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Utilising Cognitive Bias Modification to Remedy Appearance and Self-Worth Biases in Eating Disorder Psychopathology: A Systematic Review

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Abstract

Background and Objectives: This study systematically reviewed the impact of Cognitive Bias Modification (CBM) on biases related to attention (CBM-A) and interpretation (CBM-I) for appearance and self-worth stimuli and the subsequent impact on eating disorder (ED) psychopathology. **Method:** The current review was guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), with 12 studies meeting inclusion criteria (CBM-A *n* = 5; CBM-I *n* = 7). **Results:** The literature provides preliminary support for CBM-A and CBM-I efficacy in eliciting bias change in varying degrees of psychopathology (Cohen's *d* ranging between -1.67 and 1.34; 9 studies reflected improved bias, and 3 reflected no change or did not assess), while highlighting the less robust effects associated with improving ED psychopathology (*d* ranging between -1.30 and .61; 5 studies reflected symptom improvement, and 7 reflected no change or did not assess). **Limitations:** The review only considered peer reviewed research and did not report on the findings of unpublished data; thus, the current findings may not provide an accurate representation of CBM in EDs. **Conclusions**: The current findings highlight the potential of CBM as an adjunct intervention for EDs; however the limited number of investigations and high degree of heterogeneity across the included studies impedes on the generalisability of the findings.

Keywords: Cognitive bias modification, body dissatisfaction, eating disorders, attention, interpretation, review.

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Cognitive bias and eating disorders

A central tenet of cognitive theories is the use of schemata to guide and simplify the processing, organisation and retrieval of information (Vitousek & Hollon, 1990). While being highly efficient, schemata are susceptible to biased information processing that can contribute to the onset and maintenance of psychopathology (Beck, 1976). Investigations across non-clinical, subclinical and clinical samples indicate that risk for eating disorders (ED) is associated with attentional, interpretation and memory biases for stimuli pertaining to food, appearance, and negative self-worth (Aspen, Darcy, & Lock, 2013; Brooks, Prince, Stahl, Campbell, & Treasure, 2011; Jiang & Vartanian, 2018; Lee & Shafran, 2004; Rodgers & Dubois, 2016). Experimental paradigms designed to *assess* bias are typically adapted to then *modify* these processes and have subsequently been termed Cognitive Bias Modification (CBM) paradigms. While substantial work has focused on CBM of attentional (see Beard, Sawyer, & Hofman, 2012) and approach biases toward food (Kakoschke, Kemps, & Tiggemann, 2017), there is only an emerging body of work investigating appearance and self-worth related CBM. Therefore, reviewing the CBM literature which targets these putative maintaining factors is both timely and informative.

Cognitive bias modification (CBM)

Techniques targeting attentional bias (CBM-A) aim to manipulate selective attention for disorder-salient information. The most widely used technique is the modified dot probe task (adapted from MacLeod, Matthews, & Tata, 1986). During the task, pairs of stimuli are presented on a computer screen; one of which is disorder-salient (e.g., negative appearance-related word; fat), the other is positively (e.g., fit) or neutrally (e.g., mat) valanced. The two stimuli appear horizontally or vertically aligned for 500ms and then disappear. Participants are instructed to respond, as quickly as possible, to a probe replacing the locus of either stimulus. During the assessment phase, probes replace disorder and non-disorder relevant

stimuli with equal frequency (50/50); however, the contingency between the two stimuli is altered during training (e.g., 90/10 ratio; Kakoschke, Kemps, & Tiggemann, 2014). In tasks designed to induce disorder-salient bias, the probe replaces this stimulus category on a majority of trials. Alternatively, to reduce bias, probes primarily replace the locus of positive or neutral stimuli. Through repeated practice, participants learn to associate target stimuli with the targeted response and in turn begin to selectively attend to new information resembling this stimulus category (see Hallion & Ruscio, 2011for review). More recently, eye tracking software has also been used in attentional bias research due to offering a robust assessment and manipulation of attention allocation (e.g., gaze duration, fixation frequency, orientation speed; Jiang & Vartanian, 2018).

Paradigms targeting interpretation bias (CBM-I) seek to constrain individuals' interpretations of ambiguity to one particular theme (e.g., a positive or negative appearance). Training techniques, as applied to EDs, typically involve presenting individuals with a series of ambiguous terms (i.e., homographs) or scenarios that permit disorder or non-disorder interpretations. Participants are then instructed to disambiguate the term or scenario by providing the relevant information (e.g., inserting missing letters). For example: *Your friend is a very keen hiker and persuades you to join her and a group of friends on their next hike. You are apprehensive, given how far the hike was going to be. During the hike you realise that you are* '*f* - t'. To train non-disorder interpretations, participants would insert the letter '*i*' to form the word 'fit'; alternatively, the letter '*a*' would disambiguate the meaning to align with an ED-salient interpretation (i.e., '*fat*'). Following repeated practice, individuals are expected to then apply this new and adaptive interpretation style to novel ambiguous information.

Aims of the current review

In reviewing CBM procedures, MacLeod (2012) noted that the efficacy of CBM-A and CBM-I procedures beyond emotional vulnerability and psychopathology was largely uncertain. To our knowledge, no studies have examined CBM in memory bias for appearance or self-worth related information with at risk or ED samples and therefore this bias type will not be discussed in this review. The purpose of the current study was to address a gap in the literature and conduct a systematic review of the studies examining the impact of CBM approaches on attentional and interpretation biases for appearance and self-worth related information, and the subsequent impact on ED psychopathology. In turn, we seek to provide a critical synthesis of the literature findings, discuss limitations in methodology and knowledge, and provide directions for future research.

Method

The current review was guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) recommendations (Moher, Liberati, Tetzlaff, & Altman, 2009).

Search strategy

The electronic databases PsycINFO, PubMed and ScienceDirect were systematically searched on the 1st July 2018. The following terms were used as text and key words: (cognitive bias modification OR attention* bias modification OR attention bias training OR selective attention* OR interpret* bias modification) AND (body image OR body disturbance OR body *satisfaction OR eating disorder). All reference lists of identified articles were cross-checked for further relevant articles.

Inclusion and exclusion criteria

Due to the limited research conducted in the field, intervention inclusion criteria were broadened to include adaptations of standardised CBM protocols; however, the aims of the

adapted techniques needed to include the modification of biases and/or symptomatology associated with ED psychopathology. Diagnostic status was not used as an inclusion criterion, with varying degrees of psychopathology included in the review. Date of publication, geographical location and language were not inclusion criteria. Studies were excluded if they were not peer reviewed or were commentary or review articles. Authors were contacted if relevant variables were not reported, with studies excluded if this information was not provided.

