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Research report

Guilty pleasures. Implicit preferences for high calorie food in restrained eating

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ABSTRACT

In two studies, it was examined whether dietary restraint is associated with stronger positive implicit attitudes toward high calorie food. This hypothesis was tested using unipolar IAT variants that allowed us to separately measure and examine positive and negative implicit associations with high calorie food. In both studies, results showed that restrained eaters do not differ from unrestrained eaters with respect to negative implicit associations with high calorie food. However, dietary restraint does influence the strength of positive implicit associations with high calorie food: When positive implicit associations with high calorie food were measured relative to low calorie food, restrained and unrestrained eaters did not differ with respect to their implicit preferences for high versus low calorie food. In contrast, when positive implicit associations with high calorie food were assessed using non-relative IAT variants, restrained eaters showed stronger positive implicit associations with high calorie food than unrestrained eaters. Thus, restrained eaters show stronger implicit liking for high calorie food compared to unrestrained eaters.

In the last decades, the excess of high caloric, tasty food has caused major changes in the average posture of people in Western societies. Not only average body mass index (BMI), but also variation in BMI increased enormously (Wang & Beydoun, 2007). As a consequence, dieting has become a very popular means of weight control, although only few dieters are able to maintain their diet and reduce weight over an extended period of time (e.g., Jeffery et al., 2000). Moreover, repeated, unsuccessful attempts at dieting are even related to counterproductive effects. This is also referred to as dietary restraint, which is the chronic limitation of food intake in order to lose weight that is characterized by frequent lapses of restraint (Herman & Polivy, 1980). Thus, although restrained eaters are highly motivated to restrict their food intake, they do not appear to be very successful in their dieting attempts, and exhibit periods of food restriction that are punctuated by disinhibited overeating. Restrained eaters seem unable to follow their diet consistently and are prone to indulge, especially when presented a preload (e.g., Herman & Polivy, 1980), or when they are exposed to palatable food cues (e.g., Fedoroff, Polivy, & Herman, 1997, 2003; Jansen & van den Hout, 1991). Why do restrained eaters find it so difficult to resist the temptation of palatable foods and maintain their diet?

Intuitively, it would seem plausible that restrained eaters simply hold stronger positive attitudes toward high caloric, palatable food compared to normal, unrestrained eaters, causing them to indulge in these types of food. Indeed, restrained eating is thought to be related to high calorie foods being extra desirable (Gendall & Joyce, 2001; Stice, 2002), and dietary restraint is associated with the activation of positive, hedonic thoughts about food (Papies, Stroebe, & Aarts, 2007). However, there is not much direct empirical support for more positive attitudes toward high caloric, palatable foods in restrained eaters compared to unrestrained eaters. Some studies report no differences in attitudes toward high calorie food between restrained and unrestrained eaters (Roefs, Herman, MacLeod, Smulders, & Jansen, 2005), while other studies even found that restrained eaters hold more negative attitudes toward high calorie food than unrestrained eaters (Hoefling & Strack, 2008; Urland & Ito, 2005). These findings, thus, contradict the assumption that dietary restraint is associated with stronger positive attitudes toward high calorie, palatable food. However, given that restrained eaters intend to refrain from eating high calorie food, perhaps it does not come as a surprise that they are more negative towards high caloric, palatable foods than unrestrained eaters.

The relationship between dietary restraint and liking of high calorie, palatable food can, perhaps, be better understood from a dual-process perspective. Contemporary dual-process models like the Reflective-Impulsive Model (Strack & Deutsch, 2004) propose that eating behaviour is guided by two different types of cognitive processes: Reflective or explicit processes and impulsive or implicit processes. Reflective processes reflect deliberate decisions, reasoning, and personal goals and standards. Such processes are typically effortful, slow, explicit, and critically depend on cognitive

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resources (Strack & Deutsch, 2004). Since the consumption of high calorie food is inconsistent with restrained eaters' goal of weight control, it is not surprising that they evaluate high calorie food more negatively compared to unrestrained eaters (e.g., Hoefling & Strack, 2008; Urland & Ito, 2005). However, behaviour is also guided by impulsive processes, which reflect the automatic spreading of activation between associated concepts. These processes are automatic, implicit, effortless, and fast, consisting mainly of automatic preferences that strongly predispose an individual to approach or avoid relevant stimuli (Strack & Deutsch, 2004). It is not unlikely that, in restrained eaters, high calorie food is associated with positive affect in this impulsive system, which makes them prone to indulge, even though, on an explicit level, restrained eaters do not wish this to happen. Similarly, the Goal Conflict Model of Eating proposes that dietary restraint is associated with two conflicting goals: The goal of food enjoyment and the goal of weight control (Stroebe, Mensink, Aarts, Schut, & Kruglanski, 2008). According to this model, palatable food has a strong positive incentive value for restrained eaters, which makes eating palatable food a highly desired goal. However, this goal of enjoying palatable foods is inconsistent with their goal of controlling their food intake. Further, the goal of food enjoyment inhibits the goal of weight control, making the consumption of palatable food more likely (Stroebe et al., 2008).

