# Cognitive Bias Modification in Eating Disorders: An Investigation into the Extent to which Appearance and Self-worth Related Biases Influence Risk for Eating Disorder Psychopathology

By

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## ABSTRACT

Eating disorder psychopathology is associated with a propensity to overvalue and prioritise stimuli related to appearance (weight and shape), food and self-worth. Historically food-related biases have been the focus of research, but recent attention has turned to the association between cognitive bias related to appearance and self-worth and eating disorder psychopathology and its risk factors. Despite robust evidence to support the relationship between these cognitive biases and risk for eating disorder psychopathology, investigations into the use of Cognitive Bias Modification (CBM) within eating disorders remain in its infancy, with only a handful of studies existing.

The purpose of this thesis was to expand on the preliminary research into CBM for two eating disorder risk factors, body dissatisfaction and negative affect. Initially, we conducted a pilot study, investigating the comparative efficacy of three novel interventions targeting the automatic processing system in young women ($N$ = 91). We examined CBM targeting attention (CBM-A) for appearance, evaluative conditioning, and a visuospatial task, Tetris. CBM-A and Tetris were associated with significant improvements in appearance satisfaction, distress over feelings and negative affect, relative to the evaluative conditioning group.

The next study examined three CBM approaches (CBM-A for appearance, CBM-A for self-worth, and CBM-I for self-worth) relative to the active comparison condition, Tetris. We sequentially examined the degree to which attentional and interpretation bias for negative and positive appearance and self-worth related stimuli exacerbated and ameliorated body dissatisfaction and negative affect in an unselected sample of female undergraduate students ($N$ = 67). All three CBM approaches effectively induced body dissatisfaction, but not negative affect. No CBM technique significantly improved state outcomes but moderation of intervention effects was detected. First, participants with higher levels of negative affect

experienced a significant improvement in appearance satisfaction using Tetris. Second, women with high levels of dispositional body dissatisfaction, anxiety and depression in the CBM-A for appearance condition experienced greater improvements and reductions in weight satisfaction and negative affect, respectively. Third, women with high levels of anxiety in the CBM-I for self-worth condition experienced greater improvements in negative affect.

The third study focused exclusively on interpretation bias, comparing the existing CBM-I for self-worth paradigm to the newly developed CBM-I for appearance paradigm in modifying interpretation bias and symptomatology in young women ($N$ = 123). The CBM for appearance protocol produced significant changes in the targeted bias, as well as significant improvements (associated with moderate effect sizes) in appearance satisfaction, relative to the CBM-I for self-worth and CBM-I control conditions.

The final study was a randomised controlled trial which examined the long terms effects of multi-session CBM-I for appearance, CBM-I for self-worth, and a CBM-I control condition on eating disorder-related bias and symptomatology in body dissatisfied women ($N$ = 74). Completer analyses indicated that all three conditions changed positive bias; CBM-I for appearance (d = -3.50 [-.4.46 to -.2.53]) and CBM-I for self-worth (d = -1.2 [-1.83 to -.57]) significantly increased in bias while the CBM-I control condition significantly reduced positive bias (d = 1.07 [.33 to 1.82). Intent-to-treat analyses, however, showed no significant differences emerging between the interventions and the control condition. Changes to trait variables following one week of CBM-I home practice showed all three conditions had comparable effects on global eating disorder psychopathology, negative affect and clinical impairment at 2-week follow up.

In sum, the current findings give support to CBM interventions when conducted in an experimental setting, however we note that Tetris and control conditions for CBM-I had

similar effects to the CBM paradigms. We address limitations in the current methodology and discuss potential avenues for future research to investigate the application of CBM and other novel interventions in the prevention of eating disorder psychopathology.

## DECLARATION

I certify that this thesis does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text.

Emily Matheson

BPsycHons

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# CHAPTER 1

## Overview and Aims of Research

## Cognitive Biases and Eating Disorders

The transdiagnostic cognitive behavioural theory of eating disorders conceptualises the over-evaluation of controlling one's weight, shape and eating as core psychopathology (Fairburn & Cooper, 1993). Specifically, an individual judges their self-worth largely, or even exclusively on, their ability to control weight, shape and/or eating. The transdiagnostic model (Fairburn, 2008a; Fairburn, Cooper, & Shafran, 2003) identifies this self-evaluation as being pivotal to the engagement in dietary restriction; compensatory weight control behaviours (i.e. laxative use and purging); binge eating and/or significant weight loss. These behaviours increase preoccupation and dissatisfaction with one's physical appearance and self-worth creating the vicious cycle of an eating disorder. Due to the increasing prevalence, adverse consequences and costly interventions associated with eating disorders, evaluations of preventative treatment approaches have grown. One avenue of research includes the examination of novel interventions that assess for and modify cognitive biases pertaining to appearance and self-worth in those at greatest risk of eating disorder psychopathology, namely body dissatisfaction and negative affect (Jacobi & Fittig, 2011).

Investigations show that those at risk of eating disorder psychopathology demonstrate attentional, interpretation and memory biases for stimuli pertaining to appearance (weight and shape), food and self-worth (see Brooks, Prince, Stahl, Campbell, & Treasure, 2011; Jiang & Vartanian, 2018; Rodgers & Dubois, 2016 for reviews). Specifically, individuals selectively attend to, and have difficulty disengaging from, disorder-relevant stimuli (attention bias); they endorse appearance, self-worth or dietary explanations for ambiguous events or outcomes (interpretation bias); and memories relating to this information are easily activated and readily recalled (memory bias). In turn, these biases contribute to individuals making negative or unhelpful judgements about themselves, other individuals, and how the world functions.

## Applying Cognitive Bias Modification to Risk for Eating Disorders

Cognitive bias modification (CBM), originating in anxiety and depression research, seeks to manipulate maladaptive cognitive patterns shown to known contribute to the development and maintenance of various psychopathologies (Mathews & MacLeod, 2002). Techniques targeting attentional bias (CBM-A) aim to manipulate implicit selective attention for disorder-salient information (MacLeod, Rutherford, Campbell, Ebsworthy, Holker, 2002), while paradigms targeting interpretation bias (CBM-I) seek to constrain individuals' interpretations of ambiguity to one particular theme (Matthews & Mackintosh, 2000). A unique feature of CBM is the transferability of assessment and modification paradigms between psychopathologies, with paradigms easily adjusted to incorporate disorder-salient stimuli associated with various psychopathologies.

At the time of commencing this thesis there was a strong body of research examining the assessment and modification of food-related biases related to eating disorder psychopathology (Brooks et al., 2011; Dobson & Dozois, 2004; Faunce, 2010; Lee & Shafran, 2004; Williamson, Muller, Reas, & Thaw, 1999). In contrast, less attention was paid to assessing and modifying appearance and self-worth related biases. Prior to this thesis, seven studies had investigated the impact of CBM on attentional ($n$ = 4) and interpretation ($n$ = 3) biases for appearance and self-worth related information, and the subsequent impact on eating disorder psychopathology. Overall, findings gave preliminary support for CBM efficacy. However, the limited number of studies, high heterogeneity between methodologies, and highly controlled laboratory conditions in which the studies were conducted, limited the generalisability and clinical applicability of findings. Further, these preliminary effects had yet to be replicated, with no approach being tested more than once. Nor had a study examined multi-session or longer-term effects of CBM. Methodological shortcoming were also evident within these early investigations, including the exclusion of pre- and post-measures of bias

and/or symptomatology, the misuse of trait measures to assess immediate effects of CBM and poor content specificity (i.e., the use of disorder-relevant stimuli [i.e., the terms slim, thin etc.] as a means to improve disorder-salient bias and symptomatology). While these preliminary effects give reason to believe that CBM has therapeutic potential in the prevention and intervention of eating disorder psychopathology, future research is needed before robust conclusions can be made.

## Aims of the Current Research

The primary purpose of this thesis was to examine the impact of CBM approaches on eating disorder-salient biases and symptomatology in order to determine which protocols show promise as interventions. This included the comparative examination of CBM-A with other novel interventions thought to modify eating disorder psychopathology, investigating the causal effects of negative and positive disorder-salient stimuli on symptomatology, the development of a new CBM-I for appearance protocol, and the examination of multi-session and long-term effects of CBM-I in a high risk sample. Summarised below are the specific aims and results for each of the five studies that comprise the thesis.

## Summary of Chapters

The first study is a systematic review (**Chapter 2**) that provides a critical synthesis of the current literature pertaining to Cognitive Bias Modification (CBM) related to eating disorders. The review was guided by the PRIMSA evaluation framework to examine CBM efficacy in ameliorating eating disorder-salient biases and subsequent psychopathology. The review also considered methodological shortcomings associated with the literature and provided directions for future research. A version of the chapter was submitted to the *Journal of Behavior Therapy and Experimental Psychiatry* and is currently under review.

In addition to CBM, other approaches have proven effective at targeting and modifying biased cognitive processes thought to perpetuate psychopathology. Two of these

approaches, namely evaluative conditioning and the visuospatial task Tetris, were used as comparison conditions in the current thesis. Thus an overview of these approaches and a rationale for their inclusion as comparators is provided in **Chapter 3**.

The results from an initial pilot study are presented in **Chapter 4**, a comparative examination of three interventions thought to target the automatic processing system: CBM-A for appearance, evaluative conditioning, and Tetris. The study sought to determine which approach was most effective at ameliorating state levels of body dissatisfaction and negative affect. Participants ($N$ = 91) were young (aged 17-25 years) female undergraduate students. A single session of CBM-A and Tetris led to increased appearance satisfaction and reductions in distress and negative affect, relative to the evaluative conditioning approach. This paper was submitted to the *Journal of Behaviour Therapy and Experimental Psychiatry* and was subsequently rejected due to several methodological shortcomings. These limitations are discussed in the chapter and, where relevant, subsequent studies have incorporated these modifications into methodology.

The promising effects of CBM-A and Tetris were further explored in **Chapter 5.** The study expanded on the preceding methodology by comparatively examining three CBM approaches (CBM-A for appearance, CBM-A for self-worth, and CBM-I for self-worth) to Tetris. Using a mixed model design, where the induction valence was a within-subjects factors and the form of CBM training was a between-subject factors, we examined the degree to which negative and positive disorder-salient information exacerbated and subsequently ameliorated body dissatisfaction and negative affect, respectively. An unselected sample (N=67) of young female (17-25) undergraduate students was utilised. All three CBM approaches effectively induced body dissatisfaction, but not negative affect. No CBM technique significantly improved state outcomes, although CBM-A for appearance and CBM-I for self-worth were associated with changes in the predicted direction for all three outcomes

variables. Moderation of intervention effects were detected for those high in dispositional body dissatisfaction, anxiety and depression. This paper was submitted to *Behaviour Research and Therapy* and was subsequently rejected due to methodological shortcomings. These limitations are discussed, and where relevant, subsequent studies have incorporated these modifications into methodology.

Given the centrality of the modification of interpretation bias in cognitive behaviour therapy approaches for the treatment of eating disorders, the latter half of the thesis focused exclusively on evaluating CBM-I protocols. Expanding on the preceding findings related to CBM-I, **Chapter 6** addressed a key gap in the current literature with the development of a new appearance-based CBM-I protocol. The study compared this newly developed protocol to the existing CBM-I for self-worth protocol, and examined the degree to which these approaches modified disorder-salient bias and improved body dissatisfaction and negative affect. Participants ($N$ = 123) were young (aged 17-25 years) female undergraduate students. CBM-I for appearance was found to be most effective at ameliorating interpretations bias and symptomatology, relative to the CBM-I for self-worth and CBM-I control conditions. A version of this chapter has been published in the *International Journal of Eating Disorders* (Matheson, Wade, & Yiend, 2018), included as **Appendix B**.

The software used to administer the current CBM-I protocols allowed for the dissemination of training to move beyond the laboratory and into real-world settings. Subsequently, the final study (**Chapter 7**) was a randomised controlled trial that examined the long-term effects of multi-session CBM-I on eating disorder-salient biases and symptomatology in body dissatisfied women ($N$ = 74). The young women were randomised into one of three CBM-I conditions (appearance, self-worth, or control) and completed five days of home practice. Completer analyses indicated bias change in those who completed all three CBM condition, while no group differences emerged in the intent-to-treat analyses.

Using Linear Mixed Modelling, changes in trait eating disorder psychopathology were assessed, with all three conditions significantly reducing disordered eating, negative affect and clinical impairment between baseline and 2-week follow-up. This chapter is being prepared for publication.

The thesis concludes with a general discussion (**Chapter 8**) that summarises the key findings across all the studies, contextualises these against the current literature, considers study limitations, and provides suggestions for future research.

# CHAPTER 2

## A Systematic Review of the Impact of Cognitive Bias Modification on Eating Disorder Psychopathology

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**Author Contributions:**

EM led the study design, data collection, statistical analyses, results and interpretation, and manuscript preparation. TW contributed to the study design, statistical analyses, results and interpretation, and manuscript preparation.

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This chapter was submitted to the *Journal of Behavior Therapy and Experimental Psychiatry* is currently under review.

## Abstract

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. 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* = 6; CBM-I *n* = 6). The literature provides preliminary support for the use of CBM-A and CBM-I in subclinical and clinical populations, while highlighting the ineffectiveness of CBM-A at eliciting bias and symptom change in non-clinical samples. Appearance-based CBM-I approaches prove largely effective at modifying maladaptive interpretational styles (Cohen's *d* ranging between .72 to 2.92) and ameliorating ED symptomatology (*d* ranging between .61 to .80). Furthermore, results provide support for the moderating effects of training paradigm and stimuli modality on CBM efficacy. 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. 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.

# Introduction

## 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). In the case of eating disorder (ED) and associated risk factors (i.e. body dissatisfaction and negative affect; Jacobi & Fittig, 2011) stimuli pertaining to food, appearance, and negative self-worth are overvalued and prioritised above other information types (Williamson et al., 1999). Investigations into non-clinical, subclinical and clinical samples have consistently shown that people at risk of eating disorders display attentional, interpretation and memory biases for the aforementioned stimuli (Brooks, Prince, Stahl, Campbell, & Treasure, 2011; Jiang & Vartanian, 2018; Rodgers & Dubois, 2016). Specifically, individuals selectively attend to and have difficulty disengaging from disorder-relevant stimuli; they endorse appearance, self-worth or dietary interpretations for ambiguous events or outcomes; and memories relating to this information are easily activated and salient.

## Cognitive Bias Assessment

Experimental paradigms designed to assess bias are typically adapted to then modify these processes and have subsequently been termed Cognitive Bias Modification (CBM). In the area of mood disorders, numerous overviews attest to the utility, reliability and validity of paradigms at both assessing (e.g., Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007; Mathews & MacLeod, 2005) and modifying bias (e.g., Beard, Sawyer, & Hofman, 2012; Browning, Holmes, & Harmer, 2010; Hallion & Ruscio, 2011; MacLeod, 2012), with both paradigm types proving transferrable between different psychopathologies (Beard et al., 2012; Hallion & Ruscio, 2011; MacLeod, 2012). Despite the flexibility of

CBM, the ED field has been slow to evaluate modification techniques relative to other psychopathologies, rather focusing on the assessment of biases.

**Bias for food-related stimuli**

A substantial body of work has investigated and reviewed cognitive biases for food-related stimuli in samples where there is dietary restriction, anorexia nervosa and bulimia nervosa (Brooks et al., 2011; Dobson & Dozois, 2004; Faunce, 2010; Lee & Shafran, 2004; Williamson et al., 1999). Overall, reviews (e.g., Brooks et al., 2011) suggest that ED psychopathology, when assessed by the dot probe task, is associated with attentional avoidance of high caloric food (d = 0.93; 95% CI: 0.55 to 1.32) and hypervigilance for low caloric food (d = -0.72; 95% CI: -1.09 to -0.34). Memory bias studies indicate that bias for food is associated with samples engaging in greater food restriction (i.e., dieters and anorexia nervosa), with no such effect observed in bulimia nervosa. Very few studies have examined interpretation biases related to food, and of these studies, the terms interpretation and judgment bias are interchangeably used; thus hindering the interpretation of findings. In contrast to food-related stimuli, much less work has focused on the assessment of biases related to appearance and self-worth.

**Attentional Bias and Eating Disorders**

There is robust evidence that heightened levels of body dissatisfaction (Rodgers & Dubois, 2016), negative affect (Smith & Rieger, 2010) and ED psychopathology (Faunce, 2011) are indicative of attentional bias towards appearance-related stimuli. Historically, the Stroop task (Stroop, 1935) has been widely used to assess attentional bias, but given methodological shortcomings (see Jiang & Vartanian, 2018), the dot probe task (MacLeod, Mathews, & Tata, 1986), eye tracking software and visual search tasks (Hansen & Hansen, 1988) are preferred. Given that depression and anxiety are commonly comorbid with ED psychopathology, several studies have also investigated attentional biases for emotive and

threat-related stimuli in ED samples, respectively. To date, these investigations yield mixed results, with studies demonstrating both hypervigilance and avoidance of emotionally-salient stimuli in clinical samples (see Oldershaw et al., 2011). Less is known about attentional bias for self-worth related information in at risk and ED populations. Traditionally, stimuli pertaining to negative self-worth (e.g., hopeless, worthless) have been grouped with general emotive or mood-related stimuli. However, given that negative self-referent beliefs are uniquely predictive of ED psychopathology (Cooper & Cowen, 2009), this stimulus warrants further consideration separate from other emotive categories. To our knowledge, Smith and Rieger (2006) are the only researchers to investigate the causal relationship between selective attention for negative self-referent stimuli (see article for full stimuli list) and ED psychopathology, with increased attention associated with heightened negative affect; no such effects were established for body dissatisfaction.

**Interpretation Bias and Eating Disorders.**

Interpretation biases for appearance and self-worth related stimuli have been demonstrated in non-clinical, subclinical and clinical samples using a range of assessment paradigms, including the widely used word sentence association paradigm (Beard & Amir, 2009), lexical decisions tasks (e.g., Meyer & Schvaneveldt, 1971) and the scrambled sentences task (Wenzlaff & Bates, 1998). Findings indicate that individuals with varying degrees of risk and psychopathology have a tendency to endorse appearance (Brockmeyer et al., 2018; Misener & Libben, 2017; Rodgers & Dubois, 2016) and/or self-worth related (Cooper, 2005; Cooper & Cowen, 2009; Cooper & Wade, 2015; Pringle, Harmer, & Cooper, 2010) explanations for ambiguous events and/or outcomes. Further, interpretations of events vary depending on whether the outcome is self or other-referent. Specifically, Cooper (1997) demonstrated that young women with ED psychopathology endorsed weight and shape

related explanations for negative self-referent outcomes (e.g., failure to secure a job) and positive other-referent outcomes (e.g., being asked on a date).

**Memory Bias and eating disorders**.

Memory bias for appearance-related information in body dissatisfied populations has been reviewed (Rodgers & Dubois, 2016), however the seven extant studies are associated with mixed results and no firm conclusions. Given the gap in the literature, future research is required to address our limited understanding of the relationship between memory bias and risk for ED psychopathology. The roles of this bias type will not be discussed further in this review.

**Cognitive bias modification (CBM)**

Techniques targeting attentional bias (CBM-A) aim to manipulate implicit selective attention for disorder-salient information. The most widely used technique is the modified dot probe task (adapted from MacLeod et al., 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 the modification phase (e.g., 90/10; Kakoschke, Kemps, & Tiggemann, 2014). In tasks designed to induce disorder-salient bias and symptomatology, the probe replaces this stimulus category on a majority of trials. Alternatively, to reduce bias and symptoms, probes primarily replace the locus of positive or neutral stimuli. Through repeated practice, it is thought that 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, 2011; Macleod, 2012 for review). More recently, eye tracking software has 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 (Matthews & Mackintosh, 2000). Training techniques 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 a disorder-salient interpretation (i.e., '*fat*'). Following repeated practice, individuals are expected to then apply this new and adaptive interpretation style to novel ambiguous information.

Modification techniques have proven effective at modifying food-related biases and have been used for health promotion purposes to reduce food cravings and increase healthy eating choices (see Beard et al., 2012; Kakoschke, Kemps &, Tiggemann, 2017). The success of CBM techniques relative to appearance and self-worth related bias are less clear.

**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. Therefore, 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).

### 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, from which duplicate articles ($n$ = 32) were removed. 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 (e.g., unable to locate original study from >12 years ago), leaving a total of 12 studies in the current systematic review. Study characteristics for CBM-A studies are presented in **Table 1** and for CBM-I studies in **Table 2**. Mean and standard deviations of relevant variables were used to calculate Cohen's $d$ within and between group effect sizes and their 95% confidence intervals, using an online meta-analysis effect size calculator (Wilson, n.d). If means and standard deviations were unavailable, $ES_{between}$ was computed using either $t$ or $F$-values for the between-group comparison. 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).

## Cognitive Bias Modification Targeting Attention (CBM-A)

Modifying attentional biases has been the primary focus of research. To date, the modified dot probe task has been the most widely used method; however other techniques include eye tracking software and perceptual training tasks.