Results

Search results

As shown in **Figure 1**, a total of 241 studies were retrieved from the database search; 32 duplicate articles were removed and the remaining titles and abstracts (n = 216) were screened by the first author and relevant articles were retrieved (n = 15). The full texts of the articles were analysed for eligibility, of which 2 were removed for not meeting the inclusion criteria. One study was excluded due to the relevant variables not being provided by the authors (i.e., unable to locate original study from >12 years ago), leaving a total of 12 studies in the current systematic review. Study characteristics, including authors' reported results on significant statistical tests, are presented in **Tables 1 and 2** for CBM-A and CBM-I studies respectively. Means and standard deviations associated with these significant results were used to calculate Cohen's *d* within and between group effect sizes and their 95% confidence intervals (CI), using an online meta-analysis effect size calculator (Wilson, n.d); see **Tables 3 and 4** for CBM-A and CBM-I respectively. If means and standard deviations were unavailable, $ES_{between}$ was computed based on *t-/F*-values for the between-group comparison. The direction of Cohen's *d* (e.g., positive vs. negative) will vary depending on the measures used to assess bias and symptomatology (e.g., a negative effect may reflect both a reduction

in disorder-salient bias, as well as worsening of psychopathology). Further, in the current review, a negative effect size reflects a lower score in the first group or observation, relative to the second group or observation and a positive effect size reflects a higher score in the first group or observation, relative to the second. Our results and discussion are based solely upon the findings of our own effect size calculations; if the CI is entirely above or below zero, the null hypothesis is rejected and the difference within or between groups is considered significant. On occasion, this result may conflict with the statistical test result reported by the authors (e.g. Smeets et al., 2011).

The effects of CBM-A

All five CBM-A studies examined the impact of attentional retraining on ED-related psychopathology (Allen, Mulgrew, Rune, & Allen, 2018; Engel et al., 2006; Loughnan, Mulgrew, & Lane, 2015; Smeets, Jansen, & Roefs, 2011; Smith & Rieger, 2009); with only three investigating bias change (Allen et al., 2018; Loughnan, et al., 2015; Smith & Rieger, 2009).

Bias. The three studies investigating bias change utilised the modified dot probe task in unselected samples (i.e., not screened for degree of vulnerability to psychopathology). First, Loughnan and colleagues (2015) investigated single-session neutral CBM-A (attend to neutral terms, while avoiding negative weight/shape related terms), relative to a control condition, with the task proving ineffective at eliciting bias change. Second, Smith and Rieger (2009) examined four CBM-A approaches to a control condition, including: positive appearance, negative appearance, negative food (high caloric) and positive food (low caloric). Each experimental condition proved significantly and largely effective at increasing bias for the respective target stimuli (*d* ranging between .89 to 1.08). Third, Allen and colleagues (2018) failed to replicate these effects, finding a similar positive appearance approach ineffective at eliciting bias change relative to neutral and control CBM-A training.

Psychopathology. All five studies assessed the impact of attentional retraining on psychopathology. The first investigated the effects of CBM-A on trait ED psychopathology (e.g., bulimia, body dissatisfaction and drive for thinness subscales from the Eating Disorder Inventory; Garner, Olmsted, & Polivy, 1983) in an unselected sample (Engel et al., 2006). Post-training assessments indicated significantly higher scores on the bulimia subscale in those trained to avoid appearance terms (i.e., neutral CBM-A), relative to those attending to these stimuli; no such effects were observed in body dissatisfaction or drive for thinness. Given the omission of pre-assessment psychopathology, it is unclear whether the observed group differences were already present at baseline or resulted from CBM-A. Loughnan and colleagues (2015) addressed this limitation, finding a single-session of neutral CBM-A to be ineffective at ameliorating state and trait levels of body dissatisfaction between baseline, post-training and 1- and 2- week follow-up.

Appearance-based CBM-A approaches were significantly effective at exacerbating rather than ameliorating ED psychopathology. Specifically, the negative appearance CBM-A approach significantly reduced body satisfaction (d = .84), while the positive appearance condition had no impact on satisfaction levels. Smith and Rieger (2009) propose, given that a post-training mood induction (i.e., viewing images of thin models) did not reduce satisfaction levels of those in the positive appearance condition, suggests that this attentional pattern may act as a protective factor against body dissatisfaction. Similarly, Allen and colleagues (2018) found no impact of positive appearance-based CBM-A on risk factor outcomes.

Only one study utilised eye tracking software to influence ED-related risk in unselected (study one) and body dissatisfied (study two) samples (Smeets et al., 2011). Study one trained participants' attention towards either self-defined attractive (positive induction) or unattractive body parts (negative induction), with the negative induction proceeded by a positive counter induction (attend to attractive body parts). While the positive induction was

associated with negligible effects on body and weight satisfaction, the negative and positive counter inductions led to moderate to large reductions and enhancements in body and weight satisfaction, respectively; however, these observed within-group effects were not significant (see **Table 3**). Study two compared the positive induction to a control condition (attend equally to various body parts), with the positive induction resulting in moderate to large improvements in body and weight satisfaction; however, effects were not significant.

The effects of CBM-I

Six of the seven CBM-I studies investigated the impact of training on both bias and ED-psychopathology. One study examined a positive self-worth related approach, relative to negative-valanced training (Yiend, Parnes, Shepherd, Roche, & Cooper, 2014), four studies used appearance-based approaches (Gledhill et al., 2017; Matheson, Wade, & Yiend, 2018; Summers & Cougle, 2018; Williamson, Perrin, Blouin, & Barbin, 2000), while the remaining two studies targeted socio-emotional interpretation biases (Cardi et al., 2015; Turton, Cardi, Treasure, & Hirsch, 2018). Both single-session (Matheson et al., 2018; Turton et al., 2018; Williamson et al., 2000; Yiend et al., 2014) and multi-sessions approaches were used (Cardi et al., 2015; Gledhill et al., 2017; Summers & Cougle, 2018).

Bias. As shown in **Table 4**, moderate to large within and between group effect sizes were associated with bias change across the seven CBM-I studies. The largest effects were associated with appearance (Cohen's *d* ranging between -1.67 and 1.34) and self-worth based (d = 1.20) approaches, with socio-emotional paradigms producing moderate effects (d ranging between -.57 to .53).

The four appearance-based CBM-I approaches were associated with significant moderate to large effects; two used a single-session approach, while the remaining two utilised multiple sessions. The earlier single-session study (Williamson et al., 2000), exploring positive and negative self-imagery in response to ambiguous body and health-

related scenarios, found positive self-imagery led to significantly large reductions in fat-related bias in the ED sample (d = -1.02); however, bias was not extinguished nor altered to a thinness-related interpretation as intended. No effects were associated with negative-self imagery. The second study examined a new appearance-based CBM-I protocol to an existing self-worth protocol (Yiend et al., 2014) and a control condition (Matheson et al., 2018). The single-session study examined the two interventions' impact on two ED-related interpretation biases (appearance and self-worth) in an unselected university sample. The newly-developed CBM-I for appearance led to significantly moderate improvements in positive bias (d = -.66), while the self-worth condition had no impact. This is inconsistent with Yiend et al. (2014), who found the self-worth protocol to be significantly effective at eliciting positive bias change (d = 1.20) in a subclinical ED sample.

