Appetite 53 (2009) 370–375

Contents lists available at ScienceDirect

Appetite

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

Research report

Experimentally induced chocolate craving leads to an attentional bias in increased distraction but not in speeded detection

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ARTICLE INFO

Article history:
Received 19 January 2009
Received in revised form 5 July 2009
Accepted 22 July 2009

Keywords:
Attentional bias
Craving
Chocoholics
Speeded detection
Increased distraction

ABSTRACT

In the present study, the causal influence of chocolate craving on attentional bias for chocolate-related information was examined by experimentally inducing chocolate craving in a sample of high trait chocolate cravers vs. low trait chocolate cravers. A sample of 35 high trait chocoholics and 33 low trait chocolate cravers were randomly assigned to either the exposure condition in which craving was manipulated or the non-exposure condition. To measure attentional bias, a pictorial version of the visual search paradigm [Smeets, E., Roefs, A., van Furth, E., & Jansen, A. (2008). Attentional bias for body and food in eating disorders: increased distraction, speeded detection, or both? *Behaviour Research and Therapy*, *46*, 229–238] was used, assessing two components: distraction and detection. It was found that experimentally induced chocolate craving led to increased distraction by chocolate pictures in the high trait chocolate cravers, in comparison to the low trait chocolate cravers. Moreover, this measure of distraction correlated strongly with self-reported craving, but only in the chocoholics and in the exposure condition. In the non-exposure condition, high trait chocolate cravers showed speeded detection of chocolate pictures relative to non-chocoholics, but this component did not correlate with self-reported craving. It is concluded that experimentally induced craving for chocolate causes a bias in, specifically the increased distraction component of attention in high trait chocolate cravers.

Over the past decades, ample research has demonstrated attentional biases for craving-related stimuli (e.g., alcohol, drugs, and cigarettes) in individuals for whom these stimuli are of particular concern. An attentional bias is defined as the tendency to selectively attend to personally relevant information over neutral information (Mathews & MacLeod, 2005). Using the emotional Stroop paradigm, research from the field of addiction has consistently shown that alcoholics (Bauer & Cox, 1998; Cox, Hogan, Kristian, & Race, 2002; Cox, Yeates, & Regan, 1999; Stormark, Laberg, Nordby, & Hugdahl, 2000), smokers (Gross, Jarvik, & Rosenblatt, 1993; Walters & Feyerabend, 2000), and drug addicts (Franken, Kroon, Wiers, & Jansen, 2000) show increased interference when naming the colour of craving-related stimuli as compared to neutral stimuli. In addition, findings from studies using the dot-probe paradigm also support the presence of attentional biases in these individuals (Ehrman et al., 2002; Lubman, Peters, Mogg, Bradley, & Deakin, 2000).

In explaining the occurrence of these attentional biases, a link has been proposed between selective attentional processing and craving (Franken, 2003; Robinson & Berridge, 1993). Indeed, a substantial number of studies have found significant correlations between attentional bias for craving-related stimuli and levels of subjective craving (e.g., Field et al., 2007; Field, Mogg, & Bradley, 2005; Franken et al., 2000; Rosse et al., 1997; Rosse, Miller, Hess, Alim, & Deutch, 1993). Other studies suggest that this relationship only holds true for a specific component of the attentional bias. In general, two subcomponents of attention have been distinguished by attentional bias researchers using paradigms like the dot-probe paradigm (i.e., Macleod, Mathews, & Tata, 1986; Mogg, Field, & Bradley, 2005), the exogenous cueing paradigm (Fox, Russo, Bowles, & Dutton, 2001) and the odd-one-out visual search paradigm (Hansen & Hansen, 1988; Rinck, Reinicke, Ellwart, Heuer, & Becker, 2005). The first subcomponent is involved in the early attentional processing of information whereas the second subcomponent is specifically involved in late attentional processing. Depending on the attentional bias paradigm that is used, the first subcomponent is referred to as increased initial orienting (i.e., Mogg et al., 2005), engagement (i.e., Fox et al., 2001), or speeded detection (i.e., Rinck et al., 2005) while the second subcomponent is referred to as greater maintained attention (i.e., Mogg et al., 2005), slowed disengagement (i.e., Fox et al., 2001), or increased distraction (i.e., Rinck et al., 2005). Using eye-tracking, Mogg et al. (2005) showed that higher levels of craving are correlated specifically with greater maintained attention for smoking cues

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doi:10.1016/j.appet.2009.07.020

in smokers. Likewise, Field, Mogg, Zetteler, and Bradley (2004) only found a correlation between craving and the attentional bias for alcohol cues in the maintenance component of attention.