**CBM-A using the modified dot probe.** Four studies used the dot probe task to ameliorate ED-salient bias and symptomatology (Allen, Mulgrew, Rune, & Allen, 2018; Engel et al., 2006; Loughnan, Mulgrew, & Lane, 2015; Smith & Rieger, 2009). The earliest study by Engel and colleagues (2006) compared two forms of attentional training: 1) attend to weight/shape-related words (e.g., obese), while directing attention away from neutral terms

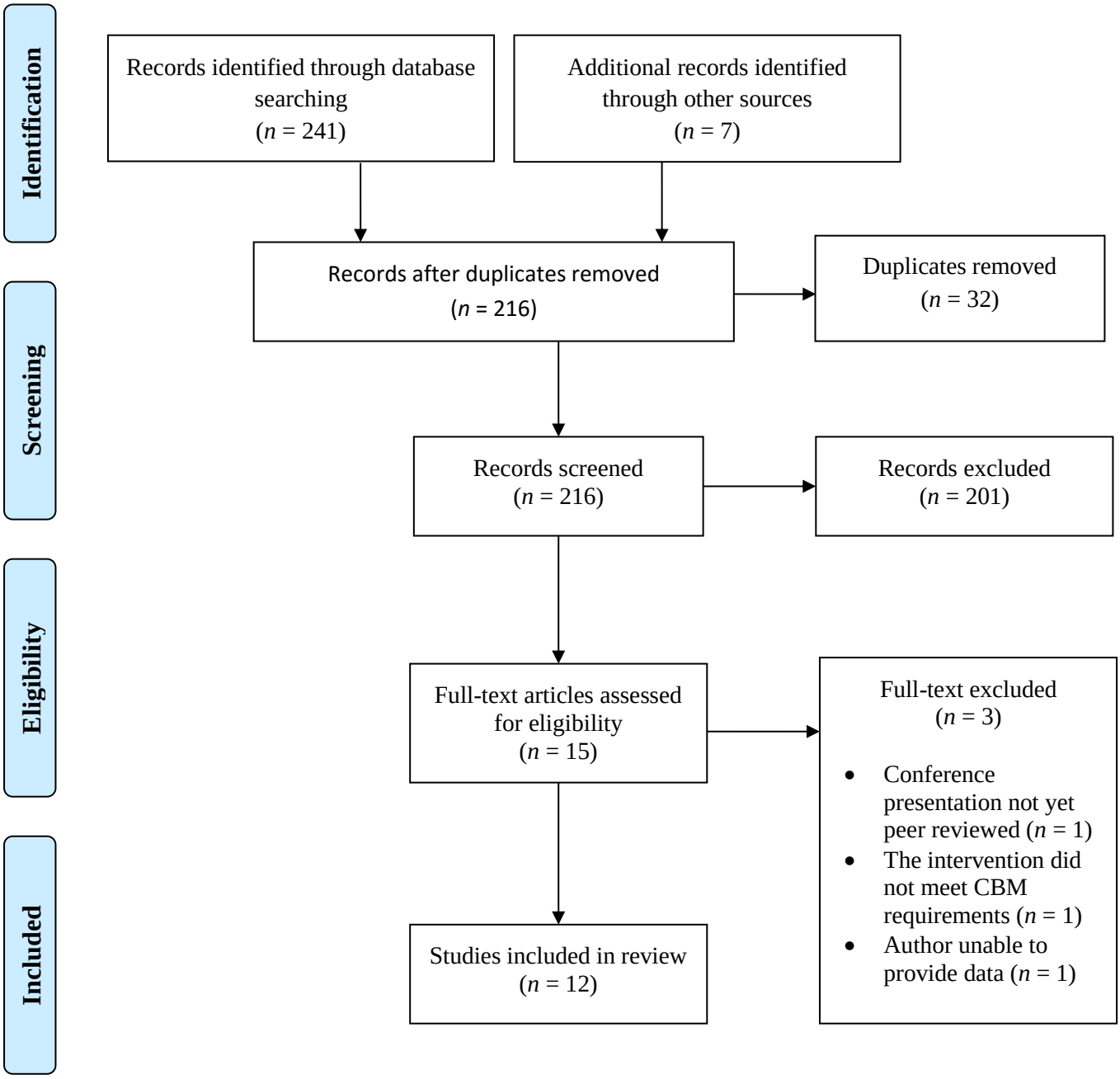


*Figure 1.* PRISMA diagram summarising the search process

Table 1

*Characteristics of Included CBM-A Studies*

| Study | Sample | Paradigm | Stimuli | Conditions (N) | Outcomes | Significant findings<br>Within group[a] Cohens d [95%CI[b]] |
|---|---|---|---|---|---|---|
| Allen et al., 2018 | Female undergraduates; General public | MDPT | Words: -ve appearance; +ve appearance; Neutral | Attend to +ve appearance, avoid -ve (31); Attend to neutral appearance, avoid -ve (37); No training (34) | AB; BISS | Neutral training reduced AB for negative appearance stimuli in women high on appearance importance<br>**d = 1.03 [.34:1.73]**<br>No significant between group changes. |
| Engel et al., 2006 | Female undergraduates | MDPT | Words: W/S; Neutral | Attend to W/S, avoid neutral (40); Attend to neutral, avoid W/S (33) | EDI-2: Bulimia; Drive for thinness; BD.<br>Only assessed post-CBM-A | Bulimia significantly higher in those attending to neutral stimuli.<br>***d = -.52 [-.53:-.06]*** |
| Gledhill et al., 2017 | Female undergraduates with high BD | Perceptual training task | 3D images of female bodies with differing BMI | Feedback provided on accuracy of body size judgements (20); Feedback confirmed participants' baseline evaluations of body size (20) | Body size evaluations; EDE-Q; BDI; RSE | Perceptual training modified body size evaluations<br>***d = .80 [.15:1.44]***<br>improved dietary restraint<br>***d = -.87 [-1.51:-.22]),*** weight & shape concerns<br>***d = -1.03 [-1.70:-.38]***<br>***d = -.91 [-1.56:-.26]***<br>eating disorder symptoms<br>***d = -1.07 [-1.73:-.41];***<br>which were maintained at 2-week FU<br>dietary restraint<br>***d = -1.0 [-1.65;-.34]***<br>weight & shape concerns<br>***d = -1.30 [-1.98:-.62]***<br>***d = -1.12 [-1.78;-.45]***<br>eating disorder symptoms<br>***d = -1.13 [-1.79:-.46]*** |
| Gledhill et al., 2017 | Outpatients: Atypical AN | As above | As above | Feedback provided on accuracy of body size judgements (21) | Body size evaluations; EDE-Q; Digit Span task (WAIS-R IQ) | Perceptual training modified body size evaluations<br>**d = -.79 (-1.41:-.16)**<br>which were maintained at 1-month FU<br>**d =-.76 [-1.39:-.14)**<br>No significant symptom change. |

| | | | | | | |
|---|---|---|---|---|---|---|
| Loughnan et al., 2015 | Female undergraduates; General public | MDPT | Words: -ve appearance; +ve appearance; Neutral | Attend to neutral, avoid -ve appearance (37); Attend to neutral & -ve equally (25) | AB; BISS; BSQ | No significant between group changes. |
| Smeets et al., 2011 | Female undergraduates | Eye tracking | Self-defined unattractive and attractive body parts | Attend to attractive body parts, +ve induction (24); Attend to unattractive body parts, -ve induction (23) | VAS scales: Body & weight satisfaction, mood | No significant between group changes. |
| Smeets et al., 2011 | Female undergraduates with high BD | Eye tracking | Images of self-defined unattractive & attractive body parts | Attend to attractive body parts (11); Attend equally to various body parts (10) | As above | No significant between group changes. |
| Smith & Rieger, 2009 | Female undergraduates | MDPT | Words: -ve W/S; +ve W/S; -ve food (high calorie); +ve food (low calorie); Neutral | Attend -ve W/S (23); Attend +ve W/S (17); Attend -ve food (18); Attend +ve food (19); Attend neutral (19) | AB; PASTAS; POMS-A; Dietary restriction behavioural task | Attending to -ve W/S words resulted in higher BD relative to control ***d = .84 [.21to 1.47].*** -ve food condition more likely to choose low fat food relative to control ***OR = 4.32 [.044 to .913].*** All CBM-A increased AB for target stimuli -ve W/S ***d = -.92 [-1.56:-.28]*** +ve W/S ***d = 1.02 [.33:1.72]*** -ve food ***d = 1.08 [39:1.77]*** +ve food ***d = .89 [.22:1.56]*** |

*Note*. N = Sample size; CI = Confidence interval; -ve = Negative; +ve = Positive; W/S = Weight and shape; AB = Attentional bias; CBM-A = Cognitive Bias Modification targeting Attention; BD = Body dissatisfaction; AN = Anorexia Nervosa; MDPT = Modified dot probe task; BDI = Beck Depression Inventory; BISS = Body Image State Scale; BSQ = Body Shape Questionnaire; EDE-Q = Eating Disorders Examination Questionnaire; EDI-2 = Eating Disorder Inventory-2; PASTAS = Physical Appearance State and Trait Anxiety Scale; POMS-A = Profile of Mood States-Adolescents; RSE = Rosenberg Self-Esteem Scale; VAS = Visual Analogue Scales;

[a] between group effect sizes are provided if a comparison to another group was investigated, with effect sizes italicised.

[b] Significant effect sizes are **bolded**.

Table 2

*Characteristics of Included CBM-I Studies*

| Study | Sample (N) | Paradigm | Stimuli | Conditions (N) | Outcomes | Significant findings Within group[a] Cohens d [95%CI[b]] |
|---|---|---|---|---|---|---|
| Cardi et al., 2015 | Females with AN | MDPT; WCT | Social cues; Ambiguous social scenarios | Attend to +ve faces and make benign interpretation of social scenarios (28) | AB; IB; DASS; SEED; ARSQ | CBM-A increased AB for positive faces in dot probe **d = -.54 [-1.07: -.01]** and visual search task **d = 1.30 [.72:1.88].** Benign answers to test trials increased from session 1 to 5 **d = -.57 [-1.10: -.04].** No significant symptom change. |
| Matheson et al., 2018 | Female undergraduates | WCT | Ambiguous appearance, self-worth and neutral scenarios | +ve appearance interpretations (44); +ve/neutral interpretations (37); Neutral interpretations (42) | IB; State BD and NA | +ve appearance increased positive IB **d =.72 [.29:1.15]** state appearance satisfaction **d = .61 [.18:1.04].** |
| Summers & Cougle, 2018 | Undergraduates and general public with high BDD symptoms | Word-sentence relatedness task | Negative/threat words (e.g., insult); positive/benign (e.g., compliment); ambiguous sentences | +ve interpretations (19); Neutral interpretations (19) | EDI; Bulimia and drive for thinness | +ve CBM-I reduced threat-related IB ***d = -1.66 [-2.41:-.93]*** increased benign IB ***d = 1.34 [.64:2.05].*** +ve CBM-I reduced Bulimia symptoms ***d = -.80 [-1.46:-.14].*** |

| | | | | | | |
|---|---|---|---|---|---|---|
| Turton et al., 2018 | Females with AN | WCT | Ambiguous social scenarios | Benign interpretations; -ve and benign interpretations (55) | IB; BD VAS; EDE-Q; DASS; ARSQ; WSAS; Dietary restriction behaviour task; Salivary cortisol levels | No significant between group changes. |
| Williamson et al., 2000 | EDs (30); BDD (30); HC (30) | Self-generated imagery | Ambiguous body and health-related scenarios | +ve self-imagery (45); -ve self-imagery (45) | IB | +ve self-imagery reduced fat-related IB in the ED sample **d = -1.02 [-1.78:-.26].** |
| Yiend et al., 2014 | Females with 5> on EAT–26 | WCT | Ambiguous self-worth related scenarios | +ve/neutral interpretations (45); -ve interpretations (43) | IB; HADS; BDI-II); STAI; PANAS; EDE-Q; Behavioral tasks (eating, weighing and mirror exposure tasks) | +ve CBM-I increased +ve IB **d = 1.20 [.75:1.65]).** +ve/neutral CBM-I reduced intrusive thoughts in weighing **d = .53 [.11:.95].** -ve CBM-I increased dietary restriction **d = .57 [.14:1.00]** intrusive thoughts, mirror task **d = -.53 [-.96: -.10].** |

*Note*. N = Sample size; CI = Confidence Interval; -ve = negative; +ve = Positive; W/S = Weight and shape; AB = Attentional bias; CBM-A = Cognitive bias modification targeting Attention; CBM-I = Cognitive bias modification targeting interpretations; 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; MDPT = Modified dot probe task; WCT = Word Completion Task ARSQ = Adult Rejection Sensitivity Questionnaire; BDI = Beck Depression Inventory; DASS = Depression Anxiety Stress Scales; EDE-Q = Eating Disorders Examination Questionnaire; EDI-2 = Eating Disorder Inventory-2; 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.

[a] between group effect sizes are provided if a comparison to another group was investigated, with effect sizes italicised.

[b] Significant effect sizes are **bolded**.

(e.g., object), and 2) attend to neutral while avoiding weight/shape. Post-training assessments of trait ED psychopathology indicated higher levels of bulimia symptomatology in those trained to avoid weight/shape terms; these effects were not mirrored in body dissatisfaction or drive for thinness. Given the omission of pre-and post-assessments of bias and the pre-assessment of trait psychopathology, it is unclear whether the observed differences in symptomology were present at baseline or resulted from changes in attentional bias. A more recent study, found a single session of CBM-A (attending to neutral while avoiding negative appearance stimuli) to be ineffective at modifying attentional bias for appearance-related information, as well as state and trait levels of body dissatisfaction immediately post-training and at 1- and 2- week follow-ups (Loughnan et al., 2015). These results may have been due to the use of an unselected sample, with Allen and colleagues (2018) finding this technique effective at reducing negative-appearance related bias in women with high appearance importance.

Only two studies have examined the effects of attentional retraining towards positive appearance-related words (Allen et al., 2018; Smith & Rieger, 2009). In the first study, CBM-A increased bias for positive appearance-stimuli but did not enhance body satisfaction. Given, that post-training satisfaction was not afflicted by a subsequent mood induction (i.e., viewing images of thin models), suggests that this attentional pattern may acts as a protective factor against body dissatisfaction (Smith& Rieger, 2009). More recently, Allen and colleagues found this attentional retraining to have no impact on bias or state body dissatisfaction.

In summary, intervention effects of CBM-A using the modified dot probe task remain equivocal. Together, the results suggest that CBM-A is ineffective at eliciting bias and symptom change in non-clinical samples, but may prove to be of therapeutic value to those with higher psychopathology. Further, the current null effects may be attributable to the

single session protocols executed by the five studies. Given that multi-session training produces larger and more reliable effects on bias and symptoms (Beard et al., 2012; Hallion & Ruscio, 2011), future research should seek to investigate the effects of multi-session CBM-A within heightened psychopathology.

**CBM-A using eye tracking software.** Although eye tracking software has been widely used to assess attentional biases in the ED field (see Rodgers & Dubois for review), only one study has used the software to modify bias (Smeets, Jansen, & Roefs, 2011). The study trained participants to direct their attention either towards self-defined unattractive (negative induction) or attractive body parts (positive induction) in an unselected (study 1) and body dissatisfied (study 2) sample. Neither induction impacted body or weight dissatisfaction. A major limitation of the study design was the omission of pre and post-assessments of attentional bias. Thus, it is unclear whether the null effects are associated with a lack of bias change.

**CBM-A using novel approaches.** In a novel adaptation of the dot probe task, Gledhill and colleagues (2017) sought to modify body size evaluations of body dissatisfied women (study 1) and women with atypical anorexia nervosa (study 2). The women underwent four daily sessions of training (35-45 mins), 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. large) towards larger bodies by providing individuals with feedback regarding the accuracy of their judgment (i.e., '*Incorrect! That body was fat*' or '*Correct. That body was thin*'); the control condition confirmed baseline judgments. Training was tailored to individual differences, such that participants were trained to judge bodies near their

categorical boundary. Boundaries were shifted in both women with high levels of body dissatisfaction and atypical anorexia, with changes persisting at 2-week and 1-month follow-up, respectively. Only body dissatisfied women reported improvements in dietary restraint, weight and shape concerns and overall ED psychopathology, with reductions maintained at 2-week follow-up. These findings provide further support for the use of CBM-A in subclinical and clinical samples and suggest that adapted CBM-A methods may be more effective at modifying disorder-salient bias and symptomatology, relative to traditional applications. Given that the perception task was developed using CBM-A principles, future research should seek to investigate whether training effects transfer to attentional bias for appearance-related stimuli.

**Cognitive Bias Modification Targeting Interpretation (CBM-I)**

Six studies have applied CBM-I to ED-related interpretation bias and psychopathology. Given that self-loathing beliefs are uniquely predictive of ED psychopathology (Cooper & Cowen, 2009), one of the six studies used CBM-I to investigate the causal relationship between positive and negative self-loathing beliefs on ED psychopathology (Yiend, Parnes, Shepherd, Roche, & Cooper, 2014). Yiend and colleagues successfully used CBM-I to manipulate individuals' interpretation of emotional ambiguity and found that these interpretation styles impacted ED behaviours. Specifically, negative interpretations were associated with increased dietary restriction and intrusive thoughts related to weight and shape, while positive interpretations led to reductions in intrusive thoughts; effects were not maintained at 1-week follow-up. Given the successful application of single-session CBM-I for (positive) self-worth, it is recommended that future efforts explore the immediate and long-term effects of multi-session training.

Three studies have investigated appearance-based CBM-I paradigms in ED psychopathology. The earliest study found that adopting positive self-imagery in response to

ambiguous body and health-related scenarios reduced fat-related interpretation bias, while the generation of negative self-imagery had no impact on bias (Williamson, Perrin, Blouin, & Barbin, 2000). Effects of CBM-I on psychopathology were not explored. Further, although positive self-imagery modified fat-related bias, bias was not extinguished nor altered to a thinness-related interpretation as intended. A limiting factor is the CBM protocol did not systematically record participants' self-generated interpretations (e.g., Rohrbacher, Blackwell, Holmes, & Reinecke, 2014), thus the degree to which participants complied with training is unknown. To date, standardised CBM paradigms have proven most effective in sub-clinical and clinical populations, relative to self-generated CBM (Holmes et al., 2009), given that individuals with greater psychopathology are likely to have more difficulty in generating positive interpretations. The second study conducted secondary analyses on ED psychopathology (Summers & Cougle, 2018) following multisession CBM-I in those with heightened body dysmorphic symptomatology (Summers & Cougle, 2016). Secondary analyses (2018) indicated that the task increased benign interpretations related to appearance and reduced bulimia symptoms in those with high pre-treatment symptomatology, although there was no impact on drive for thinness. A study by Matheson, Wade and Yiend (2018) extended these findings and compared a newly developed appearance-based protocol to an existing self-worth approach (Yiend et al., 2014) to determine which of these methods showed therapeutic potential with respects to ameliorating ED-related bias and risk. The CBM-I for appearance protocol proved to be more effective at modifying the target bias (interpretation bias for appearance) and appearance satisfaction, relative to the self-worth and control condition. These findings are inconsistent with Yiend et al. who found the self-worth protocol effective in eliciting bias and behaviour change in a subclinical ED sample. Matheson and colleagues note that the null effects are likely explained by differences in the sample demographics, namely age and clinical severity. Specifically, the self-worth training

material was unrepresentative of younger female life domains, while the adaptive interpretation styles of the unselected sample were likely less amenable to intervention effects.

Another avenue of CBM-I research is the modification of interpretation bias associated with social difficulties in ED psychopathology. One study assessed the effects of multi-session CBM-I (i.e., five training sessions) on attentional and interpretation biases related to social stimuli and the subsequent impact on ED symptomatology (Cardi et al., 2015). Multi-session CBM-A successfully increased bias for positive social cues, while CBM-I increased benign interpretations of ambiguous social scenarios; no changes to ED symptomatology were observed. A second study utilised a single session protocol and found the CBM-I intervention and control conditions to be comparably effective at modifying bias, while neither condition impacted ED behaviours (Turton, Cardi, Treasurer, & Hirsch, 2018). Unlike CBM-A, these findings indicate that single session CBM-I is insufficient at eliciting bias change within heightened psychopathology. Further, given the use of socio-emotional training material, outcomes pertaining to emotion regulation and interpersonal difficulties may better reflect intervention effects than core ED psychopathology (i.e., weight and shape concerns, dietary restriction etc.).

Overall, the current findings give preliminary support to the efficacy of CBM-I in modifying ED-related bias and symptomatology. However, with only 6 studies having used CBM-I within the ED field, considerable gaps in the literature remain, particularly in reference to the reliability of training paradigms to produce short and long-term effects. Subsequently, future research should seek to replicate the current effects, as well as explore the immediate and residual effects of multi-session training.

## Discussion

The current systematic review sought to examine the small, but emerging body of literature using CBM to impact ED-related biases and psychopathology. To date, this is the first review to systematically examine the effectiveness of both CBM-A and CBM-I on ED psychopathology and risk factors. Overall, our findings give preliminary support to the effectiveness of CBM-A and CBM-I within subclinical and clinical populations, but no firm conclusions can be drawn due to the limited number of investigations and the high degree of heterogeneity across the 12 studies.

### CBM-A

Attentional bias modification has been the primary focus for researchers of various psychopathologies, including EDs. Overall the current findings yield inconsistent effects, with respects to both modifying bias and symptomatology. A primary finding from this review is that CBM-A was ineffective at increasing attentional bias for non-disorder salient information and enhancing protective factors (e.g., body satisfaction) within non-clinical samples (Allen et al., 2018; Loughnan et al., 2015; Smeets et al., 2011; Smith & Rieger, 2009). However, intervention effects were observed within heightened symptomatology (Allen et al., 2018) and clinical samples (Cardi et al., 2015; Gledhill et al., 2017). These findings are consistent with CBM-A reviews, with sample characteristics shown to moderate CBM-A efficacy. Specifically, subclinical and clinical samples have been associated with moderate changes in bias and symptomatology, while negligible effects have been observed in healthy controls (Beard et al., 2012; Hallion & Ruscio, 2011). Thus, applying CBM-A to subclinical or clinical samples with pre-existing maladaptive biases and higher levels of psychopathology, may elicit larger and more reliable intervention effects.

The current review found one of two appearance-based CBM-A studies influenced bias but neither ameliorated symptomatology. In addition to sample characteristics, the null

effects associated with these two studies may be attributable to the therapeutic salience of training stimuli. Traditionally, the terms *thin*, *slim* or *skinny* have been synonymous with a positive appearance (Vitousek & Orimoto, 1993). However, these terms equally denote the socially prescribed body ideal; a standard of physical appearance that is virtually unattainable to the average women (Stice, 2001). Stimuli pertaining to the thin ideal have shown to increase attention for fat and thin-related stimuli (e.g., Tobin, Sears, Zumbusch, &, von Ranson, 2018), as well as induce body dissatisfaction (e.g., Atkinson & Wade, 2012). Therefore, the appearance-based stimuli used with within the CBM-A studies may have carried little therapeutic value and have the potential to increase ED-related bias and risk. Effective preventative approaches for EDs encourage balanced eating and exercise, developing self-efficacy, weight/shape acceptance and a positive body image (Watson et al., 2016). Thus, future research should seek to reassess CBM-A training stimuli and ensure that intervention protocols incorporate stimuli that reflect evidence-based principles, rather than endorsing the thin ideal.

Another key finding relates to the large and sustained effects associated with the pictorial-based CBM-A paradigm (Gledhill et al., 2017), relative to null effects obtained from word-based protocols. These results align with previous findings into the moderating effects of stimulus modality, with pictorial stimuli eliciting greater bias and symptom change than its counterpart (Beard et al., 2012). Given the visual nature of ED psychopathology, pictorial representations of appearance may carry the necessary salience to trigger bias and symptom change. Further, stimuli relatability is likely to implicate intervention effects (Rodgers & Dubois, 2016). Specifically, extreme visual depictions of weight and shape (e.g., severe thinness or obesity) have been deemed ecologically invalid due to the unrealistic nature of these body types (Glauert, Rhodes, Fink, & Grammer, 2010) and therefore should be cautiously incorporated into intervention paradigms. The findings of Gledhill and colleagues

(2017) support this notion, demonstrating that tailoring training paradigm to individual differences is likely to increase stimuli relatability and thus increase training effects.

**CBM-I**

Overall, CBM-I yielded larger and more consistent effect sizes in both modifying bias and symptomatology, relative to CBM-A. These effects may be explained by of use of sub-clinical and clinical samples in 5 of the 6 CBM-I studies. Regarding appearance-based paradigms, there is preliminary evidence that these forms of CBM-I are largely effective at ameliorating ED-related bias and symptomatology across varying degrees of clinical severity. Notably, the three studies used different modification paradigms; thus, limiting the generalisability of findings. In a previous review, changes in interpretation bias and mood states were moderated by training paradigm, with the word completion task, used by Matheson et al. (2018), proving to be most influential (Menne-Lothmann et al., 2014). Given the comparable results produced by all three approaches, future research would benefit from comparatively examining the paradigms for replicability and to determine whether one approach proves more effective.