The remaining two appearance-based studies utilised multi-session designs. The first sought to modify body size judgments of body dissatisfied women (study 1) and women with atypical anorexia nervosa (study 2; Gledhill et al., 2017). The women underwent four consecutive days of training (35 - 45 minutes each), where they were presented with 3D images of women with varying body mass indexes (BMI) ranging between 15.4 (severely underweight) and 33.7 (overweight). The bodies were presented for 150ms, after which participants were instructed to categorise the body size as either '*fat*' or '*thin*'. The intervention was designed to shift participants' categorical boundaries (classification of thin vs. fat bodies) towards larger bodies by providing individuals with feedback regarding the accuracy of their judgments (i.e., '*Incorrect! That body was fat*' or '*Correct. That body was thin*'); the control condition confirmed baseline interpretations. Training was tailored to individual differences, such that participants were trained to judge bodies near their baseline categorical boundary. Training led to significantly large shifts in categorical boundaries (i.e., shifted boundaries towards larger bodies) in body dissatisfied women (d = -.80) and those

with atypical anorexia (*d* = -.79) immediately following training, with changes persisting 1-month follow-up for the atypical anorexia sample (*d* = -.76). The second study conducted secondary analyses on ED-related bias and psychopathology in those with heightened body dysmorphic symptomatology (Summers & Cougle, 2018), following five sessions of CBM-I (Summers & Cougle, 2016). Secondary analyses (2018) indicated that CBM-I led to significantly large reductions in negative/threat appearance-related bias (*d* = -1.67) and increases in positive/benign bias (*d* = 1.34).

A new avenue of ED-related CBM research has explored the modification of negative socio-emotional biases within ED samples (Cardi et al, 2015; Turton et al., 2018) given that interpersonal difficulties (Fairburn & Harrison, 2003) and social anxiety (Kerr-Gaffney, Harrison, & Tchanturia 2018) are postulated to be risk factors for EDs. The first socio-emotional based study used a combined CBM approach, whereby inpatients with anorexia nervosa underwent five consecutive CBM sessions (CBM-A preceded CBM-I) within a two-week period (Cardi et al., 2015). The CBM-A approach (attention towards positive social stimuli, away from negative) was associated with significant moderate to large increase in attentional bias for positive social cues (e.g., smiling faces; *d* ranging between -.54 and 1.30). Meanwhile, the CBM-I condition, which trained benign interpretations of socially threatening scenarios, was also associated with significant moderate increases in benign interpretations (*d* = -.57). A second study utilised a single-session design to comparatively examine a CBM-I intervention (100% benign interpretations) to a control condition (50% benign and 50% negative interpretations) in ameliorating negative social interpretation bias in women with anorexia nervosa (Turton, Cardi, Treasure, & Hirsch, 2018). Following the single-session, the intervention and control conditions performed commensurately in modifying bias; however, only the intervention condition was associated with significant within-group changes.

Psychopathology. Six of the seven studies investigated the impact of CBM-I on ED-related psychopathology, with the exception of Williamson et al. (2000). The effects of CBM-I on psychopathology mirror that of bias change, with appearance-based paradigms associated with significant moderate to large effects on state and trait psychopathology (Gledhill et al., 2017; Matheson et al., 2018; Summers & Cougle, 2018), while self-worth protocols led to significant moderate cognitive and behavioural changes (Yiend et al., 2014). Socio-emotional approaches however, had no impact on ED psychopathology (Cardi et al., 2015; Turton et al., 2018)

Appearance-based CBM-I proved largely effective at ameliorating risk and ED psychopathology in both non-clinical (Matheson et al., 2018) and subclinical (Gledhill et al., 2017; Summers & Cougle, 2018) samples. Firstly, Matheson et al (2018) demonstrated significant moderate improvements in state appearance satisfaction (d =.61) in an unselected sample, following a single-session of CBM-I for appearance. Second, Summers and Cougle (2018) extended these findings to trait ED psychopathology, with five CBM-I sessions leading to reduced bulimia scores in those with high pre-treatment symptomatology; however, values for these effects were not available. Third, Gledhill et al., (2017) demonstrated large shifts in trait ED psychopathology (dietary restraint, weight and shape concerns and global ED scores on the Eating Disorder Examination Questionnaire; Fairburn & Beglin, 1994) in body dissatisfied women following four sessions of CBM-I, with effects maintained at two-week follow-up. These effects, however, were not replicated in a clinical sample (atypical anorexia), despite large shifts in bias.

Self-worth based paradigms developed by Yiend et al (2014) demonstrated the causal relationship between bias and subsequent symptom change, following a single-session of CBM-I. Specifically, negative interpretations were associated with increased small to moderate increases in depression (d = -.16), dietary restriction (d = .57) and intrusive

thoughts related to weight and shape during a mirror exposure task (d = -.53), of which the latter two were significant. Meanwhile, positive interpretations led to small to moderate reductions in anxiety, depression, negative affect and intrusive thoughts during two behavioural tasks (mirror exposure and weighing); however, effects were only significant for reductions in thoughts during weighing.

Discussion

The current systematic review is the first to critically synthesize the emerging body of literature examining the efficacy of both CBM-A and CBM-I on appearance and self-worth related bias and ED psychopathology. Overall, our findings give preliminary support to CBM-A and CBM-I efficacy within non-clinical, subclinical and clinical populations, however no firm conclusions can be drawn due to the limited number of investigations and the high degree of heterogeneity across the twelve studies.

CBM-A

Overall, CBM-A was largely ineffective at eliciting bias and symptom change in non-clinical samples, with only one of five studies demonstrating CBM-A efficacy (Smith & Rieger, 2009). Significantly large intervention effects on bias were observed within subclinical (Allen et al., 2018) and clinical samples (Cardi et al., 2015). However, similarly to non-clinical samples, positive symptom change was not observed within these groups. This pattern of results aligns with a recent meta-analysis on CBM meta-analyses (Jones & Sharpe, 2017), which highlights the robust effects associated with CBM-A and bias change (effects ranging between .24 and 1.16), and the less convincing effects associated with symptom reduction, particularly for depression and eating disorder symptomatology (Jones & Sharpe, 2017).

