J. Behav. Ther. & Exp. Psychiat. 41 (2010) 282–288

Contents lists available at ScienceDirect

Journal of Behavior Therapy and Experimental Psychiatry

journal homepage: www.elsevier.com/locate/jbtep

Attentional avoidance of high-fat food in unsuccessful dieters

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ARTICLE INFO

Article history:
Received 24 June 2009
Received in revised form
11 January 2010
Accepted 11 February 2010

Keywords:
Attentional bias
Food
Dietary restraint
Disinhibited eating

ABSTRACT

Using the exogenous cueing task, this study examined whether restrained and disinhibited eaters differ in their orientation of attention towards and their difficulty to disengage from high versus low-fat food pictures in a relatively short (500 ms) and a long presentation format (1500 ms). Overall, participants in the 500 ms condition showed a tendency to direct attention away from high-fat food pictures compared to neutral pictures. No differential pattern was evident for the 1500 ms condition. Correlational analysis revealed that reduced engagement with high-fat food was particularly pronounced for disinhibited eaters. Although in the short term this seems an adaptive strategy, it may eventually become counterproductive, as it could hinder habituation and learning to cope with seductive characteristics of high-fat food.

1. Introduction

Eating-disordered patients are characterized by evaluating their self-worth in terms of their weight, shape, and eating behavior (Fairburn & Brownell, 2002). Following the cognitive-behavioral model of eating disorders, activation of self-schemata about weight, shape, and eating behavior could disturb information processing in eating disorders (Williamson, White, York-Crowe, & Stewart, 2004). Accordingly, a considerable amount of research regarding disturbed information processing focuses on attentional bias for food (see for a review: Faunce, 2002). Attentional bias for food refers to attending differentially towards food-related stimuli in comparison to neutral stimuli. Consistent with the idea that eating-disordered patients are preoccupied with food, eating-disorder patients may be more attentive to food than healthy individuals. Selective attention for food could be functionally related to an approach-related motivational state (de Jong, Kindt, & Roefs, 2006), which may subsequently be responsible for maintenance of a dysfunctional pattern of eating (Williamson et al., 2004).

Previous studies using the emotional Stroop task consistently found color-naming interference for food words compared to neutral words in bulimic patients, and less consistently in anorexic patients and restrained eaters (see for a review: Dobson & Dozois, 2004). However, the use of Stroop tasks in research for attentional bias is debatable, because the color-naming interference effects can be the result of both heightened attention for food-related material as well as avoidance of food-related material (De Ruiter & Brosschot, 1994). Therefore, more recent studies used the visual probe strategy that provides more straightforward indices of spatial attention. Underlining the importance to differentiate between approach and avoidance tendencies a recent visual probe study using a 500 ms cue duration showed high-external eaters (i.e., people who tend to overeat when they are exposed to external food cues, for instance smell or sight of food) directed attention away from food words, whereas in contrast low-external eaters directed attention towards food words (Johansson, Ghaderi, & Andersson, 2004). However, a similar study in external eaters using a 500 ms cue duration showed no differences in attentional biases between groups, whereas in a 2000 ms presentation duration, a stronger attentional bias was found in high-external eaters compared to low-external eaters (Brignell, Griffiths, Bradley, & Mogg, 2009).

The tendency to direct attention towards or away from food stimuli may vary as a function of the type of food items. Accordingly, recent evidence shows that eating-disordered patients display attentional bias towards high-caloric eating pictures, whereas they direct attention away from low-caloric eating pictures compared to controls (Shafran, Lee, Cooper, Palmer, & Fairburn, 2007). A recent visual search task study revealed similar

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0005-7916/$ – see front matter
doi:10.1016/j.jbtep.2010.02.006

results. Eating-disordered patients were more distracted by high-caloric food words, compared to controls (Smeets, Roefs, van Furth, & Jansen, 2008). These findings support the view that eating-disordered individuals are characterized by enhanced attentional bias towards 'forbidden' foods and are consistent with models implying that attentional bias towards high-fat foods may give rise to problems in the normal regulation of food intake.

Thus far, empirical research has mainly focused on the early stages of information processing. Recent definitions suggest, however, that attentional bias consists of two critical components: attentional engagement and difficulty to disengage. Attentional engagement logically facilitates the detection of 'forbidden' food items. As a consequence, the individual is continuously reminded of the presence and availability of food. A subsequent inability to disengage attention from food-related cues may induce or enhance craving for 'forbidden' food (Franken, 2003; Robinson & Berridge, 2003). Both attentional processes may contribute in overlapping or distinct ways to cognitive-motivational aspects (craving) and behavioral symptoms of eating disorders (over-eating). Thus, both types of processes may inadvertently influence the regulation of food intake and may add to eating-disordered individuals' preoccupation with 'forbidden' food.