The preliminary effects of multi-session CBM-I in EDs are promising, with results indicating that 4-5 sessions of CBM-I was sufficient in eliciting bias and symptom change. These findings are consistent with previous reviews (MacLeod, 2012; Menne-Lothmann et al., 2014) which highlight the relative success associated with multisession CBM-I. Further, given that multi-sessions effect sizes have shown to incrementally increase with each additional training session (Menne-Lothmann et al., 2014), future research should seek to determine whether large and more sustainable effects are observed following >5 training sessions.

Notably, Matheson and colleagues (2018) failed to replicate the efficacy of the CBM-I for self-worth protocol, originally demonstrated by Yiend and colleagues (2014). These

findings further highlight the moderating effects of sample characteristics, particularly age and clinical severity. Yiend and colleagues originally applied the protocol to women with a mean age of 29 years and subclinical levels of ED psychopathology. Training material centred on full-time careers, long-term relationships and marriage, and children. The life domains of younger populations typically relate to study, travel and dating thus rendering the protocol unsuitable for the younger female sample used by Matheson and colleagues. It is also worth noting that the unselected sample demonstrated adaptive interpretation styles, both generally and regarding self-worth, prior to the intervention. Therefore, as observed in CBM-A, the adaptive biases of healthy individuals are likely to be less amenable when the intervention is congruent with the participants naturally occurring cognitions.

**Implication of Findings & Methodological Considerations**

Methodological rigor is imperative in shaping our evaluations and understanding of CBM efficacy. The current findings highlight various methodological shortcomings within individual studies, which impede the interpretation of results. Firstly, of the 12 studies, only 8 studies incorporated pre and post-assessments of bias and symptomatology; thus, implicating the assessment of causality and transfer effects of CBM on bias and symptom change, respectively. Therefore, future research should seek to include multiple assessments points (e.g., pre- and post-assessments of bias, state and trait symptomatology) to accurately assess the trajectory of short- and long-term effects of CBM-A on both bias and symptomatology. Second, a majority of 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, the ecological validity of the interventions is unknown. Therefore, 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 the abovementioned 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.

Modifying attentional bias is not exclusive to CBM, with cognitive behavioural therapy (CBT) techniques proving to be effective at ameliorating maladaptive attentional patterns associated with EDs. An early study found 20 sessions of CBT significantly reduced eating, shape, and weight-related attentional bias in an ED sample (Shafran, Lee, Cooper, Palmer, & Fairburn, 2008). Shafran and colleagues note that although group means reflected a reduction in disorder-salient bias, it is likely that bias was not fully extinguished in all individuals. Further, given the multimodal nature of CBT, the treatment component(s) responsible for bias change is unclear; therefore, future research should seek to elucidate which intervention techniques elicit this change. A second study narrowed the intervention scope by examining the impact of one CBT technique, mirror exposure, on gaze patterns in low and high body dissatisfied women (Glashouwer, Jonker, Thomassen, & de Jong, 2016). Multiples exposure sessions did not alter the attentional patterns of body dissatisfied women, with gaze continuing to prioritise unfavoured body parts. However, the intervention did reduce ED symptomatology; thus, suggesting that modifying bias may not be a requisite for ameliorating symptomatology. The current review highlights CBM efficacy in modifying disorder-salient bias and psychopathology; however the degree to which the technique supplements evidence-based ED interventions is unknown. Future research should seek to conduct a randomised control trial comparing CBM, CBT and a combined approach (CBM +CBT) in 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; thus, the current findings do not necessarily provide an accurate representation of CBM efficacy. 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, there is cause to believe that there is a place for both techniques when it comes to the prevention and intervention of ED psychopathology; however future research is needed before robust conclusions can be made. The field of EDs should seek to learn from and adopt the methodologically sound designs used within anxiety and depression research, thus helping to shape future applications and evaluations of CBM both within and beyond a laboratory.

# CHAPTER 3

## Interventions Impacting Automatic Processing Evaluated with Respect to Impact on Eating Disorder-related Biases and Psychopathology, excluding Cognitive Bias Modification Approaches

**Appearance Stimuli and the Automatic Processing System**

Body dissatisfaction is a common stressor for young women, with dissatisfaction identified as a top-ranking concern for females aged between 15 and 19 (Bailey et al., 2016). These concerns result in negative affect (i.e., depression and anxiety) and eating disturbances, which increase the risk of subsequent suicidal ideation, plans and attempts (Swanson, Crow, Le Grange, Swendsen, & Merikangas, 2011). The environments of these young women perpetuate dissatisfaction and negative affect through the relentless promotion of the socially-prescribed thin ideal, a standard of physical appearance that is virtually unattainable for the average woman (Stice, 2001). These societal norms also strengthen the positive associations for thin bodies and negative associations for larger bodies, through the lack of diverse body types in beauty and cosmetic care, fashion, television and film (Levine & Murnen, 2009). While young women may consciously attempt to disengage from appearance-related material, the processing of these stimuli is thought to occur outside of conscious awareness through the automatic processing system; thus, interventions targeting this level of processing may be requisite for ameliorating eating disorder psychopathology.

The automatic and reflective systems are used to process environmental information, including eating disorder-salient stimuli. The automatic system is fast, effortless, and occurs outside conscious awareness, while the reflective system is slow, intentional and consumptive of cognitive resources (Kahneman, 2011). Typically the two systems work in tandem to process information and guide behaviour. However, when cognitive capacity is compromised the automatic system assumes control, and therefore logic and conscious reasoning are relinquished (Hofmann, Friese, & Strack, 2009). Conventional eating disorder treatments involve consciously challenging individuals' unhelpful thinking styles and behaviours to improve emotive states and wellbeing. To date, Cognitive Behaviour Therapy for eating disorders (CBT-ED) has been considered the most effective treatment for non-underweight

eating disorders (Linardon, Wade, de la Piedad Garcia, & Brennan, 2017; NICE, 2017); however, the intervention does not attempt to target implicit cognitive processes. Cognitive biases, evaluative associations and the consolidation of imagery pertaining to appearance are thought to be generated and processed through the automatic processing system and have shown to perpetuate risk for eating disorder psychopathology (Martijn, Alleva, & Jansen, 2015). Therefore, novel interventions targeting cognitive distortions occurring at an automatic processing level may offer important therapeutic adjuncts that can enhance current interventions for eating disorders.

The primary focus of the current thesis was to assess the therapeutic potential of Cognitive Bias Modification (CBM) in eating disorder psychopathology. The initial studies (**Chapters 4 and 5**) comparatively assessed CBM efficacy to modalities shown previously to be effective at ameliorating implicit cognitive distortions associated with eating disorder psychopathology, including evaluative conditioning and the visuospatial task, Tetris.

**Evaluative Conditioning**

A promising strategy proven to improve body dissatisfaction is an evaluative conditioning paradigm, which trains individuals to associate their appearance with positive social stimuli (Martijn, Vanderlinden, Roefs, Huijding, & Jansen 2010). Consistent with classical conditioning theory, individuals learn a new association by pairing an unconditioned stimulus (e.g., an individual's body) with a conditioned stimulus (e.g., positive social cue) to trigger a conditioned response (e.g., social acceptance of their appearance). Martijn and colleagues (2010) proposed that body dissatisfaction is, in part, perpetuated by the perceived disapproval of others and therefore extinguishing this association would lead to increased body satisfaction and self-esteem.

The training paradigm developed by Martijn and colleagues (2010) requires participants to change into a firm-fitting t-shirt and pair of leggings, and have three

standardised images taken of their body (i.e., front, the left and the right lateral). Following an 8-day interval, participants returned to the laboratory to complete a single session of evaluative conditioning. During the task, an image of the participant's body or the body of an unknown individual appeared at random, in one of the four quadrants of a computer screen. Participants were instructed to use the computer mouse to click on the image as quickly as possible. Once a response was provided the image of the body disappeared and was replaced with a social cue for 400ms. During the training task, participants were trained to associate their physical appearance with positive social cues. Therefore, images of the participant's body were replaced exclusively by positive social cues (e.g., a smiling face), whereas the control bodies were replaced with negative or neutral cues (e.g., a frowning or ambiguous face).

Findings indicated that the body dissatisfied women reported significant improvements in body dissatisfaction and self-esteem. In line with theory, these changes in symptomatology were attributed to the newly learnt association between the individuals' appearance and social approval. These effects were replicated and extended in a randomised controlled trial, where highly dissatisfied women were randomised to an intervention of four weekly sessions of evaluative conditioning or a waitlist control condition (Aspen et al., 2015). The multi-session conditioning led to significant reductions in body dissatisfaction and improvements in self-esteem, with reductions in dissatisfaction maintained at 12-week follow-up. Further, these effects were again mirrored in the waitlist condition, following the completion of the intervention. The conditioning paradigm has also been used to reduce internalisation of the thin ideal, by pairing images of models with terms denoting falseness (i.e., artificial, phony, bogus, sham, false), while associating images of normal weight models with candour (i.e., natural, true, genuine, authentic, sincere; Martijn et al., 2013). To date the paradigm has yet to assessed or replicated independent of programme developers.

**Tetris**

Another task thought to implicate the implicit processing of appearance-related stimuli is the visuospatial task, Tetris. The task requires participants to move and rotate blocks of various shapes to create a horizontal line of blocks without gaps. Once a row is formed, the row disappears. If no lines are formed, the blocks pile higher and higher until the pile reaches the top of the screen, at which point the game ends. Traditionally, the popular computer game has been used as an active control condition, given that the task is simple, engaging and not arduous (e.g., Green & Bavelier, 2003; Nouchi et al., 2012).

More recently, therapeutic properties of Tetris have emerged, with the task proving effective at reducing attentional biases and cravings for food (Van Dillen & Andrade, 2016), as well as cravings for beverages, caffeine and nicotine (Skorka-Brown, Andrade, & May, 2014). Further, the task has led to reductions in intrusive flashbacks and distress, following the viewing of traumatic material (Holmes, James, Coode-Bate, & Deeprose, 2009; Holmes, James, Kilford, & Deeprose, 2010; James et al., 2015; Iyadurai et al., 2017). Given that Tetris requires a high visuospatial working memory, the task is thought to compete for the same cognitive resources used to generate and process visual stimuli and therefore interfes with the consolidation of previously viewed imagery, including disorder-salient stimuli (Holmes et al., 2009, 2010; May, Andrade, Kavanagh, & Hetherington, 2012; Skorka-Brown et al., 2014; Van Dillen & Andrade, 2016).

Tetris has yet to be applied to the field of eating disorders, however the task has shown to be a valid tool for reducing distress across various psychopathologies. Viewing and comparing oneself to visual images of thin bodies has shown to increase internalisation of the thin ideal (i.e., the degree to which an individual has accepted societal values of thinness and applies these values to herself) and subsequently exacerbate body dissatisfaction and negative affect (e.g., Atkinson & Wade, 2012; Groesz, Levine, & Murnen, 2002; Tiggemann &

McGill, 2004; Wade, George, & Atkinson, 2009). Therefore, following exposure to the thin ideal, engaging in Tetris may obstruct the consolidation of this visual information into memory, in turn reducing the salience of this schema and thus reducing body dissatisfaction and negative affect. Provided that the computer game proves to be more than a simple distraction task, Tetris may yet prove to have a place in the prevention of eating disorder psychopathology.

**Conclusion**

Investigations into novel interventions targeting the implicit processes associated with eating disorder psychopathology remain in its infancy. In general, the emerging literature on CBM, evaluative conditioning and visuospatial tasks is promising. However, replication of effects is key in determining whether these paradigms show true therapeutic value or whether resources are better invested in alternative prevention methods. Initially, this thesis sought to comparably examine these paradigms to determine whether one or all approaches warrant further exploration within the field of eating disorders.

# CHAPTER 4

## Modifying Automatic Processes to Influence Risk for Eating Disorders

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**Author Contributions:**

EM led the study design, recruitment, data collection, statistical analyses, results and interpretation, and manuscript preparation. TW contributed to the study design, statistical analyses, results and interpretation, and manuscript preparation.

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This chapter was submitted and subsequently rejected by *Journal of Behavior Therapy and Experimental Psychiatry* due to several methodological shortcomings. The version that appears here addresses these limitations.

## Abstract

The current study compared three different paradigms thought to influence psychological health at an automatic processing level - attentional bias, evaluative associations and visuospatial imagery - for impact on body dissatisfaction and negative affect. Female university students (N=91) were randomised into one of three conditions: cognitive bias modification targeting attention (CBM-A), evaluative conditioning, or Tetris. Immediately following a body dissatisfaction induction that significantly increased body dissatisfaction, participants underwent their respective training regimes. The CBM-A trained participants' attention toward positive appearance-related words (e.g., fit), and away from negative appearance-related items (e.g., fat). Evaluative conditioning trained participants to associate their physical appearance with positive social cues (i.e., a smiling face). Participants in the third condition played the visuospatial computer game Tetris. The CBM-A and Tetris conditions produced significant improvements in appearance satisfaction, distress over feelings, as well as negative affect, relative to the evaluative conditioning group. The evidence suggests that CBM-A and Tetris are promising approaches to investigate further with respects to modifying risk factors associated with eating disorder psychopathology.

## Introduction

Young women are routinely exposed to images of the thin ideal, a standard of physical appearance that is virtually unattainable for the average woman (Stice, 2001), resulting in a "normative discontent" in women with respects to weight and shape (Rodin, Silberstein, & Striegel-Moore, 1985). Societal norms have also strengthened the positive and negative associations between thin and larger bodies, respectively, with children as young as 3 more likely to label chubby bodies as "mean" compared to thin and normal weight bodies (Cramer & Steinwert, 1998). A recent review by Martijn and colleagues (2015) postulated that appearance related stimuli and evaluative associations are processed through the automatic processing system; a notion that is supported by a growing body of literature (Rodgers & DuBois, 2016). Therefore, given that at-risk and eating disorder populations consistently demonstrate bias information processing at an implicit level, a new avenue of research has investigated accessible interventions devised at targeting automatic processes thought to perpetuate body dissatisfaction and negative affect.

In recent years, interventions designed to target and modify automatic processes include cognitive bias modification for appearance (CBM-A; Smith & Rieger, 2009) and evaluative conditioning (Martijn et al., 2010). While there are limited and mixed findings regarding the efficacy of CBM-A for modifying attentional biases and symptomatology (Engel et al., Loughnan et al., 2015; Schmidt, Kusber, & Martin, 2018; Smith & Rieger, 2006, 2009), two studies have found that evaluative conditioning has significantly large and enduring effects on state and trait body dissatisfaction (Aspen et al., 2015; Martijn et al., 2010). A more recent development with respect to modifying automatic processes is the use of visuospatial tasks (i.e., Tetris) in the management of distress and intrusive flashbacks, following the viewing of traumatic images (Holmes et al., 2009). Visuospatial tasks are thought to compete for the same cognitive resources used to generate and process visual

stimuli, thus interfering with the consolidation of distressing imagery. Given the visual nature of body dissatisfaction, we hypothesise that Tetris has the potential interfere with the consolidation of triggering visual representations of appearance (i.e., images of the thin ideal).

The current pilot study compares the efficacy of these three different approaches at targeting cognitive distortions occurring at the automatic processing level; attentional bias, evaluative associations and visuospatial imagery. In the context of our paucity of knowledge about which intervention might influence body dissatisfaction and negative affect, only one hypothesis was proposed. Given the consistent findings that support the impact of evaluative conditioning on body dissatisfaction, we suggest that participants in this condition will experience a greater reduction in body dissatisfaction and negative affect compared to those in the CBM-A and Tetris conditions.

## Method

### Participants

The current sample size was determined using the effect size associated with improvements in body satisfaction in highly dissatisfied women relative to those with low body dissatisfaction, as a result of evaluative conditioning ($d$ = 0.63; Martijn et al., 2010). A longitudinal power analysis indicated that 36 participants in the three conditions (a total of 108) would be associated with an acceptable power of .80 and an alpha of .05 (Hedeker, Gibbons, & Waternaux, 1999). One hundred and nine university students were recruited from the volunteer research pool at Flinders University, where participation earned payment of $10 or course credit. In order to obtain a homogenous sample in order to further increase power, the inclusion criteria required participants to be female, aged between 17 and 25, and have a body mass index (BMI) between 18.5 and 29.9 (i.e., neither underweight ($n$ = 11) nor obese ($n$ = 7); World Health Organisation, 2017). This resulted in the data of 91 participants (83%)

being eligible for inclusion in the analyses. Ethics approval was obtained from the Flinders Social and Behavioural Research Ethics Committee and informed consent was obtained from each participant before commencing the study.

**Procedure**

The research was presented to participants as an investigation into the relationship between eating and thinking styles in young women. The design is depicted in **Figure 1**; A 3 (training condition) × 3 (time) design. Prior to data collection, EM generated the randomisation sequence of conditions to timeslots, using Research Randomizer Version 4.0 (Urbaniak & Plous, 2013). Participants were randomly assigned to one of three groups: CBM-A for appearance, evaluative conditioning, or Tetris. The study was conducted in a laboratory setting, containing two computers separated by a dividing panel. The procedure consisted of 5 sequential phases, starting with baseline observations of state and trait variables, followed by a body dissatisfaction induction, a second assessment of state measures, followed by a computerised task aimed at ameliorating body dissatisfaction and negative affect, and a final assessment of state measures. Participants in the evaluative conditioning completed an additional phase prior to completing baseline assessments, as outlined in the experimental task. The induction was used to temporarily induce state body dissatisfaction and negative affect, as well as reduce variability in state outcomes across the unselected sample (Segal & Ingram, 1994). Further, the induction allowed us to use a sample with body dissatisfaction levels more similar to samples in previous studies (e.g., Aspen et al., 2015; Martijn et al., 2010). Participants were formally debriefed on the study's objectives and provided with referrals for any concerns regarding body dissatisfaction and associated problems with eating.

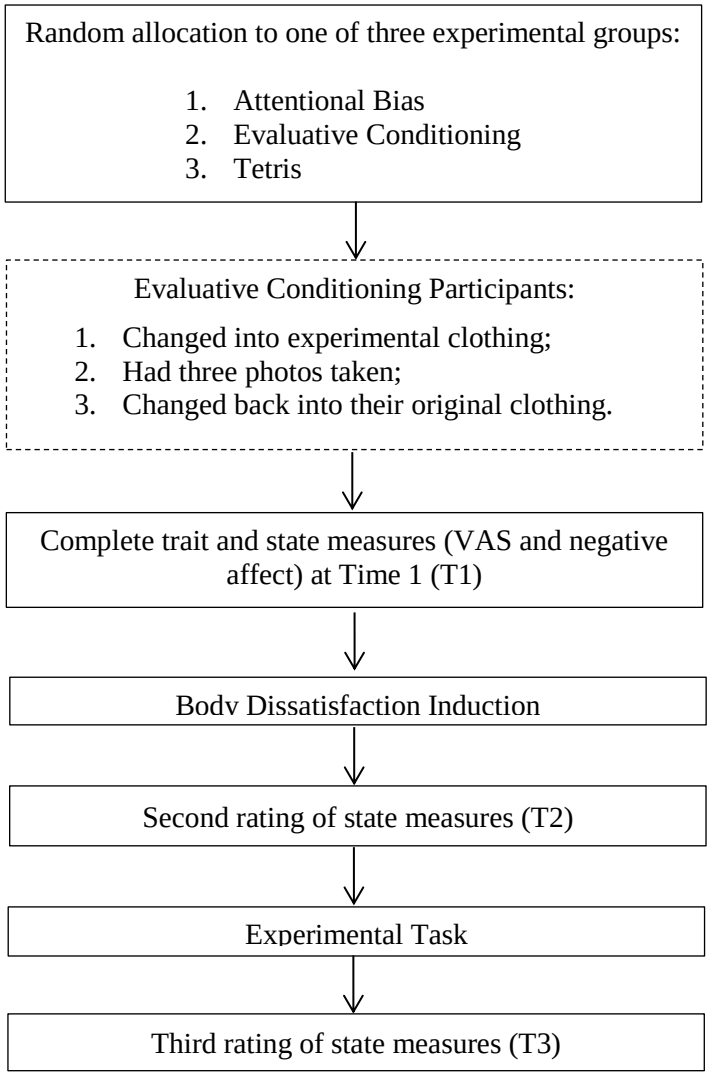


*Figure 1*. Study design

## Measures

Participants completed an online self-report questionnaire related to demographic variables and state and trait body dissatisfaction, depression and anxiety. In each case, higher scores indicated higher levels of the construct. In addition, participants were asked to report their current and ideal weight in kilograms.

### Trait measures.

***Body dissatisfaction*.** The 9-item Body Dissatisfaction subscale from the Eating Disorder Inventory (Garner, Olmsted, & Polivy, 1983) was used to measure body

dissatisfaction. Participants were asked to indicate how often the statement was true for them on a 6-point Likert scale ranging from 1 (*never*) to 6 (*always*). Responses to item numbers 3, 5, 6, 7 and 9 were reverse-coded and the total score on the nine items were converted to a mean score. The subscale has demonstrated high internal consistency (α = .90; Clausen, Rosenvinge, Friborg, & Rokkedal, 2011) and adequate convergent validity with other body dissatisfaction measures (Cumella, 2006). The internal reliability of the questionnaire in the current sample was .86.

***Negative affect***. This was assessed using the 14 items from the Depression and Anxiety subscales of the Depression Anxiety Stress Scale (Henry & Crawford, 2005; Lovibond & Lovibond, 1995). Participants rated the applicability of each statement as having occurred in the past week on a 4-point Likert scale ranging from 0 (*did not apply to me at all*) to 3 (*applied to me very much, or most of the time*). The total mean subscale scores were multiplied by two for comparison to normative data. Both subscales have demonstrated high internal consistency (α = .90–.95) and good convergent validity with independent measures of depression and anxiety (Henry & Crawford, 2005). In the current study, the internal reliability for the depression and anxiety subscales was .89 and .83, respectively.

**State outcome measures.** These were assessed on three occasions: at baseline (T1), post-negative induction (T2) and post-positive induction (T3).

***Body dissatisfaction***. Three visual analogue scales (VAS) were used to measure state body dissatisfaction. Following methods used previously by Heinberg and Thompson (1995) that were subsequently adapted by Wade and colleagues (2009), participants were asked to indicate their response to questions, including: "*How satisfied do you feel about your weight right now*?", "*How satisfied do you feel about your appearance right now*?", and "*How distressed are you by your feelings about your body right now*?". Participants indicated their level of satisfaction by dragging a slider along a 100-pixel visual analogue scale, which was

fixed with two extreme values, 0 indicating "*extreme dissatisfaction*" and 100 indicating "*extreme satisfaction*", where lower scores indicated a lower level of satisfaction. The scales have shown to be valid and reliable measures of fluctuations in body dissatisfaction, can be completed quickly, and provide improved sensitivity to small changes (Heinberg & Thompson, 1995; Tiggemann & McGill, 2004; Wade et al., 2009).