With respects to bias change, the current review revealed significantly large shifts in bias across the varying degrees of psychopathology, including non-clinical (d ranging

between .89 and 1.08; Smith & Rieger), subclinical (d = 1.03; Allen et al., 2018) and clinical samples (d ranging between .54 and 1.30; Cardi et al., 2015). While encouraging, the small number of included studies limits the reliability and generalisability of these effects, and therefore interpretation of these findings is preliminary. First, the limited efficacy of CBM-A on bias change in the current non-clinical samples is not unsurprising, given the adaptive cognitive patterns (i.e., no bias or a mild positive bias) displayed by this sample prior to CBM. Subsequently, healthy individuals are less sensitive to manipulations designed to promote positive or reduce negative biases, due to an already restricted range of possible change (Yiend, Savulich, Coughtrey, & Shafran, 2011; Hirsch & Mathews, 2000). The current results support this notion, with Allen and colleagues (2018) finding large reductions in negative-appearance bias (d = 1.03) in a body dissatisfied subsample, using the same neutral CBM-A training found ineffective in a non-clinical sample (Loughnan et al., 2015). Second, the limited effects may be attributable to methodological differences across the five CBM-A studies. Specifically, the number of distinct stimuli pairs and training trials has shown to moderate CBM-A efficacy, with greater distinctness and training trials associated with greater bias change (Heeren, Mogoașe, Philippot &, McNally, 2015). Smith and Rieger (2009), the only study to elicit bias change in a non-clinical sample, produced significantly large effects with CBM-A paradigms that incorporated 20 distinct stimuli pairs over 240 trials, while negligible effects were associated with CBM-A approaches utilising 10 stimuli pairs and 160 trials (Allen et al., 2018; Loughnan, et al., 2015). Heeren and colleagues (2015) propose that the greater number of stimuli pairs increases generalisation, as well as reduces habituation to- and boredom of training material; meanwhile greater number of trials increases the rate, intensity and duration of bias change (i.e., dose-response relationship). Thus, future research should explore the optimum number of stimuli pairs and training trials required to elicit positive bias change across varying degrees of psychopathology.

With respects to symptom change, the current review found minimal support for CBM-A efficacy in reducing ED-related risk factors or psychopathology. These results are not surprising, given previous reviews into the causal relationship between bias change and subsequent symptom reduction. Specifically, Grafton and colleagues (2017) conducted a re-analysis of the Cristea et al. (2015a) meta-analysis, finding that when bias was successfully modified, so too were symptoms; equally, unsuccessfully modifying bias, resulted in no symptom change. The current findings partially support this hypothesis, however more research is needed to confirm the causal relationship between non-disorder salient biases and reduced ED psychopathology.

Overall, findings suggest that bias change is possible in unselected samples if CBM-A incorporates a multitude of distinct stimuli pairs (e.g., ≥ 20) and training trials (e.g., ≥ 240; Smith & Rieger, 2009). Further, the currents results provide preliminary support for CBM-A in modifying bias in varying degrees of psychopathology, however this bias change does not reliably lead to symptom change. Examining CBM-A in subclinical and clinical samples, may elicit larger and more reliable effects on both bias and psychopathology and thus aiding our understanding of the clinical utility of CBM-A.

CBM-I

Overall, CBM-I yielded larger effect sizes for both bias and symptom change, relative to CBM-A, which is consistent with a previous review into the relative efficacy of CBM approaches (Cristea, Kok, & Cuijpers, 2015a). Despite these more robust effects, a similar pattern of results emerged to CBM-A, with larger and more consistent effects observed across bias change than symptomatology. Specifically, appearance, self-worth and socio-emotional based approaches were all associated with moderate to large effects on bias change (*d* ranging between -1.67 and 1.30), while only appearance-based approaches proved effective at ameliorating psychopathology (*d* ranging between -1.30 and .61). The high degree of

heterogeneity across the seven studies (i.e., clinical severity, training paradigm and number of training sessions), as well as the moderating effects associated with these factors limits the generalisability of the current findings.

With respects to bias change, the current findings mirror that of previous meta-analyses, which indicate that CBM-I is largely effective at promoting positive and reducing negative bias in varying degrees of psychopathology (Hallion & Ruscio, 2011; Cristea, Kok, & Cuijpers, 2016; Menne-Lothmann et al., 2014). Previous meta-analyses have found support for moderating effects of clinical severity, training paradigm and number of training sessions of CBM-I on bias change (Cristea, et al., 2016; Menne-Lothmann et al., 2014); however, in the current review comparable effects were revealed across all three factors. Due to the small number of studies, formal moderation analyses were not conducted in the current review. Therefore, as the number of ED-related CBM studies increases, future research should aim to conduct a meta-analysis in order to determine which paradigm parameters promote bias modification, as well as the sample types most susceptible to intervention effects.

With respects to symptom change, evidence of CBM-I efficacy was relatively weak across the seven studies, with only appearance-based approaches proving effective. While encouraging, appearance-based approaches only influenced core ED psychopathology (body dissatisfaction, dietary restriction, weigh/shape concerns), with no impact on secondary outcomes (i.e., anxiety, depression). This is consistent with previous efforts, which provide less support for CBM efficacy on secondary outcomes, relative to primary outcomes (Mogoaşe, David, & Koster, 2014). Although the self-worth and socio-emotional based approaches were relatively effective at modifying bias, neither approach ameliorated ED psychopathology (Cardi et al., 2015; Matheson et al., 2018; Turton et al., 2018; Yiend et al., 2014). First, with regards to the self-worth paradigms, the null effects reported by Matheson colleagues (2018) are unsurprising, given that no bias change was observed; thus further

supporting the causal hypothesis. It is surprising, however, that Yiend and colleagues (2014) found limited evidence of positive symptom change (1 out of 9 outcomes), given the significantly large increases in positive self-worth related interpretations (d = 1.20). Taken together, these findings suggest that while a single-session of CBM-I may be effective at eliciting bias change, additional training sessions may be required to elicit sustainable positive symptom change. Second, with regards to the socio-emotional based paradigms, a major limitation of these studies was the omission of interpersonal and social performance related variables. Although attentional and interpretation biases for negative social stimuli have been proposed to trigger ED-related behaviours (Goss & Gilbert, 2002, Rieger et al., 2010), this causal relationship has yet to be demonstrated. Therefore, in future research, primary measures of socio-emotional CBM approaches should include assessments of interpersonal and social functioning (e.g., Interpersonal Insecurity and Alienation subscales from the Eating Disorder Inventory; Garner, 2004), with ED-related variables being secondary outcomes.

Overall, there is preliminary evidence supporting CBM-I efficacy at modifying at ED-related interpretation bias and symptomatology across varying degrees of psychopathology, utilising both single- and multi-session designs. While encouraging, the reliability and robustness of CBM-I paradigms to produce large and sustainable bias and symptom change in EDs is unknown, which is, in part, due to lack of replication and few studies conducting follow-up assessments. Therefore, future research should seek to replicate, as well as extend on the previous designs by assessing both immediate, intermediate and long-term effects of CBM-I.

Implication of findings & methodological considerations

Methodological rigor and innovation are imperative in shaping our evaluations and understanding of CBM efficacy in the ED field. The current review highlights various

methodological shortcomings within and across studies that are likely to impede interpretations of the findings. First, although nine of the twelve studies incorporated pre- and post-assessments of *both* bias and symptomatology, only four studies conducted follow-up assessments and therefore the sustainability of CBM effects in ED samples remains unclear. Although previous CBM reviews have shown that successful bias modification leads to reduced symptomatology (e.g., Clarke et al., 2014; Grafton et al., 2017; Jones & Sharpe, 2017), this causal relationship has not consistently emerged in ED-related studies. In future CBM studies, common practice should include multiple assessments points of bias, as well as state and trait symptomatology, to accurately assess the trajectory of short- and long-term effects of CBM.