Hence, dual-process models propose that dietary restraint is characterized by a conflict between automatic impulses to consume high-caloric palatable foods, and goals related to weight control. Based on this dual-process perspective, one would expect that restrained eaters, in contrast to unrestrained eaters, hold more positive attitudes regarding high caloric, palatable food on an implicit level. One of the main goals of applying indirect measures, like the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998), the Extrinsic Affective Simon Task (EAST; De Houwer, 2003), and affective priming (Fazio, Sanbonmatsu, Powell, & Kardes, 1986), in the domain of eating research is to examine whether dietary restraint is indeed related to stronger positive implicit attitudes toward high calorie food. However, the intuitive assumption that restrained eaters hold more positive implicit attitudes toward high calorie foods than unrestrained eaters also has not received much empirical support to the present day. Some studies, for example, did not find a relationship between implicit attitudes toward high calorie food and restraint status (e.g., Roefs et al., 2005). Further, while there is some evidence supporting the assumption that restrained eaters have more positive implicit attitudes toward high calorie foods (e.g., Hoefling & Strack, 2008), other studies even found opposite results, indicating stronger negative implicit attitudes toward high caloric food in restrained eaters compared to unrestrained eaters (e.g., Maison, Greenwald, & Bruin, 2001; Papies, Stroebe, & Aarts, 2009; Vartanian, Polivy, & Herman, 2004).

Hence, prior research does not yield unequivocal support for stronger positive implicit attitudes toward high calorie food in restrained eaters. However, all previous studies involved a direct comparison between positive and negative affect that is associated with high calorie foods. Therefore, it is unclear whether differences between restrained eaters and unrestrained eaters were due to differences in negative implicit associations with high calorie food or positive implicit associations with high calorie food. Based on the dual-process perspective, one would expect that restrained eaters hold more positive implicit associations with high caloric food, reflecting the incentive value of high calorie, palatable food. However, one could also expect that restrained eaters have stronger negative implicit associations with high calorie food. Previous research demonstrates that restrained eaters mainly differ in their explicit endorsement of the negative aspects of high calorie food (Papies et al., 2009; Stroebe et al., 2008; Urland & Ito, 2005). These explicit negative evaluations may eventually crystallize into negative implicit associations in the impulsive system. Hence, it is possible that restrained eaters, compared to unrestrained eaters, have stronger positive implicit associations with high calorie food, but at the same time also stronger negative implicit associations with high calorie food. Thus, it seems highly relevant to examine whether restrained eaters differ from unrestrained eaters with respect to implicit positivity and/or implicit negativity regarding high calorie food.

In addition, it is important to note that all previous studies examined differences between restrained and unrestrained eaters regarding their implicit attitudes toward high calorie food relative to low calorie food, which may have inadvertently affected the results. Especially in the IAT, the choice of the target categories can have a profound influence on IAT results. The IAT is a relative measure, meaning that it compares the strength of implicit attitudes toward one target category with implicit attitudes toward the other target category. Hence, the IAT cannot reveal implicit attitudes toward single target concepts, but instead reflects implicit attitudes toward both target categories. Thus, effects in an IAT that contrasts high calorie food with low calorie food can reflect both implicit attitudes toward high calorie food and/or implicit attitudes toward low calorie food. This, of course, complicates the interpretation of findings in previous studies that used the IAT to measure implicit attitudes toward high calorie food (e.g., Maison et al., 2001; Vartanian et al., 2004), since it is unclear to what extent these findings reflect stronger negative attitudes toward high calorie food or stronger positive implicit attitudes toward low calorie food in restrained eaters compared to unrestrained eaters. Importantly, affective priming and the EAST are non-relative indirect measures, in the sense that these tasks do not involve a direct comparison of implicit attitudes between different target concepts. Nevertheless, previous studies assessing implicit attitudes toward high calorie food have nonetheless included low calorie food items in these tasks (e.g., Hoefling & Strack, 2008; Papies et al., 2009; Roefs et al., 2005). Although these measures are non-relative, the mere presence of these low calorie food items may still affect results by reminding restrained eaters of their diet intentions, thereby changing the accessibility of affective associations in the impulsive system. Therefore, it is unclear to what extent previous findings reflect differences between restrained and unrestrained eaters in implicit attitudes toward high calorie food and/or low calorie food.

The present research addresses these issues in two studies. In both studies we tested for differences between restrained and unrestrained eaters in positive implicit associations with high calorie food and negative implicit associations with high calorie food. In Study 1, we examined whether restrained eaters differ from unrestrained eaters with respect to positive and negative implicit associations with high calorie food relative to low calorie food, as in previous studies. In Study 2, in contrast, we used non-relative unipolar IAT variants, thereby eliminating the contrast of low calorie food. It was hypothesized that dietary restraint would be associated with stronger positive implicit associations toward high calorie food, and that this difference between restrained and unrestrained eaters would be more pronounced when the IAT did not involve a contrast between high calorie food and low calorie food.

