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Abstract

Objective: The difficulty for chronic dieters (i.e., restrained eaters) in regulating their food intake is a conflict between two apparently incompatible goals: eating enjoyment and weight control. The latter goal consistently relies on the deployment of cognitive resources, and very often on a significant amount of self-control. This study investigated whether self-affirmation might counteract the effect of ego depletion on restrained eaters' motivation to consume high-calorie foods.

Design: Participants ($N = 183$) were assigned to one of four conditions in a 2 x 2 (Ego depletion x Self-Affirmation) experimental design and were subsequently exposed to images of high- and low-calorie foods.

Main outcome measures: Participants completed tasks assessing their implicit and explicit preferences for high vs. low-calorie foods, along with a measure of the perceived self-control required to resist foods.

Results: Results indicated that, following ego depletion, self-affirmation facilitated restrained eaters' perceptions of self-control and led to lower explicit preferences for high calorie foods. This pattern was not apparent for implicit preferences.

Conclusion: Self-affirmation interventions may be capable of restoring self-control resources among restrained eaters. Pointers for future research and practical applications are discussed.

Keywords: *ego-depletion, restrained eaters, self-affirmation, attitudes, control*

Does self-affirmation following ego-depletion moderate restrained eaters' explicit preferences for, and implicit associations with, high-calorie foods?

The increasing availability of food in Western societies has contributed to overeating to the extent that obesity is now widespread (Smith, Orleans, & Jenkins, 2004). As a consequence, dieting has become a major adaptive behaviour strategy for attempting weight control, although dieting is far from always associated with long-term success (Elfhag & Rössner, 2005). That is, many people find it difficult to maintain a weight-loss diet and most regain the weight they initially lose (Mann et al., 2007). This is especially true for those termed "restrained eaters", who are chronic, often unsuccessful, dieters (Heatherton, Herman, Polivy, King, & McGree, 1988; Hermann & Polivy, 1980). It would seem that people in general, and particularly restrained eaters, find it difficult to resist eating palatable, high-calorie foods (Stroebe, Mensink, Schut, & Kruglanski, 2008), even though such consumption is often construed as inconsistent with weight control goals. Why is it that people struggle so much to achieve long-term weight loss? In the research reported in this paper, as a small contribution to addressing this broad question, we examine the effects of self-affirmation and ego-depletion manipulations on restrained and unrestrained eaters' motivation to consume high- vs. low-calorie foods.

Restrained eaters

A difficulty for people who wish to lose weight by reducing their calorie intake is often that they must deny themselves the shorter-term pleasures of eating high-calorie, palatable foods, in the pursuit of long-term weight loss. However, dieters' eating behaviour seems to be strongly influenced by the attractive sight, smell and taste of food, which is made more salient by everyday environments that promote the consumption of high-calorie foods

(Papies, Stroebe, & Aarts, 2008). The impact of tempting food cues is powerful for restrained eaters in particular, since they are very responsive to the anticipated enjoyment of eating palatable food (Lowe & Butryn, 2007). Restrained eaters (Herman & Polivy, 1980), who attempt to restrict their dietary intake, are characterised as both relatively 'insensitive to hunger and satiation cues' (Stroebe, 2011, p.168) and as susceptible to dietary disinhibition when their cognitive control over their eating is disrupted (e.g. by stressful events [Wardle, Steptoe, Oliver & Lipsey, 2000]) and when they subsequently contravene their own dietary rules. Restraint has been associated, for example, with eating disorders and weight gain and has consequently attracted a huge amount of research attention (see e.g. Stice, Fisher & Lowe, 2004).

The Goal Conflict Model of Eating (Stroebe, 2008; Stroebe et al., 2008) suggests that restrained eaters constantly face a self-control dilemma between two goals: those of *eating enjoyment* and *weight control*. Thus, while their weight control goal often dominates restrained eaters' motivation to enjoy eating, the fragile balance between the two often-competing goals can easily be disturbed by exposure to tempting high-calorie palatable foods. For these people, consequently, their goal of food enjoyment will dominate their weight control goal when they are exposed to tempting food cues, and they are subsequently likely to overeat (Stroebe, van Koningsbruggen, Papies, & Aarts, 2013).

