



## Looking at food in sad mood: Do attention biases lead emotional eaters into overeating after a negative mood induction?



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### ABSTRACT

**Background:** Emotional eating is associated with overeating and the development of obesity. Yet, empirical evidence for individual (trait) differences in emotional eating and cognitive mechanisms that contribute to eating during sad mood remain equivocal.

**Aim:** The aim of this study was to test if attention bias for food moderates the effect of self-reported emotional eating during sad mood (vs neutral mood) on actual food intake. It was expected that emotional eating is predictive of elevated attention for food and higher food intake after an experimentally induced sad mood and that attentional maintenance on food predicts food intake during a sad versus a neutral mood.

**Method:** Participants (N = 85) were randomly assigned to one of the two experimental mood induction conditions (sad/neutral). Attentional biases for high caloric foods were measured by eye tracking during a visual probe task with pictorial food and neutral stimuli. Self-reported emotional eating was assessed with the Dutch Eating Behavior Questionnaire (DEBQ) and ad libitum food intake was tested by a disguised food offer.

**Results:** Hierarchical multivariate regression modeling showed that self-reported emotional eating did not account for changes in attention allocation for food or food intake in either condition. Yet, attention maintenance on food cues was significantly related to increased intake specifically in the neutral condition, but not in the sad mood condition.

**Discussion:** The current findings show that self-reported emotional eating (based on the DEBQ) might not validly predict who overeats when sad, at least not in a laboratory setting with healthy women. Results further suggest that attention maintenance on food relates to eating motivation when in a neutral affective state, and might therefore be a cognitive mechanism contributing to increased food intake in general, but maybe not during sad mood.

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### 1. Introduction

Overeating is a serious problem, as it contributes to the development of obesity (e.g., Hill, Catenacci, & Wyatt, 2005; Lowe & Levine, 2005). Therefore it is important to study (cognitive) mechanisms that are related to overeating (Lowe & Levine, 2005). Different models emphasize the impact of negative emotions on excessive food intake, thereby linking emotional eating to overeating and ultimately to the risk of weight gain (e.g., Canetti, Bachar, & Berry, 2002; Macht, 2008). Basically, it is assumed that eating in response to stress or sad mood is a maladaptive emotion regulation mechanism, which affects eating behavior and weight in general (Canetti et al., 2002; Macht, 2008). For example, emotional eaters, that is, individuals who report to be prone to overeat in response to negative emotional states, are thought to be

less successful in dieting and are therefore considered to be at higher risk for developing obesity (van Strien, 2005). Yet, experimental research findings remain inconsistent with respect to the influence of negative mood on eating behavior in self-reported emotional eaters, as assessed with a standard self-report measure for emotional eating, the Dutch Eating Behavior Questionnaire (DEBQ, van Strien, Frijters, Bergers, & Defares, 1986). Even basic assumptions, for example that self-reported emotional eating is associated with actual overeating during sad mood (thus with the very behavior that this construct is based upon) could not reliably be demonstrated. Whereas some experimental studies found that food intake after a negative mood induction increased in participants with high disinhibition tendencies and/or high self-reported emotional eating (Loxton, Dawe, & Cahill, 2011; Yeomans & Coughlan, 2009), others did not find an influence of emotional eating traits on food intake during distress in the lab (e.g., Evers, de Ridder & Adriaanse, 2009; Evers, Marijn Stok, & de Ridder, 2010; Wallis & Hetherington, 2004, 2009, study 2). Similarly, Bongers, Jansen, Havermans, Roefs, & Nederkoorn (2013) reported that

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emotional eating (measured with the DEBQ) was significantly related to higher intake after a positive, but not after a negative mood induction. In contrast, van Strien et al. (2013) found increased intake in high emotional eaters compared to low emotional eaters after negative and positive mood inductions. Moreover, also findings from “outside the lab”, for example based on food diaries, failed to find a consistent link of self-reported emotional eating and food intake during distress in real-life settings (Adriaanse, de Ridder, & Evers, 2011; Ayres, Prestwich, Conner, & Smith, 2011; Conner, Fitter, & Fletcher, 1999; Wallis & Hetherington, 2009, study 1).