Study 1

In Study 1, we examined whether dietary restraint is associated with differences in implicit positive affect and implicit negative affect that is associated with high calorie foods. We measured implicit positive affective associations and implicit negative affective associations separately with unipolar IAT variants (e.g., Houben & Wiers, 2006; Jajodia & Earleywine, 2003). Unlike the

standard IAT, unipolar IAT variants do not directly contrast a positive attribute category with a negative attribute category (i.e., bipolar attribute dimension). Instead, positive attributes are contrasted with neutral attributes in one unipolar IAT variant and negative attributes are contrasted with neutral attributes in a second unipolar IAT variant. Hence, by using these unipolar IAT variants, we were able to test whether restrained eaters differ from unrestrained eaters with respect to implicit positive associations with high calorie food and implicit negative associations with high calorie food. However, like the standard IAT, these unipolar IAT variants also involve a direct contrast between two target categories. Here, we contrasted high calorie food with low calorie food as in previous studies.

Method

Participants

Participants were recruited via advertisements on the Internet. Fifty-nine female participants (age: $M = 31.44$, $SD = 9.61$; BMI: $M = 26.07$, $SD = 6.85$, range 17.10–45.33) completed this study in return for a gift certificate. BMI refers to body mass index, which is the ratio of weight to squared height (kg/m^2). Dietary restraint was measured using the Restraint Scale (Herman & Polivy, 1980). Participants with scores of 14 or lower on the Restraint Scale were classified as unrestrained eaters and participants scoring 15 or higher were classified as restrained eaters. As such, 33 participants were classified as restrained eaters, (age: $M = 30.91$, $SD = 8.13$; BMI: $M = 27.58$, $SD = 7.15$, range = 17.10–45.33; Restraint Scale score: $M = 18.27$, $SD = 3.06$), and 26 participants we classified as unrestrained eaters (age: $M = 32.12$, $SD = 11.34$; BMI: $M = 24.15$, $SD = 6.04$, range = 17.84–45.20; Restraint Scale score: $M = 9.58$, $SD = 3.49$). The two groups did not differ significantly in age, $t(57) < 1$, while restrained eaters had a marginally significant higher BMI compared to unrestrained eaters BMI, $t(57) = -1.96$, $p = .06$.

Materials and measures

Participants performed two unipolar IAT versions: A unipolar positive IAT and a unipolar negative IAT. In both IAT versions, the target categories were high calorie foods (consisting of six stimulus pictures of high-caloric snack foods; label 'snack') versus low calorie foods (consisting of six stimulus pictures of low-caloric fruits; label 'fruit'). In the unipolar positive IAT, a positive attribute category (consisting of six stimulus items: tasty, delicious, good, delightful, heavenly, outstanding; label 'pleasant') was paired with a neutral attribute category (consisting of six stimulus items: average, undefined, general, normal, usual, everyday; label 'neutral'). In the unipolar negative IAT, the same neutral attribute category was paired with a negative attribute category (consisting of six stimulus items: tasteless, unsavoury, bad, nasty, awful, disgusting; label 'unpleasant').

The IAT consisted of seven blocks: First, participants sorted affective attribute stimuli for 24 trials into two attribute categories (i.e., pleasant vs. neutral for the unipolar positive IAT, and unpleasant vs. neutral for the unipolar negative IAT) using left ('e') and right ('i') response keys on the keyboard. Second, participants sorted high calorie food and low calorie food using the same two response keys for 24 trials into the two target categories (i.e., snack vs. fruit). Third, participants sorted stimuli for all four categories for 24 trials using the two response keys. During this combined sorting block, participants sorted items of one attribute category and one target category with one response key, and the other key was used to categorize items from the other attribute category and target category (e.g., pleasant + snack vs. neutral + fruit for the unipolar positive IAT, and unpleasant + snack vs. neutral + fruit for the unipolar negative IAT). Fourth, the same response mapping was repeated for 48 more trials. Fifth, participants sorted high calorie food and low calorie again for 48 trials with the reversed response mapping (i.e., if high calorie foods were previously sorted using the left response key, they now had to be sorted using the right response key). Sixth, participants again sorted stimuli from all four categories for 24 trials, but now with the reversed response mappings for the target categories (e.g., pleasant + fruit vs. neutral + snack for the unipolar positive IAT, and unpleasant + fruit vs. neutral + snack for the unipolar negative IAT). Seventh, participants repeated the sorting conditions from the sixth block for 48 more trials.