Because the visual probe test is not well suited to differentiate between attentional engagement and disengagement, we used a modified exogenous cueing task (ECT) that was originally developed by Posner (1980) and modified by Koster, De Raedt, Goeleven, Franck, and Crombez (2005). In the ECT, a cue is presented on the left or the right side of a fixation point on a computer screen (see Fig. 1). After the cue is presented, a target appears at the same or the opposite location on the screen. Participants are instructed to respond as fast and accurately as possible to the location of the target by pressing a left or a right key. A valid trial occurs when the target appears at the same location as the cue, and an invalid trial occurs when the target appears at the opposite location as the stimulus. Participants typically respond faster on valid trials than invalid trials, which is called a normal cue validity effect. The modified ECT contains both neutral and emotionally relevant cues (that are presented on separate trials) to evaluate the role of attention for emotionally relevant cues compared to neutral cues. The task renders an index of both attentional engagement and attentional disengagement. Attentional engagement entails directing attention towards emotionally relevant cues compared to neutral cues. Attentional disengagement entails the difficulty to disengage from emotionally relevant cues compared to neutral cues. The modified ECT has already been successfully used in the context of depression (Koster, Crombez, Verschuere, Van Damme, & Wiersema, 2006; Koster et al., 2005). Underlining the importance to differentiate between both components of attentional bias, it was found that depressed patients showed stronger attentional engagement than the non-depressed group for angry faces compared to neutral faces, whereas it was specifically the non-depressed group that shifted attention more rapidly away (attentional disengagement) from the angry faces compared to the neutral faces (Leyman, De Raedt, Schacht, & Koster, 2007).

The present study used a modified ECT to explore the potential role of attentional engagement and attentional disengagement in the context of disordered eating. As a first step to explore the role of attentional biases for the dysregulation of food intake, we investigated an analogue sample of restrained eaters who are people who intend to limit their food intake, but frequently fail and indulge in exactly the foods they want to avoid (Herman & Polivy, 1980), and a control group of unrestrained eaters (i.e., people who do not try to limit their food intake). Restrained eating not only refers to actual dieting, but also to the intention to diet. To gain insight in the time course of both components of attentional bias as function of group, we used a relatively short as well as a relatively long presentation duration. Following previous research that was designed to test the differential role of attentional vigilance and avoidance in the context of threatening stimuli (Mogg, Bradley, Miles, & Dixon, 2004), we used a stimulus presentation duration of 500 ms and of 1500 ms. The expression of attentional bias with 500 ms presentation duration can be considered as initial orientation towards food, and represents initial shifts towards or away from food (Bradley, Mogg, & Millar, 2000). A longer presentation duration (e.g., 1500 ms) may provide an indication of subsequent sustained attention to or avoidance of food (Mogg et al., 2004). Possibly, restrained eaters show enhanced vigilance for high-fat foods, which may complicate their attempts to restrict their food intake. Previous work in the context of addiction showed that substance misusers are not only characterized by initial vigilance but also by a maintained attention for drug-cues (for a review see Field, Mogg, & Bradley, 2006). This pattern of sustained attention could reinforce the generation of craving, which in turn will lower the threshold for substance misuse (cf. de Jong et al., 2006). In a similar vein, difficulties with directing attention away from 'forbidden' foods may oppose the intended restriction of food intake in restrained eaters thereby contributing