Apart from addiction-related stimuli, attentional biases have also been reported for food-related stimuli. More specifically, these biases have been demonstrated in restrained eaters (Francis, Stewart, & Hounsell, 1997), dieters (Cooper & Fairburn, 1992), eating disorder individuals (for reviews see: Faunce, 2002; Lee & Shafran, 2004), people who are food deprived (Placanica, Faunce, & Soames Job, 2002), hungry (Mogg, Bradley, Hyare, & Lee, 1998), or in people who have just finished an appetizer (Overduin, Jansen, & Louwerse, 1995). In a recent study from our laboratory we used an odd-one-out variant of the visual search paradigm (Hansen & Hansen, 1998; Rinck et al., 2005) to investigate two subcomponents of attention (i.e., speeded detection and increased distraction) that might underlie the attentional bias in eating disorder patients (Smeets, Roefs, van Furth, & Jansen, 2008). Speeded detection refers to the faster detection of relevant stimuli in the environment, whereas increased distraction refers to the heightened distraction which can be brought about by these relevant stimuli. Results indicated that eating disorder patients showed evidence of increased distraction by food-related information, but not of the speeded detection of this kind of information (Smeets et al., 2008). In line with Mogg and colleagues (2005), we concluded that this increased distraction by food, might reflect a craving response. In other words, experiencing food cravings might have led eating disorder patients to be more distracted by food-related information while searching for neutral information. Nevertheless, as measuring or experimentally inducing craving was neither the goal of our study or of other previous studies, no conclusions can be drawn about the link between food cravings and the attentional bias for food. In this perspective, the purpose of the present study was to unravel the nature of this link in more detail in a non-clinical group of trait chocolate cravers experiencing intense and frequent cravings for chocolate (Benton, Greenfield, & Morgan, 1998). Specifically our aim was to induce chocolate craving in samples of high and low trait chocolate cravers and to examine the direct impact of this manipulation on the attentional processing of chocolate-related pictures in a visual search paradigm. A pictorial chocolate variant of the visual search paradigm as used by Smeets et al. (2008) was developed. Participants were randomly assigned to one of two conditions: the exposure condition, in which chocolate craving was induced, or the non-exposure condition.

It was hypothesized that high trait chocolate cravers in the non-exposure condition would show speeded detection of chocolate pictures, in comparison to low trait chocolate cravers. Based on previous addiction studies in which a craving-related bias was specifically found in maintained attention, we expected our craving induction to cause an attentional bias effect in the distraction component (which may resemble maintained attention). In this line, it was hypothesized that the craving induction (i.e., exposure) would lead to increased distraction by chocolate pictures in trait chocolate cravers, in comparison to the low trait cravers and the non-exposure condition. Finally, self-reported craving was expected to correlate with the distraction component of the attentional bias

Methods

Participants

A total of 68 female undergraduate students were invited to participate in a study ostensibly investigating the relationship between perception and cognition. Inclusion criteria were either a high (highest 25%) or a low (lowest 25%) score on the chocolate craving subscale of the Attitudes to Chocolate Questionnaire (Benton et al., 1998) which was assessed 2 weeks before the experiment. Participants with a high score (i.e., a score above 10) on the chocolate craving subscale were classified as high trait chocolate cravers (henceforth called chocoholics), and participants with a low score (i.e., a score below −10) were classified as low trait chocolate cravers (henceforth called non-chocoholics). Both chocoholics ($n = 35$) and non-chocoholics ($n = 33$) were randomly assigned to either the exposure condition or the non-exposure condition. In total 18 chocoholics and 17 non-chocoholics were assigned to the exposure condition, and 17 chocoholics and 16 non-chocoholics were assigned to the non-exposure condition. All participants received course credits for their participation. The present study was approved by the local committee for research ethics.

Materials

Pictorial chocolate visual search task. Each trial started with a brief tone, after which the participant was shown a fixation cross for 500 ms in the middle of the computer screen. Then she was presented with a 5×4 matrix of 20 pictures and was instructed to indicate whether the matrix contained 20 pictures of the same category or whether it contained one picture from a different category (the odd-one-out). If the matrix contained an odd-one-out picture (henceforth called the *target picture*), she was instructed to press the right button of a response-box. If the matrix did not contain an odd-one-out picture, she was instructed to press the left button. Note that the counterbalancing of right and left button is not necessary as only the target present trials are relevant for testing our hypotheses. The matrix remained on screen until response or for a maximum of 20 s upon which the next trial began. The location of each picture in each matrix was chosen randomly for each trial and for each participant. However, the target picture never appeared directly above or below the location of the fixation cross in order to avoid facilitated detection. Participants were informed about the four categories stimuli could come from.

Pictorial stimuli from four categories were used: chocolate, candy, couches (neutral), and handbags (neutral). The function (i.e., target or distractor) of the neutral categories (couches and handbags) was counterbalanced over participants. Matrices on target *present* trials consisted of one chocolate-related picture among 19 couches/handbags, one candy-related picture among 19 couches/handbags, one handbag among 19 couches, one couch/handbag among 19 chocolate-related pictures, one couch/handbag among 19 candy-related pictures, or of one couch among 19 handbags. Each of the six types of matrices was shown 19 times to each participant. Matrices on target *absent* trials consisted of 20 chocolate-related pictures, 20 candy-related pictures, 20 handbags, or of 20 couches. There were 114 target present trials, 40 target absent trials, and 12 practice trials. Trials with candy-related pictures were included as an additional control category to check whether the attentional bias effects are specific for chocolate or whether they generalize to other sweets.

In line with Smeets et al. (2008), the majority of the trials were target present trials because this type of trial is relevant for testing our hypotheses. Speeded detection of chocolate-related pictures is calculated by comparing response latencies to detect a chocolate-related target picture vs. a neutral target picture (e.g., handbags) among neutral distractor pictures from one other category (e.g., couches). Increased distraction is calculated by comparing response latencies to detect a neutral target picture (e.g., a handbag) among chocolate-related pictures vs. neutral distractor pictures from one other category (e.g., couches).

The visual search task lasted approximately 20 min, divided over two blocks of trials of 10 min. The participant was given a brief