The assignment of the snack and fruit categories to the left and right response key was counterbalanced across participants and was the same for both unipolar IAT versions. Further, the response assignment of the attribute categories was also counterbalanced so that half the participants in each task performed the compatible combination task (i.e., snack + pleasant vs. fruit + neutral for the unipolar positive IAT, and snack + unpleasant vs. fruit + neutral for the unipolar negative IAT) before the incompatible combination task (i.e., snack + neutral vs. fruit + pleasant or unpleasant for the unipolar positive IAT and the unipolar negative IAT, respectively). The other half of the participants performed the incompatible combination task before the compatible combination task. During both IAT versions, target and attribute stimuli were presented in the middle of the computer screen. During the task, the labels of the categories assigned to the left and right response key were presented in the corresponding upper corners of the computer screen. Stimuli remained on screen until a response was given. Feedback was presented in red beneath the stimuli after an incorrect response ('X').

Procedure

All participants were tested via the Internet. Advertisements invited people to visit our website, where they received further information about the study and a consent form. After giving consent, participants first performed the positive unipolar IAT and the negative unipolar IAT, in balanced order. This Internet-based assessment of implicit associations was recently validated by Houben and Wiers (2008). Next, participants filled out the Restraint Scale. Finally, weight and length were assessed in order to calculate participants' BMI.

Results and discussion

IAT effects were calculated with the D600 scoring algorithm (Greenwald, Nosek, & Banaji, 2003). The D600 measure was calculated so that higher scores indicate faster performance for the compatible response assignment (i.e., snack + pleasant or unpleasant vs. fruit + neutral) than for the incompatible response assignment (i.e., snack + neutral vs. fruit + pleasant or unpleasant). Analyses revealed no influential outliers on IAT data. However, of the 59 participants, 4 participants did not complete the unipolar positive IAT, and 3 participants did not complete the unipolar negative IAT. Hence, the analyses performed on the data from the positive unipolar IAT were realized with 54 participants, while analyses on the data from the unipolar negative IAT were performed with 55 participants.

Overall, one-sample t-tests (involving zero as test value) revealed that participants were significantly faster when high calorie snack foods were paired with negative attributes than when snack foods were paired with neutral attributes ($M = .29$ $SD = .35$) in the unipolar negative IAT, $t(55) = 6.10$, $p < .001$. Further, in the unipolar positive IAT, participants were significantly

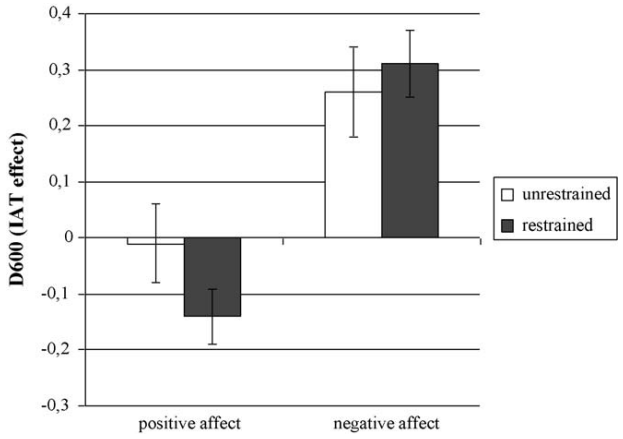

Fig. 1. Mean IAT effects (D600 effect measure) for restrained and unrestrained eaters. Mean effects are shown separately for the unipolar positive IAT and the unipolar negative IAT. Higher scores indicate stronger implicit affective associations between high calorie food and positive affect or negative affect, respectively.

faster to combine high calorie foods with neutral attributes than with positive attributes, $t(54) = -2.09$, $p = .04$ ($M = -.09$, $SD = .31$). With respect to dietary restraint status, results showed no significant difference between restrained eaters and unrestrained eaters on the unipolar positive IAT, $t(53) = 1.54$, $p = .13$, or the unipolar negative IAT, $t(54) = .22$, $p = .83$ (see Fig. 1). Thus, regardless of dietary restraint, participants held stronger negative implicit associations with high calorie food than with low calorie food ($M = .26$, $SD = .41$, and $M = .31$, $SD = .31$, for unrestrained and restrained eaters, respectively), and slightly more positive implicit associations with low-calorie food than with high calorie food ($M = -.01$, $SD = .33$, and $M = -.14$, $SD = .29$, for unrestrained and restrained eaters, respectively).[1]

In sum, the present findings show that both restrained eaters and unrestrained hold strong negative implicit associations with high calorie food to an equal extent. In addition, neither restrained eaters nor unrestrained eaters show implicit positive associations with high calorie food. Hence, we did not find support for the assumption that dietary restraint is associated with higher implicit positivity toward high calorie food. In contrast, the present findings even suggest that dietary restraint was associated with slightly decreased positivity toward high calorie food, although this difference was not statistically significant. Thus, previous findings indicating decreased implicit preferences for high calorie food in restrained eaters compared to unrestrained eaters (e.g., Maison et al., 2001; Papies et al., 2009; Vartanian et al., 2004), were probably caused by somewhat weaker positive implicit associations with high calorie food in restrained eaters rather than stronger negative implicit associations with high calorie food. However, it remains unclear to what extent these findings truly reflect implicit associations with high calorie food, rather than implicit associations with low calorie food. This issue was addressed in Study 2.