***Negative affect***. The 10-item Negative Affect scale of the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) was used to measure state negative affect. The measure comprised of ten words relating to negative emotive states (e.g., *distressed* or *jittery*) and required participants to indicate the degree to which they were experiencing the emotion on a 5-point Likert scale ranging from 1 (*very slightly or not at all*) to 5 (*extremely*). The PANAS has demonstrated good internal consistency ($\alpha = .88$; Merz & Roesch, 2011) and moderate convergent validity with other distress measures (Watson et al., 1988). In the current study the internal consistency for the subscale was .91.

**Materials**

**Body dissatisfaction induction.** To induce body dissatisfaction and negative affect participants viewed 16 sequential images of thin women from contemporary fashion advertisements. Using a modified version of the Consumer Response Questionnaire (Mills, Polivy, Herman, & Tiggemann, 2002) to enhance comparisons, participants were instructed to compare their own appearance to that of the women they viewed on the computer screen. Using a 100-pixel VAS, participants rated their agreeability (0 being '*strongly disagree'* and 100 being *'strongly agree'*) with the following statements: '*I would like my body to look like this woman's body*'; '*This woman is thinner than me*'; '*In a busy clothes shop, I would not like to try on bathing suits if this woman was also trying on bathing suits in the same change room*'. The current induction has shown to reliably induce body dissatisfaction and negative affect in unselected samples (Atkinson & Wade, 2012).

**Experimental tasks.**

***CBM-A for appearance.*** The modified dot probe task (adapted from MacLeod et al., 1986) was used to influence body dissatisfaction and negative affect by training participants to direct their attention towards positive appearance-related information. Paradigm stimuli consisted of two word categories, negative appearance-related (e.g., fat) and positive appearance-related (e.g., fit). The negatively valanced terms ($N$ = 60) were derived from a previous study conducted by Smith and Rieger (2006) and were paired with a positive counterword informed by the positive body image literature (Frisén, & Holmqvist, 2010; Tylka & Barcalow, 2015; Wood-Barcalow, Tylka, & Augustus-Horvath, 2010). All word pairs were matched on character length, and where possible syllable length (i.e., 55% of word pairs; See **Appendix A** for full list of word-pairs).

The training task was adapted from previous studies modifying selective attention in anxiety and body dissatisfaction (e.g., MacLeod et al., 1986; MacLeod et al., 2002; Smith & Rieger, 2006). Following a fixation point (e.g., + + +; presented for 500ms), a negative and positive word were presented side by side for 500ms, after which a visual dot (probe) replaced the locus of one of the two words. Using the computer keys, participants were instructed to indicate, as quickly as possible, what side of the screen the probe appeared. The probe remained on the screen until a response was provided. To control for contingency effects, the probe was manipulated to replace the target word on a majority of trials (90:10; Kakoschke, Kemps, & Tiggemann, 2014). That is, the probe replaced the locus of positive terms on 324 of the 360 trials. The task involved an initial practise phase of 24 trials and a training phase of 360 trials

***Evaluative conditioning.*** The task trained participants to associate their physical appearance with positive social cues (i.e., a smiling face), while the bodies of two unknown individuals were associated with negative or neutral cues (i.e., frowning face). The social

stimuli were taken from the NimStim Facial Stimuli Set[1] (Tottenham et al., 2009) and consisted of 15 positive faces, 15 negative faces and 15 neutral faces. The task was developed by Martijn and colleagues (2010).

Prior to completing baseline questionnaires, participants were informed that they would be required to change into a firm-fitting t-shirt and pair of leggings and have three photos taken. The experimenter provided the participant with the clothing and allowed them to change in a private room and then took three standardised images of the participant's body from the head down: front, the left and the right lateral. The participant then changed back into their original clothing and commenced the study as per the outlined procedure. This procedure differs from that of Martijn and colleagues (2010), who included an 8-day interval between the photoshoot and training (no rationale was given for this delay).

During the task, an image of the participant's body or the body of an unknown individual appeared at random, in one of the four quadrants of a computer screen. Participants were instructed to use the computer mouse to click on the image as quickly as possible. Once a response was provided the image of the body disappeared and was replaced with a social cue for 400ms. Participants were trained to associate their physical appearance with positive social cues and therefore their images were replaced exclusively by a positive social cue (e.g., a smiling face), while the control bodies were replaced by negative or neutral cues (e.g., a frowning or ambiguous face). To discriminate participants' bodies from the two controls, participants wore a contrasting coloured t-shirt (e.g., when a participant wore black, the control wore pink). The number of participants wearing black and pink t-shirts was counterbalanced. The task involved an initial practise phase of 12 trials and a training phase of 288 trials.

***Tetris*.** Participants were instructed to use the arrow keys on the keyboard, to move and rotate different shapes to make them fit together to form complete rows, with no gaps.

Once a row was formed, the row disappeared. A session ended if the falling blocks reached the top of the screen. The length of the task was matched to that of the other experimental tasks, with participants completing 15 minutes of Tetris. Participants were instructed to restart the task if it ended prior to 15 minutes.

### Statistical Analyses

A manipulation check was conducted using 3 (Training Group) x 2 (Time) mixed analysis of variance (ANOVA) to assess the changes in the three state variables between pre and post-induction. As there were no missing observations we conducted a repeated measures analysis of covariance (ANCOVA) using a 3 (training condition) × 2 (time: post-negative induction, post-training) design, adjusting for baseline observations. In order to examine differences between groups, between-group effect sizes (Cohen's *d*) with 95% confidence intervals (CI) were calculated using an online effect size calculator (Wilson, n.d).

## Results

### Baseline Variables

The mean age of participants was 20 years (*SD* = 1.95), with self-reported BMI between 18.56 and 29.39 (*M* = 22.39, *SD* = 2.79). The mean item score for trait body dissatisfaction was 3.33 (*SD* = .97), indicating that a response was between *sometimes* and *often* with respect to experiencing dissatisfaction. Additionally, body dissatisfaction was calculated as the discrepancy between participants' self-reported current and ideal body weight. Overall, 92% of the women were dissatisfied with their current body weight, with dissatisfaction applying to both circumstances of being either under (*n* =9) or over (*n* = 75) ideal weight (*M* = -4.78, *SD* = 4.58, *Min* = -20, *Max* = 5.20). As shown in **Table 1**, there were no baseline differences between the three groups with respect to any of the trait or state variables.

**Manipulation Check**

Across all three groups, the induction effectively reduced state appearance and weight satisfaction, both of which were associated with a main effect of time (appearance satisfaction, $F$[1, 88] = 21.90, $p$ <.001); weight satisfaction, $F$[1, 88] = 26.74, $p$ < 001). The induction was also successful at increasing participants' state distress, which was associated with a main effect of time, $F$(1, 88) = 17.38, $p$ < 001.There was no accompanying significant increase in state negative affect, $F$(1, 88) = 2.01, $p$ = .16. No significant main effects of training group or interactions between time and training group were observed on any of the dependent variables, indicating all groups changed commensurately over time. After the induction, there was no difference between the three groups on any of the four variables (appearance satisfaction $F$[2] = 1.90, $p$ = .16; weight satisfaction $F$[2] = .81, $p$ = .45; distress $F$[2] = .02, $p$ = .98; negative affect $F$*[*2] = .93, $p$ = .40).

**The Effect of Experimental Condition on State Variables**

As shown in **Table 2,** there was no main effect of time for state appearance satisfaction, $F$(1, 87) = 1.77, $p$ = .19 but a significant main effect of training group ($F$[2, 87] = 7.96, $p$ = <.01) and interaction between time and training group ($F$[2, 87] = 7.68, $p$ = <.01) were observed. A significant main effect of time ($F$[1, 87] = 4.05, $p$ = .047) was observed for state weight satisfaction, but no main effect of training group ($F$[2, 87] = 2.65, $p$ = .08); however a significant interaction between time and training group was observed ($F$[2, 87] = 5.20, $p$ < .01). For distress about feelings, there was no main effect of time, $F$(1, 87) = .11, $p$ = .74, but a significant main effect of training group ($F$[2, 87] = 3.40, $p$ = .04) and interaction between time and training group ($F$[2, 87] = 3.43, $p$ = .04) were observed. For state negative affect, a main effect of time ($F$[1, 87] = 23.57, $p$ <.001) was observed, however there was no main effect of training group ($F$[2, 87] = 2.88, $p$ = .06) nor a significant interaction between time and training group ($F$[2, 87] = .59, $p$ = .56).

Table 1

*Baseline Demographics and Dependent Variables*

| Variable | CBM-A ($n$ = 30 ) | | Evaluative Conditioning ($n$ = 29) | | Tetris ($n$ = 32) | | *Main effect of Group* | |
|---|---|---|---|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* | *M* | *SD* | *F(2,88)* | *p* |
| Age | 20.54 | .36 | 19.94 | .36 | 20.39 | .35 | .75 | .48 |
| Body mass index | 21.93 | 2.47 | 22.96 | 2.97 | 22.32 | 2.92 | 1.03 | .36 |
| Body dissatisfaction | 3.44 | 1.03 | 3.12 | .85 | 3.43 | 1.01 | 1.04 | .36 |
| Anxiety | .94 | .73 | 1.30 | 1.35 | 1.46 | 1.14 | 1.80 | .17 |
| Depression | 1.05 | .80 | 1.52 | 1.43 | 1.63 | 1.17 | 2.14 | .12 |
| Appearance satisfaction | 55.97 | 24.64 | 48.48 | 23.05 | 46.31 | 27.72 | 1.22 | .30 |
| Weight satisfaction | 52.73 | 31.24 | 44.07 | 24.63 | 51.03 | 29.04 | .77 | .47 |
| Distress over feelings | 41.93 | 32.21 | 32.52 | 30.50 | 37.72 | 27.90 | .72 | .49 |
| Negative affect | 1.31 | .34 | 1.49 | .77 | 1.68 | .73 | 2.55 | .08 |

Table 2

*Repeated Measures ANCOVA: Impact of Condition Adjusting Baseline Observations*

| | Time 1 covariate | CBM-A | | | Evaluative conditioning | | | Tetris | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *M* | *T2* *M (SD)* | *T3* *M (SD)* | *d* | *T2* *M (SD)* | *T3* *M (SD)* | *d* | *T2* *M (SD)* | *T3* *M (SD)* | *d* |
| Appearance satisfaction | 50.19 | 51.67(22.83) | 56.47(22.35) | .21 | 39.17(24.55) | 34.17(26.43) | .20 | 42.34(29.06) | 47.09(28.25) | .16 |
| Weight satisfaction | 49.37 | 46.53(30.23) | 53.20(29.96) | .22 | 37.00(29.31) | 34.14(27.57) | .10 | 43.84(29.20) | 49.63(27.93) | .20 |
| Distress over feelings | 37.45 | 45.60(30.07) | 36.47(28.31) | .30 | 44.72(33.82) | 44.58(31.53) | .00 | 46.41(30.47) | 34.06(24.03) | .41 |
| Negative affect | 1.50 | 1.42(.45) | 1.34(.44) | .17 | 1.60(.73) | 1.48(.47) | .16 | 1.62(.67) | 1.31(.38) | .50 |

Note: *d* refers to a within group Cohen's *d*

Cohen's *d* between-group effect sizes and their 95% confidence intervals (**Table 3**), indicated that participants in the CBM-A and Tetris conditions experienced significant improvements in state appearance satisfaction and distress over feelings related to body, relative to the evaluative conditioning group. Further, CBM-A participants experienced significant improvements in state weight satisfaction compared to those in the evaluative conditioning. Meanwhile, those in the Tetris condition experienced a significantly greater reduction in state negative affect relative to those in the evaluative conditioning.

Table 3

*Between-Group Comparisons at Post Training Adjusting for Baseline Observations*

| Variable | Appearance satisfaction | Weight satisfaction | Distress over feelings | Negative affect |
|---|---|---|---|---|
| | *d* (95% CI) | *d* (95% CI) | *d* (95% CI) | *d* (95% CI) |
| CBM-A vs. Conditioning | **.94** **(.41 to 1.48)** | **.59** **(.07 to 1.11)** | **-.66** **(-1.19 to -.14)** | -.17 (-.68 to .34) |
| CBM-A vs. Tetris | .07 (-.43 to .57) | .15 (-.35 to .65) | -.15 (-.65 to .35) | .43 (-.08 to .93) |
| Conditioning vs. Tetris | **-.88** **(-1.40 to -.35)** | -.44 (-.95 to .07) | **.51** **(.003 to 1.02)** | **.60** **(.08 to 1.11)** |

*Note.* A negative effect size indicates the first group had a lower score than the second group and a positive effect size indicates that the first group had a higher score than the second group. Significant effect sizes are bolded.

## Discussion

The current research examined the efficacy of three paradigms that target implicit cognitive distortions thought to contribute to the development and maintenance of state body dissatisfaction and negative affect. In contrast to our original hypothesis, we found CBM-A for appearance and Tetris to be more effective at ameliorating state appearance dissatisfaction and distress about body feelings than evaluative conditioning. In fact, the latter task resulted in an increase in both state appearance and weight dissatisfaction.

The inconsistency of our findings with the previous work of Martijn and colleagues (2010) suggests that one deviation from the original procedure could be instrumental. Specifically, we did not include an interlude between participants having their photos taken and completing the evaluative conditioning, whereas Martijn and colleagues had an 8-day interlude between the photoshoot and administering the conditioning procedure. The current findings don't support the notion that the procedure state exacerbated body dissatisfaction given there was no group differences on any of our measures at post-induction. However, given that change-room scenarios have been used to induce self-objectification and body dissatisfaction (e.g., Fredrickson, Roberts, Noll, Quinn, & Twenge, 1998; Quinn, Kallen, & Cathey, 2006), it is possible that changing into tight-fitting clothing and having photos taken "locked in" the induced dissatisfaction that was non-responsive to the evaluative conditioning procedure. Given that the previous two studies did not assess state body dissatisfaction immediately prior to the intervention, it is unknown whether participants completed the conditioning under a normative or heighted state of dissatisfaction. Therefore, future research should confirm whether the efficacy of evaluative conditioning is dependent on the degree of state dissatisfaction. Taken together, these results suggest that it is potentially harmful to administer evaluative conditioning when individuals are in a heightened state of dissatisfaction. When attempting to replicate the results of the previous two studies (Martijn et al., 2010; Aspen et al., 2015), a time gap should be left between obtaining photographic stimuli and administering the conditioning procedure.

Cognitive bias modification targeting attention (CBM-A) showed to be a powerful approach for reducing state body dissatisfaction and distress. This finding is inconsistent with previous studies, which have found no impact of CBM-A on symptomatology in an unselected sample (Allen et al., 2018; Loughnan et al., 2015; Smith & Rieger, 2009). The difference in findings may be attributable to participants' degree of dissatisfaction prior to

completing the attentional training. That is, previous studies did not use body dissatisfied samples nor did participants undergo an induction prior to completing the training; thus suggesting that CBM-A may be most beneficial to body dissatisfied women. A major limitation of the current pilot study is the absence of pre- and post-measures of attentional bias; thus limiting our conclusion regarding causality and transfer effects of CBM on bias and symptomatology, respectively. Specifically, it is unclear whether bias for appearance-related stimuli was present prior to training, whether training modified biases, or whether symptomatology was reduced as a result of modification of biases. Future investigations should include pre- and post-measures and investigate the efficacy of CBM-A in a body dissatisfied sample.

The visuospatial task, Tetris was effective at eliciting change in state appearance dissatisfaction, distress about feelings and negative affect and therefore performed commensurately to CBM-A. These effects extend previous findings regarding the use of Tetris in addiction and trauma symptomatology, with Tetris proving effective at reducing the impact of disorder-salient stimuli on psychopathology. Specifically, playing the popular computer game has shown to reduce food-related bias and cravings (Van Dillen & Andrade, 2016; Skorka-Brown et al., 2014), as well as intrusive flashbacks and the severity of distress caused by traumatic intrusions (Holmes et al., 2009, 2010; James et al., 2015; Iyadurai et al., 2017). Due to the scope of the current study, it is unclear whether the reduction in symptomatology was due to inference in memory consolidation or modification in selective attention for the thin ideal, or both. Future research should incorporate measures of attentional bias and memory (intrusive and recognition; James, Lau-Zhu, Tickle, Horsch, & Holmes, 2016) to better understand the effects of Tetris on eating disorder psychopathology. Further, to our knowledge, the current study is the first to explore and demonstrate the comparative effectiveness of CBM-A and Tetris on eating disorder psychopathology. These

promising effects suggest that further investigations are warranted, particularly regarding whether CBM-A and Tetris are equally effective at modifying eating disorder-salient biases. In the event that both approaches prove equally effective, it could be argued that Tetris is a more easily accessible and enjoyable intervention than CBM-A and therefore may prove to be a valuable intervention tool to pursue.

Results of the current study should be interpreted in the context of a number of limitations additional to those already mentioned. First, the current sample consisted of young female university students, with moderate levels of dissatisfaction and negative affect, thus the results are not necessarily generalizable to other populations. This is a question that future research needs to explore, particularly whether the paradigms are effective at reducing bias and symptomatology within subclinical and clinical populations. Second, despite attempting to replicate the work of Martijn and colleagues (2010), the digression from the original design impedes the interpretation of the current results. Future efforts, independent from the program developers, should seek to replicate the exact design of Martijn et al (2010), to determine whether the paradigm is as robust as reported to date. Third, the current study did not include an inactive or untreated control condition; thus the absolute effects of the three interventions are unknown (Karlsson & Bergmark, 2014). Future efforts should seek to include an inactive control condition to determine whether receiving one of these three interventions is superior to no treatment.

The current findings suggest that further research into paradigms targeting implicit cognitive processes associated with eating disorder psychopathology is warranted. Specifically, it is recommended that future research further explore the comparative efficacy of CBM-A and Tetris at modifying attentional biases associated with body dissatisfaction and negative affect and whether these two paradigms equivocally reduce symptomatology. Further, research should seek to compare the long terms effects of these two trainings to

determine whether multiple sessions produce a greater reduction in bias and symptomatology and whether these reductions remain stable over time.

# CHAPTER 5

## Using Cognitive Bias Modification to Influence Risk for Disordered Eating

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**Author Contributions:**

EM led the study design, statistical analyses, results and interpretation, and manuscript preparation. JM and GA led the recruitment and data collection. KF-S contributed to the study design. TW contributed to the study design, statistical analyses, results and interpretation, and manuscript preparation.

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This chapter was submitted and subsequently rejected from *Behaviour Research and Therapy* as it had several methodological shortcomings. The version that appears here addresses these limitations.

## Abstract

The current study aimed to compare three forms of Cognitive Bias Modification (CBM) training to determine the degree to which attentional and interpretive biases for appearance and self-worth related information influenced body dissatisfaction and negative affect. Female university students (N=67) were randomised into one of three CBM conditions, or the active comparison condition, Tetris. Initially, the negative induction process involved CBM procedures directing attention or interpretations toward negative appearance or self-worth related stimuli. Immediately following, a positive induction required participants to undergo the same form of CBM training; however, attention or interpretations were redirected towards positively valanced stimuli. All three CBM approaches effectively induced body dissatisfaction, however, no effects were apparent with respect to negative affect. No CBM techniques significantly improved body dissatisfaction or negative affect, although CBM-A for appearance and CBM-I for self-worth were associated with changes in the predicted direction for all three outcomes variables. Intervention effects were moderated by dispositional body dissatisfaction, anxiety and depression. An unexpected finding was that Tetris significantly improved body dissatisfaction among those with higher levels of depression and anxiety. Findings suggest CBM-A for appearance and CBMI-for self-worth show promise as potential intervention methods and that the use of Tetris is worth exploring with respect to improving body dissatisfaction.

## Introduction

There is extensive evidence to support the presence of attentional and interpretation bias for appearance (see Rodgers & DuBois, 2016 for review) and self-worth (Cooper, 2005; Cooper & Cowen, 2009; Cooper & Wade, 2015; Pringle et al., 2010) related stimuli in those at risk of an eating disorder. However, to date, little progress has been made in identifying whether a specific form of bias (i.e., attentional or interpretive) and information type (i.e., appearance or self-worth) has a greater impact on body dissatisfaction and negative affect. Developing a greater understanding of which bias(es) and information type induce symptomatology will aid in determining which of these mechanisms show promise as targets for interventions, especially those of relevance to prevention.

The causal relationship between cognitive biases and psychopathologies has been investigated using cognitive bias modification (CBM) procedures. Techniques targeting attention (CBM-A) and interpretations (CBM-I) manipulate bias by constraining individuals' attention or interpretations to one particular theme. Through repeated practice, a new "production rule" is formed, with CBM efficacy determined by an individual's ability to apply this newly formed rule to novel information, as well as the degree to which targeted symptomatology is impacted. A handful of studies, reviewed in **Chapter 2**, have utilised CBM-A ($n$ = 6) and CBM-I ($n$ = 6) in the field of eating disorders, however none have comparatively examined the impact of bias- and information type on body dissatisfaction and negative affect, with respects to both inducing and ameliorating symptomatology.

Accordingly, the current research aims to extend on the current knowledge in three ways. First, using three CBM procedures (CBM-A for appearance, CBM-A for self-worth, and CBM-I for self-worth), we sought to compare the degree to which attentional and interpretation bias for *negative* appearance and self-worth related stimuli induced body dissatisfaction and negative affect. Second, we compared the relative efficacy of the three

approaches at ameliorating the effects of the negative induction by retraining biases towards positively valanced stimuli. Third, we examined potential moderators of CBM, namely trait body dissatisfaction, depression and anxiety. The three CBM approaches were compared to an active comparison condition, Tetris, which was shown in the previous study to be a potentially useful intervention for improving body dissatisfaction and distress. Given that targeting interpretation bias is a core criterion of successful treatment approaches for the prevention and treatment of eating disorders, we hypothesised that participants completing the negative and positive forms of CBM-I for self-worth would experience a greater increase and reduction, respectively in body dissatisfaction and negative affect relative to those in the CBM-A conditions and Tetris.

## Method

### Participants

Seventy undergraduate students were recruited as part of the volunteer research pool at Flinders University, where participation earned payment of $15 or course credit. In order to have a homogenous sample which will increase power, the inclusion criteria required participants to be female, aged between 17 and 25, and have a body mass index (BMI) between 18.5 and 29.9 (i.e., not underweight nor obese; World Health Organisation, 2016). Of the seventy participants recruited, the data of 67 participants were included in the analyses. Three participants' data were incomplete due to technical problems that occurred during the cognitive bias modification procedure. Prior to the study's commencement, ethics approval was obtained from the Flinders Social and Behavioural Research Ethics Committee and informed consent was obtained from each participant before commencing the study.

