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A Systematic Review of Attentional Biases in Disorders Involving Binge Eating

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Abstract

Objective—Attentional bias (AB) may be one mechanism contributing to the development and/or maintenance of disordered eating. AB has traditionally been measured using reaction time in response to a stimulus. Novel methods for AB measurement include eye tracking to measure visual fixation on a stimulus, and electroencephalography to measure brain activation in response to a stimulus. This systematic review summarizes, critiques, and integrates data on AB gathered using the above-mentioned methods in those with binge eating behaviors, including binge eating, loss of control eating, and bulimia nervosa.

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Method—Literature searches on PubMed and PsycInfo were conducted using combinations of terms related to binge eating and biobehavioral AB paradigms. Studies using AB paradigms with three categories of stimuli were included: food, weight/shape, and threat. For studies reporting means and standard deviations of group bias scores, Hedges' *g* effect sizes for group differences in AB were calculated.

Results—Fifty articles met inclusion criteria and were reviewed. Individuals who binge eat in the absence of compensatory behaviors show an increased AB to food cues, but few studies have examined such individuals' AB toward weight/shape and threatening stimuli. Individuals with bulimia nervosa consistently show an increased AB to shape/weight cues and socially threatening stimuli, but findings for AB to food cues are mixed.

Discussion—While there are important research gaps, preliminary evidence suggests that the combination of AB to disorder-specific cues (i.e., food and weight/shape) and AB toward threat may be a potent contributor to binge eating. This conclusion underscores previous findings on the interaction between negative affect and AB to disorder-specific cues. Recommendations for future research are provided.

Keywords

binge eating; attentional bias; food; weight; shape; social threat

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Binge eating is the hallmark behavior of binge-eating disorder (BED), bulimia nervosa (BN), and the binge-purge subtype of anorexia nervosa (AN-B/P; American Psychiatric Association, 2013). Even among individuals who do not meet diagnostic criteria for an eating disorder, the presence of binge and loss of control (LOC) eating confers risk for elevated eating disorder psychopathology, psychosocial distress, excess body weight, and clinical impairment (Tanofsky-Kraff, Yanovski, & Yanovski, 2011; Vannucci et al., 2013). Therefore, it is important to identify mechanisms that contribute to the etiology and/or maintenance of binge eating behaviors so that potentially modifiable risk factors can be identified for targeted interventions.

Attentional bias (AB) refers to the differential allocation of attention to particular stimuli and represents one facet of selective attention (Cisler & Koster, 2010). Maladaptive AB has been theorized to contribute to psychopathology (M. Field & Cox, 2008; Williams, Mathews, & MacLeod, 1996) and psychological problems such as eating disorders (Aspen, Darcy, & Lock, 2013), anxiety (Cisler & Koster, 2010), and substance abuse (M. Field & Cox, 2008; Franken, 2003). It is currently unknown if AB is triggered by an automatic response to the stimulus category (e.g., high-calorie food in general), or whether AB is evident when content directly related to participant's fears, such as specific high-calorie foods, is presented (Pergamin-Hight, Naim, Bakermans-Kranenburg, van IJzendoorn, & Bar-Haim, 2015). Systematic reviews and meta-analyses have summarized the existing data concerning associations between eating disorders and biases in attention and information processing (Dobson & Dozois, 2004; Giel et al., 2011). Prior reviews have focused primarily on AB to food and body weight/shape in samples with full-syndrome BN and AN-B/P, and there is limited summative information on AB in binge/LOC eating or BED (Dobson & Dozois, 2004; Giel et al., 2011). While AB may be an implicit manifestation of risk factors

for binge/LOC eating across the binge eating spectrum, such as preoccupation with food, eating, and weight/shape (A.E. Field et al., 2008; Stice, Presnell, & Spangler, 2002), it is conceivable that risk factors that are less content-specific but linked to LOC also manifest as AB. These include rumination about psychosocial stressors (Nolen-Hoeksema, Stice, Wade, & Bohon, 2007) and intolerance of aversive affective states such as anxiety (Werthmann, Jansen, & Roefs, 2015). However, previous reviews have not examined AB to anxiety-inducing stimuli (e.g., threat cues) among those with binge eating behaviors, and to date no existing AB review has encompassed the full spectrum of binge eating disturbances.

Attentional Bias Components

A number of terms are used to describe the AB components, given that AB involves distinct but related aspects of selective attention (Cisler & Koster, 2010; Ouimet, Gawronski, & Dozois, 2009). *Facilitated attentional engagement* is the speed with which attention is drawn towards a salient stimulus (e.g., preferred food) relative to non-salient stimuli. Difficulty with *attentional disengagement* is the degree to which a salient stimulus captures attention and impairs the shifting of attention away from that stimulus. By contrast, *attentional avoidance* is the preferential allocation of attention away from salient stimuli (Koster, Crombez, Verschuere, Van Damme, & Wiersema, 2006).

It has also been proposed that AB be conceptualized according to information processing theory stage (Shiffrin & Schneider, 1977). Specifically, automatic "bottom-up" cognitive processing is stimulus-driven and occurs without purpose or awareness, while strategic "top-down" cognitive processing is goal-oriented and dependent on conscious awareness (Cisler & Koster, 2010; Ouimet et al., 2009). Combining the two models, "bottom up" attentional engagement involves automatic and/or strategic processing stages, depending on the duration that attention is sustained (Ouimet et al., 2009). Disengagement and avoidance appear to be mediated primarily by strategic "top down" processing mechanisms (Cisler & Koster, 2010).

Attentional Bias Measurement and Paradigms

Attention can be measured via reaction time to a stimulus, visual fixation on a stimulus, or brain activation. There are several paradigms that measure reaction time to examine AB. The procedures of four AB paradigms originally developed for measuring AB using reaction time (emotional Stroop, visual probe task, spatial cueing, and visual search paradigm) are included in this review (see Table 1 for details). Emotional Stroop involves identifying the ink color of written words that are deemed either neutral or salient (Stroop, 1935; Williams et al., 1996). Slower reaction time indicates AB to disorder-salient stimuli relative to neutral stimuli. Emotional Stroop is designed to measure exclusively facilitated attention engagement. In the visual probe task, individuals react to a probe that replaces either a neutral or a salient stimulus. Faster reaction time during the trials in which the probe replaces the disorder-salient stimuli indicates AB to these stimuli relative to the neutral stimuli (M. Field & Cox, 2008; MacLeod, 1986). The visual probe task can measure facilitated attention engagement, difficulties with attention disengagement, and if administered at longer durations, attentional avoidance. In a spatial cueing task, individuals

press a key corresponding to the location of a probe following the cue (Fox, Russo, Bowles, & Dutton, 2001; Posner, 1980). Faster reaction time on trials for which the disorder-salient cue predicts the location of the subsequent probe indicates greater facilitated attention engagement, compared to the neutral cue trials. Slower reaction time on trials for which the disorder-salient cue does not predict the location of the probe indicates difficulty with attention disengagement, relative to the neutral cue trials. The visual search task involves detecting an odd-one-out word in a matrix of either majority neutral or majority disorder-salient words, or detecting that all words are in the same category (Cisler, Bacon, & Williams, 2009; Smeets, Roefs, van Furth, & Jansen, 2008). Faster reaction time to detect salient target words indicates facilitated attention engagement relative to detecting that all words are neutral. Slower reaction time to detect neutral target word among disorder-salient words indicates attention disengagement difficulties relative to detecting that all words are neutral.

Two novel AB measurement methods that are not based on reaction time, eye tracking and electroencephalography (EEG), are also included in this review (see Table 2 for details). Eye tracking offers a direct, continuous measurement of AB (Werthmann et al., 2011). Facilitated attention engagement can be measured either through saccade latency (i.e., the time between target presentation and initial gaze shift) or initial gaze direction bias (i.e., the proportion of trials for which the initial gaze was oriented towards salient stimuli versus neutral stimuli). Difficulties with attention disengagement are indicated by overall gaze duration bias; that is, the difference in total dwell time on salient relative to neutral stimuli. EEG measures brain activity in response to stimuli exposure using event-related potentials (ERP) recorded from electrodes placed on the scalp (Blechert, Feige, Joos, Zeeck, & Tuschen-Caffier, 2011; Hajcak, MacNamara, & Olvet, 2010). Larger ERP amplitudes correspond to greater AB (Hajcak et al., 2010; Schupp, Flaisch, Stockburger, & Junghöfer, 2006). Positive and negative deflections at early (150 – 400 ms) and mid-ranges (400 – 800 ms) post stimulus presentation reflect attention engagement and disengagement processes. The positive slow wave ERP occurs from 1000–6000 ms, tapping into disengagement difficulties and avoidance (Schupp et al., 2006). Eye tracking and EEG allow people to view stimuli without interruption or time limitation, as is the case with reaction time tasks.

Theory and Current Study

Several theoretical models have been proposed to explain the role of AB within current conceptualizations of eating disorders (Williamson, White, York-Crowe, & Stewart, 2004). Although there are subtle differences across models (Williamson et al., 2004), all propose that disorder-salient stimuli (e.g., images of thin models for individuals with BN) elicit AB toward these cues, precipitating increased negative affect. Similarly, the interpersonal theory posits that individuals engage in binge eating behaviors to cope with interpersonal distress (Rieger et al., 2010), emphasizing the potential importance of social evaluative threats in binge/LOC eating. Escape theory (Heatherton & Baumeister, 1991; Williamson et al., 2004) proposes urges to avoid or escape aversive negative affect trigger binge eating. Alternative AB models of binge eating behaviors focus on the role of appetitive motivation and incentive salience mechanisms (Berridge, 2009). These models suggest that conditioned palatable food cues elicit AB toward those stimuli, resulting in exacerbated cravings and a compulsive

motivation to eat, resulting in binge eating episodes as individuals seek the anticipated food reward and alleviation of cravings. However, no review has critically evaluated the existing literature across binge eating behaviors, potentially informing these theoretical models.

Therefore, this systematic review will provide a summary of the available empirical evidence examining the associations between AB and binge eating behaviors, including binge eating, loss of control eating, and bulimia nervosa. The mechanisms that underlie ABs will be examined by considering differences in stimuli, samples, and methodologies across studies, as well as the components of selective attention. Effect sizes are reported for the available studies. A meta-analysis is not included because, with the exception of the Stroop task, which has been analyzed using meta-analytic reviews in the past (Dobson & Dozois, 2004), the other paradigms in this review have been used in a relatively small number of studies and with significant methodological differences. Research recommendations are offered and implications of the findings are discussed in the context of prevention and treatment approaches.

Methods

Literature Search and Study Selection

Literature searches on PubMed and PsychInfo were conducted using the following terms: binge eating, bulimia nervosa, anorexia nervosa, binge-purge, eating disorder*, emotional eating, disinhibited eating, attention* bias, cognitive bias, selective attention, Stroop, dot probe, visual probe, eye movement*, eye tracking, visual search, event-related potential, food*, body*, *weight, shape, and threat*. (The asterisk is a wildcard boolean search operator; if the asterisk follows the word, it will search any term that begins with the root of the word truncated by the asterisk. If the asterisk precedes the word, it will search any term that ends with the word following the asterisk.) The searches were performed in July 2017. Articles were evaluated for inclusion/exclusion criteria by the co-first author (LS). The first author conferred with co-first author (MS) regarding any articles for which inclusion was unclear. Additionally, cross-references from eligible studies and previous review articles were evaluated for potential inclusion. Studies had to be published in English in peer-reviewed journals, include samples that reported binge eating behaviors, and used an AB paradigm of interest. All included studies evaluated standardized visual AB stimuli that have been purported as salient to binge eating behaviors, specifically cues related to food, body weight/shape, and social evaluation (Aspen et al., 2013; Brooks, Prince, Stahl, Campbell, & Treasure, 2011).

Data Abstraction and Analysis

The following information was extracted from each included study: demographics [sex, age, and body mass index (BMI)] for the overall sample and comparison groups, qualitative and quantitative characteristics of the AB paradigm employed, example stimuli within each stimulus category, AB task performance by group, and correlations between AB task performance and measures of binge eating behavior. If a study included samples unrelated to this review (e.g., participants with AN), only data pertinent to binge eating were included.

To calculate effect sizes for differences between comparison groups, the mean and standard deviation of the bias score was extracted for each group. If scores were not available, the authors of the papers were contacted for additional information. When possible, Hedges' *g* was calculated for each finding. Following previous reviews (e.g., Hofmann, Sawyer, Witt, & Oh, 2010), effect sizes were interpreted using Cohen's (1988) guidelines of small (0.2), medium (0.5), and large (0.8).

Results

Study Characteristics

From the 519 articles identified, 50 articles met inclusion criteria (Figure 1). Studies were excluded if they 1) were not in English (*n*=15); 2) were not an article published in a peer-reviewed journal (*n*=45); 3) were review papers (*n*=65); 4) did not utilize a visual AB task with relevant stimuli and analyses (*n*=181); 5) did not include at least one group of participants exhibiting binge eating behaviors and a comparison group or analysis (*n*=146); 6) did not separate participants with eating disorders into distinct groups by binge eating behavior (*n* =10); or 7) did not report data on group differences or correlations in the AB paradigms in a non-treatment condition (*n*=7). In studies that included individuals with AN, findings were only considered if they pertained to individuals with the binge-purge subtype.