Study 2

In Study 1, we demonstrated that restrained eaters do not show enhanced negative implicit associations for high calorie food compared to unrestrained eaters. Both restrained and unrestrained eaters held strong negative implicit associations with high calorie food to the same extent. However, dietary restraint was also not associated with enhanced implicit positivity toward high calorie snack food. In fact, neither restrained nor unrestrained eaters showed positive implicit associations with high calorie food. Does this mean that restrained eaters are truly not more positive toward the high calorie food that they regularly indulge in compared to unrestrained eaters? It is important to note that in Study 1, like in previous studies, high calorie food was contrasted with low calorie food, which precludes any conclusions in terms of implicit associations with high calorie food. Specifically, assessing implicit preferences for high calorie food relative to low calorie food may trigger different implicit associations, than those triggered when measuring simple implicit associations with high calorie food alone. Importantly, it is unclear to what extent such relative indirect measures truly reflect implicit associations with high calorie food.

This issue was addressed in Study 2. Here, we used unipolar variants of the Single Category IAT (SCIAT; Karpinski & Steinman, 2006), which includes only a single target category instead of two target categories as in the IAT. Therefore, the SCIAT, unlike the IAT, is a non-relative measure, and also does not present any other target stimuli that may trigger additional implicit associations as in the affective priming paradigm and the EAST. As in Study 1, we assessed positive and negative implicit associations with high calorie food separately using unipolar variants of the SCIAT. Thus, in Study 2, we disambiguated both the attribute dimension and the target dimension. In this way we were able to unambiguously test whether restrained eaters differ from unrestrained eaters with respect to positive and negative implicit associations.

Method

Participants

Participants were recruited via the Internet as in Study 1. Sixty-three female participants (age: $M = 34.71$, $SD = 13.28$; BMI: $M = 25.39$, $SD = 7.25$, range 17.47–61.71) completed this study in return for a gift certificate. Using the Restraint Scale (Herman & Polivy, 1980), we classified participants scoring 14 or below as unrestrained eaters, and participants with a score of 15 or above as restrained eaters. In this way, 29 participants were classified as restrained eaters (age: $M = 33.71$, $SD = 12.52$; BMI: $M = 27.99$, $SD = 9.18$, range = 17.47–61.71; Restraint Scale score: $M = 19.97$, $SD = 4.23$), and 34 participants were classified as unrestrained eaters (age: $M = 35.53$, $SD = 14.01$; BMI: $M = 23.17$, $SD = 4.01$, range = 18.18–33.46; Restraint Scale score: $M = 9.27$, $SD = 3.41$). The two groups did not differ significantly in age, $t(60) < 1$, while restrained eaters had a significantly higher BMI compared to unrestrained eaters BMI, $t(61) = -2.78$, $p = .01$.

Materials and measures

Participants performed two unipolar SCIAT versions: A unipolar positive SCIAT and a unipolar negative SCIAT. In both SCIAT versions, the target category was high calorie foods, which was the same as used in Study 1. Further, the unipolar positive SCIAT paired a positive attribute category with a neutral attribute category, while the unipolar negative IAT paired a negative attribute category with the neutral attribute category. Attribute categories and stimuli were also the same as in Study 1.

Both SCIAT versions consisted of three blocks. In the first block, participants practiced the classification of the attribute concepts (i.e., pleasant vs. neutral for the unipolar positive SCIAT, and unpleasant vs. neutral for the unipolar negative SCIAT) for 24 trials using the left ('e') and right ('i') response key on the keyboard. In the second block, participants sorted items of one attribute

[1] We also analyzed correlations between dietary restraint as a continuous variable and scores on the positive and negative unipolar IAT. These correlational analyses showed the same pattern of results: Dietary restraint was not correlated with negative unipolar IAT scores, $r = .05$, $p = .74$, or with positive unipolar IAT scores, $r = -.20$, $p = .15$.

category and one target category with one response key, and the other key was used to categorize items from the other attribute category (e.g., pleasant + snack vs. neutral for the unipolar positive SCIAT, and unpleasant + snack vs. neutral for the unipolar negative SCIAT). The second block consisted of 72 trials. To keep the number of left and right responses comparable we used ratio 5:2:5; food-related pictures were presented 30 times, attributes that were assigned to the same response key as targets were presented 12 times, and attributes that were assigned to the other response key were presented 30 times (i.e., 42 right responses and 30 left responses). In the third block, the response assignment of the target category was reversed (i.e., if high calorie foods were previously sorted using the left response key, they now had to be sorted using the right response key) and participants performed the reversed combination for 72 trials (e.g., pleasant vs. neutral + snack for the unipolar positive SCIAT, and unpleasant vs. neutral + snack for the unipolar negative SCIAT). To keep the number of left and right responses, we again used ratio 5:2:5, so that food-related pictures were presented 30 times, attributes assigned to same response key as food targets were presented 12 times, and attributes assigned to the other response key were presented 30 times.

