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Research report

Desire lies in the eyes: Attention bias for chocolate is related to craving and self-endorsed eating permission ☆

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ABSTRACT

The present study tested the impact of experimentally manipulated perceived availability of chocolate on attention for chocolate stimuli, momentary (state) craving for chocolate and consumption of chocolate in healthy weight female students. It was hypothesized that eating forbiddance would be related to attentional avoidance (thus diminished attention focus on food cues in an attempt to prevent oneself from processing food cues) and that eating motivation would be related to attentional approach (thus maintained attentional focus on food cues). High chronic chocolate cravers ($n = 40$) and low cravers ($n = 40$) participated in one of four perceived availability contexts (required to eat, forbidden to eat, individual choice to eat, and 50% chance to eat) following a brief chocolate exposure. Attention for chocolate was measured using eye-tracking; momentary craving from self-report; and the consumption of chocolate was assessed from direct observation. The perceived availability of chocolate did not significantly influence attention allocation for chocolate stimuli, momentary craving or chocolate intake. High chocolate cravers reported significantly higher momentary craving for chocolate ($d = 1.29$, $p < .001$), and showed longer initial duration of gaze on chocolate, than low cravers ($d = 0.63$, $p < .01$). In contrast, participants who indicated during the manipulation check that they would not have permitted themselves to eat chocolate, irrespective of the availability instruction they received, showed significantly less craving ($d = 0.96$, $p < .01$) and reduced total dwell time for chocolate stimuli than participants who permitted themselves to eat chocolate ($d = 0.53$, $p < .05$). Thus, this study provides evidence that attention biases for food stimuli reflect inter-individual differences in eating motivation, – such as chronic chocolate craving, and self-endorsed eating permission.

Introduction

Attention biases for food cues have been studied extensively in the last decennia (see e.g., for a review Brooks, Prince, Stahl, Campbell, & Treasure, 2011). An attention bias refers to selective information processing that favours personally salient/relevant information (e.g., food stimuli) over neutral information (MacLeod, Mathews, & Tata, 1986). One unresolved issue is the extent to which attention bias for food cues reflects motivation for food (e.g., eating allowance, (over)eating, craving) and/or a current concern about food (e.g., eating forbiddance, cognitive restraint, trying to avoid food intake) (e.g., Brooks et al., 2011; Dobson & Dozois, 2004; Nijs, Franken, & Muris, 2010). Therefore, the aim of this study is to clarify the role of eating motivation and eating forbiddance in determining cognitive, subjective and behavioural responses to desirable food, by studying the effect of chronic chocolate craving, and an experimentally controlled manipulation of food availability (i.e., being required to eat chocolate versus being forbidden to eat chocolate) on attentional bias for food, momentary craving, and food intake.

On the one hand, eating disorder patients (ED), that is, individuals who are concerned with eating and obsessed with weight loss (i.e., high "eating forbiddance"), showed elevated attention biases for (high caloric) food stimuli in comparison to healthy controls (for a review see Brooks et al., 2011). For example, a broad range of evidence on the food Stroop task shows an interference effect for food words in eating disorder patients when compared to healthy control participants (Dobson & Dozois, 2004; Lee & Shafran, 2004), however the direction of the attention process (attentional avoidance versus attentional approach) cannot be specified by means of the Stroop task. The direction of an attention bias is important, though, because knowing whether ED patients show an attention bias towards or away from food cues could have important theoretical and clinical implications.

However, also in studies using paradigms that are capable to distinguish attention components, evidence on the direction of this attention bias is mixed. In one study ED-patients showed increased

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distraction specifically for high caloric food words but not low caloric food words during a visual search task, which was interpreted as attention bias towards food cues (i.e., attentional approach) (Smeets, Roefs, van Furth, & Jansen, 2008). In contrast, two studies using pictorial food stimuli reported that ED patients, in comparison to healthy control participants or remitted ED patients expressed significantly negative attention bias scores for (positive) eating related pictures as measured by response latency recordings during a dot-probe task. Thus, ED patients diverted their attention away from food cues (i.e., attentional avoidance) (Shafran, Lee, Cooper, Palmer, & Fairburn, 2007, 2008). Evidence from attention research in nonclinical populations suggests that dieting and restrained eating might also lead to elevated attention processes towards (or away from) food cues (Boon, Vogelzang, & Jansen, 2000; Brooks et al., 2011; Dobson & Dozois, 2004). Restrained eaters are preoccupied with their food intake and their weight (Jones & Rogers, 2003; Timmerman & Gregg, 2003; Wardle, 1987). Their constant struggle to adhere to their dieting rules could be reflected in biased processing of (high caloric) food cues (Higgs, Rutters, Thomas, Naish, & Humphreys, 2012; Tiggemann & Kemps, 2005). However, empirical evidence for attention biases for food in restrained eaters versus healthy controls remains also inconclusive. Specifically, the direction of the attention bias is not clear yet. One study (Veenstra, de Jong, Koster, & Roefs, 2010) used a paradigm that could distinguish between attentional approach and avoidance processes, and found evidence for an association of restrained eating scores and attentional avoidance (more disengagement from high-fat foods), whereas other studies provided evidence that restrained eaters show increased attention biases towards food stimuli when compared to unrestrained eaters (Hollitt, Kemps, Tiggemann, Smeets, & Mills, 2010; Meule, Vögele, & Kübler, 2012), or did not find significant differences in attention biases for food in unrestrained and restrained eaters (Ahern, Field, Yokum, Bohon, & Stice, 2010; Boon et al., 2000). Thus, even though evidence is mixed, research from ED patients and restrained eaters seems to suggest that (extreme) eating forbiddance might be related to differences in attention for food, yet the direction of this effect is unclear.