The Reflective-Impulsive model (Strack & Deutsch, 2004) complements this theory by proposing that, in this kind of situation, the conflicting choice involves a clash between the *impulse* to indulge in tempting high-calorie food (related to the goal of eating enjoyment for restrained eaters) and the more *reflective* self-imposed eating behaviour restrictions (the weight control goal). However, the latter goal relies on cognitive resources and the exercise of self-control, which may, in turn, may lead to ego-depletion ('the state of diminished resources following exertion of self-control (or other tasks that might deplete the same

resource)' [Baumeister, Vohs, & Tice, 2007, p. 352]) such that the exercise of subsequent self-control is rendered more difficult. Self-control, the capacity to alter one's responses in pursuit of long-term goals (Baumeister et al., 2007), therefore appears to play a role in failed weight control attempts. Specifically, if the requisite self-control resources are lacking (perhaps as a result of ego-depletion), this can cause temporary shifts in both motivation and attention (Inzlicht & Schmeichel, 2012), the efficient functioning of the reflective system (dieting goal) is impaired and the prevention of impulsivity (aligned to eating enjoyment goals) is less successful. Thus, impulsivity can override eating intentions when one is lacking in self-control resources, and as a consequence, be more influential in eating behaviour (Friede, Hofmann, & Wänke, 2008). Self-control levels may thus help explain research findings on restrained eaters' preferences for high-calorie palatable foods compared to low-calorie foods.

The suggestion that restrained eaters might hold more positive explicit preferences for high-calorie palatable foods than do unrestrained eaters (Stroebe et al., 2008) has received mixed empirical support. Indeed, some research has found that restrained eaters report lower explicit preferences for high-calorie palatable foods than do unrestrained eaters (Hoeftling & Strack, 2008; Urland & Ito, 2005). This might be explained by restrained eaters' intentions to refrain from indulging in these foods (as a result of a second-order preference for weight control over eating enjoyment) and therefore expressing lower preference for them. In contrast, it is plausible that restrained eaters demonstrate more positive implicit associations with high-calorie foods, because impulsive processes are implicit and automatic. For this reason, recent research has employed implicit measures, such as the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998) to investigate restrained eaters' unconscious automatic associations with high-calorie palatable foods.

There is some IAT evidence that restrained eaters make more positive implicit associations with high-calorie foods (Hoeftling & Strack, 2008; Houben, Roefs, & Jansen, 2010). However, other research has found more negative implicit associations with high-calorie foods in restrained eaters than in unrestrained eaters (Papies, Stroebe, & Aarts, 2009). It is conceivable that any manipulation that depletes restrained eaters' self-control resources might alter their immediate food preferences, such that the predictive value of explicit measures is decreased and the strength of implicit measures is increased in the prediction of eating behaviour (Friede, Hormann, & Wänke, 2008; Hofmann, Gschwendner, Castelli, & Schmitt, 2008). Many studies have explored the effect of ego-depletion on subsequent eating behaviour: there is by now much evidence to show that restrained eaters eat more than unrestrained eaters when their self-control resources have been depleted (Boon, Stroebe, Schut, & Ijntema, 2002; Guerrieri, Nederkoorn, Schrooten, Martijn, & Jansen, 2009; Heatherton, Herman, & Polivy, 1991; Lattimore & Maxwell, 2004).

However, relatively few studies have assessed the effects of reduced self-control resources on restrained eaters' explicit preferences and implicit associations with palatable high-calorie food. Friede, Hofmann, & Wänke (2008) found that when restrained eaters had not experienced ego-depletion, an explicit attitude measure was a strong predictor of the amount of food consumed whereas an implicit measure was not. In contrast, when restrained eaters were depleted of their self-control resources through an emotion suppression task, the implicit measure showed more predictive power and the explicit measure was unrelated to food consumption (see also Hofmann, Rauch, & Gawronski, 2007). It would thus appear that restrained eaters may be sensitive to a depletion of their self-control resources, and that in this state it is impulsive processes, linked to the goal of eating enjoyment, which influence consumption behaviour.

It has been suggested that self-affirmation processes (which may be activated by threats to a person's sense of self-integrity) may serve to restore depletion of self-control resources (e.g., Schmeichel & Vohs, 2009). Indeed, self-affirmation has been linked to efficacy more generally (e.g. Epton & Harris, 2008). Self-affirmation theory (Steele, 1988) is concerned with how people are motivated to maintain a sense of self-integrity and how this motive becomes apparent when people experience dissonance or threat. Applications of this framework in the domain of health-related behaviour (following Reed & Aspinwall, 1998; Sherman, Nelson & Steele, 2000) have focused on combining self-affirmation manipulations (which boost a sense of self-integrity) with health-threatening information (e.g. information that outlines the health-related risks of excessive eating or insufficient exercise). The self-affirmation manipulation is designed to reduce defensive processing of the information, thereby leading people to be more open to a balanced (unbiased) consideration of the information and of its implications for their own actions. In the time since the inception of the theory, numerous studies have indicated the beneficial effects of such manipulations on health-related motivation and behaviour (e.g. Epton & Harris, 2008; Epton, Harris, Kane, van Koningsbruggen & Sheeran, 2014) as well as in other domains (Cohen & Sherman, 2014). In particular, regarding the food consumption topic of the present study, self-affirmation manipulations have been shown to be effective, for example, in promoting fruit and vegetable consumption (Epton & Harris, 2008; Harris et al., 2014; Pietersma & Dijkstra, 2011; van Koningsbruggen et al., 2014), avoidance of unhealthy foods (Cornil & Chandon, 2013), and weight loss (Logel & Cohen, 2012). Some of this research has combined a self-affirmation intervention with health-related information (e.g., Epton & Harris, 2008) while some of it has not (Cornil & Chandon, 2013; Logel & Cohen, 2012); different methodological approaches might be expected to result in different patterns of findings since, for example, (and while acknowledging, of course, that threat may be implicit and/or explicit) the core literature on