All included studies had a cross-sectional design. Most studies included clinical samples of BN (*n*=30). The rest included participants diagnosed with BED, AN-B/P, or individuals with sub-threshold binge eating behavior. Studies measured AB using the emotional Stroop (*n*=28), visual probe task (*n*=3), spatial cueing task (*n*=3), visual search paradigm (*n*=3), eye tracking (*n*=8), and electroencephalography (*n*=6).

Emotional Stroop

The Stroop was the most commonly used AB paradigm (Table 3). Of the 28 studies, 18 used food stimuli, 15 weight/shape stimuli, and eight threat stimuli. Additionally, five used stimuli across a range of BN disorder-related words (e.g., weight/shape and food cues), without distinguishing specific categories. All studies examined female participants.

Among studies using the Stroop task with food-related cues, the majority of studies found no significant differences in AB between women with BN and healthy controls (Black, Wilson, Labouvie, & Heffernan, 1997; Davidson & Wright, 2002; Flynn & McNally, 1999; Johansson, Carlbring, Ghaderi, & Andersson, 2008; Lee, Namkoong, & Jung, 2017; Lovell, Williams, & Hill, 1997; Perpiñá, Hemsley, Treasure, & de Silva, 1993; Perpiña, Leonard, Treasure, Bond, & Banos, 1998; Ruiz, de Leon, & Diaz, 2008; Waller & Ruddock, 1995), and six studies indicated that women with BN had greater AB to food cues compared to healthy controls (Ben-Tovim & Walker, 1991; Ben-Tovim, Walker, Fok, & Yap, 1989; Cooper & Todd, 1997; Jones-Chesters, Monsell, & Cooper, 1998; Léonard, Divac, Bichindaritz, Rouer-Saporta, & Samuel-Lajeunesse, 1997; Lokken, Marx, & Ferraro, 2006). Further, all but one of the available effect sizes across both significant and non-significant findings (Black et al., 1997) indicated greater AB to food in women with BN. No differences

were found in AB to food cues between women with BN vs. AN-B/P (Léonard et al., 1997) or between women with threshold vs. subthreshold BN (Lokken et al., 2006).

The majority of Stroop task paradigms with body weight/shape cues found that women with BN had greater AB relative to controls (Davidson & Wright, 2002; Flynn & McNally, 1999; Johansson et al., 2008; Jones-Chesters et al., 1998; Ruiz et al., 2008) (Ben-Tovim & Walker, 1991; Ben-Tovim et al., 1989; Cooper & Todd, 1997; Lokken et al., 2006; Lovell et al., 1997; Perpiñá et al., 1993), with all available effect sizes indicating greater AB to weight/shape cues in women with BN compared to healthy controls. Women with clinical BN exhibited greater AB than those with recovered/subthreshold BN (Flynn & McNally, 1999; Lokken et al., 2006; Lovell et al., 1997) and women with recovered/subthreshold BN did not differ from healthy controls in AB to weight/shape cues (Lovell et al., 1997).

The majority of studies using the Stroop task with threat-related cues found that adolescent and adult women with binge eating and/or BN behaviors had greater AB to threat-related cues compared to healthy controls. Greater AB was associated with higher binge frequency in one study (McManus, Waller, & Chadwick, 1996); however, another study found no differences in AB to threat cues between women with BN, recovered BN, or healthy controls (Lovell et al., 1997). Some studies suggest that findings may be contingent upon the frequency or type of threat cue used (e.g., self-directed ego threat words, angry faces) or sample characteristics (Harrison, Sullivan, Tchanturia, & Treasure, 2010; Jones-Chesters et al., 1998; Kanakam, Krug, Raoult, Collier, & Treasure, 2013; Seddon & Waller, 2000; Waller, Watkins, Shuck, & McManus, 1996). For instance, self-directed ego threat words were associated with AB in a non-clinical sample of women who endorsed high BN symptomatology compared to those with low or no symptoms, but there were no differences for sociotropy threat, autonomy threat, physical threat, or ego threat from others words (Waller et al., 1996). Additionally, the effect may depend on whether words or images are used (Harrison et al., 2010; Kanakam et al., 2013). Additionally, some studies examined clinical samples while others used convenience samples with high BN symptomatology, thus the effects may be heterogeneous based on the sample characteristics.

In summary, facilitated attentional engagement with food, weight/shape, and threat cues appears to be greater in women with BN compared to control female participants when using the emotional Stroop. Women who engage in binge eating in the absence of compensatory behaviors appear to exhibit greater facilitated attentional engagement with threat cues compared to control female participants but research is lacking using the Stroop with food and weight/shape cues.

Visual Probe Task

Of the three visual probe studies in participants with binge eating behaviors (Table 4), two examined AB to food-related cues and one examined AB to threat-related cues. No study has utilized weight/shape cues. In a sample of children and adolescents (Shank et al., 2015), youth who engaged in objective and subjective binge eating episodes did not differ on AB for high- or low-palatable foods in analyses adjusted for age, sex, race, and BMI-z score. While higher frequency of binge eating (combined subjective and objective) was associated with greater AB toward high-palatable foods, the effect was small and the relationship was

attenuated after adjusting for body composition (Shank et al., 2015). In a primarily adult female sample, individuals with binge eating demonstrated greater difficulties with attentional disengagement from food cues, but there were no differences between healthy controls in facilitated attentional engagement or avoidance (Deluchi, Costa, Friedman, Gonçalves, & Bizarro, 2017). In a study using the visual probe task with threat cues (Cardi, Di Matteo, Corfield, & Treasure, 2013), participants were presented images of male and female faces with accepting, rejecting, or neutral expressions. Those with lifetime BN (both currently ill and recovered groups) demonstrated an AB toward rejecting faces, but attentional avoidance of accepting faces. The opposite pattern was observed in healthy controls, and the magnitude of the group difference was small-to-medium.

Overall, there are few studies using the visual probe task in individuals with binge eating behaviors. Those who binge eat exhibit greater difficulties with attentional disengagement from, but not greater facilitated attention toward food cues compared to controls. Individuals with BN exhibit greater facilitated attention toward socially threatening stimuli and greater attentional avoidance of socially non-threatening stimuli compared to controls.

Spatial Cueing Task

Three studies examined AB using a modified spatial cueing paradigm (Table 5), two that used food-related cues and one that used threat-related cues. No study has utilized weight/shape cues. Women with BED demonstrated greater facilitated attention toward food— but no difference in attentional disengagement from food— compared to healthy controls; this effect was of medium magnitude (Schmitz, Naumann, Trentowska, & Svaldi, 2014). Among healthy-weight college women, those with binge eating demonstrated more difficulty disengaging from high-calorie food images, but not low-calorie food images, compared to women without binge eating (Lyu, Zheng, & Jackson, 2016). In a nonclinical sample of female undergraduates, greater disengagement difficulties for ego-threatening images (attractive female faces) were correlated with higher BN symptom frequency (Maner et al., 2006). No effect was present for attractive male faces.

In summary, findings using the spatial cueing task are mixed with some evidence for greater facilitated attention (clinical sample) and some evidence for greater difficulties with attentional disengagement (non-clinical sample) in women who binge eat. This discrepancy may be due to a clinical vs. non-clinical sample. Women with BN exhibit difficulties with attentional disengagement from socially threatening stimuli.

Visual Search Paradigm

Three studies (Meyer, Waller, & Watson, 2000; Waller, Quinton, & Watson, 1995) used a visual search task, one with food-related cues and two with threat-related cues (Table 6). No study has utilized weight/shape cues. In a primarily female sample of German adolescents, those with BED demonstrated greater facilitated attentional engagement to food cues compared to healthy controls; this was a medium-size effect (Schmidt, Lüthold, Kittel, Tetzlaff, & Hilbert, 2016). Both studies using threat-related cues examined the relationship between BN symptoms and AB to threatening words in nonclinical female undergraduates. One (Waller et al., 1995) found that increased BN symptoms were associated with greater

AB to threat words; this effect was small. The second study (Meyer et al., 2000) found that BN symptoms were associated with greater difficulties in attentional disengagement (with a small effect size), but were not associated with facilitated attention.

Taken together, there are few studies using the visual search paradigm with individual with disorders of binge eating. Those who binge eat exhibit greater facilitated attention toward food cues. Findings on AB to social threat in individuals with BN are mixed, with some evidence for greater facilitated attention and some evidence for greater difficulties with attentional disengagement compared to controls.

Eye Tracking

Eight eye tracking studies evaluated AB in connection with binge eating behavior (Table 7). Of these, four used food-related cues and four used weight/shape-related cues. No study used threat-related cues in an eye tracking paradigm. For the studies using food cues, the findings are heterogeneous. In one study (Schag et al., 2013), all participants showed greater facilitated attention toward food (vs. neutral) images; however, women with overweight/obesity and BED had greater difficulties with disengaging from food stimuli than weight-matched and non-overweight control groups. These effects were of medium magnitude. In another study (Popien, Frayn, von Ranson, & Sears, 2015), compared to controls, those with binge eating showed greater facilitated attention toward and more difficulty with attentional disengagement from food cues. The third study (Kim, Kim, & Lee, 2016) examined AB to high- and low-calorie food (vs. non-food) images in female undergraduates with "BN tendencies" compared to a control group. The BN group exhibited greater facilitated attention toward high-calorie food cues compared to the other cues, as well as attentional avoidance for the high-calorie food versus non-food images. Finally, in a primarily female sample of German adolescents, those with BED demonstrated greater difficulties with attentional disengagement from food cues, compared to healthy controls (Schmidt et al., 2016). This was a medium size effect. There were no group differences in facilitated attentional engagement (Schmidt et al., 2016).

Four studies from the same research group (Blechert, Ansorge, & Tuschen-Caffier, 2010; Blechert, Nickert, Caffier, & Tuschen-Caffier, 2009; Svaldi, Caffier, & Tuschen-Caffier, 2011, 2012) compared women on AB for self- and other-body photographs. One (Blechert et al., 2010) found no group differences between individuals with BN and healthy controls, while another study found women with BN exhibited greater difficulty in disengagement from the lower-BMI other-body image only and greater avoidance of the higher-BMI other-body image only (Blechert et al., 2009). Women with binge eating but without compensatory behavior exhibited greater attentional engagement toward and greater difficulties with disengaging from the self-body images compared to women without binge eating (Svaldi et al., 2012). In the second study (Svaldi et al., 2011), those with binge eating demonstrated greater difficulties disengaging from the ugliest self-body part relative to controls. The effect size was medium, but the finding was attenuated after adjusting for body composition.

In summary, it appears that those who binge eat consistently exhibit difficulties with attentional disengagement from food cues in studies using eye tracking. Those with BN appear to exhibit greater facilitated attention toward as well as attentional avoidance of food-

related cues, although this finding is based on only one study. There is some evidence from eye tracking studies that those with BN have greater difficulty with disengaging from low-BMI images of other people, and that they intentionally avoid high-BMI images of other people. Those who binge eat appear to have difficulties with disengaging from images depicting themselves.

EEG

Six studies assessed attention processing with event-related potentials (ERPs) in participants with binge eating behaviors, of which four examined AB to palatable food cues, one used weight/shape cues, and two used threat cues (Table 8). Women with BN exhibited greater attentional engagement toward all food images vs. non-food images (Blechert et al., 2011). Women without BN showed greater attentional engagement toward high-calorie food vs. low-calorie food and non-food images (Blechert et al., 2011). Women with both overweight and BED had greater attentional engagement toward and greater disengagement difficulties from high-calorie (vs. low-calorie) food images compared to controls with overweight, with a large effect size (Svaldi, Tuschen-Caffier, Peyk, & Blechert, 2010). However, a sample of Spanish women with BN or BED did not exhibit greater facilitated attentional engagement or difficulties with attentional disengagement compared to healthy controls (Wolz et al., 2017). Among female university students, no relationship was observed between binge eating and attentional engagement or disengagement processes (Sarlo, Ubel, Leutgeb, & Schienle, 2013).

In the study utilizing weight/shape cues, women with and without BN (Mai et al., 2015) viewed photographs of other women's bodies. Participants with BN showed greater attentional engagement toward overweight (vs. healthy weight) body stimuli compared to women without BN. However, no group differences were observed in attentional disengagement.

In one study using threat cues (Kuhnpast, Gramann, & Pollatos, 2012), individuals viewed male and female face images with angry, fearful, happy and neutral expressions. Women with BN had more difficulties than controls with categorizing angry faces in the early presentation intervals, suggesting emotion recognition deficits at the facilitated attentional engagement stage. Women with BN exhibited greater attentional disengagement difficulties across all face types relative to controls. The second study (Blechert et al., 2011) found no group difference in AB to pleasant or unpleasant (vs. neutral) images. Taken together, EEG studies using food cues present mixed evidence for facilitated attentional engagement and disengagement difficulties in women with binge eating behaviors. In contrast to the evidence from eye tracking studies, the EEG study suggests that women with BN exhibit facilitated attentional engagement (as opposed to attentional avoidance) toward stimuli representing overweight. The EEG studies using threat cues are inconclusive and while one suggests attentional disengagement difficulties in women with BN, the other found no such effect.

Discussion

This review aimed to systematically review findings on AB to food cues, weight and shape cues, and threatening cues in individuals who engage in binge eating behaviors. Fifty articles

met the review criteria, of which 30 focused on AB to food cues, 20 to weight/shape-related stimuli, and 13 to threatening cues. All included studies used a cross-sectional design.