Second, a majority of the included studies assessed CBM-A and CBM-I in isolation. In a review on CBM, MacLeod (2012) highlighted emerging evidence to support the delivery of CBM-A and CBM-I in combination. Study designs contrasting the clinical efficacy of CBM-A and CBM-I alone and in combination are needed so that future evaluations can determine whether a hybrid approach is substantially more effective than using the modification techniques separately.

Third, the current investigations only assessed CBM in highly controlled environments; thus, while there is support for CBM efficacy, effectiveness (performance under 'real-world' conditions) of the interventions is unknown. Future evaluations should move beyond the laboratory and incorporate the intervention into real-world settings to better assess the practical application of CBM. In addressing these shortcomings, the literature will be able to better assess the therapeutic value of CBM, relative to other treatment paradigms already shown to impact ED-related bias and symptomatology.

Fourth, modifying maladaptive cognitive patterns is a cornerstone for evidence-based ED interventions. Cognitive behaviour therapy (CBT) for EDs has led to significant

reductions in eating, shape, and weight-related attentional bias (Shafran, Lee, Cooper, Palmer, & Fairburn, 2008), but the degree to which CBM techniques can supplement existing evidence-based ED interventions is unknown. Directions for future research in this area include comparatively examining the impact of CBM (both attentional and interpretation), CBT and a combined approach (CBM +CBT) on ED psychopathology.

Limitations of the review

The current review only reports on the effects of peer reviewed publications and does not consider the findings of unpublished data, and therefore does not necessarily provide an accurate representation of CBM, due to the numerous studies subjects to publication bias. Given that CBM is an emerging field within EDs, future reviews are encouraged to invite and incorporate unpublished data from authors within the field (Menne-Lothmann et al., 2014). Second, although the current review sought to provide a critical synthesis of the literature, the insufficient power did not allow for a meta-analysis of CBM effects. Thus, with the progressive development of this small body of literature, future research should seek to assess CBM findings using meta-analytic approaches.

Conclusion

The current review is the first to systematically examine both CBM-A and CBM-I within ED psychopathology. Overall, the findings give preliminary support for the both intervention approaches in eliciting bias and symptom change, with appearance-based CBM-I proving most efficacious. While the current review provides preliminary support for the use of CBM in at risk and ED populations, the supports is limited to experimental settings, with effects yet to be observed beyond the laboratory. Future research that addresses the current methodological shortcomings of extant studies is required in order to understand the therapeutic potential of CBM in ED psychopathology.

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Table 1

Characteristics and Authors' Reported Results of CBM-A Studies Included in the Review

Study (year)	Sample	Paradigm	Stimuli	Design and Conditions (N)	Outcomes	Authors' Reported Results
Allen et al. (2018)	Female undergraduates; General public	MDPT	Words: -ve appearance; +ve appearance; Neutral.	Between group: 160 trials attending to +ve appearance and avoid -ve (31); 160 trials attending to neutral and avoid –ve appearance (37); 160 trials placebo (control; 34).	AB; BISS	No significant within or between group changes on state BD. No significant within or between group changes on AB. Neutral training significantly reduced AB for negative appearance stimuli in women high on appearance importance
Engel et al. (2006)	Female undergraduates	MDPT	Words: W/S; Neutral.	Between group: 15 mins attending to W/S and avoiding neutral (40); 15 mins attending to neutral and avoid W/S (33).	EDI-2: BD; Bulimia; Drive for thinness (only assessed post CBM-A)	No significant between group changes on BD or drive for thinness. Bulimia significantly higher in those attending to neutral stimuli, relative to attending to W/S stimuli.
Loughnan et al. (2015)	Female undergraduates; General public	MDPT	Words: -ve appearance; +ve appearance; Neutral.	Between group: 160 trials attending to neutral and avoid -ve appearance (37); 160 trials attending to -ve and neutral equally (control; 25).	AB; BISS; BSQ	No significant within or between group changes on AB or state and trait BD immediately post-CBM-A and 1- and 2-week FU.
Smeets et al. (2011[a])	Female undergraduates	Eye tracking	Images: Self-defined attractive and unattractive body parts.	Between group: 160 trials attending to attractive body parts (24); 160 trials attending to unattractive body parts, followed by a +ve counter induction 80 trials (23).	VAS: BS; WS; Mood	Attending to self-defined unattractive body parts significantly reduced body and weight satisfaction. A positive counter induction significantly increased body and weight satisfaction. No significant increase in body or weight satisfaction in those

						attending to self-defined attractive body parts; no significant within or between changes in mood.
Smeets et al. (2011[b])	Female undergraduates with high BD	Eye tracking	As above.	Between group: 320 trials attending to attractive body parts (11); 320 trials attending equally to various body parts (10).	As above	Attending to self-defined attractive body parts significantly increased body and weight satisfaction; no significant within or between changes in mood.
Smith & Rieger (2009)	Female undergraduates	MDPT	Words: -ve W/S; +ve W/S; -ve food (high calorie); +ve food (low calorie); Neutral.	Between group: Each CBM-A consisted of 240 trials. Attend -ve W/S (23); Attend +ve W/S (17); Attend -ve food (18); Attend +ve food (19); Attend neutral (19).	AB; PASTAS; Dietary restriction	All CBM-A significantly increased AB for target stimuli. Attending to -ve W/S words resulted in significantly higher BD and greater likelihood of dietary restriction relative to control. No significant differences between +ve W/S, -ve food, +ve food and control condition on state BD or dietary restriction.

Note. N = Sample size; CI = Confidence interval; OR = Odds ratio; -ve = Negative; +ve = Positive; W/S = Weight and shape; AB = Attentional bias; BD = Body dissatisfaction; BS = Body Satisfaction; WS = Weight satisfaction; CBM-A = Cognitive bias modification targeting attention; MDPT = Modified dot probe task; BDI = Beck Depression Inventory; BISS = Body Image State Scale; BSQ = Body Shape Questionnaire; EDI-2 = Eating Disorder Inventory-2; PASTAS = Physical Appearance State and Trait Anxiety Scale; VAS = Visual Analogue Scales; FU = Follow-up

Table 2

Characteristics and Authors' Reported Results of CBM-A Studies Included in the Review

Study	Sample (N)	Paradigm	Stimuli	Design and Conditions (N)	Outcomes	Authors' Reported Results
Cardi et al. (2015)	Females with AN	MDPT (AB); VST (AB); WCT (IB);	Images: +ve faces; -ve faces (MDPT and VST); Ambiguous social scenarios (WCT)	Within group: 96 trials of attending to +ve faces (CBM-A) followed by 18 benign social scenarios (CBM-I) × 5 sessions (28)	AB; IB; DASS; SEED; A-RSQ	Multi-session CBM-A significantly increased AB for +ve social stimuli as measured by the MDPT and VST. Multi-session CBM-I significantly reduced -ve IB, increased neutral IB, but did not increase +ve IB, as measured by the WCT. Neutral interpretations of test trials (used within training) increased between session 1 and 5. Multi-session CBM significantly reduced anxiety and rejection sensitivity, and increased self-compassion in response to critical feedback. No significant within group changes on ED symptomatology, self-confidence, positive mood, depression or stress.
Gledhill et al. (2017[c])	Female undergraduates with high BD	Perceptual training task	3D images of female bodies with differing BMI	Between group: 186 trials feedback corrected accuracy of body size judgements (20); 186 trials feedback confirmed participants' baseline evaluations of body size (20)	Body size judgements; EDE-Q; BDI	Perceptual training modified body size judgements improved dietary restraint, weight and shape concerns, and ED symptoms, relative to the control condition.

