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Gating of attention towards food stimuli in binge eating disorder

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ABSTRACT

Cognitive models of eating disorders propose that attentional biases for disorder-relevant stimuli contribute to eating disorder pathology. Empirical evidence of a contribution of attentional biases for binge eating disorder (BED) is still scarce. The aim of the present study was to assess attention engagement towards, and disengagement from, food stimuli in overweight females with BED ($n = 25$) and a group of overweight and obese women without BED (OW; $n = 30$). Participants completed a rapid serial visual presentation (RSVP) paradigm with food and neutral words as target stimuli. This task can be used to decompose an attentional bias for food stimuli into its stimulus engagement and stimulus disengagement components. Findings indicate that facilitated stimulus engagement for food stimuli over neutral stimuli was more pronounced in the BED group compared to the OW group. Conversely, there were no substantial disengagement effects in either group. Thereby, results support the idea that early attentional processes are biased in BED.

1. Introduction

With a prevalence rate of 2%–5% (Hudson, Hiripi, Pope, & Kessler, 2007), binge eating disorder (BED) is the most common eating disorder and is linked with being overweight and obese (Yanovski, 2003). Moreover, BED is associated with substantial medical, psychological and psychosocial sequelae (Hudson et al., 2007), a reduced health-related quality of life (De Zwaan et al., 2002; Rieger, Wilfley, Stein, Marino, & Crow, 2005) and an increased mortality risk (Fichter, Quadflieg, & Hedlund, 2008). Key criteria include the occurrence of repetitive episodes of binge eating during which individuals consume unusually large quantities of food, accompanied by subjective feelings of loss of control (DSM-5; American Psychiatric Association [APA], 2013).

According to cognitive models (Williamson, Muller, Reas, & Thaw, 1999; Williamson, White, York-Crowe, & Stewart, 2004), eating disorders such as BED are maintained by attentional and other cognitive biases for disorder-relevant stimuli. Incentive-sensitization theory (Berridge, 2007, 2009; Franken, 2003) suggests an explanation of how attentional biases emerge. Originally developed to explain attentional biases in substance abuse, the theory was recently discussed as a possible account of attentional biases and a maintenance mechanism in eating and weight disorders (Nijs, Muris, Euser, & Franken, 2010; Schmitz, Naumann, Trentowska, & Svaldi, 2014). Applied to BED, the theory predicts that stimuli frequently paired with reward, such as food, lead to a process of incentive sensitization in the dopamine reward system. In line with principles of associative conditioning, the mere exposure to food stimuli will activate the reward system. As food items become associated with a reward, a high vigilance for food stimuli results. This attentional bias for food items may automatically trigger a sequence of processes that can result in a binge eating episode if control mechanisms fail.

To date, only a few studies have tested the attentional processing of food cues in individuals with BED. Evidence of the predicted contribution of food-related attentional biases in BED comes from an event-related potential (ERP) study, in which the processing of high and low caloric food pictures was compared in a group of overweight and obese women with BED and a group of overweight and obese women without BED (Svaldi, Tuschen-Caffier, Peyk, & Blechert, 2010). In this study, long-latency potentials (LLP's) were used as an indicator of motivational properties. It was shown that BED patients displayed larger LLP's for high-caloric food pictures compared to overweight controls, while no differences were found for low caloric food pictures. Such an attentional

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vigilance for food stimuli over neutral stimuli was also supported in an experimental study (Schmitz et al., 2014), which used the clarification task. This task requires participants to name visually degraded stimuli as fast as possible. It is assumed that the more relevant and salient a stimulus is, the less information is required to correctly identify it. In that study, females with BED, compared to overweight females without BED, recognized degraded food-related stimuli faster compared to neutral stimuli.

More recently, research on attentional biases has addressed component processes to improve understanding about which specific mechanisms contribute to biased attention. Experimental paradigms were developed that assist in distinguishing earlier components of attention (i.e., orienting and engagement) from later components (i.e., disengagement vs. maintenance) (Fox, Russo, Bowles, & Dutton, 2001). However, studies designed to dissociate early and late attentional processes are scarce in BED research. In fact, one study suggests that food stimuli facilitate engagement (Schmitz et al., 2014), whereas one other study suggests that impaired disengagement from food stimuli (Schag et al., 2013) distinguishes between BED and weight matched controls.

Although attentional biases were inferred from the spatial allocation of attention in both studies, specifics of the paradigms used may have contributed to the discrepant findings: The latter study used an anti-saccade task with eye-tracking (Schag et al., 2013). Food and non-food stimuli were simultaneously presented in each trial, and first and second saccade errors were analyzed as indicators of impulsive reactions and deficits in supervision/correction, respectively. The BED group generally committed more first saccade errors in both stimulus categories, whereas second saccade errors were selectively increased in the BED group for food stimuli. The latter finding suggests that the BED group experienced more difficulty disengaging attention from food stimuli. Conversely, stimulus engagement was not specifically increased for food stimuli in the BED group. The authors of that study discuss that neutral stimuli were more complex, as indicated by longer viewing times in an independent experiment. Given complexity has contributed to the salience of the neutral stimuli, this could have diminished the difference in initial attention allocation between food and neutral stimuli that constitutes the stimulus engagement effect.