Food Cues

The relationship between AB to food cues and binge eating behaviors appears contingent on the task employed and specific population studied. The evidence to date indicates that women with full-syndrome or subthreshold BN may demonstrate greater facilitated attentional engagement to food cues compared to healthy controls, although not all studies found that effect. Few studies examined attentional disengagement and avoidance in relation to food cues in women with BN so conclusions cannot be drawn at this time. Those with BN showed increased attentional engagement to all foods versus increased attention only to palatable foods in the control participants (Blechert et al., 2011), which may be reflective of chronic caloric deprivation associated with disordered eating. Of note, in studies that used samples with subthreshold or recovered BN, no AB was detected. It may be that for BN, AB serves as a maintenance factor for the disorder, or potentially an artifact of the illness secondary to dietary restriction. It is also conceivable that as a result of binge eating behaviors over time, the frontostriatal neurocircuitry becomes less responsive to rewarding properties of food, consistent with the incentive salience theory (Berridge & Robinson, 1998).

The majority of studies support the notion that individuals who engage in binge eating behaviors without compensatory behaviors exhibit AB toward food, both in the automatic facilitated attentional engagement and purposeful attentional disengagement stages. Specifically, food cues capture attention of those with binge eating behaviors faster than controls, and more time is spent attending to palatable foods, suggesting difficulties with attentional disengagement. This tendency potentially reflects the powerful reward responses and decreased inhibitory control when processing food cues, following the approach-approach pattern (Leehr et al., 2016). Decreased inhibitory control and increased impulsivity, both documented in individuals who binge eat (Mobbs, Iglesias, Golay, & Van der Linden, 2011; Schag et al., 2013), may prevent them from engaging in effective down-regulation of processing of these cues. However, this theory requires testing.

Weight- and Shape-Related Cues

Adults with BN or subthreshold BN exhibit greater facilitated attentional engagement toward weight/shape cues. Evidence also suggests that in the strategic "top down" processing stages, these individuals exhibit avoidance of images of heavier persons and bias towards images of leaner figures. Generally, individuals with BN or subthreshold BN appear to orient toward negative weight/shape stimuli more rapidly than controls, then disengage from these cues, following an approach-avoidance pattern of processing (Lang, Bradley, & Cuthbert, 1997). Overvaluation of weight/shape is a clinical symptom of BN, thus AB manifesting as more rapid orienting toward these cues may be an example of "selective automatic processing" of disorder-related cues (Ben-Tovim et al., 1989; Channon, Hemsley, & de Silva, 1988). The evidence for AB to weight/shape cues in those who binge eat without compensatory behavior is limited and inconclusive, and there is limited support for AB toward dissatisfying own body parts among individuals with binge eating. The finding that

those with BN have AB toward other's lean bodies, while those with binge eating alone show AB toward their own bodies might represent an automatic process that distinguishes these two "subtypes." Both the BN "subtype" and the binge eating only "subtype" exhibit body dissatisfaction. However, those with BN may have a tendency to compare their bodies with others' bodies that they perceive as more attractive, while those with binge eating only may be more prone to fixate on their own bodies, which they perceive as unattractive. The finding that individuals with BN purposefully avoid high BMI bodies may suggest that while both "subtypes" may exhibit body image distortion, those with BN are more prone to it. Taken together, these findings suggest biases towards weight/shape cues may be a consequence and/or a maintenance factor of the disorder aspects related to dissatisfaction with shape and weight. However, it is unclear whether such an AB is a risk factor for development of binge eating behaviors.

Threatening Cues

Studies across tasks demonstrate greater facilitated engagement toward threatening cues in women with BN and subthreshold BN. Women with subthreshold BN process threatening cues more slowly than healthy controls, suggesting that they exhibit greater cognitive avoidance of these cues, consistent with the information processing theory (Foa & Kozak, 1986). Additionally, women with BN have increased difficulties in recognizing— and devote more cognitive resources to evaluating— negative emotions (Kuhnpast et al., 2012). Exposure to threatening cues potentiates AB to palatable food in women who endorse emotional-eating tendencies (Blechert, Goltsche, Herbert, & Wilhelm, 2014), suggesting an interaction between affective states and incentive salience of palatable foods.

Taken together, these findings lend support for both the approach-avoidance and escape theories of binge eating in women with BN. Following automatic attentional engagement to threatening cues, individuals then more reflectively engage in avoidance processes, which may facilitate a strong desire to eat or be a manifestation of dietary restraint. It is possible that AB to threatening cues represents a general latent vulnerability to binge eating behaviors characterized by escape from awareness. AB to threat may distinguish those motivated to binge eat by negative reinforcement mechanisms (i.e., escape from negative emotional experiences) from those motivated by positive reinforcement mechanisms (i.e., rewarding properties of food). However, no study has examined AB to threatening cues in individuals who engage in binge eating in the absence of compensatory behaviors, thus it will be important to assess AB to threat in these individuals.

Integration of AB Types in Disorders of Binge Eating

It appears that the intersection of AB to disorder-specific cues (i.e., food and weight/shape cues) combined with AB toward threat may be a particularly potent combination of vulnerabilities leading to LOC eating. Several studies demonstrate an interaction between negative affective states and AB toward food or weight/shape cues (Blechert, Goltsche, et al., 2014; Hepworth, Mogg, Brignell, & Bradley, 2010; Rofey, Corcoran, & Tran, 2004). AB to threatening stimuli also consistently distinguishes those with BN from healthy controls.

Several theories could account for this interaction. The cognitive depletion model proposes that self-regulation is a limited resource and may become exhausted when an individual attempts to regulate response to multiple stimuli (Baumeister & Heatherton, 1996). For example, if in response to bottom-up automatic facilitated attention toward threatening cues, an individual engages in top-down regulatory attentional processes aimed at avoiding such cues (consistent with the approach-avoidance model), then putatively there are fewer cognitive resources available to engage in top-down regulation of processing of food cues. For individuals with BN behaviors, it has been proposed that weight/shape stimuli are the equivalent of threatening cues, given the social evaluative salience that they carry for individuals with weight/shape concerns (Williamson, Muller, Reas, & Thaw, 1999). Therefore, they may contribute to depletion of cognitive regulation in response to food cues in those with BN behaviors. The cognitive depletion model has, however, been criticized and the findings from a large replication study have suggested that the effects of the purported mental fatigue on self-control are much smaller than previously reported (Hagger et al., 2016).

It is also conceivable that threatening cues acquire salience over time through associative learning and become conditioned stimuli that precipitate craving and subsequent binge eating. This process would be analogous to the negative reinforcement model of addictive behaviors wherein individuals seek out drugs to cope with negative affect (Higgins, Heil, & Lussier, 2004) and is supported by findings using ecological momentary assessment among those with BN (Smyth et al., 2007). Another analogous model from the addiction literature is the compulsivity model in which binge eating is motivated primarily by the hedonic properties of food (Davis & Carter, 2009). AB to palatable food may represent sensitivity to rewarding foods, reflecting another vulnerability toward binge eating. Therefore, processes involved in AB may reflect two subtypes for development and maintenance of binge eating. One subtype involves the negative reinforcement path, in which binge eating is an escape mechanism for coping with negative affect and is captured by AB to threatening stimuli. The other subtype involves the positive reinforcement path, in which binge eating develops as a result of oversensitivity to rewarding properties of food and is captured by AB to food. More research is needed to clarify whether these attention processes map onto these proposed behavioral models.

There is some preliminary evidence to suggest that AB toward weight/shape cues may function differently in those with BN versus binge eating without compensatory behaviors. Those with BN engage with low BMI weight/shape cues more rapidly, and disengage from high BMI cues more rapidly, while those with binge eating without compensatory behaviors appear to engage with their own self-perceived unattractive body parts more rapidly. This may suggest that those with BN are more likely to be dissatisfied with their bodies due to social comparisons with other individuals whom they purportedly perceive as more attractive, while those with binge eating alone experience body dissatisfaction due to being focused on their own perceived unattractiveness. More research is needed to clarify these processes, particularly with samples who binge eat without compensatory behaviors.

Recommendations for Future Research

As previously suggested, AB may be an endophenotype of various disorders involving binge eating and as such merits further study. AB has been a treatment target in other fields (e.g., anxiety disorders), and AB modification programs have been found to be effective in reducing AB and associated psychopathology (Linetzky, Pergamin-Hight, Pine, & Bar-Haim, 2015) Therefore, further study of AB may contribute to improving existing treatments and to the development of more precise treatments for disorders related to binge eating. Future research directions are discussed below.

Cross-Diagnostic Research—Although the field of AB research is rapidly growing, most research related to binge eating has been conducted in individuals with BN. Thus, there is a need to continue to study these processes in those who binge eat without compensatory behaviors, as these individuals appear to exhibit distinct patterns of AB from those with eating disorders characterized by weight-control behaviors. It is conceivable that AB represents an endophenotype for development or maintenance of binge eating behaviors. Thus, elucidating the genetic and neural underpinnings of different forms of AB across binge eating subtypes will be important. Furthermore, examining physiological markers such as cortisol, appetite hormones, and insulin sensitivity in conjunction with cognitive markers, such as AB and executive function, may provide a more complete understanding of distinct binge eating behavioral phenotypes. These biomarkers in individuals with certain types of AB (e.g., AB to palatable food vs. threatening stimuli) may more precisely identify those who binge eat in response to stress versus hedonic cues. It is also possible that these biomarkers moderate the relationship between AB and binge eating subtypes. Additionally, neuroimaging studies may clarify whether different types of AB reflect distinct subtypes of individuals prone to binge eating (i.e., reward-driven positive reinforcement vs. avoidance-driven negative reinforcement) by identifying different neural circuitries associated with these biases (e.g., frontostriatal circuitry for the reward-based, approach-approach subtype versus the corticolimbic circuitry for the approach-avoidance subtype). The investigation of AB as it relates to binge eating would also be enriched by examining the influences of personality traits, impulsivity, and the role of family and culture in individuals' susceptibility to these various biases. This line of inquiry would likely facilitate more personalized treatments tailored to the needs and circumstances of individual patients, and clarify additional moderators of the effect of AB on binge eating.

Longitudinal Research—All included studies are cross-sectional. There is a critical need to conduct longitudinal studies examining the association of AB with adverse outcomes, such as the development of obesity, binge eating and/or compensatory behaviors. Cross-sectionally, some data support a link between AB and obesity (Roefs & Jansen, 2002; Stoeckel et al., 2008) and disordered eating (Aspen et al., 2013), but longitudinal studies would elucidate the potential mechanisms and trajectories of these phenomena. As excessive weight gain is best prevented when addressed before adulthood (Stice, Shaw, & Marti, 2006) and disordered eating behaviors typically manifest in adolescence (Smink, Van Hoeken, & Hoek, 2012), studies in youth are needed to explore the role of AB in these processes. The addiction literature has reported that longer duration of alcohol use dependence is associated with greater AB (Loeber et al., 2009), and given the normative development of motivational

and emotional circuitry across childhood and adolescence— such as increases in inhibitory control, ability to focus attention with age, and emotional volatility (Eisenberg, Smith, & Spinrad, 2011) — youth may exhibit differential patterns of AB than adults. If AB becomes more pronounced over time, intervening to reduce biases early in development may hold greater potential for prevention of binge eating and excess weight gain.

Moderating Factors—Laboratory studies examining the moderating influence of subjective state variables on AB would help clarify the role and stability of AB to food, weight/shape, and threatening cues. Some (Nijs, Franken, & Muris, 2010; Werthmann et al., 2011), but not all (Nijs, Muris, Euser, & Franken, 2010), studies found moderating effects of craving and hunger on AB to food cues in individuals with overweight. More research is needed to clarify these preliminary results. Examining the effects of momentary stress on AB may shed light on eating in response to negative emotions. AB studies included in this review did not employ experimental mood induction paradigms. However, given the variety of mood inductions employed in extant studies, the moderating effects of the type of stressor (e.g., social evaluative stress in the Trier Social Stress Test vs. sad mood induction in the personalized mood induction) on AB in individuals who engage in binge eating warrants exploration. As noted, social evaluative stress may be particularly relevant in eliciting binge eating behavior (Rieger et al., 2010). Thus, investigating social stressors versus other non-social types of stressors may be particularly informative. Inhibitory control deficits have also been implicated in binge eating behaviors (Mobbs et al., 2011; Schag et al., 2013), thus measures of inhibitory control should be included as moderators of the relationship between AB and eating behavior. Finally, it will be important to integrate these moderators to study the interactions between stress, stress reactivity, inhibitory control and palatable food cues, as these phenomena rarely occur in isolation.

Gender should also be considered as a moderator of the relationship between AB and binge eating behavior. Most of the reviewed studies were conducted with females, thus there is a large gap in knowledge regarding these processes among males who engage in binge eating behaviors. Given that nearly a third of individuals with BED are males (Smink et al., 2012), it is essential to include men in future studies to examine the moderating effects of sex. Finally, the moderating effects of culture on response to salient cues may also be examined. Although AB tasks have been employed by research groups internationally (e.g., United States, Canada, Germany and South Korea), there are few considerations given to the salience of specific food cues or socially threatening stimuli across cultures. It will be important to consider the cultural relevance of the cues used in studies across the globe and with diverse populations.