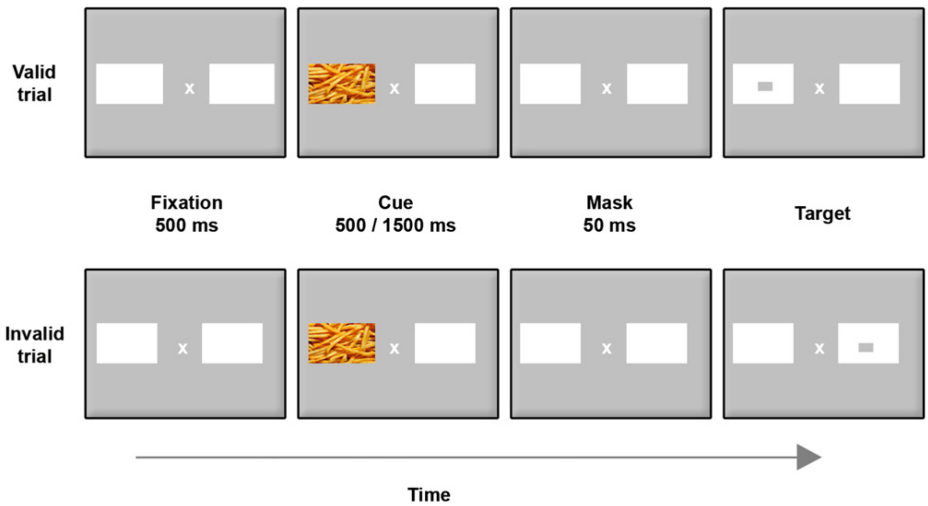

Fig. 1. Example of a valid and an invalid trial in the Exogenous Cueing Task.

to the dysregulation of their eating behavior and their preoccupation with high-fat food.

Most studies of attentional bias for food have used verbal stimuli. However, pictorial food stimuli may provide a more ecologically valid representation of food. Moreover, pictures have more direct access to the semantic system, which contains affective information. Therefore, pictures are assumed to be more strongly related to affective information than words (De Houwer & Hermans, 1994). In the context of smoking, for example, smoking-related pictures automatically elicited positive affective responses in regular smokers (Huijding & de Jong, 2006), whereas smoking-related words did not (Huijding, de Jong, Wiers, & Verkooijen, 2005). Therefore, the present study used pictures rather than words in an attempt to optimize the sensitivity of the present design to find meaningful food-related attentional biases in restrained eaters.

2. Method

2.1. Participants

At a mass-testing session, all first year female psychology students ($n = 481$) at the University of Groningen completed the Restraint Scale (RS; Herman & Polivy, 1980). Twenty-eight participants were classified as restrained eaters, indicated by scoring in the highest quartile, a score of 14 or higher on the RS (Body Mass Index: M = 24.5; SD = 4.3; range = 19.6–34.4). Twenty-seven participants were classified as unrestrained eaters, indicated by scoring in the lowest quartile, a score of 7 or lower on the RS (Body Mass Index: M = 20.8; SD = 2.0, range = 17.2–25.8). The Body Mass Index indicates the ratio of weight to squared height (kg/m2). The two groups did not differ significantly in age, $t(53) = 1.58$, $p > .05$. However, they did differ in BMI, $t(53) = 4.01$, $p < .001$. During the day of the experiment participants also completed the Dutch Eating Behavior Questionnaire (DEBQ; Van Strien, Frijters, Bergers, & Defares, 1986). Supporting the validity of the selection procedure, restrained eaters scores higher on the Restraint subscale than the unrestrained eaters, $t(53) = 8.84$, $p < .05$. In addition, the restrained group scored higher on the disinhibition subscale, $t(53) = 3.37$, $p < .05$.

2.2. Measures

A modified exogenous cueing task (ECT) was used to measure attentional bias for food cues (Koster et al., 2005). The ECT was programmed in E-prime 1.1 (Schneider, Eschman, & Zuccolotto, 2002) and run on a Windows XP computer with a 22 inch CRT monitor (resolution set to 1024 by 768 pixels).

During each trial, two rectangles (9.8 cm high and 12.3 cm wide) were presented side by side on a grey-colored background, with a fixation cross presented in the middle of the screen (see Fig. 1 for an example of a trial). The middle of the rectangles was 9.2 cm (visual angle: 8.7°) from the fixation cross. Cues and targets were presented in the middle of the rectangles. Targets were grey squares (1.25 cm by 1.25 cm). Picture cues had the same size as the white rectangles. Responses were made by pressing one of two keys, labeled left and right, on a response box.

Each trial started with a 500 ms presentation of the fixation cross and the two white rectangles. Next, a picture cue appeared during 500 ms or 1500 ms. The duration of the presentation of the picture cue was balanced over participants, half of the participants received the 500 ms and half the 1500 ms presentation duration to avoid carry-over effects. The target was presented 50 ms after cue offset and disappeared after a response was made. The following trial started immediately after the response.

The exogenous cueing task consisted of a practice block of twelve trials, followed by two test blocks of 90 trials. Each picture was presented four times to the participant (twice as valid trials: left cue – left target and right cue – right target; and twice as invalid trials: left cue – right target and right cue – left target). Furthermore, there were ten "no cue trials" that were included with the intention to create a baseline score. However, because participants responded systematically slower on no cue than on regular trials, no cue trials eventually proved to be unsuitable as baseline, and were excluded from analysis (Koster et al., 2005). The trials were presented in a new random order to each participant.