self-affirmation processes points to the important component of threat in eliciting self-affirmation effects.

Schmeichel and Vohs (2009) have suggested that a weakened resource for self-control can be restored: they found that a self-affirmation manipulation boosted self-control for participants who had been ego-depleted. Ego depletion was obtained (in studies 1 & 4) by asking participants to 'write a story about a recent trip you have taken' (p.772) but avoiding the use of the letters *a* and *n*; a second group was asked to write the story without such a restriction. By manipulating self-control using this ego-depletion task, they showed that initial efforts at self-control caused a decline in performance in subsequent intentional acts requiring self-control. They then found that these effects were absent among self-affirmed participants (i.e. those who expressed their core life values during an interval separating the two self-control depleting tasks). Interestingly, self-affirmed participants who were non-depleted did not show an enhanced performance on the subsequent self-control task compared to their non-affirmed counterparts, suggesting that self-affirmation does not benefit performance for people at baseline levels of self-control. According to Schmeichel and Vohs (2009), self-affirmation leads to high levels of mental construal which both fortifies the self-concept and boost self-regulatory function by inducing a broad-minded, long-term perspective (see also Wakslak & Trope, 2009). This suggestion has attracted widespread interest in the recent self-affirmation literature (e.g., Harris, 2011; Sherman, 2013).

Heatherton and Baumeister (1991) suggest that restrained eaters tend to be averse to the broader, long-term perspective, especially when their self-control resources are depleted. They propose that when restrained eaters experience ego-threats or negative moods, their attention is narrowed to the immediate stimulus environment and 'meaningful thought' (p. 95) is obstructed. Consequently, normal inhibitions against eating high-calorie palatable foods are suspended. As such, it is plausible that inducing a broader, longer-term perspective

through self-affirmation might counteract the effect of reduced self-control, and as a result prevent restrained eaters' behaviour from being guided by impulsive processes. Accordingly, the present study investigated whether among restrained eaters self-affirmation might moderate the effect of ego-depletion on explicit food preferences, on the reported self-control needed to resist food, and on the implicit associations with foods. Specifically, we hypothesised:

1 a) Self-affirmation would moderate the effect of ego-depletion on explicit food preferences, such that ego-depletion would only lead to higher preferences for high-calorie foods among non-affirmed participants; b) these effects would be more pronounced for restrained eaters than for unrestrained eaters;

2 a) Self-affirmation would moderate the effect of ego-depletion on the self-reported control required to resist high-calorie foods, such that ego-depletion would lead to a greater need for control only among non-affirmed participants; b) these effects would be more pronounced for restrained eaters than for unrestrained eaters;

3 a) Self-affirmation would moderate the effect of ego-depletion on positive associations with high-calorie foods, such that ego-depletion would lead to faster associations with high-calorie food only among participants who are non-affirmed; b) these effects would be more pronounced for restrained eaters than for unrestrained eaters.

Method

Participants

Two hundred and fifty-two fluent English speaking female adults participated in this study; sixty-nine did not complete the study (a 27.95% attrition rate). As a result, data from

183 participants, aged between 18 and 60 ($M = 27.29$, $SD = 10.84$), were used in the analyses reported here.

Materials

The measures were administered via an online questionnaire. This involved two writing tasks, an implicit association task, and two questionnaires containing the measures described below. All response scales were seven-point, unless indicated otherwise.

Participants were first asked to indicate their age, gender, and whether or not they spoke fluent English.

Ego-depletion manipulation. To manipulate self-control exertion, participants were asked to write a short story in one of two ways (see Schmeichel, 2007). Participants in the *non-depletion (free-writing) condition* were instructed to simply “write a story about a recent trip you have taken. It may be a trip to the supermarket, to the city, or to another country!” Participants in the *ego-depletion (regulated-writing) condition* received the same instructions but with the additional requirement, “Very important! Please do not use the letters *a* or *n* anywhere in your story.” All participants were asked to write approximately six sentences. Thus, the non-depletion group wrote without restrictions, whereas the ego-depletion group had to regulate their writing by exercising executive control to avoid the use of two common letters (a task requiring much more self-control).