On the other hand, research on attention allocation in obese and overweight populations suggests that attention biases for food are related to craving, overeating and BMI. According to the theory of incentive salience, food cues can acquire motivational properties through a conditioning process: because food cues predict the rewarding experience of eating they can become salient stimuli in the environment, and are then capable of "grabbing" attention, which in turn elicits (conditioned) approach behaviour, such as craving and (over)eating of high caloric food (Berridge, 1996, 2009; Nijs & Franken, 2012). Thus, theoretically, attention biases for craved appetitive stimuli, such as drugs or palatable foods, have a potential role in maintaining a pattern of overconsumption (Berridge, 1996, 2009; Field, Munafó, & Franken, 2009; Franken, 2007; Robbins & Ehrman, 2004). Accordingly, studies have demonstrated selective processing of food cues in overweight/obese individuals when compared to healthy weight controls. Some studies found evidence for an attention bias towards high caloric food stimuli in the direction and duration of gaze for food versus neutral stimuli in obese but not in healthy weight participants when fed (Castellanos et al., 2009), and an attention bias in initial orientation towards food versus neutral stimuli in overweight or obese participants (Nijs et al., 2010; Nijs, Muris, Euser, & Franken, 2010). However, others report an approach-avoidance reaction (initially focussing on high caloric food followed by attentional avoidance in later stages of processing) in overweight participants (Werthmann et al., 2011).

Taken together, results suggest that there is evidence that attention biases for food cues are related to overweight and obesity (associated with craving and intake of high-fat foods; i.e. high "eating motivation"), possibly apparent in attentional approach of food, as well as to (extreme) restrained eating (thus eating forbiddance in eating disordered patients and restrained eaters), possibly apparent in attentional avoidance of food. It is difficult to draw firm conclusions from previous research though, as body weight and restraint are typically confounded (e.g. Johnson, Pratt, & Wardle, 2011; Snoek, van Strien, Janssens, & Engels, 2008; Werthmann et al., 2013). Moreover, it is not always clear whether the observed effects reflect attentional approach or avoidance. One difficulty regarding the results of former studies is the use of different paradigms and methods to assess attention bias for food, which might have contributed to the inconsistency of previous results. More specifically, variation in the type of target (e.g., high caloric food or different food stimuli) and the contrast category may have led to inconsistencies (Forestell, Lau, Gyurovski, Dickter, & Haque, 2012; Werthmann et al., 2011). Recently, a meta-analysis concluded that the most direct and immediate measure for (visual) attention biases is eye tracking technology (Field et al., 2009). A further advantage of eye tracking is that the direction of attention, thus attention avoidance or attentional approach, can also be directly assessed. Therefore, concurrent recordings of eye movements during a visual probe task were used in the current study to determine the effect of food availability contexts on attention processing.

The current study tried to systematically disentangle the effects of eating motivation and eating forbiddance (as a proxy for (extreme) dietary restraint) on attention bias for food, using an eye-tracking paradigm that can distinguish between attentional approach and attentional avoidance processes. In this study we selected 'chocolate' as the target food, as it is both craved and seen as "forbidden" (Hetherington & Macdiarmid, 1993; Kemps & Tiggemann, 2009; Rodin, Mancuso, Granger, & Nelbach, 1991), and tested how the expectancy of imminent chocolate consumption influenced attention bias for chocolate. Similarly, previous research testing whether food expectancies influence cognitive performance also used chocolate as target food (Higgs, 2007).

The main research question concerned whether the manipulation of eating expectancy within four availability contexts (required to eat, forbidden to eat, individual choice, or chance) modulates attention bias for chocolate cues, and affects craving and chocolate intake. Participants who expected to be required to eat chocolate were hypothesized to show attention biases towards chocolate cues (i.e., attentional approach), whereas participants who expected that they were forbidden to eat chocolate were hypothesized to show attention biases away from food (i.e., attentional avoidance), both in comparison to participants who could choose for themselves or who expected a 50% chance to eat chocolate. Participants in those conditions were hypothesized to show an approach-avoidance pattern of attention allocation towards chocolate stimuli (e.g., first directing attention towards chocolate but then reduced maintained attention on chocolate), because of an ambivalence conflict between temptation and self-control. Craving and consumption were supposed to be affected in the same direction as the attention biases for each condition.

To account for possible effects of individual differences in the intrinsic motivational salience of chocolate that might interfere with the effectiveness of our availability manipulation, we tested this objective in high chronic chocolate cravers compared to low cravers. Chronic chocolate craving was thought to be related to an attention bias towards chocolate cues because previous research has indicated that high chocolate cravers showed more pronounced subjective, physiological and hedonic (as marked by elevated event-related potentials in the anterior frontal scalp) reactivity when viewing chocolate images in comparison to low cravers (Asmaro et al., 2012; Rodríguez, Fernández, Cepeda-Benito,