2.3. Stimulus selection

Stimulus selection was based on a study on the evaluation of high-fat and low-fat foods (Roefs, Herman, MacLeod, Smulders, & Jansen, 2005). Cues consisted of five high-fat food pictures (e.g., pizza, chocolate, croissant), five low-fat food pictures (e.g., strawberries, grapes, melon) and ten neutral pictures that were derived from the International Affective Picture System (IAPS) (Lang, Bradley, & Cuthbert, 1996).

2.4. Procedure

At the beginning of the experiment, participants conducted the modified ECT (Koster et al., 2005). The participants were seated at 60 cm viewing distance from the computer screen to perform the task. Participants were asked to respond as quickly and accurately as possible to the location of the target by pressing the corresponding key on the response box.

After the cueing task the participants were asked to answer four questions using visual analogue scales. Participants assessed the palatability of the foods by answering the question 'To what extend does this food appear palatable to you?' on a scale from 'unpalatable' to 'palatable'. Food stimuli were rated on liking using the question 'How much do you like this product', which was answered on a scale from 'don't like it at all' to 'like it very much'. Craving was assessed using the question: 'How much do you crave for this product at this moment?', which was answered on a scale from 'not at all' to 'very much'. Furthermore, the participants were asked to assess the frequency with which they ate the particular food using the question 'How frequently do you eat this food', which was answered on a scale from 'never' to 'very often'. Next, participants were asked to fill out the Hunger Scale (Grand, 1968), and the Dutch Eating Behavior Questionnaire (DEBQ). The DEBQ consists of three subscales: restrained, emotional and external eating. Combination of the latter two subscales provides a measure of disinhibited eating, which refers to a failure of restraining food intake (Van Strien et al., 1986). Furthermore, participants were asked to fill out the RS (Herman & Polivy, 1980) again to ensure the reliability of our selection.

3. Results

3.1. Group characteristics

Restrained and unrestrained eaters did not differ with respect to their assessment of the palatability of high-fat food, $t(53) = 0.15$, $p > .1$, and low-fat food, $t(53) = 0.96$, $p > .1$. They did also not differ in how much they reported to like high-fat food, $t(53) = 0.72$, $p > .1$, and low-fat food, $t(53) = 0.80$, $p > .1$. At the moment of testing, restrained and unrestrained eaters did not differ in their reported craving for high-fat food, $t(46) = 0.89$, $p > .1$,[1] and low-fat food, $t(53) = 0.42$, $p > .1$. Restrained and unrestrained eaters did not differ in their self-reported frequency with which they ate high-fat food, $t(53) = 1.10$, $p > .1$, and low-fat food, $t(53) = 0.32$, $p > .1$. Furthermore,

[1] Through lack of equality of variances, adapted degrees of freedom were used.

restrained and unrestrained eaters did not differ with respect to their motivational state of hunger, $t(53) = 0.20$, $p > .1$ (see Table 1 for M's and SD's). Pretest and posttest measures of the RS did not differ, $t(53) = 1.02$, $p = .31$, and showed high test–retest reliability, $r = 0.91$.

3.2. Exogenous cueing task

Following the procedure described by Koster et al., (2005), trials of the ECT with errors (2.3%) and trials with reaction times below 200 ms and above 750 ms (4.8%) were excluded from analyses. Restrained and unrestrained eaters did not differ with respect to their number of errors, $t(53) = 0.81$, $p > .1$, $d = 0.22$.

Data were analyzed using a 3 (cue type: high-fat food, low-fat food, or neutral pictures) × 2 (cue validity: invalid or valid) × 2 (group: restrained or unrestrained eaters) × 2 (presentation duration: 500 ms or 1500 ms) mixed models analysis of variance with the first two factors being within-subjects factors. If the relevant interactions were significant, the effects were further analyzed by calculating cue validity effects to examine maintained attention to cues, and attentional engagement as well as attentional disengagement scores to examine the exact attentional processes that were involved (e.g., Koster et al., 2005). Cue validity effects were calculated by subtracting the valid scores from the invalid scores. The emotional modulation of attentional engagement and disengagement are calculated as follows:

$$\text{Attentional engagement} = \text{RT valid neutral cue} - \text{RT valid food cue}$$

$$\text{Attentional disengagement} = \text{RT invalid food cue} - \text{RT invalid neutral cue}$$

Positive scores on attentional engagement are indicative of directing attention towards the food cues compared to the neutral cues. Positive scores on attentional disengagement indicate a difficulty to disengage from food cues compared to neutral cues. In terms of RTs: if in valid trials the response to food stimuli is faster than the response to neutral stimuli, this points to attentional engagement, whereas if in invalid trials the response to food stimuli is slower than to neutral stimuli, this is indicative of a difficulty to disengage attention from food stimuli.