Manipulation check. Participants were asked about the amount of effort they had expended on the task: “How much effort did that last writing task involve for you?” (*no effort at all* [1] to *a huge amount of effort* [7]), as well as how much attention they had to pay to the task: “How much attention did you have to pay to what you were doing on the writing task?” (*no attention at all* [1] to *all my attention* [7]) and how much control they needed to exercise on the writing task (“How much control did you need to exercise on that writing task?” (*no control* [1] to *complete control* [7])), $\alpha = .91$.

Self-affirmation manipulation. Following a standard procedure (Sherman et al., 2000, Study 2; Harris & Napper, 2005), participants in the *self-affirmation condition* were presented with a list of 12 values (e.g., *honesty, forgiveness, loyalty, goodness, sincerity*) and asked to select which value was most important to them. Next, they wrote a short paragraph (2-3 sentences) explaining why this value was important to them, and describing how they used it in their everyday lives. Participants in the *no-affirmation condition* were asked to think about a stereotypical office and write a short statement (2-3 sentences) describing this office (D. Jessop, personal communication, November 1st 2012).

Implicit food associations. The Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998) measures the association between stimuli belonging to two conceptual categories (e.g. *flower, insects*) and two evaluative attributes (e.g. *good, bad*). The particular IAT used in this study was one modified from an open-source web-based version created by Mason (2013). The target categories consisted of six images of high-caloric foods (> 3 kcal/g; e.g. *chips, pizza*; labelled 'hot snack') and six images of low-caloric foods (< 1.0 kcal/g; e.g. *salad, fruit*; labelled 'cold snack') as used by Houben, Roefs, and Jansen (2010). Attribute concepts were pleasant words (*tasty, delicious, good, delightful, heavenly, outstanding*) or unpleasant words (*tasteless, unsavoury, bad, nasty, awful, disgusting*).

Stimuli were presented in the middle of the computer screen and the labels of categories, assigned to the left and right response keys, were presented in the corresponding upper corners of the screen. Participants were instructed to classify the stimuli to either attribute as quickly and as accurately as possible. Stimuli remained on the screen until a response was given. Feedback was presented in red beneath the stimuli if participants gave an incorrect response.

Participants received two practice trials in which they simply had to match the categories to the labels 'hot snack' and 'cold snack', and the attribute concepts to words

‘pleasant’ and ‘unpleasant’. They were then required to match compatible category and attribute pairs (high-calorie foods + pleasant attributes, low-calorie foods + unpleasant attributes) over two blocks. These pairs were interpreted as “compatible” because they are “commonly thought of as the *belief or stereotype*” (Lane, Banaji, Nosek, & Greenwald, 2007, p.64).

A further two blocks matching “incompatible” category and attribute pairs (high-calorie foods + unpleasant attributes, low-calorie foods + pleasant attributes) followed after another practice trial. Following Greenwald, Nosek, and Banaji’s (2003) recommended criteria, IAT effects were calculated using the D600 scoring algorithm in such a way that positive scores indicated faster responses for compatible pairing assignment (i.e., associating high-calorie foods with a positive attribute faster than with a negative attribute, and low-calorie foods with a negative attribute faster than with a positive attribute); whereas negative scores indicated faster responses for incompatible pairing assignment (i.e., associating high-calorie foods with a negative attribute faster than with a positive attribute, and low-calorie foods with a positive attribute faster than with a negative attribute).

Explicit food preferences. Explicit preferences toward the foods used in the IAT were assessed. Participants were asked to indicate palatability: “How palatable is this food [...] to you right now?” (*not at all* [1] to *extremely* [7]), and desirability: “To what extent would you desire to eat this food [...] right now if it were in front of you?” (*not at all* [1] to *a huge extent* [7]). The mean for palatability and desirability of low-calorie food scores ($\alpha = .86$) was subtracted from the mean palatability and desirability high-calorie food scores ($\alpha = .94$) to determine participants’ relative explicit preference for high-calorie foods compared to low calorie foods. Positive scores indicated greater desirability and palatability of high-calorie foods relative to low-calorie foods; whereas negative scores indicated greater desirability and palatability of low-calorie foods relative to high-calorie foods.

Perceived control needed to resist food. Participants were also assessed on how much control they felt they would require to resist eating each food if it were in front of them: “How much control do you think you would need to fight the urge to eat this food [...] right now if it were in front of you?” (*no control* [1] to *complete control* [7]). The mean overall control needed to resist low-calorie food score ($\alpha = .80$) was subtracted from the mean control needed to resist high-calorie food score ($\alpha = .88$) to determine relative ability to resist high-calorie foods compared to low-calorie foods. Positive scores indicated greater control needed to resist high-calorie foods relative to low-calorie foods; negative scores indicated greater control needed to resist low-calorie foods relative to high-calorie foods.

