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Attention bias for chocolate increases chocolate consumption – An attention bias modification study

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ABSTRACT

Objective: The current study examined experimentally whether a manipulated attention bias for food cues increases craving, chocolate intake and motivation to search for hidden chocolates.
Method: To test the effect of attention for food on subsequent chocolate intake, attention for chocolate was experimentally modified by instructing participants to look at chocolate stimuli ("attend chocolate" group) or at non-food stimuli ("attend shoes" group) during a novel attention bias modification task (antisaccade task). Chocolate consumption, changes in craving and search time for hidden chocolates were assessed. Eye-movement recordings were used to monitor the accuracy during the experimental attention modification task as possible moderator of effects. Regression analyses were conducted to test the effect of attention modification and modification accuracy on chocolate intake, craving and motivation to search for hidden chocolates.
Results: Results showed that participants with higher accuracy (+1 SD), ate more chocolate when they had to attend to chocolate and ate less chocolate when they had to attend to non-food stimuli. In contrast, for participants with lower accuracy (−1 SD), the results were exactly reversed. No effects of the experimental attention modification on craving or search time for hidden chocolates were found.
Limitation: We used chocolate as food stimuli so it remains unclear how our findings generalize to other types of food.
Conclusion: These findings demonstrate further evidence for a link between attention for food and food intake, and provide an indication about the direction of this relationship.

In an obesogenic food environment, as present in the western world, we are constantly surrounded by an abundance of palatable food cues. Ignoring or attending to these food cues may influence our eating behaviour. For example, imagine you are walking through the main shopping street of your town on a Saturday: If you notice all the delicious food cues from shops or restaurants you may end up consuming a lot of high caloric food, such as waffles, French fries and hamburgers. If you focus instead on shoes in shop windows, ignoring all food cues, you might end up with a full shoe cabinet, but probably not with a full stomach.

Attention for delicious, yet unhealthy, food temptations could contribute to a lack of control over food intake, for example by facilitating overeating or food intake of unhealthy snacks. Indeed, evidence from several studies measuring attentional bias for food suggests that attention for food is related to obesity and craving for food. For example, neuroimaging studies showed that a greater activation of reward and attention centres in the brain during food exposure is related to obesity, poorer weight control and weight gain (Murdaugh, Cox, Cook, & Weller, 2012; Stice, Yokum, Bohon, Marti, & Smolen, 2010; Yokum, Ng, & Stice, 2011). In addition, elevated attention biases for food cues have been observed in overweight and obese samples in comparison to participants with a healthy weight (e.g., Castellanos et al., 2009; Nijs, Franken, & Muris, 2010; Werthmann et al., 2011). Moreover, several studies showed that attention biases for food are related to hunger and craving in healthy weight and overweight participants (e.g., Kemps & Tiggemann, 2009; Mogg, Bradley, Hyare, & Lee, 1998; Nijs, Muris, Euser, & Franken, 2010; Piech, Pastorino, & Zald, 2010; Smeets, Roefs, & Jansen, 2009; Werthmann et al., 2011). Thus, evidence from these cross-sectional studies establishes an association of attention for food and eating-related behaviours or increased BMI but did not test the hypothesized causal relation of attention bias and food intake.

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There is preliminary evidence suggesting that changes in attention for food cues may be causally related to changes in eating behaviour: one previous study that manipulated attention focus for food after a body image challenge (i.e., confronting participants with advertisements of thin models and body parts) showed that attending high caloric food words elevated the chance to choose low caloric over high caloric cookies, in comparison to participants who attended neutral words (Smith & Rieger, 2009). This finding suggests that attending to high calorie foods and being exposed to body image comparisons could activate dietary restraint. However, because attention to food was manipulated in the context of body image satisfaction and because the amount of cookies was fixed, this study does not inform about the relation of purely the attention for food and the amount of food intake.

Thus, given the correlational nature of most previous studies, the causal impact of attention for food cues on food intake remains unclear, and this question can only be addressed by experimentally manipulating attentional bias followed by a measure of food intake. The aim of the current study was therefore to manipulate attention bias for food cues, to test whether a causal relationship exists between manipulated attention for food on the one hand and craving and food intake on the other hand.

Experimentally inducing changes in attentional processes to affect subsequent behaviour has been termed attention bias modification (ABM). This method has been explored extensively in the field of anxiety research. Several studies have shown that training attention away from threatening stimuli reduced an attentional bias for these cues and led to a decrease in anxiety symptoms in adults and children in comparison to a control group (Bar-Haim, Morag, & Glickman, 2011; Hakamata et al., 2010; Hallion & Ruscio, 2011; Mathews & MacLeod, 2002).