All effects are reported as significant at $p < .05$. Effect-sizes are also reported using partial eta-squared (η_p^2; small: 0.01, medium: 0.06, and large effect: 0.14 (Cohen, 1977)) or Cohen's d (small: 0.20, medium: 0.50, and large effect: 0.80 (Cohen, 1992)).

3.2.1. Overall effects

Most importantly, a medium sized presentation duration × validity × cue type interaction effect was found, $F(2, 102) = 2.97$, $p = .05$, $\eta_p^2 = 0.06$. This pattern was similar for both groups, as is apparent from the non-significant four-way interaction, $F(2, 102) = 1.3$, $p > .2$, $\eta_p^2 = 0.02$. To interpret this three-way interaction effect, we first examined for each presentation duration whether the validity × cue type interaction reached significance. Then, we calculated the cue validity effects, attentional engagement scores and the attentional disengagements scores.

3.2.2. 500 ms Condition

Response latencies as a function of cue type, cue validity, and group for the 500 ms condition are presented in Table 2. The 3 (cue type: high-fat food, low-fat food or neutral pictures) × 2 (cue validity: invalid or valid) × 2 (group: restrained or unrestrained eaters) mixed ANOVA showed a main effect of cue type, $F(2, 54) = 4.43$, $p < .05$, $\eta_p^2 = 0.14$. As can be seen in Table 2, this reflects the finding that participants were generally faster in their responding during low-fat food trials than during either neutral or high-fat food trials. Most important for the present context, this main effect was qualified by the predicted cue type × validity interaction, $F(2, 54) = 7.20$, $p < .01$, $\eta_p^2 = 0.21$, indicating that the cue validity effect varied as a function of stimulus type.

A normal cue validity effect was found for trials containing neutral cues, $t(27) = 2.6$, $p < .05$, $d = 0.22$. Participants were faster on valid than on invalid trials. High-fat food trials showed a tendency in the opposite direction, $t(27) = 1.82$, $p = .08$, $d = 0.21$, whereas there was no significant cue-validity effect for low-fat food trials, $t(27) = 0.87$, $p > .1$, $d = 0.12$. The cue validity effect of the high-fat food trials differed significantly from the cue validity effects of the low-fat food, $t(27) = 2.74$, $p < .05$, $d = 0.50$, and the neutral condition, $t(27) = 3.36$, $p < .01$, $d = 0.80$. This indicates that participants tended to direct attention away from high-fat food, which resulted in a reverse cue validity effect.

Participants showed negative attentional engagement scores for high-fat food trials that were significantly different from zero, M = −8.8 ms, $t(27) = 3.80$, $p < .01$, $d = 1.35$, indicating that there was slower attentional engagement with high-fat food cues compared to neutral cues. Engagement scores for low-fat food trials did not differ from zero, M = 1.5 ms, $t(27) = 0.64$, $p > .1$, $d = 0.12$. There was slower attentional engagement with high-fat food than with low-fat food cues, $t(27) = 3.33$, $p < .01$, $d = 0.84$.

For both high-fat food trials and low-fat food trials participants displayed negative disengagement scores suggesting that more time was required to shift attention away from neutral than from food stimuli (−3.5 ms and −4.5 ms, respectively). However, for neither the high-fat nor the low-fat food stimuli the disengagement score reached significance, $t(27) = 1.38$, $p = .18$, $d = 0.26$ and $t(27) = 1.97$, $p = .06$, $d = 0.63$, respectively.

Table 1
Participants' characteristics.

Characteristics	Group: Unrestrained eaters		Group: Restrained eaters	
RS	4.81 (1.92)		16.46 (2.98)	
DEBQ – Restraint Scale	1.82 (0.61)		3.29 (0.62)	
DEBQ – Disinhibition Scale	2.68 (0.40)		3.06 (0.44)	
BMI	20.83 (1.99)		24.47 (4.28)	
Hunger Scale	3.06 (0.64)		3.11 (1.17)	
Visual Analogue Scales (0–100)	High-fat food	Low-fat food	High-fat food	Low-fat food
Palatability	78.87 (11.45)	78.26 (8.01)	78.46 (9.18)	76.04 (9.12)
Liking/tastiness	82.75 (12.37)	80.45 (10.65)	84.75 (7.76)	82.54 (8.73)
Craving	60.71 (25.79)	60.62 (17.53)	55.39 (17.91)	58.70 (16.39)
Frequency of eating	56.62 (13.10)	48.13 (13.64)	52.91 (11.94)	46.92 (14.68)

Note. Mean characteristics, with SD in parentheses. RS = Restraint Scale (Herman & Polivy, 1980); DEBQ = Dutch Eating Behavior Questionnaire (Van Strien et al., 1986); BMI = Body Mass Index.