Dietary restraint. Participants then completed the 10-item Restraint Scale (Polivy, Hermann, & Warsh, 1978). This measure of dietary restraint consists of two subscales: *concern for dieting* and *weight fluctuations* (van Strien, Breteler & Ouwens, 2002). Following Houben *et al.* (2010), those with a score of 15 or above were classified as *restrained eaters* ($n = 72$) and those with a score 14 or below were classified as *unrestrained eaters* ($n = 111$).

Design and Procedure

The study employed a 2 x 2 x 2 (Ego-Depletion [ego-depleted, non-depleted] x Self-Affirmation [self-affirmed, non-affirmed] x Restraint Group [unrestrained, restrained]) between-participants design. Participants were first ego-depleted or non-depleted, and then self-affirmed or non-affirmed. All participants then completed the IAT, the explicit food preference measure, the control needed to resist food measure and finally the dietary restraint measure. The number of participants in each condition were as follows: ego-depleted and self-affirmed (restrained = 20, unrestrained = 26) $n = 46$; ego-depleted and non-affirmed (restrained = 15, unrestrained = 23) $n = 38$; non-depleted and self-affirmed (restrained = 14,

unrestrained = 29) $n = 43$; non-depleted and non-affirmed (restrained = 23, unrestrained = 33) $n = 56$.

Participants were recruited by email and on a social network site, using the “snowball” sampling procedure (Solowij et al., 1992). This procedure involved requesting (in the recruitment message) that participants send the link to their female friends (over 18 years of age). Email messages were sent out with access to the experiment attached as an online link, which randomly allocated participants to one of the four experimental conditions. Data were collected online and data collection ceased once recruitment success tailed off. Participation was entirely voluntary and confidential. Participants were entered into two separate prize draws of £25 each.

Results

A preliminary 2 x 2 (Ego-depletion [ego-depleted, non-depleted] x Self-affirmation [self-affirmed, non-affirmed]) independent measures ANOVA on dietary restraint scores showed no main effect of either Ego-depletion, $F(1, 179) = 1.19, p = .29$, or Self-affirmation, $F(1, 179) = 0.01, p = .93$, and no interaction effect, $F(1, 179) = 0.10, p = .75$. A further preliminary 2 x 2 x 2 (Ego-depletion [ego-depleted, non-depleted] x Self-affirmation [self-affirmed, non-affirmed] x Restraint Group [unrestrained, restrained]) independent measures ANOVA on age showed no main effect of either Ego-depletion, $F(1, 175) = 1.71, p = .19$, Self-affirmation, $F(1, 175) = 2.30, p = .13$, or Restraint group, $F(1, 175) = 1.17, p = .28$, and there were no interaction effects. We were therefore confident that participants had been successfully randomly allocated to condition.

Ego-depletion Manipulation Check

As predicted, ego-depleted participants reported expending significantly greater effort ($M = 5.24, SD = 0.94$) on the writing task than did non-depleted participants ($M = 3.09, SD = 1.08$), $t(181) = 14.26, p < .001, 95\% CI [1.86, 2.45], d = 2.12$.

Explicit Food Preferences

A 2 x 2 x 2 (Ego-depletion [ego-depleted, non-depleted] x Self-affirmation [self-affirmed, non-affirmed] x Restraint Group [unrestrained, restrained]) independent measures ANOVA on explicit food preferences revealed no significant main effects and no significant two-way interaction effects. There was, however, a significant three-way interaction effect, $F(1, 175) = 5.22, p = .02, \eta^2 = .03$ (see Figure 1).

In order to explore this three-way interaction, restraint groups were subsequently assessed separately. A 2 x 2 (Ego-depletion [ego-depleted, non-depleted] x Self-affirmation [self-affirmed, non-affirmed]) independent measures ANOVA among unrestrained eaters showed no significant interaction effect, $F(1, 107) = 1.11, p = .30, \eta^2 = .01$ (see Figure 1a)¹. However, a similar ANOVA for restrained eaters showed a significant interaction effect, $F(1, 68) = 4.52, p = .04, \eta^2 = .06$ (see Figure 1b)². Simple main effects analyses revealed no significant effect of the Self-affirmation for non-depleted restrained eaters. There was, however, a significant effect of Self-affirmation among ego-depleted restrained eaters, $F(1, 68) = 5.23, p = .03, \eta^2 = .07$, such that non-affirmed restrained eaters showed greater preference for high-calorie foods ($M = 0.28, SD = 1.21$) than did self-affirmed restrained eaters ($M = -1.09, SD = 1.44$). Although there was no effect of Ego-depletion for non-affirmed restrained eaters, there was a marginally significant effect of Ego-depletion among self-affirmed restrained eaters, $F(1, 68) = 3.00, p = .09, \eta^2 = .04$, such that ego-depleted

¹ There was no significant main effect of Ego Depletion, $F(1, 107) = 1.43, p = .23, \eta^2 = .01$, or of Self-affirmation, $F(1, 107) = 1.35, p = .25, \eta^2 = .01$.