Task Standardization—In order to draw more definitive conclusions about the role of AB in binge eating behaviors, the field would benefit from a more homogeneous approach to measuring AB. For instance, in visual probe tasks, the images are presented at varying latencies (between 200 and 2000 ms), potentially tapping into different attentional processes of attention engagement and sustained attention, but are often interpreted similarly. In interpretation of results, it is important to consider the varying aspects of the tasks and how they may be influencing results. Moreover, not all studies provided enough information to

calculate between-group effect sizes. Although we contacted authors for this information, a sizeable number of effect sizes were still unavailable. Such missing data limits the ability to examine effects across studies. Future research should consider presenting findings in a standardized manner and including effect sizes when possible.

It is also important to consider the type of cues used within tasks. Some studies used word-based cues, while others used picture-based cues. It is possible that the magnitude of the AB effect may differ depending on the type of cue. However, there is also a lack of standardization in the cues used within each cue type, which may contribute to inconsistent findings. For example, among Stroop tasks, different studies used various categories of words as threatening stimuli, such as adolescent social context words, threatening words, and negative emotion words. Similarly, food images used across studies vary in color, size, palatability, and content, which may introduce error in measurement of AB to food cues (Blechert, Meule, Busch, & Ohla, 2014). One group studying AB has introduced a database of standardized images collected from researchers globally (Blechert, Meule, et al., 2014). Using standardized images is an important step toward producing results that are comparable across studies, in order for future reviews to conduct meaningful meta-analyses.

Alternatively, it may also be informative to customize the AB tasks as content-specific by using cues that are most salient to each individual. This would allow for studying the intensity of response based on the salience of the cues, which could have implications for interventions aimed at altering attention to these cues. Finally, honing our understanding and use of the innovative methodologies of eye tracking and EEG would allow for examining AB to more ecologically valid complex scenes of food and people (Popien et al., 2015). These methodologies may also eliminate some drawbacks of reaction-time based tasks, such as the time limitation which interferes with assessing avoidance processes. The use of these innovative methods may address the issues of task standardization present in reaction-time research.

Conclusions

Individuals with binge eating appear to exhibit AB, although there is significant heterogeneity in study samples, grouping variables, and AB tasks. AB to food cues may represent oversensitivity to rewarding properties of food, making it a vulnerability and maintenance factor for binge eating. AB to weight/shape cues may be a maintenance factor for binge eating alone and with compensatory behaviors but may function differently in BN vs. binge eating alone groups; however, this requires further study. AB to threatening stimuli warrants study in individuals who engage in binge eating without compensatory behaviors to determine whether it is a common underlying feature across the binge eating spectrum. Longitudinal research should examine whether AB is a risk factor for developing disorders of binge eating. Ultimately, AB may be an important factor to target for intervention and prevention of binge eating behaviors.

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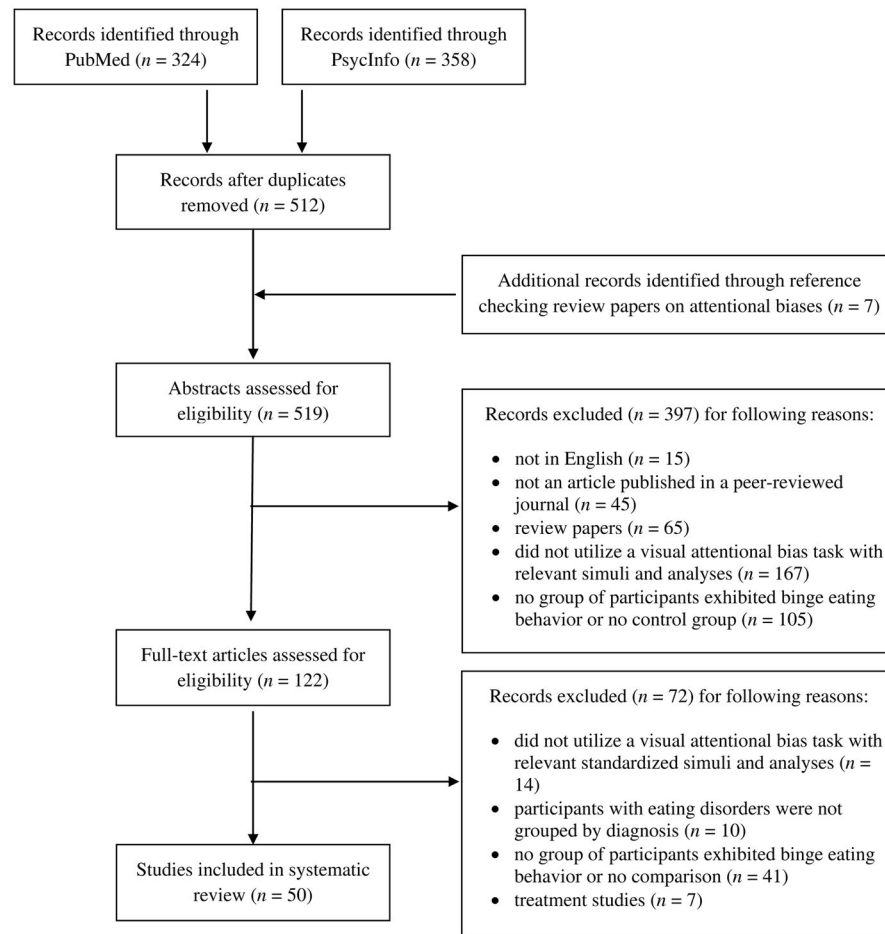
Figure 1.
Study Inclusion Flow. Date last searched: July 9, 2017.

Table 1

Attentional bias paradigms based on reaction time.

Paradigm	Description	Outcome Measure	Attention Components Measured
Emotional Stroop (Ouimet et al., 2009; Stroop, 1935; Williams et al., 1996)	Participants are instructed to name aloud the ink color of written words that are deemed either neutral or salient. Cognitive interference means taking longer to name the ink color of disorder-salient words (e.g., "thighs") than neutral words (e.g., "tower"). Disorder-salient content is assumed to serve as a distractor, limiting attention resources for the more deliberate task of naming the ink color of these words.	Reaction time Slower reaction time indicates AB to disorder-salient stimuli relative to neutral stimuli	Facilitated attentional engagement
Visual Probe Task (M. Field & Cox, 2008; MacLeod, 1986; Ouimet et al., 2009)	A fixation cross is presented to center participant's gaze and then followed by paired images, typically one salient (e.g., pizza) and one neutral (e.g., clock). Immediately following the stimulus pair presentation, a probe appears on either the left or right region of the screen and participants must respond as quickly as possible.	Reaction time Faster reaction time during the trials in which the probe replaces the salient stimuli indicates AB to disorder-salient stimuli relative to neutral stimuli	Facilitated attentional engagement at briefer durations (200 ms) Difficulties with attentional disengagement at intermediate durations (~500 ms) Attentional avoidance at longer durations (1000 ms), if measured
Spatial Cueing Task (Cisler et al., 2009; Fox et al., 2001; Posner, 1980)	Participants fixate on a central point on the screen, then on one region of the screen where a directional cue is presented. Participants press a key corresponding to the location of a probe that appears following the cue. In the *valid* trials, the directional cue predicts the location of the subsequent probe. In the *invalid* trials, the directional cue does not accurately predict the location of the probe and thus draws attention away from it.	Reaction time Faster reaction time on valid salient cue trials indicates AB (facilitated attentional engagement) relative to valid neutral cue trials Slower reaction time on invalid salient cue trials indicates AB (difficulty with attentional disengagement) relative to invalid neutral cue trials	Facilitated attention engagement: difference between salient and neutral cue reaction times on valid trials Difficulties with attentional disengagement: difference between salient and neutral cue reaction times on invalid trials
Visual Search (Cisler et al., 2009; Smeets et al., 2008)	Participants are presented with a word matrix. Matrices may contain 20 words in the same category, 19 neutral words, and one salient "target" word, or 19 salient words and one neutral "target" word. Participants press a key to indicate whether the matrix contains an odd-one-out word or is entirely comprised of words within the same category.	Reaction time Faster reaction time to detect salient target words indicates AB (facilitated attentional engagement) relative to detecting that all words are neutral Slower reaction times to detect neutral target words within matrices of salient words indicate AB (attentional disengagement difficulties) relative to detecting that all words are neutral	Facilitated attention engagement: faster detecting of salient words relative to neutral matrices Difficulties with attentional disengagement: slower detecting of neutral words in matrices with salient words

Note: AB = attentional bias.

Table 2

Novel attentional bias measurement methods.

Method	Outcome Measure	Attention Components Measured
Eye Tracking (Werthmann et al., 2011)	Saccade latency: the time between target presentation and initial gaze shift Initial gaze direction bias: the proportion of trials in which the initial gaze was oriented towards salient stimuli versus neutral stimuli Overall gaze duration bias: the difference in total dwell time on salient versus neutral stimuli	Facilitated attentional engagement: measured via saccade latency and initial gaze direction bias Difficulty with attentional disengagement and attentional avoidance: measured via overall gaze duration bias
Electroencephalography (EEG) (Blechert et al., 2011; Hajcak et al., 2010)	Event-related potentials (ERP): measures of brain activity in response to stimuli exposure, as recorded from electrodes placed on the scalp by EEG Early posterior negativity (EPP): ERP with a negative deflection that occurs approximately150–300 ms following stimulus presentation P300: ERP with a positive deflection which reflects brain activity approximately 300–400 ms following stimulus presentation Late positive potential (LPP): ERP that occurs approximately 400–800 ms after stimulus presentation Positive slow wave potential (PSW): ERP that occurs approximately 1000–6000 ms after stimulus presentation	Larger ERP amplitudes correspond to greater AB Facilitated attentional engagement and difficulties with attentional disengagement: early posterior negativity (e.g., N2), P300, and late positive potential (LPP) Difficulties with attentional disengagement and attentional avoidance: late positive potential (LPP), positive slow wave potential (PSW)

Note: AB = attentional bias; ERP = event-related potentials.

Table 3

Attentional biases as measured by the Emotional Stroop.

Study	Sample	Groups	Paradigm	Findings
Albery et al. (2016)	88 adults from the United Kingdom 100% female M_{age} = 30.4 y[†]	BN (n = 45; Age = 28.9±10.2)[†] HC (n = 43; Age = 31.9±10.6)[†]	Stimuli 1 Food-related words (e.g. chocolate, binge) 2 Body-related words (e.g. skinny, model) 3 Neutral words (e.g. compass, flowers) Stimulus presentation: computer task; words presented individually Instructions: respond to the color of the word (red, blue, yellow, green) by pressing the appropriately colored key on a keyboard	**Interference for food (vs. neutral) words** • BN > HC (g = 0.72) **Interference for body (vs. neutral) words** • BN > HC (g = 0.93)
Ben-Tovim and Walker (1991)	93 adults and adolescents from Australia 100% Female M_{age} = 17.6 y M_{BMI} = 21.4 kg/m²	BN (n = 27; Age = 26.8±9.1 y; BMI = 23.3±4.6 kg/m²) HC High-DFT (n = 29; Age = 13.6±1.1 y; BMI = 21.8±5.7 kg/m²) HC Low-DFT (n = 37; Age = 14.0±1.3 y; BMI = 19.7±3.47 kg/m²)	Stimuli 1 Food target words (e.g. chips) 2 Matched neutral non-food words (e.g. crown) 3 Shape target words (e.g. flabby) 4 Matched neutral non-shape words (e.g. fables) Stimulus presentation: each set of words presented on a notecard in 10 × 10 array Instructions: Name ink color of words as quickly as possible and do not correct any mistakes.	**Interference for food (vs. neutral) words** • BN > HC High-DFT = HC Low-DFT (BN vs. HC High-DFT: g = 0.57; BN vs. HC Low-DFT: g = 0.57) **Interference for shape (vs. neutral) words** • BN > HC High-DFT, HC Low-DFT (BN vs. HC High-DFT: g = 0.48; BN vs. HC Low-DFT: g = 0.55)
Ben-Tovim et al. (1989)	57 adults from Australia 100% Female M_{age} = 24.2 y M_{BMI} = 21.7 kg/m²	BN (n = 19; Age = 26.9±10 y; BMI = 22.6±4.7 kg/m²) HC (n = 38; Age = 22.8±4.5 y; BMI = 21.3±2.5 kg/m²)	Stimuli 1 Food target words (e.g. chips) 2 Matched neutral non-food words (e.g. crown) 3 Shape target words (e.g. flabby) 4 Matched neutral non-shape words (e.g. fables) Stimulus presentation: each set of words presented on a notecard in 10 × 10 array Instructions: Name ink color of words as quickly as possible and do not correct any mistakes.	**Interference for food (vs. neutral) words** • BN > HC (g = 1.12) **Interference for shape (vs. neutral) words** • BN > HC (g = 0.84)
Black et al. (1997)	45 adults from the United States 100% female M_{age} = 22.1 y M_{BMI} = 22.7 kg/m²	BN (n = 16; Age = 23.8; BMI = 23.0) HC-Res (n = 16; Age =20.6; BMI = 23.7) HC (n = 13; Age = 21.9; BMI = 21.2)	Stimuli 1 Food target words (e.g. cake, diet) 2 Weight/shape target words (e.g. fat, thighs) 3 Neutral control words (e.g. sit, tower) Stimulus presentation: computer task; words presented individually	**Interference for food (vs. control) words** • NS group differences (BN vs. HC-Res: g = −0.20; BN vs. HC: g = 0.38) **Interference for weight/shape (vs. control) words** • NS group differences (BN vs. HC-Res: g = 0.13; BN vs. HC: g = 0.39)