The assignment of the snack target category to the left or right response key was counterbalanced across participants and was the same for both unipolar SCIAT versions. The response assignment of the attribute categories was also counterbalanced so that half the participants in each SCIAT variant first performed the compatible combination task (i.e., snack + pleasant vs. neutral for the unipolar positive SCIAT, and snack + unpleasant vs. neutral for the unipolar negative SCIAT), and then the incompatible combination task (i.e., snack + neutral vs. pleasant or unpleasant for the unipolar positive SCIAT and the unipolar negative SCIAT, respectively). The other half of the participants performed the incompatible combination task before the compatible combination task. Target and attribute stimuli were always presented in the middle of the computer screen and the labels of the categories assigned to the left and right response key were presented in the corresponding upper corners of the computer screen. Stimuli remained on screen until a response was given. Feedback was presented in red beneath the stimuli after an incorrect response ('X').

Procedure

As in Study 1, participants were tested via the Internet. After giving consent, participants first performed the positive unipolar SCIAT and the negative unipolar SCIAT, in balanced order. Next, they filled out the Restraint Scale, which was followed by a weight and length assessment.

Results and discussion

As in Study 1, SCIAT effects were calculated with the D600 scoring algorithm (Greenwald et al., 2003), in such a way that higher scores indicate faster performance for the compatible response assignment (i.e., snack + pleasant or unpleasant vs. neutral) than for the incompatible response assignment (i.e., snack + neutral vs. pleasant or unpleasant). Analyses revealed no influential outliers on IAT data. However, of the 63 participants, 1 participant did not complete the unipolar positive IAT, and 1 participant did not complete the unipolar negative IAT. Hence, analyses on both the unipolar positive SCIAT and the unipolar negative SCIAT were performed with 62 participants.

Overall, one-sample *t*-tests (involving zero as test value) showed that participants associated snack foods significantly stronger with positive attributes than with neutral attributes in the unipolar positive IAT, $t(61) = 8.88, p < .001$ ($M = .27$ $SD = .24$). However, in the unipolar negative IAT, participants did not associate snack foods more strongly with negative attributes than with neutral attributes, $t(61) = 1.39$, $p = .17$. ($M = .04$, $SD = .22$). Thus, these results already indicate that our findings in Study 1 were probably affected by the low calorie food contrast. While Study 1 showed overall negative implicit associations with high calorie food but not positive implicit associations, the present findings yield a reversed pattern of results indicating strong positive implicit associations with high calorie food but not negative implicit associations.

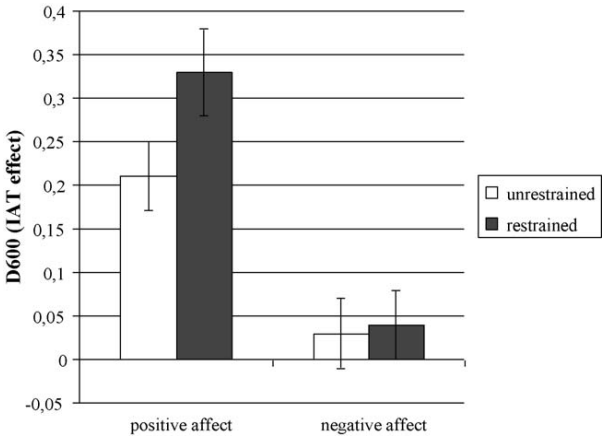

Fig. 2. Mean IAT effects (D600 effect measure) for restrained and unrestrained eaters. Mean effects are shown separately for the unipolar positive SCIAT and the unipolar negative SCIAT. Higher scores indicate stronger implicit affective associations between high calorie food and positive affect or negative affect, respectively.

Next, we examined whether dietary restraint significantly influenced both positive unipolar IAT scores and unipolar negative IAT scores. Results demonstrated that restrained eaters and unrestrained eaters differed significantly on the unipolar positive IAT, $t(60) = -2.09$, $p = .04$ (see Fig. 2). Follow-up one-sample *t*-tests demonstrated that restrained eaters, $t(28) = 7.38$, $p < .001$ ($M = .33$, $SD = .24$), as well as unrestrained eaters, $t(32) = 5.49$, $p < .001$ ($M = .21$, $SD = .22$), associated snack foods more strongly with positive affect than with neutral affect. However, this association between snack foods and positive affect was significantly stronger in restrained eaters compared to unrestrained eaters. There was no effect of dietary restraint on the unipolar negative IAT, $t(60) = -.17$, $p = .87$ (see Fig. 2). Both restrained eaters ($M = .04$, $SD = .20$) and unrestrained eaters ($M = .03$, $SD = .24$) did not associate snack foods more strongly with negative affect compared to neutral affect.[2] Hence, these findings demonstrate that dietary restraint is associated with stronger implicit positivity toward high calorie food. When, in contrast to Study 1, high calorie foods are not compared to low calorie food, both restrained eaters and unrestrained eaters do not associate high calorie food with negative affect. They do, however, associate high calorie food with positive affect, and this positivity is more pronounced in restrained eaters.