² There was no significant main effect of Ego Depletion, $F(1, 68) = 0.15, p = .70, \eta^2 = .00$, or of Self-affirmation, $F(1, 68) = 1.26, p = .27, \eta^2 = .02$.

participants indicated lower preferences for high-calorie foods ($M = -1.09$, $SD = 1.44$) than did non-depleted participants ($M = -0.23$, $SD = 1.67$).

We should note that when we teased apart the effects separately for preferences for high-calorie and low-calorie foods, the above pattern of effects was apparent for high-calorie food preferences (three-way interaction: $F(1, 175) = 4.84$, $p = .03$, $\eta^2 = .03$) but not for low-calorie food preferences (three-way interaction: $F(1, 175) = 0.19$, $p = .66$, $\eta^2 = .00$).

Control Required to Resist Food

A $2 \times 2 \times 2$ (Ego-depletion [ego-depleted, non-depleted] x Self-affirmation [self-affirmed, non-affirmed] x Restraint Group [unrestrained, restrained]) independent measures ANOVA revealed no significant main effect of either Ego-depletion or Self-affirmation. There was, however, a significant main effect of Restraint group, $F(1, 175) = 4.46$, $p = .04$, $\eta^2 = .03$, 95% CI [.03, .84], such that restrained eaters reported greater relative control needed to resist high calorie foods ($M = 0.03$, $SD = 1.28$) than did unrestrained eaters ($M = -0.34$, $SD = 1.39$). There were no significant two-way interaction effects, although there was a significant three-way interaction effect, $F(1, 175) = 6.05$, $p = .02$, $\eta^2 = .03$ (see Figures 2a & b)³. In order to explore this, restraint groups were subsequently analysed separately. A 2×2 (Ego-depletion [ego-depleted, non-depleted] x Self-affirmation [self-affirmed, non-affirmed]) independent measures ANOVA for unrestrained eaters showed no significant

³ With these key investigations run as multiple regression analyses with dietary restraint entered as a continuous variable, the three-way interaction with respect to explicit preferences was marginally statistically significant, $p = .071$, as was the three-way interaction with respect to perceived control, $p = .058$.

interaction effect, $F(1, 107) = 1.48, p = .23, \eta^2 = .01$ (see Figure 2a)⁴. However, a similar ANOVA among restrained eaters showed a significant interaction effect, $F(1, 68) = 5.24, p = .03, \eta^2 = .07$ (see figure 2b)⁵. Simple main effects analyses revealed no effect of the Self-affirmation for non-depleted participants. There was, however, a significant effect of Self-affirmation for ego-depleted participants, $F(1, 68) = 4.03, p = .05, \eta^2 = .06$, such that ego-depleted non-affirmed participants reported greater control needed to resist high-calorie foods ($M = 0.41, SD = 0.72$) than did ego-depleted self-affirmed participants ($M = -0.45, SE = 1.46$).

Further simple main effects analyses revealed no effect of Ego-depletion for non-affirmed restrained eaters. There was, however, a significant effect of Ego-depletion for self-affirmed restrained eaters, $F(1, 68) = 4.36, p = .04, \eta^2 = .06$, such that non-depleted self-affirmed participants reported greater control needed to resist high-calorie foods ($M = 0.46, SD = 1.36$) than did ego-depleted self-affirmed participants ($M = -0.45, SD = 1.46$).

When we assessed the effects for perceived control needed to resist high-calorie and low-calorie foods separately, the analyses for high-calorie foods showed only a main effect for dietary restraint, $F(1, 175) = 4.53, p = .035, \eta^2 = .03$; for low-calorie foods, there were no significant main effects and no significant interactions.

Implicit Food Associations

A 2 x 2 x 2 (Ego-depletion [ego-depleted, non-depleted] x Self-affirmation [self-affirmed, non-affirmed] x Restraint Group [unrestrained, restrained]) independent measures

⁴ There was no significant main effect of Ego Depletion, $F(1, 107) = 0.25, p = .62, \eta^2 = .00$, or of Self-affirmation, $F(1, 107) = 0.51, p = .48, \eta^2 = .01$.

⁵ There was no significant main effect of Ego Depletion, $F(1, 68) = 0.54, p = .46, \eta^2 = .01$, or of Self-affirmation, $F(1, 68) = 0.31, p = .58, \eta^2 = .01$.

ANOVA revealed no significant main effect of either Ego-depletion or Self-affirmation.