Study	Sample	Groups	Paradigm	Findings
Cooper, Anastasiades, and Fairburn (1992)	54 adults from the United Kingdom 100% Female M_{age} = 23.6 y M_{BMI} = 21.5 kg/m²	BN (n = 36; Age = 24.3±6.2 y; BMI = 21.8±2.2 kg/m²) HC (n = 18; Age = 22.1±3.5 y; BMI = 20.9±1.5 kg/m²)	Instructions: Say the color of the words aloud and press the corresponding color key as quickly as possible. Stimuli 1 Target words: fat, diet, thighs, cakes, hips 2 Neutral control words: sit, dare, filter, tower, wool Stimulus presentation: each set of words presented on a notecard in 10 × 10 array Instructions: Name ink colors of words as quickly as possible and immediately correct any mistakes.	**Interference for target (vs. neutral) words** • BN > HC (g = 0.77) • Among BN, positively correlated with EAT (r = .36), but became NS when controlling for depressive symptoms[‡] • Among HC, NS association with EAT[‡]
Cooper and Fairburn (1993)	75 adults from the United Kingdom 100% female M_{age} = 24.2 y M_{BMI} = 22.3 kg/m²	No groups; all participants diagnosed with BN	Stimuli 1 Target words: fat, diet, thighs, cakes, hips 2 Neutral control words: sit, dare, filter, tower, wool Stimulus presentation: each set of words presented on a notecard in 10 × 10 array Instructions: Name ink color of words as quickly as possible and immediately correct any mistakes.	**Interference for target (vs. control) words** • Number of words color-named per second was negatively associated with EAT scores (r = −. 24)
Cooper and Fairburn (1992)	36 individuals from the United Kingdom 100% female[†]	BN (n = 12)[†] Dieting HC (n = 12)[†] Non-dieting HC (n = 12)[†]	Stimuli 1 Target words: fat, diet, thighs, cakes, hips 2 Neutral control words: sit, dare, filter, tower, wool Stimulus presentation: each set of words presented on a notecard in 10 × 10 array Instructions: Name ink color of words as quickly as possible and immediately correct any mistakes.	**Interference for target (vs. control) words** • BN > Non-dieting HC = Dieting HC
Cooper and Todd (1997)	30 individuals from the United Kingdom 100% female[†]	BN (n = 12)[†] HC (n = 18)[†]	Stimuli 1 Eating-related words (e.g. diet, cakes) 2 Matched neutral non-eating words (e.g. damp, fantasy) 3 Weight-related words (e.g. scales, heavy) 4 Matched neutral non-weight words (e.g. routes, states) 5 Shape-related words (e.g. fat, shape) 6 Matched neutral non-shape words (e.g. medals, ward) Stimulus presentation: each set of words presented on a notecard in 5 × 10 array	**Interference for eating-related (vs. control) words** • BN > HC (g = 1.06) **Interference for weight-related (vs. control) words** • BN > HC (g = 0.98) **Interference for shape-related (vs. control) words** • NS group differences (g = 0.84)

Study	Sample	Groups	Paradigm	Findings
Davidson and Wright (2002)	35 adults from the United Kingdom 100% female M_{age} = 25.2 y M_{BMI} = 21.1 kg/m²	BN (n = 17; Age = 25.5±6.4 y; BMI = 21.2±3.2 kg/m²) HC (n = 18; Age = 24.9±6.1 y; BMI = 21.1±2.0 kg/m²)	Instructions: Name ink color of words as quickly as possible and immediately correct any mistakes. Stimuli 1 Food words (e.g. dinner, sugar) 2 Matched neutral non-food words (e.g. record, ocean) 3 Body size words (e.g. large, weight) 4 Matched neutral non-body size words (e.g. morning, easy) Stimulus presentation: computer task; words presented individually with 2000 ms ITI Instructions: Press one of four buttons to identify the ink color of words as quickly and accurately as possible.	**Interference for food (vs. neutral) words** • NS difference between BN and HC (g = 0.50) • High EAT BN > Low EAT BN[‡] **Interference for body size (vs. control) words** • BN > HC (g = 0.72) • NS difference between high and low EAT BN[‡]
Fairburn, Cooper, Cooper, McKenna, and Anastasiades (1991)	74 adults from the United Kingdom 100% female M_{age} = 20.4 y M_{BMI} = 21.5 kg/m²	BN (n = 24; Age = 21.3±3.8 y; BMI = 22.6±3.1 kg/m²) HC (n = 50; Age = 20.0±1.1 y; BMI = 20.9±1.6 kg/m²)	Stimuli 1 Target words: fat, diet, thighs, cakes, hips 2 Neutral control words: sit, dare, filter, tower, wool Stimulus presentation: each set of words presented on a notecard in 10 × 10 array Instructions: Name ink color of words as quickly as possible and immediately correct any mistakes.	**Interference for target (vs. control) words** • BN > HC[‡]
Flynn and McNally (1999)	58 adults from the US 100% female M_{age} = 28.5 y[†]	BN (n = 15; Age = 27.1±7.0 y)[†] Short-term Rec-BN (n = 15; Age = 28.2±6.6 y)[†] Long-term Rec-BN (n = 15; Age = 35.5±7.0 y)[†] HC (n = 13; Age = 22.3±4.7 y)[†]	Stimuli 1 Food words (e.g. cake, cookie) 2 Matched neutral office supply words (e.g. eraser, folder) 3 Body words (e.g. hips, thighs) 4 Matched neutral animal words (e.g. goldfish, kitten) Stimulus presentation: computer task; words presented individually with 500 ms ITI Instructions: Name the colors of the words as quickly as possible while ignoring their meanings. Note: prior to Emotional Stroop task, participants completed a cognitive task to activate concerns about body weight.	**Interference for food (vs. office supply) words** • No group showed interference for food words (BN vs. short-term Rec-BN: g = 0.04; BN vs. long-term Rec-BN: g = 0.30; BN vs. HC: g = 0.11) **Interference for body (vs. animal) words** • BN > Short-term Rec-BN = HC > Long-term Rec-BN (BN vs. short-term Rec-BN: g = 0.63; BN vs. long-term Rec-BN: g = 1.12; BN vs. HC: g = 0.58)
Formea and Burns (1996)	58 university students from the United Kingdom 100% female M_{age} = 19.0 y[†]	Participants grouped on BULIT-R and BDI BN, diagnosed on BULIT-R (n = 22; Age = 19.8±3.2 y)[†]	Stimuli 1 Target words relating to food, weight, and shape (e.g. sandwich, plump, stomach) 2 Matched neutral control words (e.g. luggage, plush, harbor)	**Interference for target (vs. control) words** • Block 1: BN > Non-BN non-depressed = non-BN depressed[‡] • Blocks 2, 3, and 4: NS group differences[‡]

Study	Sample	Groups	Paradigm	Findings
		Non-BN depressed (n = 11; Age = 19.0±2.6 y)[†]; Non-BN non-depressed (n = 25; Age = 18.4±1.0 y)[†]	**Stimulus presentation**: computer task; words presented individually with 1500 ms stimulus duration and 3000 ms ITI. **Instructions**: Name ink color of words as quickly and as accurately as possible.	
Harrison et al. (2010)	140 adults from the United Kingdom; 100% female; M_{age} = 28.1 y; M_{BMI} = 21.4 kg/m²	BN (n = 50; Age = 27.5±8.8 y; BMI = 21.0±2.4 kg/m²); HC (n = 90; Age = 28.5±9.9 y; BMI = 21.6±1.9 kg/m²)	**Stimuli**: 1 Images of male and female angry faces; 2 Images of male and female neutral faces; 3 Images of neutral objects (i.e. chairs). **Stimulus presentation**: computer task; pictorial stimuli presented in one of four colors	**Interference for face (vs. chair) images** • BN > HC (g = 0.87) **Interferences for angry (vs. neutral) face images** • BN > HC (g = 0.87)
Johansson et al. (2008)	78 adults from Sweden; 100% female; M_{age} = 24.4 y; M_{BMI} = 21.9 kg/m²	BN (n = 20; Age = 24.6±3.9 y; BMI = 21.3±2.2 kg/m²); Sub-BN (n = 27; Age = 24.9±4.5 y; BMI = 22.4±3.8 kg/m²); HC (n = 31; Age = 23.8±2.6 y; BMI = 21.8±2.6 kg/m²)	**Stimuli**: 1 High calorie food words (e.g. pizza); 2 Oversized body words (e.g. fat); 3 Neutral object words (i.e. household items). **Stimulus presentation**: web-based task; words presented individually. **Instructions**: Ignore meaning of the words and focus on colors in which they are presented. Instructed to click the box on the screen representing ink color of each word as quickly as possible.	**Interference for high calorie food (vs. neutral) words** • NS group differences among BN, sub-BN and HC (BN vs. Sub-BN: g = −0.22; BN vs. HC: g = 0.07; Sub-BN vs. HC: g = 0.28) **Interference for oversized body (vs. neutral) words** • BN > HC (g = 0.77)
Jones-Chesters et al. (1998)	32 adults from the United Kingdom; 100% female; M_{age} = 25.9 y; M_{BMI} = 22.9 kg/m²	BN (n = 16; Age = 25.3±7.7 y; BMI = 23.8±3.0 kg/m²); HC (n = 16; Age = 26.6±7.5 y; BMI = 22.1±2.8 kg/m²)	**Stimuli**: 1 Weight/shape words; 2 Matched weight/shape control words; 3 Food/eating words; 4 Matched food/eating control words; 5 Negative emotion words (e.g. guilt); 6 Matched emotion control words; 7 Affectively neutral words (i.e. animal names); 8 Matched animal name control words. **Stimulus presentation**: computer task; words presented individually; each participant completed both block and mixed design, with order randomized between the two conditions. **Instructions**: Name out loud the colors in which the words are displayed as quickly and accurately as possible, ignoring the meaning of the words.	**Interference for weight/shape (vs. control) words** • BN > HC[‡] **Interference for food/eating (vs. control) words** • BN > HC[‡] **Interference for negative emotion (vs. control) words** • Blocked condition only: BN > HC[‡] **Interference for neutral animal names (vs. control words)** • NS group differences[‡] **Overall interference** • Interference greater for BN in blocked vs. mixed task conditions[‡] • Among BN, overall interference not associated with EAT (r=.17)

Study	Sample	Groups	Paradigm	Findings
Kanakam et al. (2013)	74 older adolescent and adult twins from the United Kingdom 100% female[†]	Lifetime BN (n = 26)[†] Non-BN co-twins (n = 6)[†] HC twins (n = 42)[†]	**Stimuli** 1. Images of male and female neutral faces (i.e. social stimuli) 2. Images of male and female angry faces (i.e. social threat stimuli) 3. Images of chairs (i.e. non-social stimuli) Stimulus presentation: computer task; pictorial stimuli presented individually for up to 4000 ms in one of four colors Instructions: Name the color of the picture you see as quickly as possible.	**Interference for social (vs. non-social) images** • NS trend: Lifetime BN > HC twins ($g = 0.40$) • NS trend: Non-BN co-twins < HC twins ($g = -0.16$) • Monozygotic twins, but not dizygotic twins, demonstrated significant within-pair similarity ($r = .47$) **Interference for social threat (vs. neutral social) images** • Lifetime BN > HC twins ($g = 0.71$) • Non-BN co-twins > HC twins ($g = 0.91$) • Within-pair correlations were not significant for either monozygotic or dizygotic twins, though within-pair similarity tended to be greater for monozygotic twin pairs[†]
Lee et al. (2017)	39 adults from South Korea 100% female $M_{age} = 23.5$ y $M_{BMI} = 22.5$ kg/m²	BED ($n = 13$; Age = 23.6±2.6 y; BMI = 25.6±3.8 kg/m²) BN ($n = 12$; Age = 23.7±2.2 y; BMI = 21.5±2.2 kg/m²) HC ($n = 14$; Age = 23.3±2.2 y; BMI = 20.4±2.6 kg/m²)	**Stimuli** 1. Food pictures: six foods from a set of Korean and Western foods that received highest craving ratings by each participant 2. Neutral pictures Stimulus presentation: computer task; cue ("XXX") displayed for 500 ms in center of screen; "interference" pictorial stimuli appeared for 2700 ms; then colored word appeared for 1000 ms Instructions: using right hand, press a red key when the cue and word matched and a green key when they did not match	**Interference for food (vs. neutral) images** • NS differences between groups (BED vs. HC: $g = 0.23$; BN vs. HC: $g = -0.26$)
Léonard et al. (1997)	74 adults from France 100% female $M_{age} = 25.7$ y $M_{BMI} = 19.1$ kg/m²	AN-BP ($n = 25$; Age = 25.6±5.6 y; BMI = 16.5±1.5 kg/m²) BN ($n=20$; Age = 26.2±5.2y; BMI = 20.8±2.3 kg/m²) HC ($n = 29$; Age = 25.4± 6.1y; BMI = 20.2±2.1 kg/m²)	**Stimuli** 1. Eating words (e.g. pancake, vomiting) 2. Eating control words (e.g. carpet, mattress) 3. Body words (e.g. belly, thighs) 4. Body control words (e.g. district, shop) Stimulus presentation: each set of words presented on a notecard in 8 × 12 array Instructions: Name ink color of words as quickly as possible.	**Interference for eating (vs. control) words** • BN = AN-BP > HC (BN vs. AN-BP: $g = 0.18$; BN vs. HC: $g = 1.50$; AN-BP vs. HC: $g = 1.06$) **Interference for body (vs. control) words** • NS group differences (BN vs. AN-BP: $g = 0.15$; BN vs. HC: $g = 0.39$; AN-BP vs. HC: $g = 0.18$) • Positively associated with EDI-body dissatisfaction subscale among AN-BP ($r = .39$, $p = .053$) and BN ($r = .44$, $p = .052$)
Lokken et al. (2006)	90 adults from the US 100% Female	HC and Sub-BN grouped on BULIT-R	**Stimuli** 1. Eating target words (e.g. diet, cake)	**Interference for eating (vs. neutral) words**