Table 2
Response latencies as a function of group, cue type and cue validity; and cue validity effects, attentional engagement scores and attentional disengagement scores as a function of cue type in the 500 ms condition.

	High-fat food		Low-fat food		Neutral pictures	
	Invalid	Valid	Invalid	Valid	Invalid	Valid
Response latencies						
Group						
Unrestrained eaters ($n = 27$)	288 (38)	294 (32)	288 (33)	283 (27)	289 (35)	283 (35)
Restrained eaters ($n = 28$)	275 (18)	282 (27)	273 (20)	272 (20)	282 (22)	275 (19)
Cue validity effects	−6.2 (18.1)		3.1 (18.8)		6.2 (12.4)	
Attentional engagement scores	−8.8 (12.2)		1.5 (12.0)			
Attentional disengagement scores	−3.6 (13.7)		−4.5 (12.1)			

Note. Mean response latencies (in ms), with SD in parentheses.

3.2.3. 1500 ms Condition

No interaction effects were found in the 1500 ms condition. No evidence was found for prolonged attentional engagement for food in restrained and unrestrained eaters. The 3 (stimulus valence: high-fat food, low-fat food or neutral pictures) × 2 (cue validity: invalid or valid) × 2 (group: restrained or unrestrained eaters) mixed ANOVA only revealed a main effect of validity, $F(1, 25) = 10{,}46$, $p < .01$, $\eta_p^2 = 0.30$. Participants responded faster on valid trials than on invalid trials, indicating a normal cue validity effect. This effect appeared independent of cue type, $F(2, 50) = 0.57$, $p > .1$, $\eta_p^2 = 0.02$. Thus, during relatively long stimulus presentation (1500 ms) no differential attentional processes for food were evident in restrained and unrestrained eaters.

3.2.4. Other overall effects

The overall analysis also revealed a significant main effect of presentation duration, $F(1, 51) = 7.10$, $p < .05$, $\eta_p^2 = 0.12$. Participants responded faster on trials in the 500 ms condition (M = 282.0) than in the 1500 ms condition (M = 301.1). There was also a significant main effect of validity, $F(1, 51) = 8.85$, $p < .01$, $\eta_p^2 = 0.15$, indicating that participants had overall faster responses to valid trials than to invalid trials. The main effect of validity sustains the validity of the task. The analysis did also show a borderline significant main effect of group, $F(1, 51) = 3.90$, $p = .05$, $\eta_p^2 = 0.07$. Overall restrained eaters tended to respond faster than unrestrained eaters. No main effect of cue type was found, $F(2, 102) = 0.46$, $p > .1$, $\eta_p^2 = 0.01$.

3.3. Post-hoc correlational analysis

To further explore the relationship between eating behavior and attentional bias in the 500 ms condition, we also executed a post-hoc correlational analysis. Because the RS that was used to select participants may reflect both inhibited as well as disinhibited eating (Soetens, Braet, Dejonckheere, & Roets, 2006), we computed Pearson's p–m correlations between the indices of attentional bias (cue validity effects, attentional engagement and attentional disengagement) on the one hand and restrained eating (DEBQ Restraint, Van Strien et al., 1986) and disinhibited eating (DEBQ Disinhibition, Van Strien et al., 1986) on the other hand. Correlational analysis allows the maintenance of the continuity of the scores on dieting thereby retaining optimal power to detect differential patterns of attentional bias as a function of both successful and unsuccessful dieting. The scores of both scales were normally distributed (DEBQ Disinhibition: skewness/se = 0.27; kurtosis/se = 0.40, DEBQ Restraint: skewness/se = 0.03; kurtosis/se = 1.54; cf. Tabachnik & Fidell, 1996). See Table 3 for an overview of the correlations.

3.3.1. Attentional engagement and cue validity effects

A negative correlation was found between the attentional engagement scores for high-fat food and DEBQ Disinhibition, indicating that the higher participants score on DEBQ Disinhibition, the less engagement with high-fat food cues. A similar pattern is evident for the cue validity effects converging to the interpretation that disinhibited eaters tend to direct attention away from food. No relationship was found between the attentional engagement scores or cue validity effects of both the high-fat food cues and the low-fat food cues and the DEBQ Restraint. Restraint status seemed not to affect the allocation of attention towards food stimuli.