Gledhill et al. (2017[d])	Outpatients: Atypical AN	As above	As above	Within group: 186 trials where feedback was provided on accuracy of body size judgements × 4 sessions (21)	Body size evaluations; EDE-Q; Digit Span task (WAIS-R IQ)	Perceptual training modified body size judgements immediately post training, which were maintained at 1-month FU. No significant symptom change.
Matheson et al. (2018)	Female undergraduates	WCT	Ambiguous scenarios pertaining to +ve appearance, +ve self-worth and, imperative and declarative knowledge (neutral).	Between group: 67 +ve appearance scenarios (44); 67 +ve self-worth scenarios (37); 67 neutral scenarios (42)	IB; State BD and NA	CBM-I for appearance significantly increased AS and positive IB; no such effects were associated with CBM-I for CBM-I self-worth or control.
Summers & Cougle (2018)	Undergraduates and general public with high BDD symptoms	WSRT; WCT	-ve (e.g., insult) and +ve (e.g., compliment) appearance-related words (WSRT); appearance and non-appearance related sentences (WSRT) and scenarios (WCT)	Between group: 38 +ve/benign appearance sentences (WSRT) followed by 64 +ve/benign appearance scenarios (WCT) × 4 sessions (19); 38 neutral sentences (WSRT) followed by 64 neutral scenarios (WCT) × 4 sessions (19);	IB; EDI; Bulimia and drive for thinness	Multi-session CBM-I significantly reduced -ve IB and increased +ve IB, relative to control. Multi-session CBM-I significantly reduced bulimia symptomatology in those with high pre-treatment symptoms. No significant within or between groups changes on drive for thinness
Turton et al. (2018)	Females with AN	WCT	Ambiguous scenarios pertaining to -ve and benign social situations.	Within group: 90 benign scenarios followed by 90 scenarios with a 50:50 ratio between -ve and benign scenarios (55).	IB; BD VAS; EDE-Q; DASS; ARSQ; WSAS; Eating task; Salivary cortisol levels	No significant between group differences on IB, with both forms of CBM-I significantly reducing -ve IB. No significant within or between group changes on eating behaviours or cortisol levels.
Williamson et al. (2000)	EDs (30); BDD (30); HC (30)	Self-generated imagery	Ambiguous body, health and neutral scenarios.	Between group +ve self-imagery in response to 30 ambiguous body, health and neutral scenarios (45); -ve self-imagery in response to 30 ambiguous body, health and neutral	Fat and thinness-related IB	+ve self-imagery significantly reduced fat-related IB in those with ED symptomatology, but did not increase thinness-related IB as intended. +ve self-imagery had no impact on IB of those with BDD. -ve self-imagery did not significantly

				scenarios (45)		impact IB in the ED sample, but significantly increased fat-related IB in those with BDD.
Yiend et al. (2014)	Females with 5> on EAT–26	WCT	Ambiguous +ve and -ve self-worth related scenarios.	Between group: 67 +ve/neutral self-worth related scenarios (45); 67 -ve self-worth related scenarios (43)	IB; HADS; BDI-II); STAI; PANAS; EDE-Q; Behavioral tasks (eating, weighing and mirror exposure tasks)	+ve CBM-I led to significant increase in +ve IB and significant reductions in anxiety, depression, negative affect, intrusive W/S thoughts during weighing and mirror exposure. -ve CBM-I did not increase -ve IB, but did significantly increase depression, dietary restriction and intrusive thoughts during mirror exposure.

Note. N = Sample size; CI = Confidence Interval; -ve = Negative; +ve = Positive; W/S = Weight and shape; AB = Attentional bias; IB = Interpretation bias; BD = Body dissatisfaction; HC = Healthy Controls; AN = Anorexia Nervosa; BN = Bulimia Nervosa; EDNOS = Eating Disorder Not Otherwise Specified; ED = eating disorder; BDD = Body dysmorphic disorder; CBM-I = Cognitive bias modification targeting interpretation; MDPT = Modified dot probe task; WCT = Word Completion Task; WSRT = Word sentence relatedness task; ARSQ = Adult Rejection Sensitivity Questionnaire; BDI = Beck Depression Inventory; DASS = Depression Anxiety Stress Scales; EAT–26 = Eating Attitudes Test–26; EDE-Q = Eating Disorders Examination Questionnaire; EDI = Eating Disorder Inventory; HADS = Hospital Anxiety and Depression Scale; PANAS = Positive and Negative Affect Schedule; SEED = Short Evaluation of Eating Disorders; STAI = State-Trait Anxiety Inventory; VAS = Visual Analogue Scales; WSAS = Work and Social Adjustment Scale.

Table 3

CBM-A Studies' Effect Sizes as Calculated for the Systematic Review (for reported significant statistical test results only)

Study (year)	Conditions (N)	Bias Outcome	M (SD)		Cohen's *d* [95% CI]	Symptom Outcome		M (SD)		Cohen's *d* [95% CI]
Within group			Pre	Post				Pre	Post	
Allen et al. (2018)	Attend neutral, avoid –ve appearance (high appearance importance; 16)	AB –ve appearance	18.04 (42.71)	-18.59 (26.31)	**1.03 [.30 to 1.77]**					
Smeets et al. (2011[a])	Attend unattractive body parts (23)					BS		5.91 (2.15)	4.95 (2.11)	.45 [-.13 to 1.04]
						WS		5.88 (1.93)	5.25 (1.92)	.33 [-.25 to .91]
	Attend attractive body parts (counter induction; 23)					BS		4.95 (2.11)	5.58 (2.08)	-.30 [-.88 to .28]
						WS		5.25 (1.92)	5.80 (1.89)	-.29 [-.87 to .29]
	Attend attractive body parts (24)					BS		5.64 (1.64)	5.76 (1.65)	-.07 [-.64 to .49]
						WS		5.80 (2.02)	5.73 (1.82)	.04 [-.53 to .60]
Smeets et al. (2011[b])	Attend attractive body parts (11)					BS		3.45 (1.65)	4.89 (1.85)	-.82 [-1.69 to .05]
						WS		3.63 (1.98)	4.97 (2.04)	-.67 [-1.53 to .19]