### Procedure

The design is depicted in **Figure 1**. A 4 (training condition) × 3 (time) mixed design was implemented. Prior to data collection, two of the researchers (WYM and GA) generated

the randomisation sequence of conditions to timeslots, using Research Randomizer Version 4.0 (Urbaniak & Plous, 2013). On arrival, participants were informed of the study's five sequential phases, which were tailored according to which condition the participant had been allocated to. Initially, participants completed the standardised baseline questionnaires, as well as, measures of state body dissatisfaction and state negative affect, which were the dependent variables of interest. Second, participants completed an attentional task (CBM-A conditions), a perceptual task (CBM-I condition) or Tetris (control condition), aimed at exacerbating outcome variables (negative induction). Third, participants completed a second rating of the outcome variables. Fourth, participants completed a second attentional task, perceptual task or Tetris aimed at improving outcome variables (positive induction). Fifth, participants completed a final rating of outcome variables. Participants were formally debriefed on the study's objectives and provided with referrals for any concerns regarding body dissatisfaction and associated problems with eating.

**Measures**

Participants completed an online self-report questionnaire related to demographic variables and state and trait (moderators) body dissatisfaction, depression and anxiety. In each case, higher scores indicated higher levels of the construct.

***Trait Measures.*** These were assessed at baseline and used to examine potential moderators of intervention effects.

***Body dissatisfaction*.** This was assessed using the 9-item Body Dissatisfaction subscale from the Eating Disorder Inventory (Garner et al., 1983), using a 6-point Likert scale ranging from 1 (*never*) to 6 (*always*). Responses to item numbers 3, 5, 6, 7 and 9 were reverse-coded and the total score on the nine items were converted to a mean score. The internal reliability of the questionnaire in the current sample was .85.

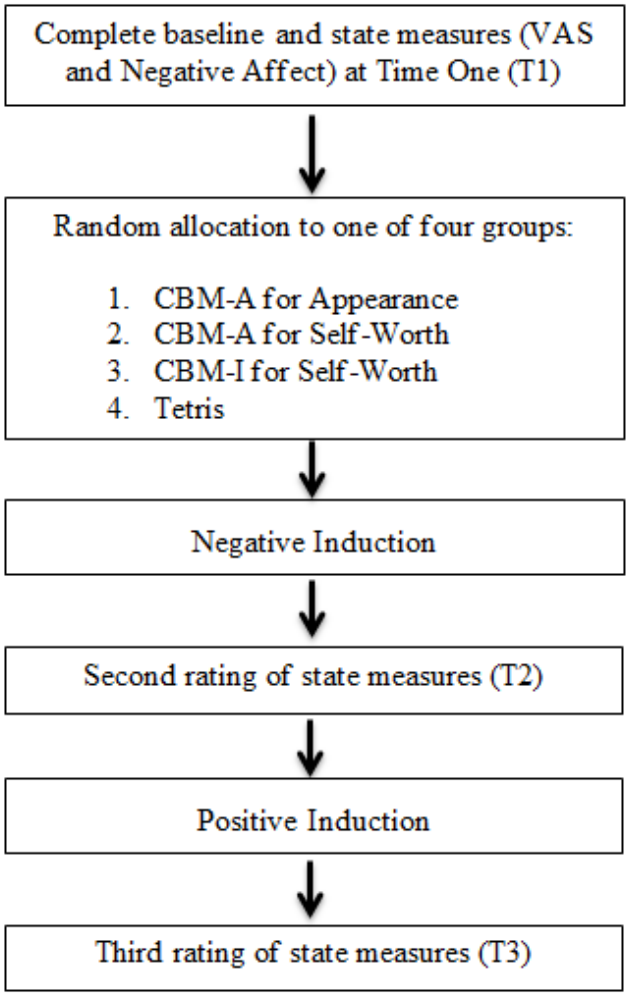


*Figure 1.* Study design

***Negative affect***. This was assessed using 14 items from the Depression and Anxiety subscales of the Depression Anxiety Stress Scale (Henry & Crawford, 2005; Lovibond & Lovibond, 1995). Participants rated the applicability of particular statements as having occurred in the past week on a 4-point Likert scale ranging from 0 (*did not apply to me at all*) to 3 (*applied to me very much, or most of the time*). The total mean subscale scores were multiplied by two for comparison to normative data. In the current study, the internal reliability for the depression and anxiety subscales was .93 and .87.

**State outcome measures.** These were assessed on three occasions: at baseline (T1), post-negative induction (T2) and post-positive induction (T3).

***Body dissatisfaction***. Three visual analogue scales (VAS) were used to measure state body dissatisfaction. Following previous methods (Heinberg and Thompson, 1995; Wade et al., 2009), participants were asked to indicate their response to three questions, including:, "*How satisfied do you feel about your appearance right now*?", "*How satisfied do you feel about your weight right now*?" and "*How distressed are you by your feelings about your body right now*?". Participants indicated their level of satisfaction by dragging a slider along a 100-pixel visual analogue scale, which was fixed with two extreme values, 0 indicating "*extreme dissatisfaction*" and 100 indicating "*extreme satisfaction*".

***Negative affect***. The 10-item Negative Affect scale of the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) was used to measure state negative affect. The measure comprised of ten words relating to negative emotive states (e.g., *distressed* or *jittery*) and required participants to indicate the degree to which they were experiencing the emotion on a 5-point Likert scale ranging from 1 (*very slightly or not at all*) to 5 (*extremely*). In the current study the internal consistency for the subscale was .87, and the range of corrected item-total correlations was .41 to .77.

**Cognitive Bias Modification (CBM) Paradigms**

***CBM targeting attention for appearance.*** The modified dot probe task (adapted from MacLeod et al., 1986) was used to influence body dissatisfaction and negative affect by training participants to direct their attention towards appearance-related information. Paradigm stimuli consisted of two word categories, negative appearance-related (e.g., fat) and positive appearance-related (e.g., fit). The negatively valanced terms ($N$ = 60) were derived from a previous study conducted by Smith and Rieger (2006) and were paired with a positive counterword informed by the positive body image literature (Frisén, & Holmqvist, 2010;

Tylka & Wood-Barcalow, 2015; Wood-Barcalow et al., 2010). All word pairs were matched on character length, and where possible syllable length (i.e., 55% of word pairs; See **Appendix A** for full list of word-pairs).

The training tasks were adapted from previous studies modifying selective attention in anxiety and body dissatisfaction (e.g., MacLeod et al., 1986; MacLeod et al., 2002; Smith & Rieger, 2006). Following a fixation point (e.g., + + +; presented for 500ms), a negative and positive word-pair was presented for 500ms, after which it disappeared and the locus of one of the two terms was replaced by a visual dot (probe). Using the computer keys, participants were instructed to indicate, as quickly as possible, what side of the screen the probe appeared. The probe remained on the screen until a response was provided. The two training inductions differed on the degree to which the probe replaced negative and positive stimuli. The negative induction intended to induce an attentional bias for negative appearance stimuli and subsequently increase dissatisfaction and negative affect and therefore the probe was manipulated to replace the negative terms on a majority of trials (90:10; Kakoschke, Kemps, & Tiggemann, 2014). Alternatively, the positive induction aimed to reduce bias and symptomatology, thus the probe primarily replaced the locus of positive terms. The two inductions task involved an initial practise phase of 24 trials and a training phase of 360 trials.

***CBM targeting attention for self-worth*.** The modified dot-probe task was also used as a means to modify selective attention for self-worth related information; with the same procedure used as the preceding condition. Similarly, the paradigm comprised of two stimuli categories that were negatively and positively related to self-worth. Target stimuli were sourced from the CBM-I for self-worth paradigms originally developed by Yiend and colleagues (2014). The negatively valanced items (e.g., vile, worthless, unlovable etc.), are characteristic of the self-loathing beliefs that exclusively predictive of eating disorder

psychopathology (Cooper and Cooper 2009). Meanwhile, positive terms reflect self-acceptance and -compassion (e.g., smart, loving, conscientious). As per the CBM-A for appearance condition, all word pairs were matched on character length, and where possible syllable length (i.e., 53% of word pairs; See **Appendix A** for full list of word-pairs). Similarly, during the negative induction participants' attention was directed toward negatively valanced items on a majority of trials, and then towards positive items during the positive induction. Participants completed a practice phase of 24 trials, and then a training phase of 360 trials.

***CBM targeting interpretation for self-worth*.** The previously reported word completion and questions tasks (Yiend et al., 2014) was used to modify interpretation bias related to self-worth. Word completion tasks, first described by Matthews and Mackintosh (2000), have shown to be effective at modifying biases in subclinical levels of anxiety and depression (Bowler et al., 2012; Menne-Lothmann et al., 2014) and eating disorders (Yiend et al, 2014).

The CBM-I training comprised 67 trials, each consisting of two consecutive components: an ambiguous scenario (including word completion) and a comprehension question. First, participants were presented with a 3-line ambiguous scenario, where the last word was purposely incomplete. Scenarios retained their emotional ambiguity until the final word was formed, which then disambiguated the meaning in a negative or positive direction towards one's self-worth. Lastly, to reinforce the meaning of the disambiguated passage, participants were presented with a comprehension question that required the completion of the words '*Yes*' or '*No*'. As per the proceeding tasks, participants were provided with practice trials (i.e., 4 scenarios) before completing the 67 training scenarios in both the negative and positive inductions. An example from the two inductions follow:

***Negative induction.***

Scenario: "*You make a slightly critical remark about a friend, and then learn that she has, by chance, heard about it. You think this means you are v-le."* (vile)

Comprehension questions: "*Do you think that you are a nasty person? Y--*" (Yes).

***Positive induction.***

Scenario: "*Your partner has been acting distant. You seek to reassure yourself that they are not annoyed with you for doing something wrong. You call them twice in quick succession. In your view you are being l-v-ng.*" (loving).

Comprehension: "*Are you too dependent on your partner? N -*" (No).

***Active Comparison Condition, Tetris.*** Participants were instructed to use the arrow keys on the keyboard, to move and rotate different shapes to make them fit together to form complete rows, with no gaps. Once a row was formed, the row disappeared. A session ended if the falling blocks reached the top of the screen. The length of the task was matched to that of the other experimental tasks, with participants completing 15 minutes of Tetris. Participants were instructed to restart the task if it ended prior to 15 minutes.

**Statistical analyses**

In order to address the first aim, we examined the degree to which the different training conditions increased body dissatisfaction and negative affect using a 4 (training condition: CBM-A for appearance, CBM-A for self-worth, CBM-I for self-worth, control) × 2 (time: baseline, post-negative induction) repeated measures ANOVA. With respects to the second aim, we examined the comparative effectiveness of the different conditions in ameliorating the outcome variable using a 4 (training condition: CBM-A for appearance, CBM-A for self-worth, CBM-I for self-worth, control) × 2 (time: post-negative induction, post-positive induction) repeated measures analysis of covariance (ANCOVA), controlling

for baseline observations. Post hoc analyses were conducted using Cohen's d between and within-group effect sizes and their 95% confidence intervals.

Exploratory analyses were conducted to test potential moderators of the different CBM trainings. Trait body dissatisfaction, anxiety and depression were selected as potential moderators and outcome variables constituted change over time in appearance satisfaction, weight satisfaction, and negative affect. To reduce multicollinearity, all variables were centred and dummy coded variables were created for the three experimental conditions; 1 if experimental, 0 otherwise (Aiken & West, 1991). Separate hierarchical multiple regressions were conducted for each combination of moderator and outcome variable. Step 1 contained the three dummy-coded variables, which represented the comparison between the three CBM and control (reference) conditions. Step 2 contained the moderator. Meanwhile, the product term was entered at Step 3, representing the interaction between condition and moderating variable and indicated the moderating effect.

## Results

### Descriptives

The mean age of participants was 20.16 years (*SD* = 2.09), with a median age of 20. The women had a self-reported BMI ranging between 18.50 and 29.92 (*M* = 23.04, *SD* = 2.94), which according to the World Health Organisation (2016) falls between the normal and overweight ranges, respectively. The mean item score for trait body dissatisfaction was 3.14 (*SD* =.39), indicating that a response was between *sometimes* and *often* with respect to experiencing body dissatisfaction. Additionally, body dissatisfaction was calculated as the discrepancy between the participants' self-reported current and ideal body weight. A total of 94% of the women indicated that they were dissatisfied with their current body weight, with dissatisfaction applying to both circumstances of being either under (*N* =5) or over (*N* = 58) one's ideal weight (*M* = -5.02 *SD* = 4.35, *Min* = -21.60kg, *Max* = 5kg). As shown in **Table 1**,

there was no difference between the four conditions with respect to any of the descriptive variables or the three dependent variables.

**The Effects of Condition on Outcome Measures: Negative Induction**

We conducted a manipulation check of the negative forms of CBM by examining the changes in the three dependent variables between baseline and post-negative induction using a 4 (training condition) × 2 (time) repeated measures ANOVA. All respective inductions successfully reduced appearance satisfaction, which was associated with a main effect of time, $F[1, 63] = 4.30$, $p = .04$. There was no accompanying reduction in weight satisfaction, $F[1, 63] = 1.58$, $p = .21$, nor increase in negative affect, $F[1, 63] = 1.29$, $p = .26$. There were no significant main effects of condition or interactions between time and condition for appearance and weight satisfaction. A significant interaction between time and training condition was observed for negative affect, $F[3, 63] = 3.05$, $p = .04$, indicating that negative affect decreased in the Tetris condition but increased in all other conditions. Post hoc analyses, using Cohen's *d* between group effect sizes and their 95% confidence (see **Table 3**), indicated that there were no significant differences between the conditions.

**The Effects of Condition on Outcome Measures: Positive Induction**

In order to examine the comparative effectiveness of the positive forms of CBM at improving body dissatisfaction and negative affect, we conducted 4 (training condition) × 2 (time) repeated measures ANCOVA, controlling for baseline observations. No main effects of time, $F[1, 62] = 3.26$, $p = .08$, or training condition, $F[3, 62] = .11$, $p = .96$, were observed for appearance satisfaction; but there was a significant interaction between time and condition $F[3, 62] = 4.06$, $p = .01$. For weight satisfaction, there were no main effects of time, $F[1, 62]$

Table 1

*Baseline Descriptive and Dependent Variables*

| Variable | CBM-A Appearance ( *n* = 17) | | CBM-A Self-Worth (*n* = 16) | | CBM-I Self-Worth (*n* = 15) | | Tetris (*n* = 19 ) | | *Main effect of Group* | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* | *M* | *SD* | *M* | *SD* | *F(3, 63)* | *p* |
| Age | 21.09 | 2.51 | 21.11 | 2.02 | 20.42 | 1.83 | 20.09 | 1.76 | 1.07 | .37 |
| Body mass index | 23.56 | 2.65 | 23.32 | 2.98 | 21.41 | 2.39 | 23.63 | 3.27 | 2.13 | .11 |
| Body dissatisfaction | 3.43 | .29 | 3.37 | .37 | 3.39 | .52 | 3.38 | .39 | .08 | .97 |
| Anxiety | 1.31 | 1.54 | 1.34 | 1.07 | .86 | .77 | 1.23 | 1.36 | .49 | .69 |
| Depression | 1.43 | 1.67 | 1.38 | 1.24 | 1.05 | 1.15 | 1.43 | 1.54 | .26 | .86 |
| Appearance satisfaction | 53.76 | 24.53 | 54.38 | 26.43 | 56.07 | 22.73 | 43.32 | 23.58 | 1.02 | .39 |
| Weight satisfaction | 51.53 | 28.10 | 51.94 | 26.96 | 54.40 | 19.42 | 44.74 | 26.30 | .46 | .71 |
| Negative affect | 1.45 | .67 | 1.41 | .57 | 1.23 | .32 | 1.45 | .25 | .72 | .54 |

Table 2

*Repeated Measures ANOVA: Impact of CBM Training on State Outcomes Measures between Pre and Post Negative Induction*
Note: *d* refers to the within-group Cohen's *d*

| | Appearance Satisfaction | | | Weight Satisfaction | | | Negative Affect | | |
|---|---|---|---|---|---|---|---|---|---|
| | *T1* *M (SE)* | *T2* *M (SE)* | *d* *(95% CI)* | *T1* *M (SE)* | *T2* *M (SE)* | *d* *(95% CI)* | *T1* *M (SE)* | *T2* *M (SE)* | *d* *(95% CI)* |
| CMB-A Appearance | 53.77 (5.91) | 49.71 (6.19) | .17 (-.51 to .84) | 52.06 (6.24) | 48.21 (6.40) | .15 (-.52 to .82) | 1.45 (.12) | 1.54 (.14) | -.17 (-.85 to .50) |
| CMB-A Self-worth | 54.36 (6.09) | 52.94 (6.38) | .06 (-.63 to .75) | 52.22 (6.42) | 50.92 (6.57) | .16 (-53 to .86) | 1.41 (.12) | 1.46 (.14) | -.10 (-.79 to .59) |
| CBM-I Self-worth | 56.07 (6.27) | 52.53 (6.59) | .15 (-.57 to .86) | 52.74 (6.87) | 51.38 (7.04) | .05 (-.66 to .77) | 1.23 (.13) | 1.44 (.16) | -.39 (-1.11 to .34) |
| Tetris | 43.32 (5.59) | 41.84 (5.86) | .06 (-58 to .70) | 45.34 (5.92) | 44.79 (6.06) | .02 (-61 to .66) | 1.45 (.11) | 1.30 (.14) | .28 (-36 to .92) |

Table 3

*Repeated Measures ANCOVA: Impact of CBM Training on State Outcomes Measures between Pre and Post Positive Induction, Controlling for Baseline observations*

| | Appearance Satisfaction | | | | Weight Satisfaction | | | | Negative Affect | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *T1 Covariate* | *T2 M (SE)* | *T3 M (SE)* | *d (95% CI)* | *T1 Covariate* | *T2 M (SE)* | *T3 M (SE)* | *d (95% CI)* | *T1 Covariate* | *T2 M (SE)* | *T3 M (SE)* | *d (95% CI)* |
| CMB-A Appearance | | 47.50 (2.52) | 53.15 (2.67) | -.54 (-1.23 to .14) | | 46.55 (2.75) | 52.21 (2.58) | -.53 (-1.21 to .15) | | 1.49 (.09) | 1.32 (.09) | .47 (-.21 to 1.15) |
| CMB-A Self-worth | | 50.14 (2.60) | 48.49 (2.75) | .16 (-.53 to .85) | | 49.15 (2.84) | 50.66 (2.65) | -.14 (-.84 to .55) | | 1.44 (.09) | 1.54 (.09) | -.29 (-.98 to .41) |
| | 51.46 | | | | 50.34 | | | | 1.39 | | | |
| CBM-I Self-worth | | 48.12 (2.69) | 52.03 (2.85) | -.37 (-1.10 to .34) | | 49.38 (2.94) | 51.90 (2.75) | -.24 (-.95 to .48) | | 1.59 (.09) | 1.36 (.10) | .64 (-.08 to 1.38) |
| Tetris | | 49.66 (2.41) | 47.53 (2.56) | .20 (-.44 to .84) | | 49.35 (2.62) | 48.70 (2.45) | .06 (-.58 to .69) | | 1.24 (.08) | 1.34 (.09) | -.28 (-.92 to .36) |

Note: *d* refers to the within-group Cohen's *d*

= .05, $p$ = .83 or training condition, $F$[3, 62] = .08, $p$ = .97, nor an interaction between time and condition $F$[3, 62] = 1.86, $p$ = .15. Negative affect was associated with a main effect of time, $F$[1, 62] = 19.49, $p$ < .00, but not condition, $F$[3, 62] = 1.23, $p$ = .31, and a significant interaction between time and condition, $F$[3, 62] = 6.64, $p$ = .001. Further testing of the significant interactions for appearance satisfaction and negative affect (see **Table 3**), revealed that the three groups did not significantly differ on the three outcome variables. The analyses showed no significant differences within or between groups.

The interactions are displayed in **Figure 2**. The interaction for appearance satisfaction was driven by two groups (CBM-A for appearance and CBM-I for self-worth) experiencing an improvement while two groups experienced a decline. The interaction for negative affect showed that these same two conditions experienced a decline in negative affect while CBM-A for self-worth and Tetris experienced further increases.

**Moderators of CBM on the Dependent Variables: Negative Induction**

We found no significant interactions for weight satisfaction or negative affect between baseline (T1) and post-negative induction (T2). For changes in appearance satisfaction between T1 and T2, adding the interaction term at Step 3 explained significant additional variance for anxiety $\Delta R^2 = .16$, $\Delta F$ (3, 59) = 3.97, $p$ = .01; and depression, $\Delta R^2 = .17$, $\Delta F$ (3, 59) = 4.48, $p$ = .01 indicating that both variables significantly moderated intervention effects with regards to appearance satisfaction. As shown in **Figure 2a** and **2b**, for those in the Tetris condition, there was a significant increase in appearance satisfaction over time for those who scored higher rather than lower in anxiety and depression, respectively. This is contrasted with the experimental conditions, which revealed a reduction in appearance satisfaction over time for those who scored higher rather than lower in anxiety.

Table 4

*Effect Sizes (Cohen's d) for Between-Groups Comparisons*

| Variable | Appearance satisfaction *d* (95% CI) | Weight satisfaction *d* (95% CI) | Negative affect *d* (95% CI) |
|---|---|---|---|
| **T1-T2** | | | |
| CBM-A (A) vs. CBM-A (SW) | -.13 (-.81 to .55) | -.13 (-.79 to .58) | .15 (-.54 to .83) |
| CBM-A (A) vs. CBM-I (SW) | -.11(-.81 to .58) | -.12 (-.82 to .57) | .17 (-.52 to 17) |
| CBM-A (A) VS. Tetris | .33 (-.34 to .96) | .13 (-.52 to .79) | .42(-.25 to 1.08) |
| CBM-A (SW) vs. CBM-I (SW) | .02 (-.69 to .72) | -.02 (-.72 to .69) | .04 (-.67 to .74) |
| CBM-A (SW) vs. Tetris | .45 (-.23 to 1.12) | .24 (-.43 to .91) | .28 (-.39 to .95) |
| CBM-I (SW) vs. Tetris | .43 (-.25 to 1.12) | .25 (-.43 to .93) | .23 (-.44 to .91) |
| **T2-T3** | | | |
| CBM-A (A) vs. CBM-A (SW) | .44 (-25 to 1.12) | .15 (-.53 to .83) | -.62 (-1.32 to .08) |
| CBM-A (A) vs. CBM-I (SW) | .10 (-.59 to .80) | .03 (-.66 to .72) | -.11(-.80 to .59) |
| CBM-A (A) vs. Tetris | .52 (-.14 to 1.18) | .34 (-.32 to 1.00) | -.05 (-.71 to .60) |
| CBM-A (SW) vs. CBM-I (SW) | -.36 (-1.07 to .35) | -.12 (-.83 to .58) | .50(-.22 to 1.21) |
| CBM-A (SW) vs. Tetris | .09 (-.58 to .75) | .19 (-.48 to .86) | .55 (-.14 to 1.24) |
| CBM-I (SW) vs. Tetris | .42 (-.27 to 1.10) | .31 (-.37 to .99) | .05 (-.62 to .73) |

*Note.* A negative effect size indicates the first group had a lower score than the second group and a positive effect size indicates that the first group had a higher score than the second group; CBM-A = Cognitive Bias Modification Targeting Attention, CBM-I = Cognitive Bias Modification Targeting Interpretation, (A) = appearance and (SW) = self-worth

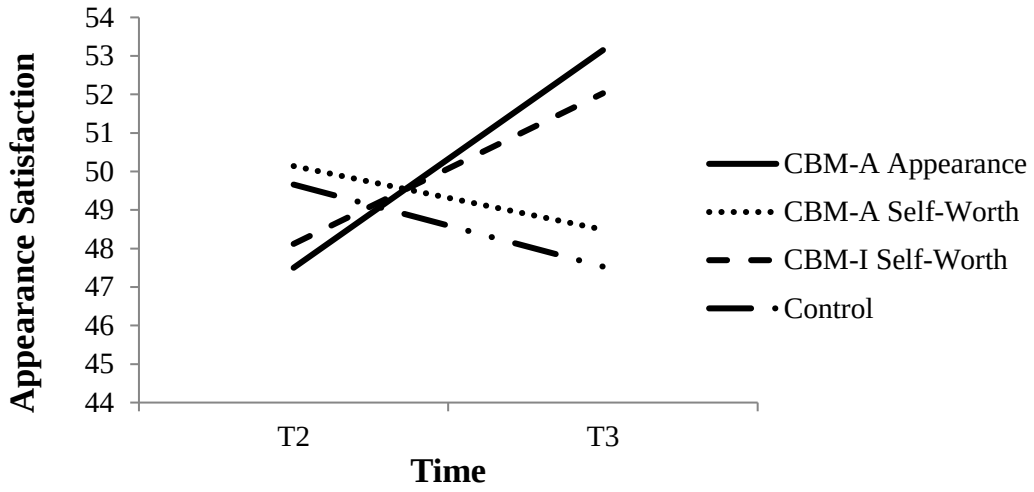


Figure 2a.