General discussion

The aim of the present research was to test whether dietary restraint is related to stronger positive implicit attitudes toward

[2] When we analyzed the correlations of dietary restraint as a continuous variable with positive and negative unipolar IAT scores, the pattern of results was the same: Dietary restraint correlated significantly with positive unipolar IAT scores, $r = .26$, $p = .04$, indicating that higher dietary restraint is associated with stronger positive implicit associations with high calorie food. Dietary restraint, however, was not significantly correlated with unipolar negative IAT scores, $r = .03$, $p = .79$.

high calorie food. While previous research suggests that is not the case and even indicates that the opposite might be true (e.g., Maison et al., 2001; Papies et al., 2009; Roefs et al., 2005; Vartanian et al., 2004), there are some methodological issues pertaining to the measurement of implicit attitudes that complicate the interpretation of previous findings. Specifically, previous research cannot clarify whether restrained eaters differ from unrestrained eaters with respect to positive or negative affect that is associated with high calorie food, and previous findings may have been inadvertently affected by implicit attitudes with low calorie food. Therefore, in two studies, we examined positive and negative implicit associations with high calorie food separately. In Study 1, high calorie food was contrasted with low calorie food as in previous research. In Study 2, we used a non-relative measurement that assessed implicit associations only with high calorie food.

Findings from Study 1 showed no difference between restrained eaters and unrestrained eaters with respect to their positive and negative associations with high calorie food, relative to low calorie food. Both restrained and unrestrained eaters associated high calorie food, relative to low calorie food, with negative affect, but not with positive affect. Hence, these findings are consistent with previous research showing no differences in implicit preferences for high versus low calorie food (e.g., Roefs et al., 2005). However, inspection of the mean IAT scores showed that restrained eaters, compared to unrestrained eaters, appeared somewhat less positive toward high calorie food when contrasted with low calorie food. Thus, the present findings also seem to suggest that previous findings suggestive of stronger negative implicit attitudes toward high calorie food in restrained eaters were due to decreased implicit positivity toward high calorie food rather than increased implicit negativity for high calorie food. However, because Study 1 still involved a contrast between high calorie food and low calorie food, it is unclear to what extent these findings truly reflect implicit attitudes toward high calorie food. Contrasting high calorie food with low calorie food may evoke other implicit associations in addition to implicit affective associations with high calorie food due to the forced contrast between "good food" and "bad food". Therefore in Study 2, we assessed only implicit associations with high calorie food using a non-relative variant of the IAT, the SCIAT.

While Study 1 showed that both restrained eaters and unrestrained eaters associated high calorie food with negative affect to the same extent, Study 2 showed no evidence for implicit associations between high calorie food and negative affect in restrained eaters and unrestrained eaters. Hence, both restrained eaters and unrestrained eaters appear to associate high calorie food with negative affect when compared to low calorie food (Study 1), but do not associate high calorie food in itself with negative affect (Study 2). Further, in Study 2, restrained eaters more strongly associated high calorie food with positive affect compared to unrestrained eaters. Together these findings suggest that restrained eaters do not associate high calorie food more strongly with positive affect when contrasted with low calorie food, probably because they try to restrict their food intake to low calorie food. However, this does not mean that restrained eaters do not also associate high calorie food with positive affect, and even more so than unrestrained eaters as evidenced by the findings from Study 2.

Importantly, the present findings also suggest that the relationship between dietary restraint and implicit preferences for high calorie food may be better examined using non-relative measures like the SCIAT. The present findings suggest that restrained eaters, compared to unrestrained eaters, may be more prone to indulge in high calorie food because they associate these types of food more strongly with positive affect. However, this relationship between dietary restraint and implicit preferences becomes blurred when using relative measures like the IAT which involve a contrast between high calorie food and low calorie food. Such relative measures do not only measure implicit associations with high calorie food, but are also affected by implicit associations with low calorie food, and might even trigger different implicit associations due to contrast effects than non-relative measures. When investigating whether restrained eaters consume greater amounts of high calorie food than unrestrained eaters due to stronger implicit preferences for these types of food, it is theoretically more sound to measure implicit preferences for high calorie food without the low calorie confound. Nevertheless, it might also be interesting for future research to examine implicit associations with low calorie food using non-relative measures like the SCIAT to test whether dietary restraint is also associated with differences in implicit preferences for low calorie food, and how this is related to consumption of low calorie food.