Study (year)	Conditions (n)		Bias Outcome	t (*p*)	Cohen's *d* [95% CI]	Conditions	Symptom Outcome		M (SD)		Cohen's *d* [95% CI]
Between group at post-intervention									Group 1	Group 2	
Engel et al. (2006)						Attend W/S[1] (40) vs. Avoid W/S[2] (33)	Bulimia		34.33 (5.02)	36.79 (4.19)	**-.52 [-.53 to -.06]**
Smith & Rieger (2009)	Attend -ve W/S (23)	vs. control (19)	AB -ve W/S	2.96 (.004)	**.94 [-1.56 to-.28]**	Attend -ve W/S[1] vs. control[2]	Body dissatisfaction		16 (6.16)	11 (5.70)	**.84 [.21:1.47]**
	Attend +ve W/S (17)		AB +ve W/S	3.07 (.003)	**1.02 [.33 to 1.72]**						
	Attend -ve food (18)		AB -ve food	3.29 (.002)	**1.08 [39 to 1.77]**	Attend -ve food[1]	Food consumption[d]	Low fat cookie	66.7%	28.6%	**4.32[c] [0.44 to .91]**

Attend +ve food (19)	AB +ve food	2.74 (.008)	**.89 [.22 to 1.56]**	vs. control[2]	Full fat cookie	33.3%	71.4%	

Note. For each significant result reported in the original paper we used the published means and standard deviations to calculate a corresponding effect size and its 95% confidence interval (CI). If the CI is entirely above or below zero we conclude that the effect is significant (denoted by **bold**). On occasions this can mean an author reported a significant statistical test, but the effect size was non-significant. Under these conflicting conditions our review uses the effect size criterion for significance and the result would be classified as non-significant (e.g. Smeets et al., 2011). A negative effect size indicates that the first group or observation was lower than the second group or observation and a positive effect size indicates that the first group or observation was higher than the second. Cohen's d effect sizes are defined as: negligible (= 0 and < .15), small (≥.15 and <.40), medium (≥.40 and <.75), large (≥0.75 and <1.10), very large (≥1.10 and <1.45) and huge (≥1.45). -ve = Negative; +ve = Positive; AB = Attentional bias; IB = Interpretation bias; BS = Body satisfaction; WS = Weight satisfaction; W/S = Weight and shape.

a Study one of Smeets et al. (2011)

b Study two of Smeets et al. (2011)

c Odds ratio for choosing low fat vs. full fat cookie following CBM-A

Table 4

CBM-I Studies' Effect Sizes as Calculated for the Systematic Review (for reported significant statistical test results only)

Study (year)	**Conditions (N)**	**Bias Outcome**	**M (SD)**		**Cohen's *d* [95% CI]**	**Symptom Outcome**	**M (SD)**		**Cohen's *d* [95% CI]**
Within group			Pre	Post			Pre	Post	
Cardi et al. (2015)	Attend +ve faces (CBM-A) and interpret benign social scenarios (CBM-I) × 5 sessions (28)	+ve AB social stimuli (MDPT)	-10.6 (45.6)	9.7 (27.1)	**-.54 [-1.07 to -.01]**	Anxiety	23.4 (9.9)	20.8 (11.2)	.25 [-.28:.77]
		+ve AB social stimuli (VST)	1222.6 (235.3)	949.0 (182.6)	**1.30 [.72 to 1.88].**	Rejection sensitivity	18.8 (6.4)	17 (6.3)	.28 [-.24:.81]
		-ve IB (WCT)	6.2 (2.8)	5.0 (2.8)	.43 [-.10 to .96]				
		Neutral IB (WCT)	2.3 (1.8)	3.3 (2.0)	-.53 [-1.06 to .01]	Self-compassion	1.7 (1.9)	2.9 (2.8)	-.50 [-1.03:.03]
		Neutral IB (test items in WCT)	2.1 (1.5)	2.9 (1.3)	**-.57 [-1.10 to -.04]**				
Gledhill et al. (2017)	Perceptual training × 4 sessions (21)	Body size judgments (Immediately post)	19.2 (2.33)	21.90 (4.26)	**-.79 (-1.41 to -.16)**				
		Body size judgments (1-month FU)	19.2 (2.33)	21.88 (4.38)	**-.76 [-1.39 to -.14)**				
Matheson et al. (2018)	+ve appearance interpretations (44)	+ve IB	.35 (.08)	.72 (.09)	**-.66 [-1.10 to -.23]**	Appearance satisfaction	39.84 (3.94)	55.75 (4.04)	**.61 [.18 to 1.04]**
Turton et al. (2018)	Benign interpretations (55)	-ve IB	5.47 (2.65)	4.05 (2.72)	**.53 [.15 to .91]**				
	-ve/benign interpretations (55)	-ve IB	5.73 (2.68)	4.74 (2.59)	.38 [-.001 to .75]				
Williamson et al. (2000)	+ve self-imagery in ED (15)	Fat-related IB	1.4 (.44)	2.0 (.71)	**-1.02 [-1.78 to -.26].**				
	-ve self-imagery in BDD (15)	Fat-related IB	1.8 (.49)	1.5 (.43)	.49 [-.24:1.22]				
Yiend et al. (2014)	+ve self-worth interpretations (45)	+ve IB	2.99 (.54)	2.24 (.70)	**1.20 [.75 to 1.65]**	Anxiety	6.68 (3.3)	5.96 (3.18)	.22 [-.19 to .64]
						Depression	7.69 (4.95)	6.69 (4.56)	.21 [-.20 to .62]
						Negative affect	44.84 (7.6)	41.68 (8.14)	.40 [-.02 to .82]
						Intrusive thoughts mirror	5.94 (3.21)	4.74 (3.14)	.38 [-.04 to .79]

							Intrusive thoughts weighing	6.93 (3.19)	5.23 (3.19)	**.53 [.11 to .95]**
	-ve self-worth interpretations (43)						Depression	3.05 (2.91)	3.56 (3.37)	-.16 [-.59 to.26]
							Food consumption	2.33 (1.49)	1.65 (.78)	**.57 [.14 to 1.00]**
							Intrusive thoughts mirror	4.86 (3.04)	6.62 (3.56)	**-.53 [-.96 to -.10]**