In the other study, an attention cueing paradigm was administered with food and neutral stimuli (Schmitz et al., 2014). In this variant of the dot-probe task, only one stimulus is presented in each trial, spatially shifted to the left or to the right. Behavioral performance measures are used to dissociate the effects of stimulus engagement from those of stimulus disengagement. It was found that the BED group relative to weight-matched controls displayed facilitated stimulus engagement towards food stimuli, whereas stimulus disengagement effects of comparable magnitude were found in both groups. The authors of that study discuss that the stimulus onset asynchrony (SOA) of the irrelevant first stimulus and the imperative second stimulus was relatively short (100 ms), making the paradigm sensitive for early stimulus engagement effects. Conversely, the SOA might have been too short to capture possible effects of later stimulus disengagement.

Additionally, there are a number of studies in which component processes possibly contributing to attentional biases were studied in overweight and obese participants relative to normal weight controls, without explicitly controlling for BED in the first groups. For instance, facilitated stimulus engagement towards food stimuli was found in overweight and obese women compared to normal weight controls (Castellanos et al., 2009; Nijs et al., 2010; Werthmann et al., 2011). Additionally, some studies report impaired disengagement from food stimuli in overweight compared to normal weight controls (Castellanos et al., 2009; Werthmann et al., 2011), while other findings suggest effects of comparable magnitude (Nijs et al., 2010). As none of these studies controlled for BED, co-morbid BED may have contributed to the effects.

In summary, evidence suggests that women with BED are characterized by an altered attentional processing of food stimuli compared to overweight women without BED. These findings generally converge with cognitive-behavioral models of eating disorders (Vitousek & Hollon, 1990; Williamson et al., 1999, 2004). Specifically, incentive-sensitization theory (Berridge, 2007; Franken, 2003) proposes an early ("attention-grabbing") vigilance for rewarding food stimuli, as well as an impaired disengagement from food stimuli. Limited evidence in support of a facilitated stimulus engagement (Schmitz et al., 2014) and impaired stimulus disengagement (Schag et al., 2013) was offered in independent studies. As discussed, some of the inconsistencies obtained may be explained by specifics of the respective paradigms.

It is the aim of the current study to contribute to the sparse evidence concerning an attentional bias for food stimuli in women with BED. To this end, a rapid serial visual presentation (RSVP) paradigm (Raymond, Shapiro, & Arnell, 1992) was employed that has not been used as a research tool in this domain yet. However, the task has been successfully shown to detect attentional biases in individuals with substance-dependence. This was shown for alcohol-related stimuli in participants with alcohol use disorders (Hoppner, Broese, Wendler, Berger, & Thome, 2011; Tibboel, De Houwer, & Field, 2010), substance-associated stimuli in participants with opiate dependence (Liu, Li, Sun, Hu, & Ma, 2008), smoking-related stimuli in smokers (Munafo, Johnstone, & Mackintosh, 2005; Waters, Heishman, Lerman, & Pickworth, 2007), and for gambling-associated stimuli in individuals characterized by pathological gambling (Brevers et al., 2011). Consistent with the two studies previously conducted, the RSVP task helps tease-apart stimulus engagement and stimulus disengagement effects. However, differently from the Schmitz et al. (2014) and Schag et al. (2013) study, the RSVP paradigm taps the stage when information is gated into working memory for further processing and memory consolidation (Martens & Wyble, 2010). Thus, possibly converging evidence across the different paradigms would confirm that attentional biases are not confined to the perceptual allocation of visual attention, but that they also affect the stage of gating information into working memory.

In line with incentive sensitization theory (Berridge, 2007, 2009; Franken, 2003) and in line with previous findings of an attentional bias in BED (Schag et al., 2013; Schmitz et al., 2014), we hypothesized that there will be an attentional bias for food items in BED relative to control participants. More specifically, we predicted an increased stimulus engagement effect towards food stimuli and a reduced stimulus disengagement effect away from food stimuli.

2. Method

2.1. Participants

Recruitment strategies included announcements in local newspapers as well as notices at the affiliated outpatient clinic. Inclusion criterion for the binge-eating disorder group (BED; $n = 25$) was the presence of BED according to DSM-5 criteria (American Psychiatric Association [APA], 2013). Inclusion criterion for the overweight/obese group (OW; $n = 30$) was a body mass index (BMI = weight/height^2) ≥ 25 in the absence of a lifetime eating disorder. As gender differences regarding food-related cravings have previously been reported (Cepeda-Benito, Fernandez, & Moreno, 2003) and theoretical models attribute craving as central in the maintenance of BED (Berridge, 2007;