Typically, ABM studies have relied on a modified version of the visual-probe paradigm as training. During this task, two stimuli (symptom-relevant/neutral) are presented side by side on a computer screen, and then a probe appears in the location of one of the stimuli. Participants are instructed to react to the probe by a manual response. To manipulate attention towards (or away) from disorder-related cues, the probe replaces the relevant stimuli in 100% (or 0%) of all trials. The rationale of the training presumes that an implicit learning process is elicited through attending to the systematic contingencies, which improves task performance, thereby gradually modifying an attention bias towards (or away from) the disorder-relevant cue (Bar-Haim, 2010). However, one disadvantage of modifying the visual probe paradigm in this way is that it modifies attention processes indirectly by manipulating and measuring the manual response reactions. Yet, targeting visual attention processes directly by the modification procedure and simultaneously monitoring visual attention as measure for modification accuracy, for example by recording eye movements, could provide a more precise modification of attention.

One alternative approach to manipulate attention biases, which overcomes the disadvantage of modifying attention indirectly, is a modified antisaccade task in combination with the assessment of eye-movements. Saccades are rapid eye-movements (e.g., Munoz & Everling, 2004). Saccadic eye-movements are closely related to visuo-spatial attentional engagement and represent a faster measure for attentional processing than the recordings of response reactions (e.g., Bannerman, Milders, de Gelder, & Sahraie, 2009; Hutton, 2008; Munoz & Everling, 2004). The antisaccade task has typically been used as a measure of cognitive inhibitory control (e.g., Hallett, 1978; Hallett & Adams, 1980; or for a review Hutton, 2008). In general, the antisaccade task can be seen as a stimulus-response mapping task with regard to attentional processing: During the task participants are required to inhibit reflexive eye movements (saccades) towards a peripherally presented target, and have to shift their gaze in the opposite direction (i.e., perform an antisaccade). This process requires a top-down inhibitory cognitive control execution, because participants have to suppress their reflexive response (prosaccade towards target), and instead have to voluntarily initiate the inverse response by saccading towards the mirror position of the target (Munoz & Everling, 2004). Thus, this method provides the possibility to combine a direct modification of attention with the monitoring of accuracy by implementing recordings of eye-movements.

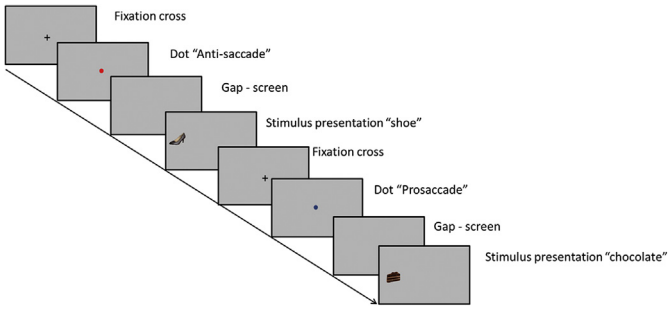

Fig. 1. Schematic presentation of trials during the modification task. Depending on the respective condition, participants had always to make a prosaccade towards chocolate and an anti-saccade away from shoes during the stimulus presentation (in the "attend chocolate condition", as depicted here) or they had always to make an anti-saccade away from chocolate and a pro-saccade towards shoes (in the "attend shoe" condition, not depicted).

In the present study, the standard antisaccade task was adapted to manipulate attention towards versus away from chocolate. The aim of the current study was to test experimentally if modification of attention for chocolate versus attention for shoes would contribute to differences in chocolate consumption, changes in craving or motivation to search for hidden chocolates (as indexed by search time). To modify attention allocation for chocolate versus neutral cues the contingencies of pro- and antisaccades towards or away from chocolate were altered: In the "attend chocolate" group, participants always had to perform a prosaccade towards chocolate stimuli and an antisaccade away from neutral stimuli (shoes), whereas in the "attend shoes" condition, participants always had to perform a prosaccade towards shoes and an antisaccade away from chocolate. We expected that participants in the "attend chocolate" group would consume more chocolate, report more craving and search longer for hidden chocolate, as index for higher motivation for chocolate, in comparison to participants in the "attend shoes" group.

Another advantage was that eye-movements were monitored during the anti-saccade task. This is the first study that applied a measure for the accuracy of attention during an attention modification procedure. Thus, we further tested if accuracy during the attention modification moderated the influence of modified attention on chocolate consumption, craving and search time for hidden chocolates.

1. Method

1.1. Participants

Female participants ($n = 56$) were recruited by flyers and the local electronic recruitment system. Only female students were eligible for participation to eliminate possible gender effects with regard to eating behaviour. All participants were undergraduate students. The study received ethical approval from the local ethics committee.