There was, however, a significant main effect of Restraint group, $F(1, 175) = 5.25, p = .02, \eta^2 = .03, 95\% \text{ CI } [.02, .32]$, such that unrestrained eaters showed stronger positive associations with high-calorie foods / negative associations with low-calorie foods ($M = 0.15, SD = 0.53$) than did restrained eaters ($M = -0.03, SD = 0.44$). There was a significant two-way interaction between Ego-depletion and Self-affirmation, $F(1, 175) = 4.44, p = .04, \eta^2 = .03$ (see Figure 3). Simple main effects analyses revealed a significant effect of Self-affirmation for non-depleted participants, $F(1, 179) = 5.75, p = .02, \eta^2 = .03$, such that self-affirmed non-depleted participants showed stronger positive associations with high-calorie foods/ negative associations with low-calorie foods ($M = 0.21, SD = 0.46$) than did non-affirmed non-depleted participants ($M = -0.03, SD = 0.52$).

Relationships between the dependent measures

Correlations between explicit food preferences, perceived control required to resist food, and implicit food associations were all statistically significant. Explicit food preferences were positively correlated with both perceived control required to resist food ($r = .79, p < .001$) and implicit food associations ($r = .35, p < .001$), indicating that as relative explicit preferences for high-calorie foods increased, so did relative perceived control needed to resist high-calorie foods and relative implicit positive associations with high-calorie foods/ negative associations with low-calorie foods. Control required to resist food and implicit food associations were also significantly positively correlated ($r = .31, p < .001$), indicating that as relative control needed to resist high-calorie foods increased, so did implicit positive associations with high-calorie foods/ negative associations with low-calorie foods.

Discussion

The results of the current study showed that both the ego-depletion and the self-affirmation manipulations influenced restrained eaters' explicit preferences and reported control required to resist high-calorie foods. However, the manipulations did not yield any differences between restrained and unrestrained eaters on their implicit associations with those foods. Specifically, the results showed that ego-depleted restrained eaters who were self-affirmed reported a significantly lower preference for high-calorie foods compared to ego-depleted restrained eaters who were not self-affirmed. Moreover, ego-depleted restrained eaters who were self-affirmed reported that they needed less control to resist these high-calorie foods than did their counterparts who were not self-affirmed. There were no such effects for unrestrained eaters. Thus, the moderation effects within hypotheses 1 and 2 were supported by these findings, although the precise pattern of effects was somewhat at odds with these.

These findings are commensurate with those of Schmeichel and Vohs (2009) who ascribe their effects to self-affirmation's ability to induce higher levels of mental construal, which in turn enhances people's efforts to protect their long-term goals from anticipated temptations (Fujita & Roberts, 2010). It is certainly possible in our study that self-affirmation facilitated ego-depleted restrained eaters' capacity for self-control through higher levels of mental construal and in doing so reinforced reflective processes (i.e. monitoring their weight control goal). As such, reflective processes among ego-depleted restrained eaters who are self-affirmed might have directed attention to their negative attitudes towards high-calorie foods and simultaneously increased their perceived ability to resist high-calorie foods significantly more so than was the case among their non-affirmed counterparts. Thus, it may be that the self-affirmation manipulation in this study increased ego-depleted restrained eaters' attention to the pursuit of weight control goals at the expense of their eating enjoyment goals.

Self-affirmed restrained eaters who were not ego-depleted did not show less explicit preference for high-calorie foods than did their non-affirmed counterparts. These results are congruent with those of Schmeichel and Vohs (2009), which showed no difference between non-affirmed and self-affirmed non-depleted groups on a task demanding self-control. This suggests that self-affirmation may only facilitate restrained eaters' capacity for self-control in the context of ego-depletion. Thus, a manipulation that boosts levels of mental construal may only have an impact for depleted restrained eaters, and not for their non-depleted counterparts.

The hypotheses regarding the IAT were not supported. The results showed that restrained eaters and unrestrained eaters' implicit associations with high-calorie food were not influenced by the ego depletion and self-affirmation manipulations. The IAT results did reveal that unrestrained eaters made faster positive associations with high-calorie foods than did restrained eaters. Previous research has been mixed in this regard (Papies, Stroebe, & Aarts, 2009; Hoefling & Strack, 2008; Houben, Roefs, & Jansen, 2010). However, the current study utilized manipulations whereas the aforementioned research did not; therefore these comparisons may be rather specious. Thus in terms of the effect of manipulations, the results showed that the only significant difference was between non-depleted, self-affirmed participants and non-depleted, non-affirmed participants: the former showed faster positive associations with high-calorie foods than did the latter. There were no interactions involving dietary restraint, contrary to the hypothesis. It may be that this indicates no clear difference in food-related impulsive cognitions between restrained and unrestrained eaters.

