retrospectively report on the temptation they had experienced prior to the taste-test. This was intended to prevent the perceived temptation from influencing intake. However, participants could have based their judgment of temptation on the amount of snack consumption, thereby

REDUCE TEMPTATION OR RESIST IT?

inflating the correlation between these two variables. To circumvent these methodological issues, future studies could comprehensively address the temporality of the variables by using a time series design, whereby assessment of implicit food evaluation, temptation, and intake are taken at multiple time points, thereby providing the opportunity to examine the within-subjects correlations between them (Roe, 2012). Second, snack consumption was assessed in a controlled laboratory-based setting after a 2-hour period of fasting. This design was intended to provide control over variables which have been suggested by previous research to affect eating behaviour (e.g., diet-related cues (Papies & Hamstra, 2010), pre-load (Herman, Polivy, & Esses, 1987), food variety (Rolls et al., 1981), portion size (Hill & Peters, 1998), etc.). However, to increase ecological validity, future research could usefully explore associations between implicit food evaluation, temptation, and snack intake in a more naturalistic setting. Third, the current study recruited a sample of young female university students, as previous research has shown that the goal of weight management is common among this population (Fishbach et al., 2003; Wardle et al., 2004; Wardle, Haase, & Steptoe, 2005). Nevertheless, to demonstrate the generalizability of the relationships shown in the current study, it would be valuable to investigate them among a more diverse sample of weight-concerned individuals.

In conclusion, the current study contributes to an understanding of the relationship between individuals' implicit evaluation of unhealthy food and their consumption of such foods. Namely, the findings suggest that the relationship between a more negative evaluation of unhealthy food and lower snack intake is mediated by experienced temptation to indulge in that food.

REDUCE TEMPTATION OR RESIST IT?

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REDUCE TEMPTATION OR RESIST IT?

Table 1.

Correlations between variables.

	1	2	3	4	5	6	7	8
1 Implicit food evaluation		.30**	.15*	.14†	.01	.04	.10	.18*
2 Implicit goal evaluation			-.01	-.02	.05	.19*	.15††	.05
3 Intake (kJ)				.31**	.21*	.12	-.15††	.27**
4 Temptation					.38**	.05	.07	.75**
5 Hunger						-.03	.02	.27**
6 BMI							.05	.08
7 Motivation								.01
8 Explicit food evaluation								

†† $p < .08$, † $p < .07$, * $p < .05$, ** $p < .001$.

REDUCE TEMPTATION OR RESIST IT?

Figure captions

Figure 1. Mediation of the relationship between implicit evaluation of snack food and intake of unhealthy snack food by temptation. *Note.* Bold arrows denote significant relationships.

REDUCE TEMPTATION OR RESIST IT?

Figure 1.

REDUCE TEMPTATION OR RESIST IT?

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