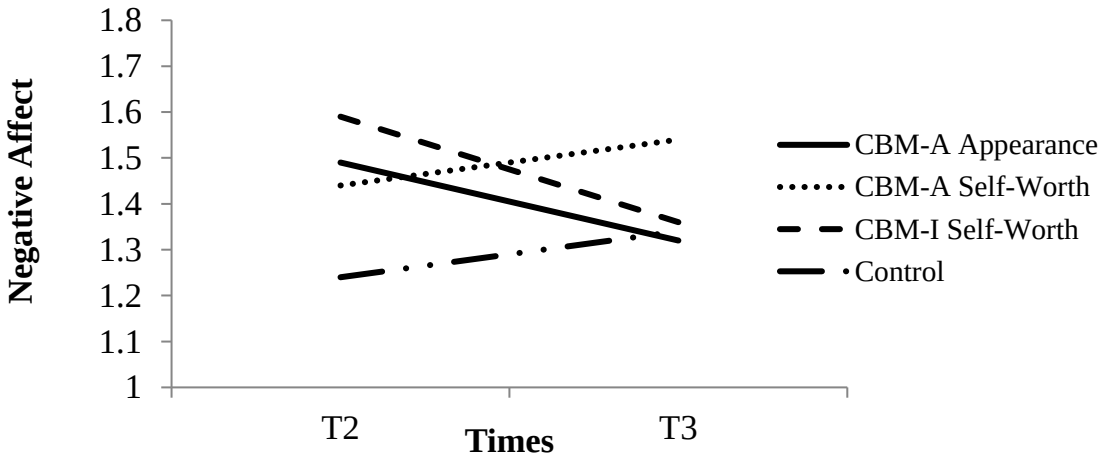


Figure 2b.

Figure 2. Trajectory of change in outcome variables between post-negative and post-positive inductions, controlling for baseline observations

**Moderators of CBM on the Dependent Variables: Positive Induction**

There were no significant interactions associated with appearance satisfaction between post-negative induction (T2) and post-positive induction (T3). **Figure 3a** shows the interaction between dispositional body dissatisfaction and experimental conditions with respect to changes in weight satisfaction between T1 and T2. Adding the interaction term at Step 3 accounted for a significant proportion of the variance in weight satisfaction, $\Delta R^2 = .32$, $\Delta F$ (3, 59) = 10.44, $p < .001$.For those in the CBM-A for appearance condition, there was a significant increase in weight satisfaction over time for those who scored higher rather than lower in body dissatisfaction, relative to the other conditions. **Figures 3b** and **3c** illustrate the significant interactions between experimental group and levels of anxiety $\Delta R^2 = .13$, $\Delta F$ (3, 59) = 4.54, $p = .01$ and depression $\Delta R^2 = .19$, $\Delta F$ (3, 59) = 6.73, $p = .001$, with regards to changes in negative affect between T2 and T3. In relation to anxiety (see **Figure 3b**), for those in the CBM-A for self-worth, there was an increase in negative affect over time for those who scored higher rather than lower. In contrast, participants training in CBM-A for appearance, CBM-I for self-worth and Tetris, there was a reduction in negative affect among those who scored higher (rather than lower) on anxiety. As shown in **Figure 3c**, a similar pattern of results was observed with respects to depression, however for those in the CBM-I for self-worth condition their level of negative affect did not appear to differ depending on the level of depression.

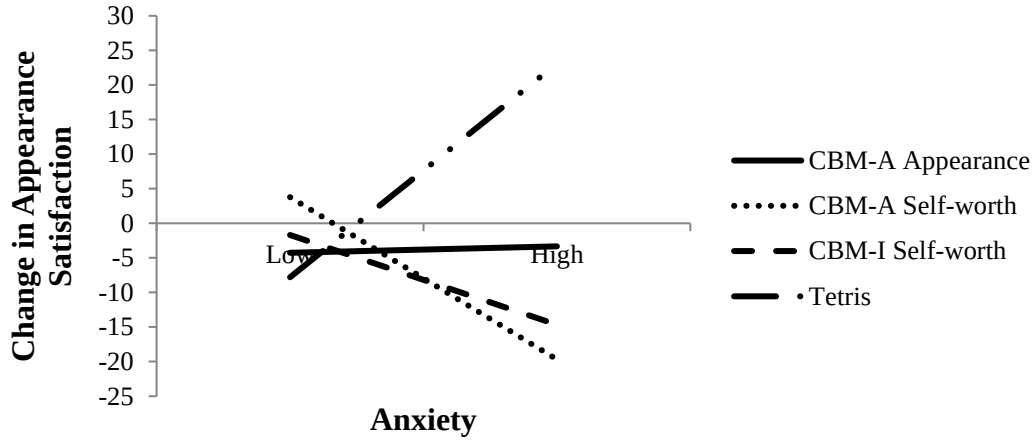


*Figure 3a.*

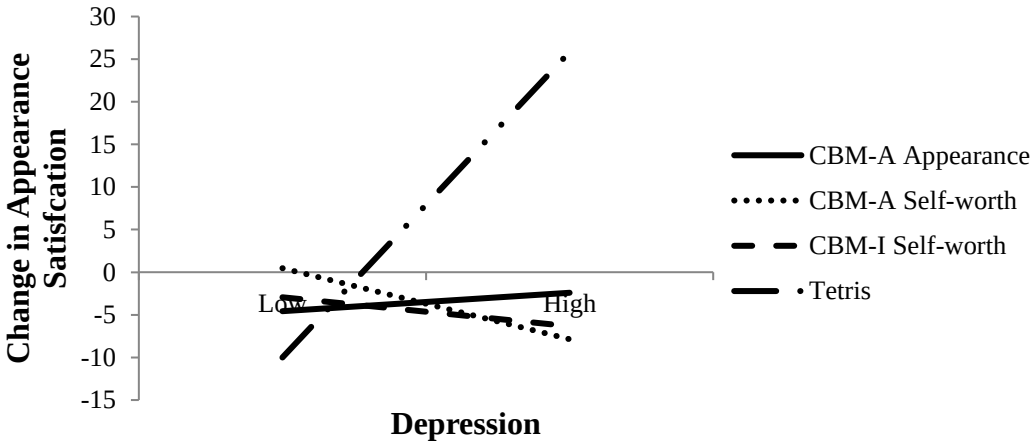


*Figure 3b.*

*Figure 3.* Predicted appearance satisfaction between T1 and T2 in the experimental and control groups, by moderators (M±SD).

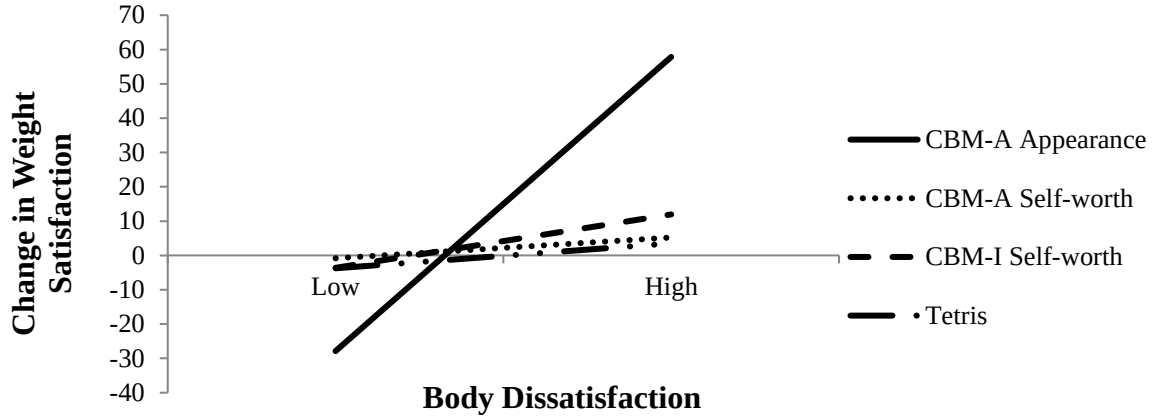


*Figure 4a.*

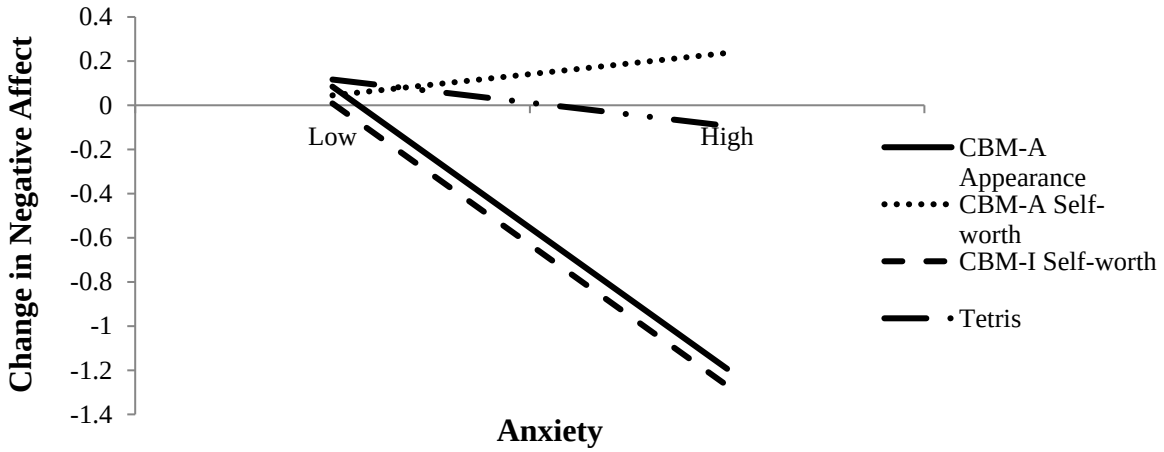


*Figure 4b.*

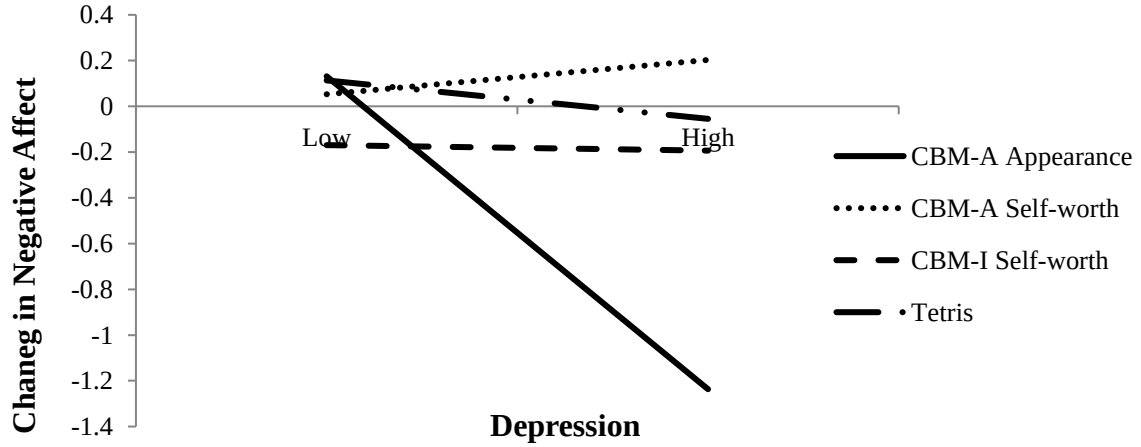


*Figure 4c.*

Figure 4. Predicted weight satisfaction and negative affect between T2 and T3 in the experimental and control groups, by moderators (M±SD).

## Discussion

The aim of the current research was to use CBM to examine the causal effects of different cognitive bias and information type on risk factors for eating disorder psychopathology. The approaches included CBM-A for appearance, CBM-A for self-worth and CBM-I for self-worth, relative to an active comparison condition, Tetris. First, we examined the effects of inducing biases towards negative appearance or self-worth related information on body dissatisfaction and negative affect. Second, we examined the relative effectiveness of the CBM approaches at counteracting the effects of the negative induction, by retraining biases towards positively valanced stimuli. Contrary to the original hypothesis, CBM-I for self-worth was not associated with significant increases (negative induction) or reductions (positive induction) in body dissatisfaction and negative affect, relative to the other training conditions. With respects to the negative induction, we found a significant decline in appearance satisfaction across the four groups; however, these adverse effects were not mirrored in weight satisfaction or negative affect. With respects to the positive induction, no training approaches significantly reduced body dissatisfaction or negative affect.

Of the brief interventions examined, two approaches (CBM for appearance and CBM-I for self-worth) showed trends towards improvements in appearance satisfaction, and negative affect. These patterns of results are consistent with Yiend and colleagues (2014) who found CBM-I for self-worth to be an effective method for exacerbating, as well as ameliorating negative affect. Notably, Yiend and colleagues only assessed the effects of CBM-I on dispositional body dissatisfaction and found no significant effects immediately following the intervention. Thus, the current study is the first to report on a possible causal relationship between positive self-beliefs and state body dissatisfaction. Given the trend of improvements in state body dissatisfaction following a single-session of CBM-I, long-term effects on trait psychopathology may be achieved.

With respect to attentional retraining, the current findings mirror that of previous work, which found no significant changes in state body dissatisfaction after a single session of CBM-A targeting appearance-related bias (Allen et al., 2018; Loughnan et al., 2015; Smith & Rieger, 2009). Firstly, Smith and Rieger CBM-A increased bias for positive appearance-stimuli but did not enhance body satisfaction. Given, that post-training satisfaction was not afflicted by a subsequent mood induction (i.e., viewing images of thin models), suggests that this attentional pattern may acts as a protective factor against body dissatisfaction (Smith& Rieger, 2009). More recently, Loughnan et al. (2015), as well as Allen et al. (2018) found neutral and positive appearance CBM-A, respectively, to be insufficient at eliciting bias change and symptom change in unselected samples. Considered together, neutral information and single session CBM-A may be insufficient at eliciting bias and symptom change in non-clinical samples; however, this needs to be assessed in a fully powered study with pre and post-assessments of both bias and symptomatology.

An interesting finding was the null effects associated with Tetris. These effects are inconsistent with the preceding study, which found Tetris to be an effective method for ameliorating body dissatisfaction, distress pertaining to body dissatisfaction and negative affect, following mood induction. A possible explanation for this discrepancy in findings pertains to the omission of a mood induction in the current study. Specifically, Tetris is proposed to interfere with the consolidation of previously viewed visually distressing stimuli, in turn reducing intrusive flashbacks of stimuli and symptomatology. Therefore, in the absence of these stimuli and heightened symptomatology, the therapeutic qualities of the task are rendered.

Our third objective was to assess whether dispositional body dissatisfaction, anxiety and depression moderated CBM intervention effects. A key finding of note was that, in the positive induction, intervention effects of CBM-A for appearance on weight satisfaction and

negative affect, were moderated by body dissatisfaction, anxiety and depression. That is, women with high levels of dispositional body dissatisfaction, anxiety and depression experienced greater improvements and reductions in weight satisfaction and negative affect, respectively. A similar pattern emerged for those in the CBM-I for self-worth condition, but only with respects to high levels of anxiety and improving negative affect. There are limited studies that have explored potential moderators of CBM intervention effects with respects to risk factors for disordered eating; nevertheless, the finding aligns with Stice, Marti, Shaw and O'Neil (2008), who noted that those with a higher risk of developing an eating disorder are likely to benefit more from targeted interventions, relative to low risk groups.

Four major limitations of this study include the small sample size and use of an unselected sample, the absence of pre- and post-measures of attentional and interpretation bias and the omission of a control condition. Firstly, the small sample size and nil assessment of cognitive bias implicate the generalisability of our findings. In order to conclude a causal relationship between bias and symptomatology, it is imperative that future studies assess the two. Second, participants were young female university students; it is therefore unclear whether these findings would generalize to other populations, including males or the wider community. Relatedly, while the population examined in this study are considered to be at increased risk of eating disorder psychopathology, future research would benefit from examining the use of these intervention approaches in high-risk populations including body-dissatisfied women. Third, while it is not uncommon for studies to focus solely on emotive outcomes and exclude pre and post measures of bias (e.g., Engel et al., 2000; Hayes, Hirsch, Krebs, & Matthews, 2010; Hertel, Vasquez, Benbow, & Hughes, 2011; Smeets et al., 2011; Salemink, van den Hout, & Kindt 2007a, b), this methodological shortcoming fails to capture the causal relationship between bias and symptomatology. Thus, future designs should seek to include pre and post measures of both bias and symptomatology to best assess the causal

and transfer effects of CBM interventions. Fourth, the omission of a control condition limits the conclusions that can be made regarding the efficacy of the experimental conditions, particularly whether the changes in symptomatology were specific to the intervention or wider priming effects of the laboratory setting.

In sum, the results give support to CBM-A for appearance and CBM-I for self-worth as promising techniques for reducing aspects of body dissatisfaction and negative affect. While this study builds on the preliminary findings of **Chapter 4**, future research using more rigorous experimental designs is necessary in order to determine whether these approaches effectively modify both bias and symptomatology. Second, it would be of interest to investigate the long term efficacy of these brief interventions. Specifically, future research should examine whether multi-session CBM generates a pronounced reduction in bias and symptomatology and whether these changes persist over time.

# CHAPTER 6

## A New Cognitive Bias Modification Technique to Influence Risk Factors for Eating

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**Author Contributions:**

EM led the study design, recruitment, data collection, statistical analyses, results and interpretation, and manuscript preparation. TW and JY contributed to the study design, statistical analyses, results and interpretation, and manuscript preparation

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A version of this chapter has been published in *International Journal of Eating Disorders* (Matheson et al., 2018). A copy of the published version is included in **Appendix B**.

## Abstract

Eating disorder psychopathology is associated with a propensity to interpret ambiguous stimuli to be negatively related to one's appearance and self-worth. The relative impact of modifying interpretation bias for these respective stimuli is unknown. Hence the main aim of the current study was to compare two cognitive bias modification protocols targeting interpretation bias (CBM-I), one focused on appearance and the other on self-worth, in terms of impacting interpretation bias, body dissatisfaction and negative affect. The appearance-based CBM-I protocol was developed for the current study. Female university students (N=123) were randomised into one of three CBM-I conditions: appearance, self-worth or control. Immediately following a negative induction that significantly increased body dissatisfaction and negative affect, participants underwent their respective CBM-I training. The CBM-I for appearance produced significant changes in the targeted bias, as well as significant improvements (moderate effect sizes) in appearance satisfaction, relative to the CBM-I for self-worth and control conditions. The results support the usefulness of the CBM-I for appearance protocol, suggesting that this technique warrants further investigation with respect to modifying interpretation bias and risk factors associated with eating disorder psychopathology. Null effects of CBM-I for self-worth should be interpreted in light of study limitations, including the potential unsuitability of training material for young women. CBM-I for both types of interpretation bias should be evaluated in future research.

## Introduction

Cognitive theories propose that psychological dysfunction can be, in part, attributed to cognitive bias; the tendency to preferentially process disorder-salient stimuli above all other information types. Non-clinical, subclinical and clinical samples have consistently shown that eating disorder risk is associated with the interpretation of ambiguous stimuli to be negatively related to one's appearance (Rodgers & Dubois, 2016) and self-worth (e.g., Cooper & Cowen, 2009; Pringle et al., 2010). For instance, a friend stating they joined a gym would be interpreted as evidence that they too should exercise to improve their weight and shape (interpretation bias related to appearance) or that they are lazy for not doing so (interpretation bias related to self-worth), rather than considering a more adaptive resolution (e.g., a friend's pride in their new found motivation).

Cognitive bias modification for interpretation (CBM-I), aims to modify biases by training individuals to adopt adaptive explanations for ambiguity. Given that individuals with greater psychopathology are likely to have more difficulty in generating positive interpretations, standardized CBM-I paradigms have proven more effective relative to self-generated CBM-I (Rohrbacher, Blackwell, Holmes, & Reinecke, 2014). Four studies utilizing such standardized paradigms relevant to eating disorders exist. Of the four studies, only one approach has shown to impact eating disorder symptomatology, namely CBM for (positive) self-worth (Yiend et al., 2014). Further, although it is well documented that at-risk eating disorder populations display appearance-related interpretation bias, a CBM-I protocol aimed at modifying these biases does not exist.

In a review of CBM procedures, MacLeod (2012) noted that the effectiveness of CBM-I procedures beyond anxiety and depression was largely uncertain. The small body of literature summarized in **Chapter 2**, emerging since this review, suggests that CBM-I shows therapeutic potential in eating disorders. Direct comparisons of CBM-I for appearance and

self-worth stimuli may indicate which protocol shows most promise, or whether both are worth pursuing, thus helping to efficiently shape future evaluations in the field. Therefore, the primary objective of the current study was to examine the effects of two CBM-I protocols, one targeting bias related to appearance and the other targeting bias related to self-worth, with respect to modifying disorder-salient bias and improving two risk factors for eating disorder psychopathology, body dissatisfaction and negative affect (Jacobi & Fittig, 2011). The cognitive-behavioural model would suggest that self-worth is a central maintaining factor of appearance concern and disordered eating (Fairburn, 2008a), so we hypothesised that CBM-I for self-worth would be more effective at modifying the targeted interpretation bias, as well as improving risk factors (body dissatisfaction and negative affect), than CBM-I for appearance and control.