Study	Sample	Groups	Paradigm	Findings
	M_{age} = 19.3 y M_{BMI} = 22.6 kg/m²	BN (n = 30; Age = 19.1±1.4 y; BMI = 22.1±4.3 kg/m²); Sub-BN (n = 30; Age = 19.4±1.2 y; BMI = 23.4±4.7 kg/m²); HC (n = 30; Age = 19.5±1.0 y; BMI = 22.2±2.5 kg/m²)	**2** Eating control words (e.g. damp, nests) **3** Weight target words (e.g. scales) **4** Weight control words (e.g. paper) **5** Shape target words (e.g. flabby) **6** Shape control words (e.g. field) <u>Stimulus presentation</u>: each set of words presented on a notecard in 5 × 10 array <u>Instructions</u>: Name ink color of words as quickly as possible and immediately correct any mistakes.	• BN = Sub-BN > HC (BN vs. Sub-BN: g = 0.38; BN vs. HC: g = 1.11; Sub-BN vs. HC: g = 1.13) **<u>Interference for weight (vs. neutral) words</u>** • BN > HC (BN vs. Sub-BN: g = 0.13; BN vs. HC: g = 0.72; Sub-BN vs. HC: g = 0.52) **<u>Interference for shape (vs. neutral) words</u>** • BN > Sub-BN = HC (BN vs. Sub-BN: g = 0.74; BN vs. HC: g = 1.17; Sub-BN vs. HC: g = 0.72) **<u>Overall interference</u>** • BULIT-R scores positively correlated with interference for eating (r = .36), weight (r = .28) and shape (r = .41) words
Lovell et al. (1997)	68 adults from the United Kingdom 100% female M_{age} = 27.0 y M_{BMI} = 22.8 kg/m²	BN (n = 24; Age = 26.9±11.1y; BMI = 21.8±3.5kg/m²); Rec-BN (n = 11; Age = 34.4±10.5 y; BMI = 24.6±4.8 kg/m²); HC (n = 33; Age = 24.7±8.1 y; BMI = 22.9±3.6 kg/m²)	<u>Stimuli</u> **1** Food words (e.g. sugar, feast) **2** Food control words (i.e. music related) **3** Shape/weight words (e.g. chubby, hips) **4** Shape/weight control words (i.e. travel related) **5** Adolescent conflict words (e.g. independence, dating, lonely) **6** Adolescent conflict control words (i.e. animal related) <u>Stimulus presentation</u>: each set of words presented on a notecard in 10 × 10 array <u>Instructions</u>: Name ink color of words as quickly and accurately as possible and immediately correct any mistakes.	**<u>Interference for food (vs. control) words</u>** • NS group differences‡ **<u>Interference for shape/weight (vs. control) words</u>** • BN > Rec-BN = HC‡ • Positively associated with BDI (r = .29) but NS association with BMI‡ or current hunger‡ • Among Rec-ED: positively associated with Maturity Fears subscale of EDI-II (r = .58) but NS association with the other EDI-II subscales‡; NS association with recovery duration (r = −.17) **<u>Interference for adolescent conflict (vs. control) words</u>** • NS group differences‡
McManus et al. (1996)	60 individuals from the United Kingdom 100% female M_{age} = 22.5 y†	BN/AN-BP (n = 30; Age = 22.5±5.0y); HC (n = 30; Age = 22.5±3.8y; BMI = 22.0)	<u>Stimuli</u> **1** Sociotropy threat words (e.g. isolated) **2** Sociotropy control words (e.g. imagined) **3** Autonomy threat words (e.g. powerless) **4** Autonomy control words (e.g. penciled) **5** Discomfort anxiety threat words (e.g. pain) **6** Discomfort anxiety control words (e.g. path) **7** Ego-others threat words (e.g. ridiculed)	**<u>Interference for sociotropy threat (vs. control) words</u>** • NS group differences (g = 0.27) **<u>Interference for autonomy threat (vs. control) words</u>** • BN/AN-BP > HC (g = 0.62) • For BN/AN-BP group, positively correlated with number of binge episodes per week (r = .33) **<u>Interference for discomfort anxiety threat (vs. control) words</u>**

Study	Sample	Groups	Paradigm	Findings
			8 Ego-others control words (e.g. reappeared) **9** Ego-self threat words (e.g. worthless) **10** Ego-self control words (e.g. wavering) Stimulus presentation: each set of words presented on a notecard in 4 × 24 array Instructions: Ignore the words and name the color of the ink in which they are presented.	• BN/AN-BP > HC ($g = 0.91$) <u>**Interference for ego-others threat (vs. control) words**</u> • NS group differences ($g = 0.51$) <u>**Interference for ego-self threat (vs. control) words**</u> • BN/AN-BP > HC ($g = 0.61$) • For BN/AN-BP group, positively correlated with number of binge episodes per week ($r = .58$) and with BITE severity ratings ($r = .35$)
Perpiñá et al. (1993)	46 adults from the United Kingdom 100% female $M_{age} = 26.7$ y $M_{BMI} = 24.4$ kg/m²	BN ($n = 14$; Age = 26.4±4.9 y; BMI = 26.6±8.3 kg/m²) HC ($n = 32$; Age = 26.9±6.0 y; BMI = 23.4±3.5 kg/m²)	Stimuli **1** Food words **2** Food control words **3** Body-size words **4** Body-size control words Stimulus presentation: each set of words presented on a notecard in 8 × 12 array	<u>**Interference for food (vs. control) words**</u> • NS group difference between BN and HC[‡] <u>**Interference for body-size (vs. control) words**</u> • BN > HC[‡]
Perpiñá et al. (1998)	28 adults from the United Kingdom 100% female $M_{age} = 28.8$ y $M_{BMI} = 21.1$ kg/m²	BN ($n = 10$; Age = 27.8±8.2 y; BMI =21.1±2.2 kg/m²) HC ($n = 18$; Age = 29.3±9.7 y; BMI =21.1±2.7 kg/m²)	Stimuli **1** Food words **2** Food control words **3** Body-size words **4** Body-size control words Stimulus presentation: each set of words presented on a notecard in 8 × 12 array	<u>**Interference for food (vs. control) words**</u> • NS group difference between BN and HC ($g = 0.97$) <u>**Interference for body-size (vs. control) words**</u> • NS group differences ($g < 0.01$) • For BN, positively correlated with change in skin conductance level ($r = .78$)
Rofey et al. (2004)	165 adults from the US 100% female $M_{age} = 19.2$ y[†]	No groups; all participants completed the BULIT-R and Positive and Negative Affect Scale	Stimuli **1** Food words (e.g. spaghetti) **2** Neutral words (i.e. types of animals) Stimulus presentation: computer task; each word presented individually Instructions: Pay attention to the meaning of each word and, as quickly and accurately as possible, press a key corresponding to the color of each word.	<u>**Interference for food (vs. neutral) words**</u> • Mood on Positive and Negative Affect Scale served as a moderator. Negative mood: high BULIT-R > low BULIT-R[‡] • Positive mood group showed the opposite pattern[†]
Ruiz et al. (2008)	62 older adolescents and young adults from Mexico 100% female[†]	In-patient BN ($n = 26$)[†] HC ($n = 36$)[†]	Stimuli **1** Positive food words (e.g. salad, cereal) **2** Negative food words (e.g. soda, fat)	<u>**Interference for positive food words**</u> • NS group differences ($g = 0.15$) <u>**Interference for negative food words**</u> • NS group differences ($g = 0.19$)

Study	Sample	Groups	Paradigm	Findings
			3 Positive body shape words (e.g. silhouette, thin) **4** Negative body shape words (e.g. obesity, binge eating) **5** Neutral words matched for each of the four target word lists (e.g. stair, city) Stimulus presentation: computer task	**Interference for positive body shape words** • BN > HC ($g = 0.84$) **Interference for negative body shape words** • BN > HC ($g = 1.10$)
Seddon and Waller (2000)	80 adults from the United Kingdom 100% female M_{age} = 21.7 y M_{BMI} = 21.7 kg/m²	Participants completed the BITE Younger adults (n = 48; Age = 19.7±1.0 y; BMI = 21.3±2.4 kg/m²) Older adults (n = 32; Age = 24.7±5.0 y; BMI = 22.2±2.2 kg/m²)	**Stimuli** **1** Negative emotional words (e.g. despair) **2** Positive emotional words (e.g. delight) **3** Neutral control words (e.g. device) Stimulus presentation: computer task; words presented individually with 1000 ms ITI Instructions: Press a button corresponding to the color in which the word was displayed.	**Interference for negative (vs. control) words** • Younger adults: NS difference between high and low BITE groups ($g = 0.50$); NS association with BITE symptom score ($r = .25$); negatively associated with BITE severity score ($r = -.34$) • Older adults: high BITE > low BITE group ($g = 1.00$); positively associated with BITE symptom score ($r = .44$); NS association with BITE severity score ($r = .23$) **Interference for positive (vs. control) words** • Younger adults: NS difference between high and low BITE groups ($g = 0.42$); NS association with BITE symptom score ($r = .25$); negatively associated with BITE severity score ($r = -.33$) • Older adults: NS difference between high and low BITE groups ($g = 0.21$); NS association with BITE symptom score ($r = .23$); NS association with BITE severity score ($r = .23$)
Waller and Ruddock (1995)	60 adults from the United Kingdom 100% female M_{age} = 24.6 y M_{BMI} = 22.1 kg/m²	BN (n = 30; Age = 25.0±6.5 y; BMI = 22.4±3.1 kg/m²) HC (n = 30; Age = 24.2±6.1 y; BMI = 21.7±2.1 kg/m²)	**Stimuli** **1** Food words (e.g. dinner) **2** Food control words (e.g. mirror) **3** Abuse words (e.g. flash) **4** Abuse control words (e.g. chat) Stimulus presentation: each set of words presented on a notecard in 4 × 24 array Instructions: Name the colors in which the words are printed as quickly as possible, ignoring the words themselves, and immediately correct any mistakes.	**Interference for food (vs. control) words** • NS difference between BN and HC groups‡ **Interference for abuse (vs. control) words** • Among those with ED who reported history of sexual abuse, positively associated with BITE severity ($r = .36$) and binging frequency ($r = .46$)
Waller et al. (1996)	80 older adolescents and adults from the United Kingdom 100% female	Participants completed the EDI High-BN† (n = 20) Low-BN† (n = 60)	**Stimuli** **1** Sociotropy threat words (e.g. isolated) **2** Sociotropy control words (e.g. imagined)	**Interference for self-directed ego threat (vs. control) words** • High-BN > low-BN ($g = 0.73$)

Study	Sample	Groups	Paradigm	Findings
	M_{age} = 18.7 y M_{BMI} = 20.9 kg/m²		**3** Autonomy threat words (e.g. powerless) **4** Autonomy control words (e.g. penciled) **5** Physical threat (e.g. pain) **6** Physical threat control words (e.g. path) **7** Ego threats from others words (e.g. ridiculed) **8** Ego threats from others control words (e.g. reappeared) **9** Self-directed ego threat words (e.g. worthless) **10** Self-directed ego threat control words (e.g. wavering) Stimulus presentation: each set presented in a list of 96 words	• Positively associated with EDI Bulimia scale (r = .35) **Interference for other threat words** • NS group differences between high-BN and low-BN[‡] • NS associations with EDI Bulimia scale (rs = −.03–.13)

Note: Studies are organized alphabetically. Interference in all cases above refers to slower color-naming time for target (vs. control) words. Clinical diagnoses are based on DSM criteria (e.g. for BN) unless noted otherwise.

[†]No further demographics available.

[‡]Effect sizes not available.

Abbreviations: M = mean; BMI = body mass index; NS = non-significant; BED = binge eating disorder; BN = bulimia nervosa; Sub-BN = subclinical bulimia nervosa; AN-BP = anorexia nervosa, binge/purge type; HC = healthy control; Rec = recovered; ITI = intertrial interval; EAT = Eating Attitudes Test; BULIT-R = Bulimia Test-Revised; BDI = Beck Depression Inventory; BITE = Bulimic Investigatory Test; EDI = Eating Disorders Inventory; Res = DEBQ, restraint subscale; DFT = drive for thinness.

Table 4

Attentional biases as measured by the visual probe task.