A goal of the current study was to study if self-reported emotional eating is related to elevated attention bias for food and actual food intake during sad mood (vs neutral mood). Research in addiction and eating context has already shown that elevated attention processing of desired cues (i.e., attention bias) is related to craving and consumption (Field, Munafó, & Franken, 2009; Franken, 2003; Nijs, Franken, & Muris, 2009). Correspondingly, several studies have shown that elevated attentional biases for high-calorie foods are related to a higher reward drive, hunger, (chronic) craving, overweight and obesity (Castellanos et al., 2009; Mogg, Bradley, Hyare, & Lee, 1998; Tapper, Pothos, & Lawrence, 2010; Werthmann, Roefs, Nederkoorn, & Jansen, 2013; Werthmann et al., 2011). Thus, attention bias might be a cognitive mechanism that indicates food-related motivation and contributes to food intake. Therefore, we aimed to test if self-reported emotional eating is related to elevated attention bias for food during sad mood. Attention bias for food might be a more sensitive measure to capture food-related motivation in the laboratory, in contrast to actual food intake. Moreover, attention bias for food could also be a moderator of food intake in emotional eaters after a negative mood induction. In addition, it was examined if prolonged attention for food relates to increases in food calorie intake and if this relation is affected by mood. Particularly the attention maintenance component has been associated with motivational top-down processing and might therefore be a good indicator for eating motivation (LaBerge, 2002). Specifically, previous research examining the link of attention for appetitive cues and appetitive behavior indicated that particularly attentional maintenance on appetitive cues was associated with differences in motivation for the appetitive cue (Brignell, Griffiths, Bradley, & Mogg, 2009; Field, Mogg, Zettler, & Bradley, 2004; Field et al., 2009; Werthmann, Field, Roefs, Nederkoorn, & Jansen, 2013). Thus, to further test the importance of attention bias for emotional eating, we also aimed to explore if attentional maintenance is a better predictor of overeating during sad mood than self-reported emotional eating.

In sum, measuring attention bias for food during sad mood could serve two purposes: attentional biases for food during sad mood might be less controllable than actual eating behavior during a taste test, and might therefore offer a more sensitive, less obtrusive measure of increased eating motivation during sad mood than actual food intake in the lab for emotional eaters. In addition, assessing attentional biases for food during sad mood could provide us with more knowledge on the cognitive working mechanisms that lead to increased food intake during sad mood.

Research that examined if attention for food is related to self-reported emotional eating is sparse. Hepworth, Mogg, Brignell, and Bradley (2010) observed that during a sad mood induction a response-latency based measure of attention bias for food and self-reported appetite increased. Moreover, this bias correlated positively with emotional eating and the DEBQ score overall, however in a regression analysis the interaction term of emotional eating and experimental mood induction was not predictive for attention. Yet, direct food intake was not assessed in this study and attention biases for food were measured indirectly through reaction times. Thus, this previous result questions the link of emotional eating, attention bias for food and food intake, yet experimental evidence for this relation is still lacking and leaves therefore the exploration of cognitive mechanisms contributing to overeating in emotional eaters during sad mood unresolved.

With regard to the measurement of attention bias we extended this previous finding by employing eye tracking, which has been found to be the most sensitive and direct way to test individual differences in attention allocation in the domain of addiction (Field et al., 2009). Moreover, we made use of pictures instead of words as stimuli during the visual probe task, because it has been argued that pictures are more ecologically valid for the assessment of visual attention for appetitive cues (e.g., Brignell et al., 2009; Hepworth et al., 2010). Thus, this is, to our knowledge, the first study to test the impact of mood on attentional biases experimentally by using eye tracking as a novel and dynamic measure of visual attention allocation for pictorial food stimuli.

To summarize, the aims of this study were twofold: first, it was tested if self-reported emotional eating is related to increased attention bias for food and higher food intake in a negative affective state versus in a neutral affective state. An interaction effect of emotional eating and induced mood on attentional biases and food intake was predicted. Second, we aimed to explore if maintained attention for food would be a better predictor of food intake in a negative affective state than self-reported emotional eating.

## 2. Method

### 2.1. Participants

Participants (N = 85) were recruited through flyers, Facebook, and via e-mail. Only female students were eligible for participation, because emotional eating has been considered mainly prominent in women (van Strien et al., 1986). Participants were randomly assigned to either the negative mood or the neutral mood condition.

### 2.2. Materials and procedure

#### 2.2.1. Mood induction

A combination of music and autobiographical recall was used to induce a negative or a neutral mood, because similar mood inductions have been successfully used in previous research (Jansen et al., 2008; Martin, 1990). In the negative mood condition, participants listened to ‘Adagio for Strings’ by Samuel Barber for 8 min while writing about a recent negative experience, whereas participants in the neutral mood condition listened to a neutral piece of music ‘Dancing with the Sun’ by Celia Felix (2010) and wrote about a recent study course. A mood booster was introduced after the first half of the attention paradigm to ensure that mood levels remained negative/neutral during the testing procedure. During the booster, participants again listened to the respective music piece for 1 min and had to re-read their writings. Participants listened to the music pieces on headphones.

#### 2.2.2. Visual probe paradigm

To assess attentional biases for food stimuli in contrast to neutral stimuli, eye movements and manual response latencies were recorded during a visual probe task. In this task two pictorial stimuli appear simultaneously on the left and right sides of a computer screen, followed by a probe (in this case a small star) that replaces one of the stimuli. Participants are instructed to respond as quickly as possible to the location of the star by pressing a corresponding key on the key board. The logic of this task presumes that the attention of the participant is automatically drawn towards the personally more relevant stimulus, and therefore leads to faster responding to the star if the star replaces the image that draws the attention. Besides the assessment of response latencies to the probe location, attention processes were measured by the recording of eye movements that occur during the stimuli presentation. The same paradigm was already used in previous research (see Werthmann et al., 2011).

**2.2.2.1. Overview.** Each trial started with a fixation cross that disappeared directly after participants fixated on it, which was followed

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