In sum, the present research demonstrates that dietary restraint is associated with stronger positive implicit attitudes toward high calorie food. As such, the present findings are consistent with a dual-process account of eating behaviour that differentiates between spontaneous, implicit, more automatic or impulsive cognitive processes and more deliberate, explicit, controlled or reflective cognitive processes (Strack & Deutsch, 2004). According to such models, the reflective system reflects one's personal goals and standards, while the impulsive system consists of affective associations that activate spontaneous approach or avoidance tendencies. It is postulated that restrained eaters are characterized by a tug-of-war between the reflective system that reflects their goal of weight control and food restriction, and the impulsive system, which spontaneously activates positive attitudes and approach tendencies toward high calorie food (Strack & Deutsch, 2004; Stroebe et al., 2008). In contrast to many previous research findings, the present research indeed demonstrates that restrained eaters do hold more positive implicit attitudes toward high calorie food. These positive attitudes, in turn, should, according to the dual-process model, activate a behavioural motivation to approach these types of food (e.g., Strack & Deutsch, 2004). Indeed, research has demonstrated a stronger automatic tendency to approach high calorie food in restrained eaters compared to unrestrained eaters (de Jong & Veenstra, 2007). Thus, in restrained eaters, high calorie food automatically activates positive affect and the behavioural motivation to approach and indulge in high calorie food, which conflicts with their deliberative decision to restrict the intake of high calorie food. How then is this conflict resolved, and which of these two types of cognitive processes determines eating behaviour?

According to the dual-process model, the strongest competitor wins. That is, the cognitive process that generates the strongest signal will guide behaviour. Since restrained eaters hold stronger positive implicit attitudes toward high calorie food than unrestrained eaters, the impulsive system will probably generate a stronger signal to indulge in restrained compared to unrestrained eaters. In this respect, it is important to note that we only found a stronger implicit preference for high calorie food in restrained eaters compared to unrestrained eaters in the SCIAT. In contrast, the relative IAT did not show a stronger relative preference for high calorie food than for low calorie food in restrained eaters. Hence, these results seem to contradict the assumption that the impulsive system sends out a strong signal to indulge in high calorie food in restrained eaters when the situation involves a choice between high calorie food and low calorie food. However, it is questionable how often restrained eaters are really confronted with such a choice between high and low calorie food, and the main question is why restrained eaters eat so much high calorie food in comparison to unrestrained eaters. Since the non-relative SCIAT probably better captures implicit associations with high calorie food than

the relative IAT, the SCIAT may also better predict high calorie food consumption than the IAT. This issue should be addressed in future research by comparing the predictive validity of the high calorie SCIAT and the high versus low calorie IAT.

Finally, it is important to note that the reflective system is capable of dampening automatic impulses, which, however, requires cognitive resources. Hence, according to the dual-process model behaviour should be more strongly determined by impulsive processes whenever one is unable to expend the cognitive resources needed for deliberative decision making (Strack & Deutsch, 2004). In line with this prediction, research has demonstrated that consumption of snack food is more strongly guided by implicit attitudes than by personal dietary standards when cognitive resources are depleted due to a previous act of self-control (Hofmann, Rauch, & Gawronski, 2007). Hence, for understanding failures of dietary restraint, one should not only look at implicit attitudes, but also at the boundary conditions which increase the likelihood that these implicit attitudes will guide behaviour. Since the impulsive system will generate a stronger signal to consume high calorie food in restrained eaters compared to unrestrained eaters due to their increased positivity, restrained eaters will need to expend more cognitive resources to inhibit these automatic impulses. As a consequence, it is not surprising that the conflict between impulsive and reflective processes will often result in automatic impulses taking the upper hand in restrained eaters, leading to lapses of dietary restraint. Moreover, chronic dieting is in itself almost a continuous act of self-control, especially in our Western societies where there is an abundance of high calorie food. In such cases, dieting may act as a constant drain on cognitive control resources (e.g., Baumeister & Excline, 2000). Therefore, it is plausible that cognitive resources in restrained eaters are generally to a greater extent depleted compared to unrestrained eaters.

Thus, it may not only be the case that impulsive processes may generate a stronger impulse to consume high caloric food in restrained eaters, but the reflective system in restrained eaters may also exert weaker control compared to unrestrained eaters. Research has indeed demonstrated that restrained eaters are less able to exert cognitive control compared to unrestrained eaters (Nederkoorn, Van Eijs, & Jansen, 2004). The net effect is that impulsive processes, like implicit attitudes and approach tendencies, guide behaviour more strongly than dietary restraint standards, which may explain restrained eaters' frequent lapses of self-control. Based on these insights, there are two possible routes that could prevent lapses of dietary restraint. First, future research should examine the relationship with consumption separately for positive and negative implicit associations. While positive associations probably predict increased consumption, negative associations may act as a protection against overeating. If this is the case, future research could examine whether strategies to increase negative implicit associations with high calorie food, such as evaluative conditioning (see Houben, Havermans, & Wiers, submitted for publication for an application in the domain of alcohol abuse), decrease consumption and overeating. Second, future research could examine whether cognitive control resources can be increased (rather than depleted as in Hofmann et al., 2007), so that behaviour is more strongly guided by behavioural standards rather than impulsive processes.

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