Study	Sample	Groups	Paradigm	Findings
Cardi et al. (2013)	76 adults and older adolescents from the United Kingdom 100% female [†]	Lifetime BN ($n = 26$; $n_{current}$: $n = 17$, n_{past}: $n = 9$) [†] HC ($n = 50$) [†]	**Stimuli** 1 Gray-scale images of male and female faces with accepting expressions 2 Gray-scale images of male and female faces with rejecting expressions 3 Gray-scale images of male and female faces with neutral expressions Stimulus duration: 500 ms and 1250 ms Instructions: Press button to classify probe as vertical or horizontal dots.	**AB for rejecting (vs. paired neutral) face images** • At both stimulus durations: lifetime BN > HC (500ms: $g = .31$; 1250ms: $g = .56$) **AB for accepting (vs. paired neutral) face images** • At both stimulus durations: lifetime BN < HC (500ms: $g = -0.45$; 1250ms: $g = -0.41$)
Deluchi et al. (2017)	42 adults from Brazil 95.2% female $M_{age} = 47.0$ y $M_{BMI} = 48.1$ kg/m²	Participants completed the BES High-BES ($n = 19$; BMI = 47.85 kg/m²) [†] Low-BES ($n = 23$; BMI = 48.24) [†]	**Stimuli** 1 Unhealthy food images rich in fats and/or sugars 2 Neutral images Stimulus duration: 100, 500, and 2000 ms Instructions: Press up or down arrows on computer keypad to indicate direction of target arrow as quickly and accurately as possible.	**AB for unhealthy food (vs. neutral objects)** • Across all stimulus durations: high-BES > low-BES ($g = 0.63$) • 500 ms stimulus duration: high-BES > low-BES ($g = 0.85$) • NS findings for 100 ($g = 0.24$) or 2000 ms ($g = -0.02$)
Shank et al. (2015)	76 children and adolescents from the United States 86.8% female $M_{age} = 14.5$ y $M_{BMI-z} = 1.71$	LOC ($n = 47$; Age = 13.8±2.4 y; BMI-z = 2.0±0.4) HC ($n = 29$; Age = 15.6±1.6 y; BMI-z = 1.2±0.8)	**Stimuli** 1 High palatable food images (e.g. pizza) 2 Low palatable food images (e.g. mushrooms) 3 Neutral images of household objects (e.g. paintbrush) Stimulus duration: 2000 ms Instructions: Press button to classify probe as left or right arrow.	**AB for high (vs. paired low) palatable food images** • NS group differences ($g = -0.24$) • NS association with hunger ($r = .18$) **AB for high palatable food (vs. paired neutral non-food) images** • NS group differences ($g = 0.32$) • NS association with hunger ($r = -.11$) • Among youth with LOC, positive association between AB and BMI-z ($r = .30$) • Among HC, trend of negative association between AB and BMI-z ($r = -.36$) • Positive association with LOC episode frequency ($r = .24$), which was attenuated after adjusting for BMI-z ($r = .22$) **AB for low palatable food (vs. paired neutral non-food) images** • NS group differences ($g = -0.01$) • NS association with hunger ($r = -.04$)

Note: Studies are organized alphabetically. Clinical diagnoses are based on DSM criteria (e.g. for BN) unless noted otherwise.

[†]No further demographics available.

[‡]Effect sizes not available.

Abbreviations: M = mean; NS = non-significant; AB = attentional bias; BN = bulimia nervosa; BED = binge-eating disorder; HC = healthy controls; BES = Binge Eating Scale; BMI = body mass index; BMI-z: body mass index based on age-, sex-, and country-specific BMI reference data; LOC = loss of control.

Table 5

Attentional biases as measured by the spatial cueing task.

Study	Sample	Groups	Paradigm	Findings
Lyu et al. (2016)	64 adult undergraduate students from China 100% female M_{age} = 21.5 y M_{BMI} = 20.0 kg/m²	Healthy weight sub-BED (n = 33; Age = 21.5±1.4 y; BMI = 20.4±2.3 kg/m²) HC (n = 31; Age = 21.4±1.5 y; BMI = 19.6±2.1 kg/m²)	Stimuli 1. High- and low-calorie food images (e.g. ice cream, potato chips) 2. Matched household item images (e.g. brush, clock) Stimulus duration: 300 ms Instructions: Indicate left or right location of the dot by pressing 'A' or 'L' respectively, on standard computer keyboard.	**AB for high-calorie foods** • Sub-BED > HC[‡] **AB for low-calorie foods and neutral cues** • No AB for low-calorie foods or household items in either group[‡]
Maner et al. (2006)	66 adults from the United States 100% female M_{age} = 18.5 y[†]	Participants completed EDI High EDI-BN (n = 6)[†] Low EDI-BN (n = 60)[†]	Spatial cueing stimuli 1. Highly attractive male and female face images with neutral expressions 2. Average-looking male and female face images with neutral expressions Stimulus duration: 500 ms Instructions: Following a single cue image in one quadrant, press "a" or "k" key to classify probe as a circle or square. Only analyzed invalid trials, in which probe appeared in a different location from the stimulus.	**AB for attractive female faces (vs. mean reaction time across all stimuli)** • High EDI-BN > low EDI-BN (g = 1.08) • Positively correlated with EDI-BN (r = .28) **Overall AB** • NS association with EDI-BN for average-looking female faces, attractive male faces or average-looking male faces[‡]
Schmitz et al. (2014)	60 adults from Germany 100% female M_{age} = 44.0 y M_{BMI} = 33.4 kg/m²	BED-OW (n = 27; Age = 46.0±14.5 y; BMI = 34.7±5.1 kg/m²) HC-OW (n = 33; Age = 42.4±13.5 y; BMI = 32.4±6.4 kg/m²)	Spatial cueing stimuli 1. High calorie food images (e.g. chocolate, pizza) 2. Neutral images of household items (e.g. hole puncher, light bulb) Stimulus duration: 100 ms Instructions: Following a single cue image, press left or right button to indicate position of subsequent dot probe, while ignoring question mark probe.	**AB for food (vs. neutral) cues** • Stimulus and probe position "congruent" trials, representing stimulus engagement: BED > HC (g = 0.58) • Stimulus and probe position "incongruent" trials, representing stimulus disengagement: NS group differences (g = 0.27) • Positive correlation between stimulus engagement effect and self-reported arousal ratings (r = .34)

Note. Studies are organized alphabetically. Clinical diagnoses are based on DSM criteria (e.g. for BN) unless noted otherwise.

[†] No further demographics available.

[‡] Effect sizes not available.

Abbreviations: M = mean; NS = non-significant; HC = healthy controls; OW = overweight; BMI = body mass index; BED = binge eating disorder; sub = subthreshold; EDI = Eating Disorder Inventory; BN = bulimia nervosa.

Table 6

Attentional biases as measured by the visual search paradigm.

Study	Sample	Groups	Paradigm	Findings
Meyer et al. (2000)	50 adults from the United Kingdom 100% Female $M_{age} = 21.5$ y[†]	No groups; all participants completed the EDI	<u>Stimuli</u> 1 Ego-threat words (e.g. fail) 2 Matched neutral words (e.g. fund) Stimulus duration: 1000 ms; time between the target word and subsequent matrix presentation varied (500, 1000, 1500 or 2000 ms) Instructions: Following (threat or neutral) target word presentation, indicate whether the word is present or absent from the subsequent 4×4 word matrix. The matrix included the target word half of the time among otherwise neutral words.	<u>**Response time for threat (vs. neutral) words present in the matrices**</u> • For interstimulus interval of 1500 ms, greater BN symptoms associated with greater AB ($r = .25$) • NS association with BN symptoms at interstimulus intervals of 500 ms ($r = -.09$), 1000 ms ($r = .03$), or 2000 ms ($r = -.09$)
Schmidt et al. (2016)	50 adolescents from Germany 88% Female $M_{age} = 14.7$ y $M_{BMI-z} = 1.8$ kg/m²	BED ($n = 25$; Age = 14.7 ± 2.9 y; BMI-z = 1.8 ± 0.8) HC ($n = 25$; Age = 15.3 ± 2.4 y; BMI-z = 1.8 ± 0.8)	<u>Stimuli</u> 1 Food images: high- low- and medium-calorie foods (e.g., chocolate, pizza, tomato, broccoli, bread, fish) a. Preferred: each participant rated how much liked each food image; median split within each participant was used to divide foods into preferred vs. not 2 Matched non-food images Stimulus duration: fixation cross for 500 ms, followed by matrix of images; matrix remained on screen until manual response was given Instructions: press the right button if there was an image of a different category and press the left button if there were only images of the same category	<u>**Response time for food (vs. non-food) images present in the matrices**</u> • BED > HC ($g = 0.48$) for all food • NS differences for preferred ($g = .36$) or non-preferred foods ($g = .31$)
Waller et al. (1995)	100 adults from the United Kingdom 100% Female $M_{age} = 22.0$ y $M_{BMI} = 21.5$ kg/m²	Participants completed EAT-26 High EAT-26-BN ($n = 26$)[†] Low EAT-26-BN ($n = 74$)[†]	<u>Stimuli</u> 1 Threat words (e.g. pain) 2 Matched neutral words (e.g. page) Stimulus duration: 1000 ms Instructions: Following (threat or neutral) target word presentation, indicate whether the word is present or absent from the subsequent 4×4 word matrix. The matrix included the target word half of the time among otherwise neutral words.	<u>**Response time for threat (vs. neutral) words present in the matrices**</u> • Positive correlation with self-reported BN symptoms ($r_s = .20$) • Among high-EAT-26-BN, slower to identify threat (vs. neutral) words[‡] • Among low-EAT-26-BN, response times equivalent for threat (vs. neutral) words[‡] <u>**Response time for threat (vs. neutral) words absent from the matrices**</u> • NS association with self-reported BN symptoms[‡]

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Study	Sample	Groups	Paradigm	Findings
				• Both high- and low-EAT-26-BN groups slower to identify threat words as absent[‡]

Note: Studies are organized alphabetically. Clinical diagnoses are based on DSM criteria (e.g. for BED) unless noted otherwise.

[†]No further demographics available.

[‡]Effect sizes not available.

Abbreviations: M = mean; NS = non-significant; AB = attentional bias; BN = bulimia nervosa; EAT-26 = Eating Attitudes Test; EDI = Eating Disorder Inventory; BMI = body mass index; BMI-z: body mass index based on age-, sex-, and country-specific BMI reference data; BED = binge eating disorder; HC = healthy control

Table 7

Attentional biases as measured by eye tracking paradigms.

Study	Sample	Groups	Paradigm	Findings
Blechert et al. (2010)	39 adults from Germany 100% Female M_{age} = 27.0 y M_{BMI} = 21.5 kg/m²	BN (n = 18; Age = 26.9±8.4 y; BMI = 22.9±3.4 kg/m²) HC (n = 21; Age = 27.1±4.8 y; BMI = 20.3±2.1 kg/m²)	**Stimuli** 1 Whole-body photograph of self with omitted head 2 Whole-body photograph of BMI-matched participant with omitted head Stimulus duration: 150 ms and 1100 ms Metric: saccade latency Instructions: Only upon presentation of green or blue frame surrounding photos (one color denoted targets), move eyes from central fixation cross to target photo as quickly as possible, then return gaze to fixation cross.	**AB for self-target (vs. other-target)** • No differences by stimulus duration[‡]; analyses averaged across durations • NS group differences in saccade latency[‡]
Blechert et al. (2009)	42 adults from Germany 100% Female M_{age} = 26.5 y M_{BMI} = 21.4 kg/m²	BN (n = 20; Age = 26.6±7.7 y; BMI = 22.6±3.4 kg/m²) HC (n = 22; Age = 26.5±4.7 y; BMI = 20.3±2.24 kg/m²)	**Stimuli** 1 Whole-body photographs of self with omitted head 2 Whole-body photographs of higher BMI individuals with omitted head 3 Whole-body photographs of lower BMI individuals with omitted head Stimulus duration: 6000 ms Metrics: gaze dwell time bias; saccade latency; initial saccade direction Instructions: Slides consist of your own body photo in the middle and other body photos to the left and right. Look at the pictures. You will have to evaluate them later.	**AB for self image** • Dwell time: NS group differences[‡] • NS group differences for saccade latency[†] or initial saccade direction[‡] **AB for higher BMI figures** • Dwell time: BN < HC[‡] • NS group differences for saccade latency[†] or initial saccade direction[‡] **AB for lower BMI figures** • Dwell time: BN > HC[‡] • NS group differences for saccade latency[†] or initial saccade direction[‡]
Kim et al. (2016)	86 adult undergraduates from Korea 100% Female M_{age} = 21.2 y[†]	Split by high and low scores on a Korean version of BULIT-R High BULIT-R (n = 38; Age = 21.5±2.0 y)[†] Low BULIT-R (n = 38; Age = 21.1±2.0 y)[†]	**Stimuli:** 1 High-calorie food images (e.g., cookies, coffee with whipped cream) 2 Low-calorie food images (e.g., fruits, nuts) 3 Nonfood images (stationary and household objects) Stimulus Duration: 4000 ms Metrics: fixation latency; dwell time; percentage dwell time for 0–1000, 1000–2000, 2000–3000, and 3000–4000 ms intervals Instructions: Fixate eyes freely	**AB towards high-calorie food (vs. low-calorie food)** • Fixation latency: high-calorie > low-calorie for high BULIT-R[‡]; NS for low BULIT-R[‡] • Dwell time: NS group differences[‡] • Percentage dwell time: NS group differences[‡] **AB towards high-calorie food (vs. nonfood)** • Fixation latency: high-calorie > nonfood for high BULIT-R[‡]; NS for low BULIT-R[‡]