## Method

### Participants

One hundred and forty-five university students were recruited from a volunteer research pool, where participation earned course credit. To have a homogenous sample and thus increase power, the inclusion criteria required participants to be female, aged between 17 and 25, and have a body mass index (BMI) between 18.5 and 29.9 (i.e., not underweight nor obese; World Health Organisation, 2017). Of the 145 participants recruited, the data of 123 participants were included in the analyses; $n = 3$ were excluded for falling outside the age range and $n = 19$ were excluded for not meeting weight criteria ($n = 10$ were underweight and $n = 9$ were obese). Prior to commencement, ethics approval for the study was obtained from the Flinders Social and Behavioural Research Ethics Committee and informed consent was obtained from each participant.

## Materials

### Body dissatisfaction induction

To induce body dissatisfaction and negative affect participants viewed 16 sequential images of thin women from contemporary fashion advertisements. Using a modified version of the Consumer Response Questionnaire (Mills et al., 2002) to enhance comparisons, participants were instructed to compare their own appearance to that of the women they viewed on the computer screen. Using a 100-pixel VAS, participants rated their agreeability (0 being '*strongly disagree'* and 100 being *'strongly agree'*) with the following statements: '*I would like my body to look like this woman's body*'; '*This woman is thinner than me*'; '*In a busy clothes shop, I would not like to try on bathing suits if this woman was also trying on bathing suits in the same change room*'. Inductions are routinely used in unselected samples to reduce variation in mood state levels (Segal & Ingram, 1994) and thus increase effect sizes for any subsequent improvements. The current induction has been shown to reliably induce body dissatisfaction and negative affect in unselected samples (Atkinson & Wade, 2012).

### Cognitive Bias Modification Targeting Interpretation (CBM-I)

The CBM-I training took the previously reported (e.g. Yiend et al., 2014) form of word completion and question tasks. Word completion tasks, first described by Matthews and Mackintosh (2000), have shown to be effective at modifying biases in subclinical levels of anxiety and depression (Bowler et al., 2012) and eating disorders (Yiend et al., 2014). The training material used in the CBM-I for self-worth and CBM-I control conditions, was sourced from Yiend and colleagues (2014). To our knowledge, there has not been a CBM-I training specifically designed to modify appearance-related interpretation bias using the word completion task.

Therefore, using the framework described in the aforementioned studies, the authors developed the training task 'CBM-I for appearance'. Training stimuli were informed by

appearance-based feedback and rejection sensitivity scales (Altabe, Wood, Herbozo, & Thompson, 2004; Park, 2013; Park, Calogero, Young, & DiRaddo, 2010; Tantleff-Dunn, Thompson &, Dunn, 1995), as well as a pilot study conducted with 21 women aged between 21-27 years ($M$ = 24.35, $SD$ = 1.33). The women were asked to rate appearance-related terms (e.g., fit) on two 9-point Likert scales, which assessed relatedness to appearance (1 being '*completely unrelated'* and 9 being '*completely related'*) and affective valence (1 being *'completely unpleasant* and 9 being '*completely pleasant*). Based on these ratings, target words were chosen according to the degree to which they related to appearance and were positively endorsed.

The CBM-I training comprised 67 trials, each consisting of two consecutive components: an ambiguous scenario (including word completion) and a comprehension question. First, participants were presented with a 3-line ambiguous scenario, where the last word was purposely incomplete. Scenarios retained their emotional ambiguity until the final word was formed, which then disambiguated the meaning in a positive direction towards either one's appearance or self-worth. Lastly, to reinforce the positive meaning of the disambiguated passage, participants were presented with a comprehension question that required the completion of the words '*Yes*' or '*No*'. Control scenarios related to imperative (e.g., making a cup of tea) and declarative (e.g., facts about butterflies) knowledge and retained neutrality when disambiguated. Training was delivered through an online survey program and incorporated 4 initial practice trials. Both CBM-I for appearance (Matheson, Yiend, & Wade, 2018) and self-worth (Houlihan, Yiend, & Cooper, 2017) training materials are available via Open Science Framework. A sample training item from the three CBM-I conditions follow:

Appearance: "*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*" (fit). The trained interpretation is reinforced by the comprehension question (with feedback given reflecting whether participants have responded 'correctly' or not) here: "*Are you surprised by your level of fitness? '*Correct' answer*: No*. There are an equal number of randomly distributed 'yes and 'no' responses required.

Self-worth: *"Your partner has been acting distant. You seek to reassure yourself that they are not annoyed with you for doing something wrong. You call them twice in quick succession. In your view you are being l-v-ng"* (loving). Comprehension question: *Are you too dependent on your partner? No.*

Control: "*You turn the kettle on and wait for the water to boil. You get a teabag out of the tin, which you put into a mug, and pour the boiling water onto the teabag. Next, you add the m- - k*" (milk). Comprehension question: *Have you made a cup of tea? Yes*.

**Similarity Ratings Task**

The similarity ratings task (SRT) assessed modification of interpretation bias between pre- and post-training (Eysenck, Mogg, May, Richards, & Mathews, 1991; Mathews & Mackintosh, 2000). Similarly, the SRT assessing self-worth related bias was sourced from Yiend and colleagues (2014). Meanwhile, the authors developed corresponding tasks for the newly developed CBM-I for appearance condition. The SRTs comprised of two consecutive subtasks: 1) a word completion task and 2) a recognition test. Together, the two SRTs consisted of 40-word completion scenarios (20 appearance-relevant and 20 self-worth relevant), which were separated into two parallel sets and their presentation counterbalanced between pre- and post-training.

The word completion task appeared in a similar format to that described in the CBM-I training; however, the aim of the SRT was to assess, rather than to modify, biases. Thus, when the fragmented word was complete, each scenario and comprehension question retained

emotional ambiguity, rather than reflecting and reinforcing positive interpretations, respectively. Further, each scenario was presented with a corresponding title, such as the "Family Christmas Card": *Every year your mother organises a family portrait to use for Christmas cards. The photographer places you front and centre. You start to think about how many people will see the c-rd. (card). Is the card for celebrating Easter?" N- (No).*

In the recognition task, test sentences appeared beneath a title that corresponded with the previously encoded assessment scenarios. Participants were instructed to rate how similar in meaning the sentence was to the original passage on a scale between 1 (*very different*) and 4 (*very similar)*. Each scenario had four corresponding test sentences; two target sentences and two foils sentences. Target items reflected either a positive or negative interpretation of the scenario. While, foil sentences were unrelated to appearance or self-worth and assessed participants' general response bias (i.e., the tendency to respond to ambiguity in a positive or negative manner). Thus, the inclusion of both target and foil items, allowed for the distinction between modifying interpretation bias and more general priming effects of training (Mathews & Mackintosh, 2000). Test sentences were programmed to appear individually and at random. A sample set of test sentences for the "*Family Christmas Card*" scenario follow:

*People will enjoy seeing your photo on the Christmas card (*positive target)

*People will dislike your appearance in the photo* (negative target)

*The photographer was kind (positive foil)*

*The photographer was rude (negative foil)*

**Measures**

**Interpretation bias** Similarity rating scores were used to assess the changes in interpretation and response bias, using target and foil items respectively (Yiend et al, 2014). Interpretation bias indices were calculated separately for appearance and self-worth, at pre- and post-training, by subtracting the mean negative target rating from the mean positive

target rating. Meanwhile, general response bias indices (mean positive foil rating minus mean negative foil rating) captured participants' tendency to respond in a more positive or negative manner. Bias scores ranged between -4 and 4, with 0 indicating no bias, and positive and negative values indicating a positive or negative bias, respectively.

**Trait measures**. The 9-item Body Dissatisfaction subscale from the Eating Disorder Inventory (Garner et al., 1983) was used to measure body dissatisfaction. Participants were asked to indicate how often the statement was true for them on a 6-point Likert scale ranging from 1 (*never*) to 6 (*always*). Responses to item numbers 3, 5, 6, 7 and 9 were reverse-coded and the total score on the nine items were converted to a mean score. The internal reliability of the questionnaire in this sample was .85.

Depression and anxiety were assessed using the two relevant subscales from the Depression, Anxiety and Stress Survey (Lovibond & Lovibond, 1995). Participants rated the applicability of statements as having occurred in the past week. Responses were scored on a 4-point Likert scale ranging from 0 (*did not apply to me at all*) to 3 (*applied to me very much, or most of the time*). Total mean subscale scores were multiplied by two for comparison to normative data. The internal reliability for the current depression and anxiety subscales was .92 and .81, respectively.

**State measures**. Visual analogue scales (VAS; Heinberg & Thompson, 1995) were used to assess participants' state level of appearance and weight satisfaction, by indicating a response to the following questions: (1) "*How satisfied do you feel about your appearance right now?*" (2) "*How satisfied do you feel about your weight right now*?" Participants indicated their level of satisfaction by dragging a slider along a 100-pixel VAS, which was fixed with two extreme values (0 indicating *extreme dissatisfaction* and 100 indicating *extreme satisfaction*).

Negative affect was assessed using the Negative Affect subscale from the Positive Affect and Negative Affect Schedule (Watson et al., 1988). The measure was comprised of ten words relating to negative feelings (e.g., *distressed* or *jittery*) and required participants to indicate the level to which they were experiencing this feeling on a 5-point Likert scale ranging from 1 (*very slightly or not at all*) to 5 (*extremely*). Internal consistency for the Negative Affect subscale for the present study was .91.

**Procedure**

The procedure is depicted in **Figure 1**. Participants attended a single session with six sequential phases lasting a total of 90 minutes. After data collection, participants were formally debriefed about the study objectives and provided with referrals for any concerns regarding body dissatisfaction.

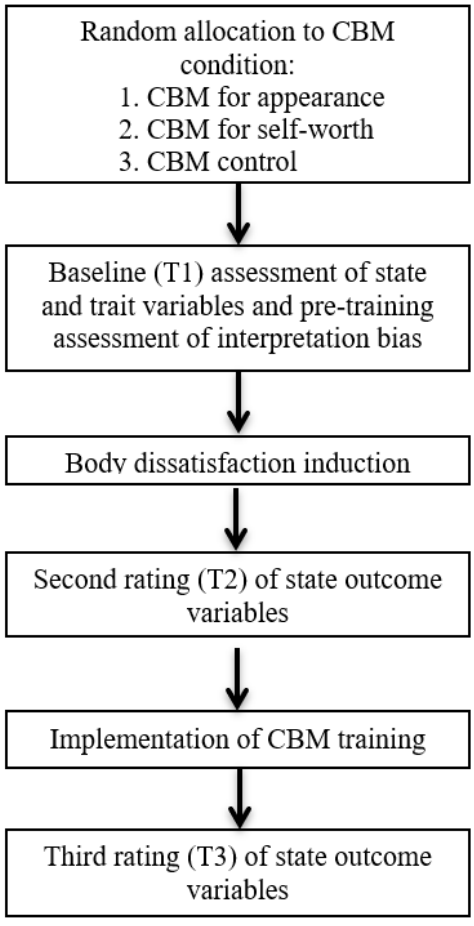


*Figure 1*. Study Design

## Results

### Participant Characteristics and Baseline Measures

As shown in **Table 1** the three groups did not differ on any baseline variables. Negative affect was severely positively skewed, however results remained unchanged when inverse transformations were applied; thus, original scores are reported.

### Body Dissatisfaction Induction

A manipulation check was conducted using 3 (Training Group) x 2 (Time) mixed analysis of variance (ANOVA) to assess the changes in the three state variables between pre and post-induction. Across all three groups, the induction significantly exacerbated body dissatisfaction and negative affect as indicated by a main effect of Time (appearance satisfaction, $F[1, 120] = 29.16$, $p < .001$; weight satisfaction, $F[1, 120] = 19.61$, $p < .001$; negative affect $F[1, 120] = 21.66$, $p < .001$). There were no significant main effects of Training Group for any of the three dependent variables; nor significant interactions between Training Group and Time. After the induction, there was no difference between the three groups on any of the three variables (appearance satisfaction $F[2] = .94$, $p = .39$; weight satisfaction $F[2] = .76$, $p = 47$; negative affect $F[2] = .64$, $p = .53$). Hence all groups experienced commensurate changes on the outcome variables.

### The Impact of CBM-I on State Variables

Changes in body dissatisfaction and negative affect between pre-training (i.e. post-induction) and post-training, across the three groups were assessed using 3 (Training Group) × 2 (Time) repeated measures ANOVA.

As shown in **Table 3**, appearance satisfaction was associated with a main effect of Time, with no main effect of Training Group and a significant interaction between Time and Training Group. A significant main effect of Time was observed for weight satisfaction and

Table 1

*Baseline demographics and dependent variables*

| Variable | CBM-I Appearance ( *n* = 44) | | CBM-I Self-Worth (*n* = 37) | | CBM-I Control (*n* = 42) | | *Main effect of Group* | |
|---|---|---|---|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* | *M* | *SD* | *F(2, 122)* | *p* |
| Age | 19.55 | 1.61 | 19.49 | 1.33 | 19.21 | 1.41 | .62 | .54 |
| Body mass index | 22.70 | 2.82 | 23.08 | 2.98 | 22.47 | 2.67 | .46 | .63 |
| Body dissatisfaction | 3.63 | 1.00 | 3.67 | .92 | 3.52 | .88 | .26 | .77 |
| Anxiety | 1.35 | 1.11 | 1.43 | 1.16 | 1.61 | 1.21 | .57 | .57 |
| Depression | 1.25 | 1.21 | 1.44 | 1.34 | 1.72 | 1.40 | 1.41 | .25 |
| Appearance satisfaction | 49.41 | 23.95 | 45.43 | 25.14 | 52.88 | 26.17 | .87 | .42 |
| Weight satisfaction | 46.11 | 31.35 | 44.91 | 26.40 | 53.31 | 27.25 | 1.03 | .36 |
| Negative affect | 1.33 | .45 | 1.48 | .53 | 1.49 | .72 | 1.06 | .35 |
| Appearance interpretation bias | .15 | .79 | -.07 | .69 | -.12 | .72 | 1.77 | .17 |
| Response bias (appearance-related foils) | .55 | .43 | .40 | .42 | .43 | .52 | 1.20 | .30 |
| Self-worth interpretation bias | .48 | .58 | .43 | .62 | .25 | .49 | 1.99 | .14 |
| Response bias (self-worth related foils) | .45 | .58 | .42 | .47 | .35 | .48 | .39 | .68 |

*Note*. CBM-I = Cognitive bias modification targeting interpretation bias

Table 2

*Mean (standard deviation) state variables and raw target and foil scores across condition pre- and post CBM-I training*
*Note*. CBM-I = Cognitive bias modification targeting interpretation bias; Pre-training = post-induction assessment of outcome variables.

| | CBM-I Appearance | | CBM-I Self-Worth | | CBM-I Control | |
|---|---|---|---|---|---|---|
| | *Pre-Training M (SD)* | *Post-Training M(SD)* | *Pre-Training M(SD)* | *Post-Training M(SD)* | *Pre-Training M(SD)* | *Post-Training M(SD)* |
| Appearance satisfaction | 39.84 (27.18) | 55.75 (29.21) | 37.05 (25.26) | 45.14 (24.76) | 44.95 (25.74) | 50.36 (25.25) |
| Weight satisfaction | 38.31 (30.90) | 51.62 (32.59) | 40.16 (26.19) | 46.27 (24.66) | 45.57 (27.00) | 52.02 (25.04) |
| Negative affect | 1.55(.12) | 1.22 (.09) | 1.74 (.13) | 1.49 (.10) | 1.61 (.12) | 1.36 (.09) |
| Appearance Bias | | | | | | |
| Positive target | 2.58 (.45) | 2.87 (.39) | 2.47 (.38) | 2.51 (.30) | 2.46 (.35) | 2.48 (.33) |
| Negative target | 2.42 (.49) | 2.17 (.51) | 2.54 (.47) | 2.53 (.50) | 2.58 (.47) | 2.36 (.56) |
| Positive foil | 2.54 (.43) | 2.64 (.39) | 2.45 (.31) | 2.45(.31) | 2.38 (.38) | 2.50 (.35) |
| Negative foil | 1.99 (.32) | 1.89 (.34) | 2.05 (.36) | 2.08 (.42) | 1.95 (.45) | 1.95 (.44) |
| Self-worth Bias | | | | | | |
| Positive target | 2.96 (.36) | 3.0 (.35) | 2.94 (.30) | 2.86 (.41) | 2.81 (.39) | 2.85 (.34) |
| Negative target | 2.49 (.38) | 2.45 (.38) | 2.51 (.50) | 2.51 (.42) | 2.56 (.48) | 2.45 (.40) |
| Positive foil | 2.52 (.41) | 2.49 (.43) | 2.47 (.28) | 2.52 (.31) | 2.38 (.38) | 2.41 (.36) |
| Negative foil | 2.07 (.35) | 2.07 (.32) | 2.06 (.40) | 2.16 (.32) | 2.02 (.36) | 2.04 (.48) |

Table 3

*Two-way and Three-way ANOVA: Impact of CBM-I on State Variables and Bias between Pre- and Post-Training*

| | | *df* | *F* | *p* |
|---|---|---|---|---|
| **State variables** | | | | |
| *Appearance satisfaction* | | | | |
| | Time | 1, 120 | 45.42 | <.001 |
| | CBM-I Training Group | 2, 120 | .90 | .41 |
| | Time × CBM-I Training Group | 2, 120 | 4.95 | .01 |
| *Weight satisfaction* | | | | |
| | Time | 1, 120 | 35.10 | <.001 |
| | CBM-I Training Group | 2, 120 | .45 | .64 |
| | Time × CBM-I Training Group | 2, 120 | 2.68 | < .07 |
| *Negative affect* | | | | |
| | Time | 1, 120 | 37.35 | <.001 |
| | CBM-I Training Group | 2, 120 | 1.34 | .27 |
| | Time × CBM-I Training Group | 2, 120 | .42 | .66 |
| **Bias Change Variables** | | | | |
| *Change in Bias for Appearance* | | | | |
| | Time | 1, 120 | 17.75 | <.001 |
| | Bias Type | 1, 120 | 56.69 | <.001 |
| | CBM-I Training Group | 2, 120 | 7.32 | .001 |
| | Time × Bias Type | 1, 120 | 8.03 | .01 |
| | Time × CBM-I Training Group | 2, 120 | 5.55 | .01 |
| | Bias Type × CBM-I Training Group | 2, 120 | 2.69 | .07 |
| | Time × Bias Type × CBM-I Training Group | 2, 120 | 1.79 | .17 |
| *Change in Bias for Self-Worth* | | | | |
| | Time | 1, 120 | .05 | .83 |
| | Bias Type | 1, 120 | .18 | .68 |
| | CBM-I Training Group | 2, 120 | 1.42 | .25 |
| | Time × Bias Type | 1, 120 | 1.85 | .18 |
| | Time × CBM-I Training Group | 2, 120 | .75 | .48 |
| | Bias Type × CBM-I Training Group | 2, 120 | .75 | .47 |
| | Time × Bias Type × CBM-I Training Group | 2, 120 | .71 | .50 |

*Note*. CBM-I = Cognitive bias modification targeting interpretation bias; Pre-training = post-induction assessment of outcome variables. Time = Pre- and Post-training; Bias Type = Target and Foils; CBM-I Training Group = CBM-I for appearance, CBM-I for self-worth, CBM-I control.

negative affect, no main effect of Training Group, nor was an interaction between Time and Training Group associated with either variable.

Post hoc analyses were conducted on the significant interaction between Time and Training Group for appearance satisfaction using Cohen's *d* within-group effect sizes and their 95% confidence intervals. Analyses revealed that CBM-I for appearance was associated with a significant medium sized improvement in appearance satisfaction, *d* = .61 [.18:1.04]; these effects were not mirrored in the CBM-I for self-worth (*d* = .31 [-.15:.77]) or CBM-I control (*d* = .21 [-.22:.64]) conditions.

**Impact of CBM-I on Modifying Bias**

Interpretation and response bias indices (calculated by collapsing the different directions of interpretation, see methods) were considered together in a three-way mixed ANOVA, to compare the specific interpretative consequences of CBM-I (indicated by responses to target items) to wider priming effects of training (indicated by responses to foil items), respectively. (Yiend, Mackintosh, & Mathews, 2005; Yiend et al, 2014; Lee, Mathews, Shergill, & Yiend, 2016; Savulich, Shergill, & Yiend, 2017). A mixed model ANOVA was conducted, with Training Group (CBM-I for appearance vs. CBM-I for self-worth vs. CBM-I control) as a between-subjects factor and Bias Type (target vs. foil) and Time (pre- vs. post-training) as within-subject factors.

As shown in **Table 3**, for self-worth bias indices, no main effects or three-way interaction were observed. Meanwhile, for appearance bias indices (see **Table 3**), significant main effects of Time, Bias Type and Training Group were observed. Accompanying the effects was a significant interaction between Training Group and Time. Post hoc analyses of the interaction were conducted using Cohen's *d* within-group effect sizes and their 95% confidence intervals. Analyses revealed a significant medium sized increase in positive bias in the CBM-I for appearance condition (*d* =.72 [.29:1.15]); however, the CBM-I for self-

worth (*d* =.02 [-.47:.44]) and CBM-I control (*d* =.10 [-.32:.54]) conditions were not associated with such effects. No significant three-way interaction between Time, Training Group and Bias Type was observed, indicating no significant difference in the trajectory of interpretation vs. response bias between the three training groups over time.

**Directions of Bias Change Associated with CBM-I**

Using pre- and post-training interpretation bias indices for appearance and self-worth, we examined the direction of change and whether this was congruent with the training that participants received. Of the 44 participants in the CBM-I for appearance condition, 29 (66%) showed a change in the predicted direction (i.e., increased positive interpretations towards appearance), 12 (27%) showed a change in the adverse direction (i.e., reduced positive interpretations), and 3 (7%) showed no change in bias. After removing the data of unresponsive participants (i.e. those who showed no change in bias), the difference in proportions of congruent and incongruent bias change was significant, $\chi^2(1, N = 41) = 7.05$, $p < .01$. For the 37 participants in the CBM-I for self-worth condition, 15 (40.5%) demonstrated a bias change congruent with training (i.e., increased positive interpretations towards self-worth), while the scores of 21 (56.8%) participants were incongruent (i.e., reduced positive interpretations) and 1 (2.7%) showed no change. The difference in proportions of congruent and incongruent bias change was not significant, $\chi^2(1, N = 36) = 1$, $p < .32$.

## Discussion

The current research sought to comparatively examine two CBM-I approaches and their influence on modifying interpretation bias and two risk factors for eating disorder psychopathology. In contrast to the original hypothesis, results supported the newly developed CBM-I for appearance protocol, with the approach proving to be more effective at modifying the targeted bias and improving symptomatology than CBM-I for self-worth.

Specifically, CBM-I for appearance increased positive-appearance related interpretations of ambiguity and produced significant medium sized improvements in appearance satisfaction. No significant changes to bias or symptomatology were observed in those who completed CBM-I for self-worth.