However, it is possible that these unexpected findings are attributable to the particular (IAT) measure was used for exploring implicit associations. The IAT is a relative measure, such that it compares positive associations with high-calorie and low-calorie foods and, at the same time, negative associations with high-calorie and low-calorie foods. As such,

the IAT cannot reveal implicit associations with one target concept (high-calorie foods), but instead reflects implicit associations with two target concepts (high-calorie foods versus low-calorie foods). Houben, Roefs, and Jansen (2010) addressed this issue by comparing an IAT measure to a non-relative IAT variant - a single category IAT (SCIAT) which eliminates the contrast with low-calorie foods. They found that, in the IAT, both unrestrained and restrained eaters equally associated high-calorie foods more negatively than low-calorie foods. In the SCIAT with only high-calorie foods however, restrained eaters positively associated high-calorie foods significantly more than unrestrained eaters. Accordingly, the forced contrast in this study may have inadvertently affected the findings.

It is noteworthy that all three dependent measures were significantly positively correlated. Indeed, as explicit preference for high-calorie foods increased, control needed to resist these high-calorie foods also increased, as well as implicit preferences for those foods. One possible limitation of the study is that it measured implicit associations and explicit preferences soon after the manipulations: it is thus possible that the observed effects were short-lived. A second limitation concerns the reliance on self-report measures, such that some participants may have shown a social desirability bias in reporting preferences for low-calorie foods. It may be valuable to replicate this study using a non-relative measure, such as the SCIAT, to examine whether control and self-affirmation moderate restrained eaters' implicit food associations as predicted. Given the contrasting outcomes that were found in Houben and colleagues' study (2010), it seems likely that using a SCIAT instead of an IAT would identify different outcomes from those of our study. In addition, given that this study appears to be one of the first to employ a self-affirmation intervention in this particular context, further replication studies (involving both male and female participants and different social-cultural contexts) would be useful. Finally, while the current study investigated the impact of

self-affirmation and ego-depletion on food preferences, there is much scope to examine the effect of these manipulations on objective measures of eating behaviour.

Previous research has demonstrated that depleting restrained eaters of their self-control resources increased the likelihood of impulsive processes guiding eating behaviour (Friede, Hofmann, & Wänke, 2008; Hofmann, Rauch, & Gawronski, 2007). However, the present study is compatible with the suggestion that a self-affirmation intervention may be capable of restoring the self-control resources that restrained eaters require in order to avoid these ego-depletion effects. Although it is unclear exactly how self-affirmation affects self-control and impulsive processes, the present findings represent a step towards promoting our understanding of this. Indeed, our study hints that reflective processes and high-level construals are promoted via self-affirmation when restrained eaters are low on resources. It is hoped that further research will be able to make use of these findings both in assisting people who are attempting long-term weight-loss and in elucidating the mechanisms by which self-affirmation and ego depletion processes exercise their effects. As a part of this, such research could usefully explore in more detail the effects of self-affirmation on both construal level and temporal perspective (perhaps with established measures such the Consideration of Future Consequences scale [Strathman, Gleicher, Boninger & Edwards, 1994]). At the same time, we should not be overly sanguine about the direct practical implications of our research: as one reviewer has pointed out, for example, one of our findings might be explained by our self-affirmed participants experiencing an increased level of control over socially-desirable reporting of their explicit attitudes. Moreover, we need to be vigilant to the possibility of unwanted effects of self-affirmation manipulations: in our study, for example, it was apparent that unrestrained, depleted, self-affirmed participants showed a somewhat higher (albeit nonsignificant) preference for high calorie foods than did their non-affirmed counterparts.

Thus, while it would not be appropriate to make premature claims regarding the applied implications of the research that we report in this paper (especially, for example, as self-affirmation did not benefit restrained eaters who were not ego-depleted), the detrimental health consequences of being overweight (Smith, Orleans, & Jenkins, 2004) speak in favour of pursuing this line of research and assessing its implications for public health. Indeed, the possibility that people might actually be able to successfully control their consumption behaviour without the need for complex and expensive interventions such as medical treatments (Bray & Ryan, 2012), including weight loss surgery (Picot, Jones, Colquitt, Loveman, & Clegg, 2012), may provide some optimism that safer and more sustainable population-level alternative interventions might be developed.

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Figure 1. Mean differential explicit food preference scores for the ego-depletion and the self-affirmation group among a) unrestrained eaters and b) restrained eaters. Higher scores indicate greater desirability and palatability of high-calorie foods relative to low-calorie foods. Error bars represent standard errors.

b)

Figure 3. Mean implicit food association scores on the IAT for the ego-depletion and the self-affirmation groups. Higher positive D600 scores indicate faster implicit positive associations with high-calorie foods / negative associations with low-calorie foods. Error bars represent standard errors.