3.3.2. Attentional disengagement

There was a negative correlation between disengagement scores of high-fat food pictures and DEBQ Restraint. This indicates that participants scoring high on DEBQ Restraint more easily disengage from high-fat food pictures compared to neutral pictures. The DEBQ Disinhibition revealed a roughly similar pattern of facilitated disengagement from food stimuli.

Summarizing, participants scoring high on DEBQ Disinhibition show less attentional engagement with high-fat food cues. Participants scoring high on DEBQ Restraint show more disengagement from high-fat food cues.

4. Discussion

The present study investigated whether restrained eaters are characterized by enhanced engagement for and/or an impaired disengagement from food stimuli. The main results can be summarized as follows: in the relatively short stimulus presentation (500 ms) (i) restrained and unrestrained eaters showed a pattern of initial avoidance of high-fat food compared to neutral stimuli; (ii) restrained eaters and unrestrained eaters displayed slower attentional engagement with high-fat food stimuli compared to neutral stimuli; (iii) correlational analysis indicated

Table 3
Correlations between subscales of restrained and disinhibited eating and cue validity scores, engagement scores and disengagement scores of different cue types in the 500 ms condition ($n = 28$).

	DEBQ – disinhibition	DEBQ – restraint
Cue validity effects		
High-fat food	−0.51**	−0.23
Low-fat food	−0.50**	−0.14
Neutral pictures	−0.18	−0.03
Engagement scores		
High-fat food	−0.37*	0.12
Low-fat food	−0.12	0.08
Disengagement scores		
High-fat food	−0.18	−0.38*
Low-fat food	−0.48**	−0.27

Note. DEBQ = Dutch Eating Behavior Questionnaire (Van Strien et al., 1986).
*$p < .05$.
**$p < .01$.

that disinhibited eaters showed slower attentional engagement for high-fat food, whereas no evidence was found for a difficulty in disengagement from high-fat food in disinhibited eaters. During relatively long stimulus presentation (1500 ms) (iv) no differential attentional processes were evident.

Interestingly, restrained and unrestrained eaters showed avoidance of high-fat foods during the short presentation duration, whereas there was no avoidance of low-fat foods. In a similar vein, restrained and unrestrained eaters showed less engagement for high-fat foods, whereas there was no reduced engagement for low-fat foods. So unexpectedly, restrained eaters did not display enhanced engagement for high-fat food. The tendency to display less attentional engagement with and/or direct attention away rather than towards 'forbidden' foods is consistent with their explicit motivation to avoid eating high-fat food. However, this pattern was not unique for restrained eaters. Apparently, unrestrained eaters have a common strategy to avoid high-fat food in an early stage of attention. For a proper appreciation of this finding, it is important to note that we used a stimulus presentation duration of 500 ms to test the presence of enhanced vigilance for visual food cues (cf., Mogg et al., 2004). It should be acknowledged that with a presentation duration of 500 ms, shifts of attention are possible. Thus, if an attentional bias is observed, this might reflect maintained attention instead of initial vigilance (e.g., Field & Cox, 2008). Therefore, it cannot be ruled out that the restrained (and/or unrestrained) in this experiment did initially orient their attention automatically towards high-fat food stimuli, but subsequently tried to avoid the pictures (e.g., as a cognitive strategy to reduce craving and prevent disinhibited food intake). In that case, the observed avoidance of high-calorie foods might reflect a secondary cognitive strategy instead of an initial automatic process. To arrive at more final conclusions in this respect it would be important to replicate this study by adding an even shorter presentation duration (e.g., 200 ms).

The apparent absence of differences in attentional bias between restrained eaters and unrestrained eaters is consistent with previous research using a (500 ms) dot probe methodology (Boon, Vogelzang, & Jansen, 2000). As the effect size of the relevant interaction was negligible, it seems not very likely that the absence of a group difference should be attributed to insufficient power of the present study. Another and theoretically more interesting explanation could be that the group of restrained eaters as indexed by the RS is heterogeneous in their ability to control food intake. There is evidence that individuals scoring high on the RS may comprise of both successful and unsuccessful dieters (Soetens et al., 2006), and food cues may elicit different attentional processes in these so-called inhibited versus disinhibited restrainers.