Study	Sample	Groups	Paradigm	Findings
				• Dwell time: NS group differences‡ • Percentage dwell time: NS group differences for 0–1000‡, 1000–2000‡, or 3000–4000‡ ms; NS trend for 2000–3000 such that high BULIT-R < low BULIT-R (g = 0.43)
Popien et al. (2015)	57 adults from Canada 75% Female M_{age} = 21.7 y M_{BMI} = 23.1 kg/m²	BE (n = 27; Age = 21.6±3.4 y; BMI = 24.4±4.9 kg/m²) HC (n = 30; Age = 21.8±2.2 y; BMI = 22.0±3.4 kg/m²)	**Stimuli** 1 Images of real-world scenes containing high-calorie food 2 Images of real-world scenes containing low-calorie food 3 Images of real-world scenes containing both high- and low-calorie food 4 Images of real-world scenes that did not contain food <u>Stimulus duration: 8000 ms</u> Metrics: percent total gaze dwell time on food items (calculated for each 2000 ms stimulus presentation interval) and time to first fixation for food items Instructions: Look freely at the image throughout the presentation, as if watching a slide show.	**AB for high-calorie food** • Dwell time: BE > HC‡ • Time to first fixation for high-calorie food items faster in BE‡ **AB for low-calorie food** • Dwell time: BE > HC‡ • Time to first fixation for low-calorie food items faster in BE‡v **AB for high- and low-calorie food (in images that contained both types of food)** • Dwell time: BE > HC‡ • Time to first fixation for high-calorie food items faster in BE‡ • NS group differences in time to first fixation for low-calorie food items‡
Schag et al. (2013)	70 adults from Germany 100% Female M_{age} = 39.7 y M_{BMI} = 31.2 kg/m²	OW/OB-BED (n = 24; Age = 39.7±11.7 y; BMI = 35.4±5.6 kg/m²) OW/OB-HC (n = 24; Age = 39.9±12.6 y; BMI = 35.4±5.4 kg/m²) HC (n = 22; Age = 39.4±11.8 y; BMI = 22.5±1.6 kg/m²)	**Stimuli** 1 High and low calorie food images 2 Matched images of everyday objects <u>Stimulus duration: 3000 ms</u> Metrics: percent total gaze dwell time and initial fixations on each stimulus type Instructions: Freely explore the image pairs as if watching TV.	**AB for food (vs. nonfood) cues** • Dwell time: OW/OB-BED > OW/OB-HC = HC (OW/OB-BED vs. OW/OB-HC: g = 0.54; OW/OB-BED vs. HC: g = 0.62) • NS group differences on initial fixation‡
Schmidt et al. (2016)	50 adolescents from Germany 88% Female M_{age} = 14.7 y M_{BMI-z} = 1.8 kg/m²	BED (n = 25; Age = 14.7±2.2 y; BMI-z = 1.8±0.8) HC (n = 25; Age = 15.3±2.4 y; BMI-z = 1.8±0.8)	**Stimuli** 1 Food images: high- low- and medium-calorie foods (e.g., chocolate, pizza, tomato, broccoli, bread, fish) a. Preferred: each participant rated how much liked each food image; median split within each participant was used to divide foods into preferred vs. not 2 Matched non-food images	**AB for food (vs. nonfood) cues** • Percent initial gaze direction: NS differences for all foods (g = −0.08), preferred foods (g = 0.10), or non-preferred foods (g = −0.20) • Gaze duration: BED > HC for all foods (g = 0.64) and preferred foods (g = 0.55); NS differences for non-preferred foods (g = 0.40)

Study	Sample	Groups	Paradigm	Findings
Svaldi et al. (2012)	46 adults from Germany 100% Female M_{age} = 40.3 y M_{BMI} = 33.8 kg/m²	BE (n = 23; BMI = 37.7±6.9 kg/m²)[†] HC-OW (n = 23; BMI = 29.8±3.9 kg/m²)[†]	Stimulus duration: 3000 ms Metrics: percent initial gaze direction and gaze duration Instructions: freely explore pairs of food and non-food images on the computer screen as if watching television Stimuli 1 Whole-body photographs of self with omitted face 2 Whole-body photographs of weight-matched controls with omitted face Stimulus duration: 3000 ms/trial Metrics: frequency of fixation and gaze dwell time for first (265 ms) and second (570 ms) fixations Instructions: Paired self and control images were presented side-by-side. During the cue condition, participants were told on which side the self image would appear. In no cue condition, participants did not know where the image would appear.	**AB for self body** • Cue condition: BE > HC for 1st (g = 0.75) and 2nd (g = 0.69) fixation frequency; NS group differences for dwell time[‡] • No cue condition: NS group differences for fixation frequency[‡], 1st dwell time,[‡] or 2nd dwell time[‡] **AB for control body** • Cue condition: BE < HC for 1st (g = −0.86) and 2nd (g = −0.67) fixation frequency; NS group differences for 1st dwell time; BE < HC for 2nd dwell time (g = −0.82) • No cue condition: NS group differences for fixation frequency[‡], 1st dwell time[‡], or 2nd dwell time[‡]
Svaldi et al. (2011)	44 adults from Germany 100% Female M_{age} = 44.2 y M_{BMI} = 35.1 kg/m²	BE (n = 26; BMI = 38.7±8.2 kg/m²)[†] HC-OW (n = 18; BMI = 30.0±3.8 kg/m²)[†]	Stimuli 1 Whole-body photographs of self (omitted face) 2 Whole-body photographs of weight-matched controls (omitted face) Stimulus duration: 8000 ms Metrics: gaze dwell time and frequency of fixations on specific body parts Instructions: Watch images of yourself and a control person. After task, identify ugliest and most beautiful body parts of your own image and the control body image.	**AB for ugliest self body part** • Dwell time: BE > HC (g = 0.61) • Fixation frequency: BE > HC (g = 0.63) **AB for ugliest control body part** • Dwell time: BE > HC[‡] for block 1, NS group differences for block 2[‡] • Fixation frequency: NS group differences for block 1, BE > HC for block 1[‡]

Note: Studies are organized alphabetically. Clinical diagnoses are based on DSM criteria (e.g. for BN) unless noted otherwise.

[†]No further demographics available.

[‡]Effect sizes not available.

Abbreviations: M = mean; NS = non-significant; AB = attentional bias; BN = bulimia nervosa; AN-BP: anorexia nervosa, binge eating/purging type; HC = healthy controls; BED = binge eating disorder; BE = binge eating; OW = overweight; OB = obese; BMI = body mass index; BULIT-R = Bulimia Test-Revised.

Table 8

Attentional biases as measured by electroencephalography.

Study	Sample	Groups	Paradigm	Findings
Blechert et al. (2011)	54 adults from Germany 100% Female M_{age} = 26.2 y M_{BMI} = 21.5 kg/m²	BN (n =22; Age = 26.1±7.5 y; BMI = 22.6±3.2 kg/m²) HC (n =32; Age = 26.2±5.0 y; BMI = 20.7±2.4 kg/m²)	Stimuli 1 High calorie food images (e.g. pizza) 2 Matched low calorie food images (e.g. fruit) 3 Nonfood pleasant images (e.g. baby animals) 4 Nonfood neutral images (e.g. tools) 5 Nonfood unpleasant images (e.g. attacking animals) Stimulus duration: 3 images/second ERPs measured: EPN (220–310 ms) Instructions: Watch images during rapid serial visual presentation task, with images presented from each category in a pseudorandom order.	**AB for food (vs. neutral) images** • Significant group by category interaction[‡] • BN: high-calorie food = low-calorie food > neutral[‡] • HC: high-calorie food > low-calorie food = neutral[‡] **AB for pleasant/unpleasant (vs. neutral) images** • NS effect or interaction of group[‡]
Kuhnpast et al. (2012)	26 adults from Germany 100% Female M_{age} = 25 y M_{BMI} = 21.7 kg/m²	BN (n = 13; Age = 24.6±7.1 y; BMI = 21.7±3.7 kg/m²) HC (n =13; Age = 25.4±3.2 y; BMI = 21.6±2.0 kg/m²)	Stimuli 1 Happy male and female face images 2 Fearful male and female face images 3 Angry male and female face images 4 Neutral male and female face images Stimulus duration: 1500 ms ERPs measured: N170 (120–180 ms); N2 (190–260 ms); P3 (270–500 ms) Instructions: Attend to stimuli very closely.	**AB for angry face images (vs. low level baseline)** • N170, temporal/occipital region: BN < HC[‡] **Overall AB** • N170, temporal/occipital region: NS group differences for emotions other than angry faces[‡] • N2, anterior and medial regions: NS group differences[‡] • P3, anterior, medial and posterior areas: BN > HC for all face types[‡]
Mai et al. (2015)	40 adults from Germany 100% Female M_{age} = 24.6 y M_{BMI} = 21.3 kg/m²	BN (n = 20; Age = 24.6±7.5 y; BMI = 20.7±3.4 kg/m²) HC (n = 20; Age = 24.6±3.3 y; BMI = 21.8±2.6 kg/m²)	Stimuli 1 Whole-body photographs of healthy weight women with omitted head 2 Whole-body photographs of underweight women with omitted head 3 Whole-body photographs of overweight women with omitted head Stimulus duration: 4000 ms ERPs measured: N170 (150–220 ms); P2 (180–270 ms); N2 (250–350 ms); P3 (350–450 ms); PSW (500–900 ms) Instructions: Attentively watch the pictures and avoid exploratory eye movements and eye blinks.	**AB for overweight (vs. healthy weight) body stimuli** • P2: Only among BN, significantly higher response to overweight body stimuli[‡] **AB for overweight (vs. underweight) body stimuli** • P3: Only among HC, significantly higher response to overweight body stimuli[‡] **AB for underweight (vs. healthy weight) body stimuli** • N2: Only among HC, significantly more negative response to underweight body stimuli[‡]

Study	Sample	Groups	Paradigm	Findings
				AB for underweight (vs. overweight) body stimuli • N2: Only among HC, significantly more negative response to underweight body stimuli[‡] **Overall AB** • N170, PSW: NS group differences[‡] • P3 amplitudes for overweight and healthy weight body stimuli: BN < HC[‡] • P3 amplitudes for underweight body stimuli: BN = HC[‡]
Sarlo et al. (2013)	33 adults from Austria 100% Female M_{age} = 22.5 y M_{BMI} = 21.4 kg/m²	No groups; all participants completed EDI	Stimuli 1 High calorie food images (e.g. chocolate) 2 Neutral nonfood images (e.g. shapes) Stimulus duration: 4000 ms ERPs measured: P300 (280–400 ms); LPP1 (500–1000 ms) and LPP2 (1000–1500 ms) Instructions: View each picture, understand its content, and allow yourself to experience any emotional or appetitive response to the image. Rate current appetite and arousal.	**AB for food images (vs. low level baseline)** • When passively viewing pictures, NS associations between self-reported binge eating and ERP amplitudes[‡]
Svaldi et al. (2010)	44 adults from Germany 100% Female M_{age} = 39.7 y M_{BMI} = 33.5 kg/m²	BED (n = 22; Age = 41.9±13.9 y; BMI = 36.5±6.9 kg/m²) HC (n = 22; Age = 37.5±13.6 y; BMI = 30.5±3.9 kg/m²)	Stimuli 1 High calorie food images (e.g. cake) 2 Matched low calorie food images (e.g. vegetables) Stimulus duration: 6000 ms ERPs measured: LPP (500–800 ms); PSW (1000–6000 ms) Instructions: Passively watch images (viewing section) and then watch images that you will have to taste later (availability section).	**AB for high (vs. low) calorie food cues** • BED > HC for centro-parietal LPP (g = 0.81) and PSW (g = 0.82) **Overall AB** • NS associations between ERPs and hunger, craving, forbiddance[‡]
Wolz et al. (2017)	39 adults from Spain 100% female M_{age} = 32.4 y M_{BMI} = 26.5 kg/m²	BE (n = 19; Age = 35.0±9.6 y; BMI = 31.2±10.5 kg/m²) HC (n = 20; Age = 30.0±9.0 y; BMI = 22.0±2.8 kg/m²)	Stimuli 1 Images of chocolate products 2 Images of neutral office items Stimulus duration: 1200 ms ERPs measured: N2 (180–350 ms); LPP (300–1000 ms) Instructions: No information provided in manuscript.	**AB for chocolate (vs. neutral) cues** • NS differences for N2 peak amplitude[‡] • NS differences for LPP peak amplitudes[‡]

Note: Studies are organized alphabetically. Clinical diagnoses are based on DSM criteria (e.g. for BN) unless noted otherwise.

[†] No further demographics available.

†Effect sizes not available.

Abbreviations: M = mean; NS = non-significant; AB = attentional bias; BED = binge-eating disorder; BN = bulimia nervosa; HC = healthy control; BMI = body mass index; BE = binge eating; EDI = Eating Disorder Inventory; ERP = event-related potential; EPN = early posterior negativity (negative deflection at 200–300 ms); LPP = late positive potential (positive deflection that lasts up to 6000 ms); LPP1 = late positive potential at 500–1000 ms; LPP2 = late positive potential at 1000–1500 ms; N2 = negative deflection at 190–260 ms); N170 = ERP associated with processing of facial features (negative deflection at 140–220 ms); P2 = positive deflection at 180–200 ms); P3 = positive deflection at 300 ms; P300 = positive deflection at 300–500 ms) PSW = positive slow wave (positive deflection at 1000 – 6000 ms)