Study (year)	**Conditions (n)**	**Outcome**	**M (SD)**		**Cohen's *d* [95% CI]**	**Conditions (n)**	**Symptom Outcome**	**M (SD)**		**Cohen's *d* [95% CI]**
Between group at post-intervention										
			1	2				FU	1	2
Gledhill et al. (2017a)	Perceptual training[1] (20) vs. control[2] (20)	Body size evaluations	20.23 (3.57)	22.66 (2.41)	**-.80 [-1.44 to .15]**	Perceptual training[1] (20) vs. control[2] (20)	Dietary restraint	4	2.31 (1.23)	3.41 (1.31)	**-.87 [-1.51 to -.22]**
								14	2.13 (1.18)	3.41 (1.38)	**-1.0 [-1.65 to -.34]**
							Weight concern	4	3.70 (1.02)	4.66 (.82)	**-1.03 [-1.70 to -.38]**
								14	3.59 (.94)	4.73 (.81)	**-1.30 [-1.98 to -.62]**
							Shape concern	4	3.29 (1.19)	4.21 (.78)	**-.91 [-1.56 to -.26]**
								14	3.00 (1.24)	4.18 (.83)	**-1.12 [-1.78 to -.45]**
							ED Global	4	2.81 (.97)	3.77 (.82)	**-1.07 [-1.73 to -.41].**
								14	2.64 (1.08)	3.73 (.91)	**-1.13 [-1.79 to -.46]**
Summers & Cougle (2018)	CBM-I[1] (19) vs control[2] (19)	-ve IB	2.07 (.76)	3.39 (.82)	**-1.67 [-2.41 to -.93]**					
		+ve IB	4.74 (.83)	3.67 (.76)	**1.34 [.64 to 2.05]**					

Note. For each significant result reported in the original paper we used the published means and standard deviations to calculate a corresponding effect size and its 95% confidence interval (CI). Where the CI that we calculated differs from zero we conclude that the effect is significant (denoted by **bold**). On occasion this can mean a significant result on an author-reported statistical test, but an effect size which we cannot be 95% confident is greater than zero. Under these conflicting conditions our review uses the effect size criterion for significance and the result would be classified as non-significant. Cohen's d effect sizes are defined as: negligible (= 0 and < .15), small (≥.15 and <.40), medium (≥.40 and <.75), large (≥0.75 and <1.10), very large (≥1.10 and

<1.45) and huge (≥1.45). -ve = Negative; +ve = Positive; AB = Attentional bias; IB = Interpretation bias; BS = Body satisfaction; WS = Weight satisfaction; W/S = Weight and shape. A negative effect size indicates the first group or observation was lower than the second group or observation and a positive effect size indicates that the first group or observation was higher than the second.

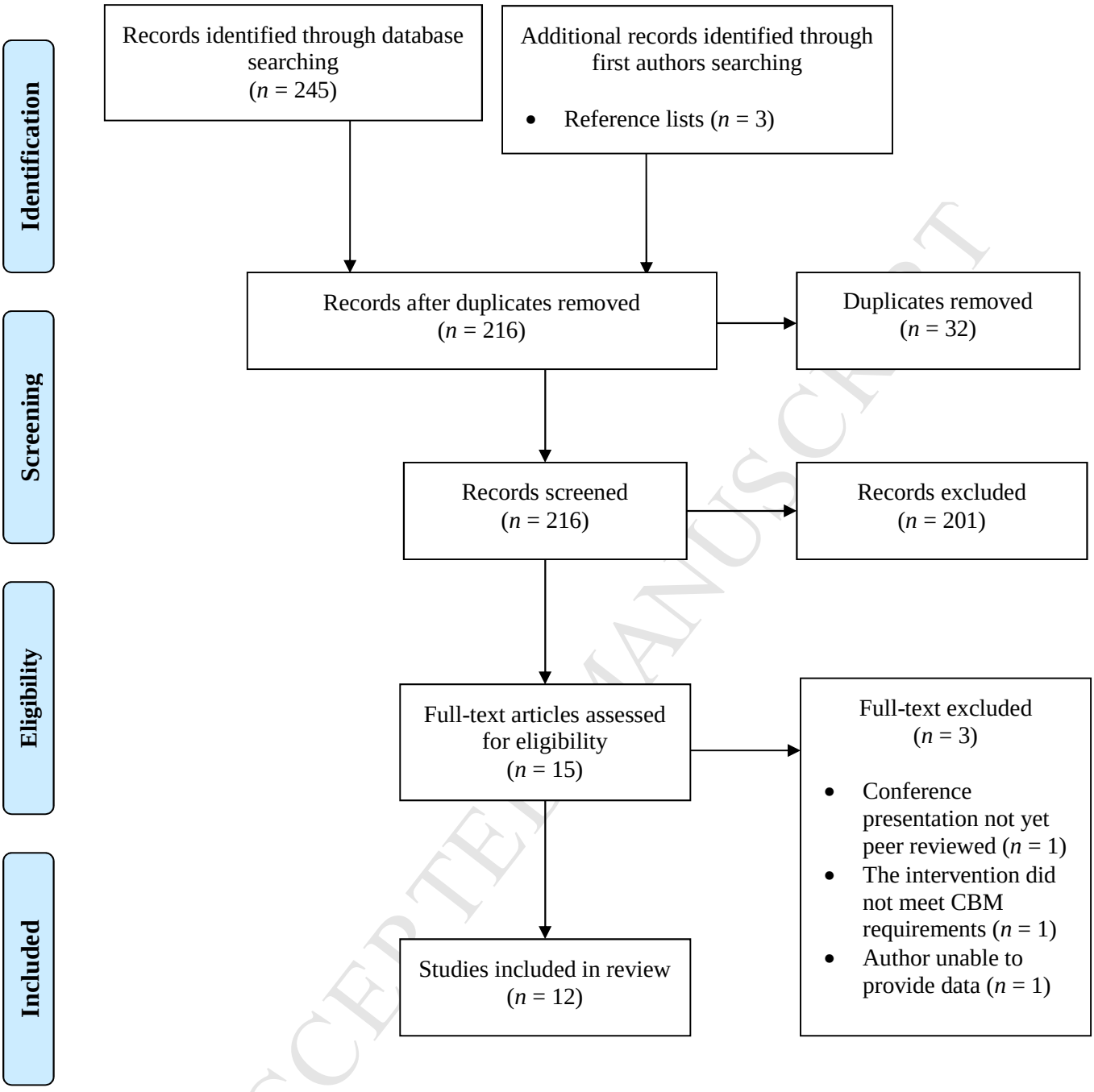

Figure 1. PRISMA diagram summarising the search process

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Highlights

- First systematic review conducted on CBM in eating disorder psychopathology
- Appearance-based CBM-I were effective at modifying bias and symptomatology
- CBM-A was ineffective at eliciting bias and symptom change in non-clinical samples
- CBM is not a standalone treatment but may supplement evidence-based ED treatments

Conflict of Interest and Authorship Conformation Form

Please check the following as appropriate:

- o All authors have participated in (a) conception and design, or analysis and interpretation of the data; (b) drafting the article or revising it critically for important intellectual content; and (c) approval of the final version.
- o This manuscript has not been submitted to, nor is under review at, another journal or other publishing venue.
- o The authors have no affiliation with any organization with a direct or indirect financial interest in the subject matter discussed in the manuscript
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The authors whose names are listed certify that they have no conflicts of interests to disclose.