In accordance with the importance to distinguish between inhibited and disinhibited eaters, correlational analyses revealed that disinhibited eaters showed less attentional engagement with food than inhibited eaters. This finding is consistent with earlier research showing that individuals whose eating is easily triggered by food-relevant stimuli irrespective of hunger (i.e., external eating as defined by Van Strien et al., 1986) also tended to direct their attention away from food stimuli (Johansson et al., 2004). Although a pattern of attentional avoidance of food provides no indication that attentional bias for food plays an important role in the pathogenesis of disinhibited eating, a pattern of avoidance of food seem to reflect disinhibited eaters' explicit strategy to restrict their food intake. However, repeated periods of prolonged deprivation may enhance the reward value of food (cf. Brown, Jackson, & Stephens, 1998). Therefore, it cannot be ruled out that in the long run, the seemingly highly adaptive strategy to direct attention away from 'forbidden' food may become counterproductive and may be associated with disinhibited eating patterns.

In addiction, current approaches assume that there is a reciprocal relationship between craving and "attentional bias" (Franken, 2003). In line with this view, it has even been argued that the development of attentional bias for drug stimuli may be the core process underlying craving and compulsive-drug-use (Lubman, Peters, Mogg, Bradley, & Deakin, 2000). Attentional bias could conceivably play a similar role in craving for food and over-eating. Accordingly, for disinhibited eaters, their tendency to attentionally avoid food items may be considered as an adaptive strategy, as it may prevent the generation of craving for 'forbidden' food. However, when a context increasingly activates craving (i.e., if a context also contains features of smell, sight and/or availability of food), this may reduce avoidance of attentional engagement with food, by which the process could change into enhanced attentional engagement with food. In turn, heightened attention for food could intensify craving, and may lead to food intake. One way to test this would be to see whether manipulation of craving will lead to enhanced attentional engagement with food in disinhibited eaters, and whether this in turn will lead to increased food intake.

No effects were found for attentional disengagement from food in restrained eaters. Contrary to expectations, restrained eaters did not seem to have difficulty to disengage their attention from food. Possibly, problems in disengagement attention from food occur in shorter stimulus presentation formats. Consistent with this argument, no evidence was found at longer stimulus presentation duration (1500 ms) for impaired attentional disengagement and/or attentional avoidance.

To the best of our knowledge, no study thus far has investigated attentional engagement and disengagement for food using the modified ECT, so replication of these findings will be needed. Future research should further investigate the correlation between attentional bias for food and disinhibited eating by selecting the sample on the basis of disinhibited eating. In addition, it would be important to see whether the present results can be generalized to clinical samples of anorexia nervosa and bulimia nervosa patients. In anorexia nervosa patients, for example, a vigilance-avoidance pattern for food could be expected, like attentional bias studies in fear patients (e.g., Mogg et al., 2004). In bulimia nervosa and binge eating-disorder patients, enhanced vigilance and maintained attention for food might be involved, similar to the attentional pattern in addiction (e.g., Field, Mogg, Zetteler, & Bradley, 2004).

An important limitation of the present study concerns its correlational nature. On the basis of the present data it cannot be decided whether reduced attentional engagement affects dysfunctional eating patterns in disinhibited eaters or whether attentional bias is just an epiphenomenon. One way to test the alleged causal role of attentional bias would be to train attentional bias for food in a healthy group to see whether an individual would report more eating-disorder-related concerns, as two recent studies did for attentional bias for body and shape-related words (Engel et al., 2006; Smith & Rieger, 2006). Another potential limitation of the present approach concerns the possibility that the mere presentation of valent cues (such as food stimuli) may give rise to a general response interference effect that can compromise the distinction between attentional engagement and disengagement indices (Mogg, Holmes, Garner, & Bradley, 2008). However, because no main effects of cue type were observed on response latencies, such potential interference effect seems not involved in the present study. Finally, building on previous work testing the vigilance-avoidance hypothesis in the context of threat using complex visual cues, we used a 500 ms cue duration to assess initial orientation. Because such stimulus presentation duration allows for the occurrence of multiple shifts in attention, it would be important for future research to use even shorter presentation durations (e.g., 200 ms) to examine potential differences between restrained and unrestrained eaters in earlier stages of attention.

5. Conclusion

In sum, people generally show avoidance and less engagement for high-fat food during early stages of attention. Avoidance and reduced engagement for high-fat food did particularly apply for disinhibited eaters. It remains to be tested whether disinhibited eaters hold on to this pattern of avoidance in potentiated contexts (cf., Hepworth, Mogg, Brignell, & Bradley, in press) and whether this pattern of avoidance reflects an initial automatic process or a secondary cognitive strategy (e.g., to counteract cue-elicited craving).

Acknowledgements

We thank Bert Hoekzema for programming the Exogenous Cueing Task in E-Prime, the bachelor students who carried out the experiment, and those who kindly volunteered to participate in the study.

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