Our results are inconsistent with those of Yiend and colleagues (2014) who found CBM-I for self-worth to be an effective approach for retraining disorder-salient bias and reducing intrusive thoughts related to appearance. The inconsistencies may relate to differences in sample demographics, namely age and clinical severity. Specifically, the current study used an unselected sample with varying levels of psychopathology and a mean age of 19 years, relative to a subclinical sample with a mean age of 29 years. Subsequently, age and clinical severity may determine the suitability of training material and the degree of pre-existing bias, respectively. First, the content of the self-worth training material may have been somewhat unsuitable for the younger sample. Self-worth in younger female populations is likely to hinge on appearance, studies and dating, as opposed to marriage, children and a full-time career, which were reoccurring themes in the existing self-worth training scenarios. Exposure to scenarios that one has yet to experience or achieve may foster negative self-worth bias and subsequently feelings of failure or discontent. In future studies of similar aged females to the present sample, researchers should review the CBM-I for self-worth material and modify training scenarios to be more reflective of younger female life domains. More generally, researchers using CBM should place close attention to the suitability of the training content and seek to match or adapt items to be as relevant as possible to the concerns of the sample. In the wider interpretation bias literature, the importance of the content match with the concerns of the sample has been termed ‘content specificity’ and has been the subject of specific investigation in some vulnerable populations (e.g. Savulich, Freeman, Shergill & Yiend, 2015). Second, prior to the intervention, the current sample reported high levels of

general response bias and positive self-worth bias, indicating a propensity to respond to ambiguity in an optimistic manner, both generally and regarding self-worth. Therefore, modifying bias in a direction that is already congruent with participants' cognitions is likely to reduce the potency of the intervention.

An important contribution of the current research was the development of a CBM-I for appearance protocol. Although there was a specific effect of CBM-I on interpretation bias (target items), a similar pattern of results also emerged for general response bias (foil items). Matthews and Mackintosh (2000) propose that the current assessment of bias may be sensitive to experimental noise, resulting in target and foil items being equally encoded and considered similar in meaning to the original message. Specifically, the text method assesses bias on the assumption that the individual will consistently respond to ambiguity with one form of interpretation (e.g., positive target), therefore rejecting the three alternative interpretations (e.g., positive foil, negative target and negative foil). For example, an interpretation such as, "*People will enjoy seeing your photo on the Christmas card*" (positive target) leads to the correct rejection of the positive foil "*the photographer was kind*". However, when encoding the original passage, these specific interpretations are not visible to the individual. As such, more generic interpretations may have been generated and encoded into memory, such as "*the photographer found me appealing*", "*I felt accepted*" or "*the experience was enjoyable*". In this case, both the positive target and foil item would be considered as accurate representations of the outcome, thus leading the individual to rate both items as similar in meaning. While we can conclude that we induced an interpretation bias as well as a more general positive bias, our inability to distinguish between these two effects represents a limitation of the current CBM-I protocol which may require further modification.

Current findings should be interpreted in the context of limitations additional to those already mentioned. Firstly, the design did not include qualitative assessments at debriefing,

thus participants' awareness of the study's intentions is unknown. The impact of participants' awareness of intervention intentions on CBM-I efficacy remains unclear, with some evidence suggesting this knowledge enhances bias modification and symptom change (Mobini et al., 2014), while others found it to hinder treatment effects (Orchard, Apetroaia, Clarke, & Creswell, 2017). Future efforts should look to include quantitative and/or qualitative awareness checks to determine the relationship between awareness and CBM-I efficacy. Second, despite null effects of CBM-I for self-worth on bias and symptomatology (i.e., weight satisfaction and negative affect), the approach should not be considered ineffective. Current findings are likely to be indicative of ceiling effects. The current unselected sample were positively biased at baseline, both generally and towards self-worth, and as such participants bias is likely to be less amenable to positive manipulation. These findings are consistent with previous studies, which found an adaptive interpretation bias in healthy populations prior to completing CBM-I training (e.g. Yiend, Savulich, Coughtrey, & Shafran, 2011; Hirsch & Mathews, 2000). Applying CBM-I for self-worth to a subclinical or clinical sample, with maladaptive biases and higher levels of trait body dissatisfaction and negative affect, may elicit changes in a positive direction (Yiend et al., 2014). Therefore, future efforts should seek to compare the two CBM-I approaches in a subclinical or clinical sample to determine whether the current findings were due to varying degrees of psychopathology.

Overall, development of a CBM-I approach that assesses and modifies appearance-related interpretation bias is an important contribution to the currently limited understanding of the role of CBM-I in eating disorders. Given that state variables of an unselected sample were impacted after a single session of CBM-I for appearance, long term effects of the approach in a subclinical population should be explored. Specifically, it would be of value to investigate whether multi-session training generates a more pronounced improvement in bias and symptomatology, and whether these changes persist over time.

# CHAPTER 7

## Using Multi-session CBM-I to Influence Eating Disorder Psychopathology: A Randomised Controlled Trial

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**Author Contributions:**

EM led the study design, recruitment, data collection, statistical analyses, results and interpretation, and manuscript preparation. TW contributed to the study design, statistical analyses, results and interpretation, and manuscript preparation.

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This chapter is being prepared for submission to the *Journal for Behaviour Therapy and Experimental Psychiatry* and therefore some of the content in this chapter may appear in a published format at a later date.

## Abstract

This randomised controlled trial examined the long-term effects of multi-session cognitive bias modification for interpretation bias (CBM-I) on eating disorder-related bias and symptomatology in body dissatisfied women ($N$ = 74). The young women ($M_{age}$ = 20.09 years, $SD$ = 2.11) were randomised into one of three CBM-I conditions (appearance, self-worth, or control) and completed five days of home practice, which involved training interpretations to be consistent with either a positive appearance or self-worth, relative to benign interpretations trained in the control condition. Completer analyses indicated that all three conditions changed positive bias; CBM-I for appearance ($d$ = -3.50 [-.4.46 to -.2.53]) and CBM-I for self-worth ($d$ = -1.2 [-1.83 to -.57]) increased bias while the CBM-I control condition significantly reduced positive bias ($d$ = 1.07 [.33 to 1.82). These effects were not replicated in intent-to-treat analyses, with no significant differences emerging between the interventions and the control condition for interpretation and general response bias. Changes in trait outcome variables following 1-week of home practice and at 2-week follow-up indicated that all three conditions commensurately reduced disordered eating, negative affect and clinical impairment, as indicated by a main effect of time for all three variables. Post-hoc analyses indicated that the three outcome variables were associated with significant moderate reductions between baseline and 2-week follow-up, with within-group effects ranging from .33 to .53 (Cohen's $d$). These results replicate and build upon previous findings regarding the effectiveness of the CBM-I for appearance protocol. Given the impact of the control group, and the uncertainty regarding mechanisms of change, this technique warrants further investigation within clinical eating disorder samples in order to ascertain its usefulness.

## Introduction

While it has been suggested that cognitive bias modification for interpretation bias (CBM-I) is an effective preventative and intervention technique for eating disorder psychopathology (MacLeod, 2012), there is a paucity of research examining this issue. To date, single session appearance and self-worth based CBM-I have proven effective at modifying eating disorder-salient bias and symptomatology in non-clinical (Matheson et al., 2018) and subclinical (Yiend et al., 2014) populations, respectively. Despite their efficacy, these two approaches have yet to be compared within a multi-session protocol design; thus, it remains unclear whether additional intervention points produce greater and enduring effects on bias and symptomatology in subclinical samples.

Only two studies have examined multi-session CBM-I within eating disorder psychopathology. The first targeted attentional and interpretation biases pertinent to social stimuli in an in-patient sample of women with anorexia nervosa (Cardi et al., 2015). The five sessions of CBM-A (direct attention toward positive social cues and away from negative cues) and CBM-I (train benign interpretations of socially-relevant scenarios) were associated with significant modifications to attentional and interpretation bias; however, there was no impact on eating disorder symptoms. The second study conducted secondary analyses on eating disorder symptomatology (i.e., bulimia and drive for thinness; Summers & Cougle, 2018), following the application of an appearance-based CBM-I in those with heightened body dysmorphic symptomatology (Summers & Cougle, 2016). Secondary analyses (2018) indicated that the task increased benign interpretations related to appearance and reduced bulimia symptoms in those with high pre-treatment symptomatology, although there was no impact on drive for thinness. These findings give preliminary support for multi-session appearance-based CBM-I in eating disorder psychopathology; however, investigations beyond secondary analyses are required. Furthermore, CBM-I has yet to be applied beyond a

controlled experimental setting, with both investigations using laboratory-based designs; thus, the ecological validity of CBM-I in eating disorder treatment remains unclear.

Multi-session CBM has been associated with larger and more reliable effects for ameliorating disorder-salient bias and symptomatology, relative to single session approaches (Beard et al., 2012; Menne-Lothmann et al., 2014). Thus, the current study sought to conduct a randomised controlled trial to comparatively examine the effects of home practice CBM-I for appearance and CBM-I for self-worth on eating disorder-salient interpretation bias and symptomatology, in body dissatisfied women. Furthermore, the current study sought to address one of two key limitations raised by Matheson et al. (2018), thought to contribute to the null effects of CBM-I for self-worth on bias and symptom change. Specifically, Matheson and colleagues noted that age and clinical severity implicate the suitability of training material and amenability of bias and symptom change, respectively. In order to determine which factor confounds CBM-I efficacy, we firstly controlled for clinical severity; thus, training material remained unaltered, but was applied to a sample with greater psychopathology, as observed in Yiend et al (2014). Based on the encouraging findings of single (Matheson et al., 2018) and multi-session (Summers & Cougle, 2018) effects associated with appearance-based CBM-I, we expect the CBM-I for appearance intervention to elicit greater change in bias and symptomatology than the CBM-I for self-worth and control conditions. The information gained from this research will assist in determining whether the CBM-I protocols warrant integration into multimodal prevention and intervention programs currently being used to treat eating disorder psychopathology.

## Method

### Participants

One hundred and ninety-two university students were recruited from a first-year volunteer research pool, where they received course credit or payment for participation. To

achieve a homogenous sample, the inclusion criteria required participants to be female, aged between 17 and 25, and have a body mass index (BMI) between 18.5 and 29.9 (i.e., not underweight nor obese; World Health Organisation, 2017). As shown in **Figure 1**, of the 192 participants recruited, the data of 158 participants were included in the analytic sample for phase one; $n = 34$ were excluded for not meeting weight criteria ($n = 14$ were underweight and $n = 20$ were obese). Inclusion criterion for the multi-session CBM-I training (phase two) included a score of ≥47 on the Weight Concerns Scale (WCS; Killen et al., 1996; Killen et al., 1994); a score of this magnitude is indicative of increased risk of developing eating disorder psychopathology. Of the 158 participants, 79 participants met eligibility criteria for phase two; with 5 participants declining participation. Of the 74 eligible participants, 59 (80%) completed five days of home practice and 64 (86%) completed the 7- (Time 2) and 14-day (Time 3) follow-ups.

**Procedures**

On arrival, participants were provided with a brief description of the two phases and advised that eligibility for phase two would be established immediately following the completion of phase one. In phase one (baseline) participants completed the initial screening questionnaire (i.e., WCS; Killen et al., 1996; Killen et al., 1994) to determine eligibility for phase two. Following screening, participants were randomized, using the randomization function in *Qualtrics,* into one of the three conditions: CBM-I appearance, CBM-I self-worth or CBM-I control, stratified by the WCS score (<47 or ≥47). Following randomisation, five sequential phases ensued: the completion of self-report state (T1) and trait (T1) measures; a body dissatisfaction induction; a second rating of state outcomes (T2); respective CBM-I training; a final rating of state outcomes (T3). Ineligible participants were formally debriefed on study objectives, while eligible participants were invited to phase two and advised of the relevant components (i.e., home practice and two follow-up questionnaires). All participants

were provided with referrals for concerns regarding body dissatisfaction and associated problems with body dissatisfaction and eating concerns.

During phase two participants completed five consecutive days of home practice and two follow-up questionnaires, 7 (T2) and 14 (T3) days following the laboratory session. Home practice and follow-up questionnaires were delivered via email correspondence and administered through the online system, *Qualtrics*. Prior to commencement, the Flinders Social and Behavioural Research Ethics Committee approved the study and informed consent was obtained from each participant.

**Materials**

**Body dissatisfaction induction.** An induction was used to temporarily induce state body dissatisfaction and negative affect, as well as reduce variability in state outcomes across the unselected sample (Segal & Ingram, 1994). Participants viewed 16 sequential images pertaining to the thin ideal (i.e., images of fashion models) and rated their agreeability (0 being '*strongly disagree'* and 100 being *'strongly agree'*) with the following statements on a 100-pixel Visual Analogue Scale (VAS; '*I would like my body to look like this woman's body*'; '*This woman is thinner than me*'; '*In a busy clothes shop, I would not like to try on bathing suits if this woman was also trying on bathing suits in the same change room*' (Mills et al., 2002). The current induction has shown to reliably induce body dissatisfaction and negative affect in unselected samples (Atkinson & Wade, 2012).

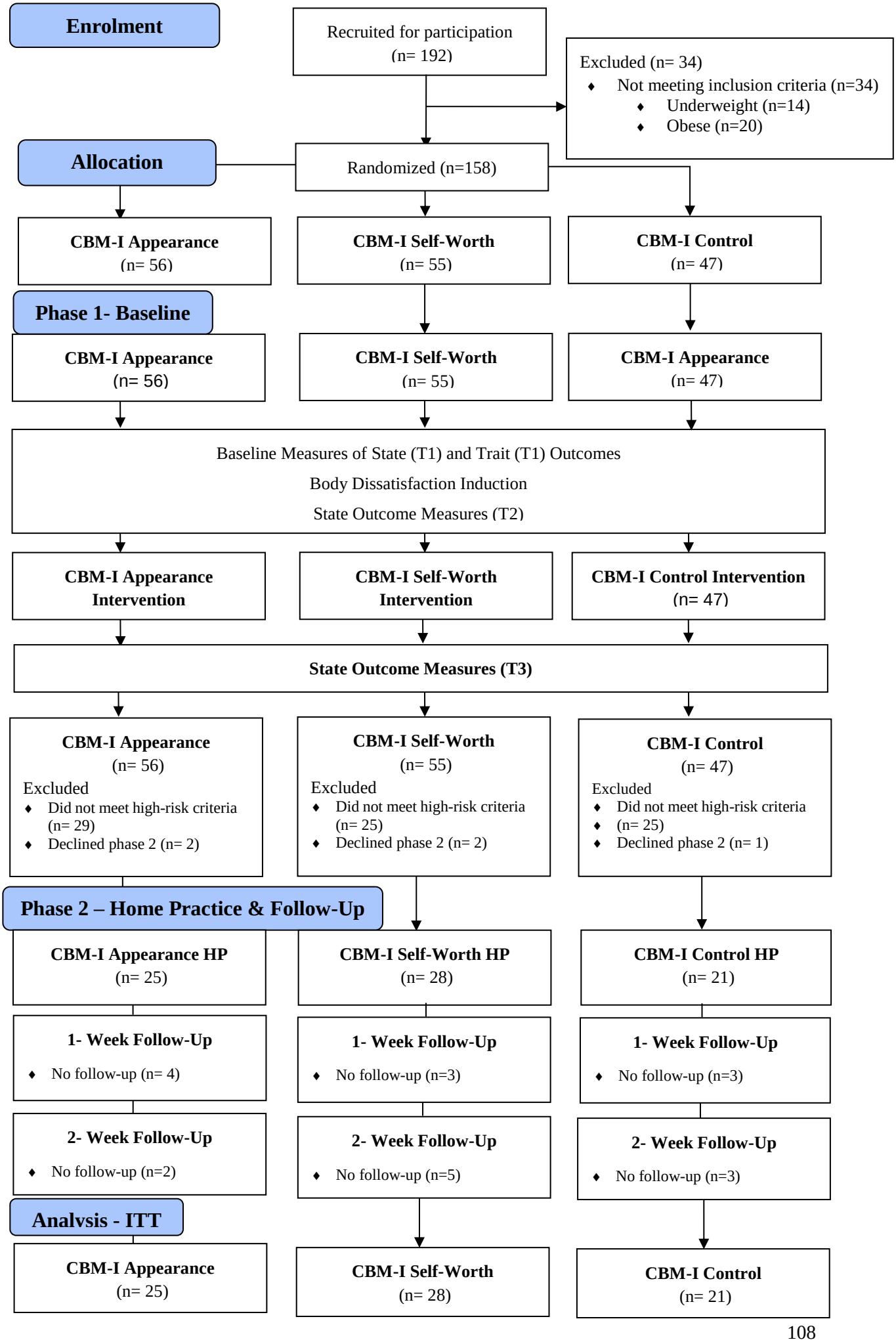




*Figure 1*. CONSORT flow diagram. HP = home practice; T1 = time 1; T2 = time 2; ITT = intent-to-treat.

**Cognitive Bias Modification**

The training material for all three CBM-I conditions was as reported in Matheson and colleagues (2018) and is available via Open Science Framework (Houlihan et al., 2017; Matheson et al., 2018). Participants were presented with hypothetical scenarios that were potentially threatening to one's appearance or self-worth and were instructed to insert the appropriate missing letters into a fragmented word appearing at the end of scenario (e.g., "*A colleague mentions to you that they have joined a new gym. They suggest that you join them in one of the gym classes. Your colleague suggested for you to join the gym because you look sp-r-y*" [sporty]). Once formed, the word disambiguated the scenario to be congruent with a positive appearance or self-worth. Training scenarios were followed by a comprehension question, which reinforced the positive meaning of the disambiguated passage (e.g., "*Was your colleague suggesting that you appear out of shape? N-*" [No]). The control condition took the same format of training; however, scenarios related to procedural and declarative knowledge and had a neutral resolution when disambiguated.

The current multi-session design was based on a method used previously with interpretation biases for negative social cues in eating disorder patients (Cardi et al., 2015). Overall, 6 CBM-I training blocks were constructed (1 used at baseline and 5 for home practice), each consisting of 18 training scenarios. The original CBM-I training materials, each consisting of 67 scenarios, were duplicated and randomised into 6 training blocks. The authors assessed for and removed duplicates within each block and randomised the presentation of scenarios, with no scenario appearing more than once in a training session. Home practice was delivered via email correspondence and used the online survey system, *Qualtrics*.

**Similarity Ratings Task**

The similarity ratings task (SRT) was used to assess changes in interpretation and general response bias between pre- (baseline) and post-multisession training (7- and 14-day follow-ups). The assessment task took the same form as reported by Matheson and colleagues (2018); consisting of two consecutive subtasks: 1) a word completion task, and 2) a recognition test. Similar to the CBM-I training, the word completion task required participants to read through ambiguous scenarios describing situations that were potentially threatening to one's appearance or self-worth (e.g., New Surfer: *Your friends have invited you to go surfing for the first time. You are standing on the board in your bikini when you see two of your friends smiling and laughing in your d-r-ct—n* [direction]. *Are your family going surfing? N-* [No]). Unlike the training phase, when complete, assessment scenarios and comprehension questions retained and reinforced emotional ambiguity, respectively.

In the recognition task, participants rated how similar in meaning (1 being *very different* and 4 being *very similar)* test sentences were to the previously encoded assessments scenario. Assessment scenarios had four corresponding test sentences; two target sentences (reflected a positive or negative interpretation of the scenario) and two foils sentences (control items capturing general positive or negative responsiveness). Test sentences appeared individually and at random, beneath the corresponding assessment title. A sample set of test sentences for the "*New Surfer*" scenario follow:

*Your friends are happy that you are trying something different (*positive target)

*Your friends think you look overweight on the surf board in your bikini* (negative target)

*The weather was pleasant* (positive foil)

*The weather was unpleasant* (negative foil)

The SRT comprised of 40 assessment items (20 appearance-relevant and 20 self-worth relevant), which were separated into two parallel sets and their presentation counterbalanced between the three assessments phases.

**Screening Measure**

***Weight concern***. The WCS (Killen et al., 1996; Killen et al., 1994) was used to distinguish between low and high risk for eating disorder psychopathology. The 5 item self-report questionnaire assesses for weight and shape concerns, fear of weight gain, dieting frequency, weight importance and feelings of fatness. The WCS has demonstrated good test-retest reliability ($r$ = .71; Killen et al., 1994) and predictive validity (Jacobi, Abascal, & Taylor, 2004; Killen et al., 1996; Killen et al., 1994), with a score of ≥47 associated with increased risk for developing an eating disorder. Internal consistency in the current study was .74.

**Outcome Measures**

**State measures**. These were assessed on three occasions during the laboratory session: baseline (T1), post-negative induction/pre-training (T2) and post CBM-I training (T3).

***Body dissatisfaction.*** Visual analogue scales (VAS; Heinberg & Thompson, 1995) were used to assess participants' state level of appearance and weight satisfaction, by indicating a response to the following questions: (1) "*How satisfied do you feel about your appearance right now?*" (2) "*How satisfied do you feel about your weight right now*?" Participants indicated their level of satisfaction by dragging a slider along a 100-pixel VAS, which was fixed with two extreme values (0 indicating *extreme dissatisfaction* and 100 indicating *extreme satisfaction*).

***Negative affect.*** Negative affect was assessed using the Negative Affect subscale from the Positive Affect and Negative Affect Schedule (Watson et al., 1988). The measure

was comprised of ten words relating to negative emotive states (e.g., *distressed* or *jittery*) and required participants to indicate the degree to which they were experiencing the emotion on a 5-point Likert scale ranging from 1 (*very slightly or not at all*) to 5 (*extremely*). Internal consistency for the Negative Affect subscale for the present study was .91

**Trait measures.** In each case, higher scores indicated higher levels of psychopathology. Where necessary, baseline scales were adapted at 7- and 14-day follow-ups to reflect the assessment period (i.e., 7 days).

***Bias***. Similarity rating scores were used to calculate interpretation and response bias indices, using target and foil items, respectively (Matheson et al., 2018; Yiend et al, 2014). Interpretation bias indices were calculated for each information type (i.e., appearance and self-worth) by subtracting the mean negative target rating from the mean positive target rating, at the three assessment points. Meanwhile, foil data was used to generate two general response bias indices (mean positive foil rating minus mean negative foil rating); one using foil data from the appearance test sentences, the other from the self-worth test sentences. Bias scores ranged between -4 and 4, with 0 indicating no bias, and positive and negative values indicating a positive or negative interpretation bias, respectively.

***Disordered eating***. The Eating Disorder Examination-Questionnaire (EDE-Q; Fairburn & Beglin, 2008) was used to assess global eating disorder psychopathology over the preceding 28 days. The 22-item measure assesses cognitive symptoms pertaining to restraint, eating concerns, shape concern and weight concern. Items are scored on a 7-point Likert scale, ranging from 0 (*No days) to* 6 (*Every day*). The four subscales are summed and averaged to derive a global EDE-Q score. The global score has demonstrated strong internal consistency ($\alpha$ = .95; Kelly, Carter, Zuroff, & Borairi, 2013) and high convergent validity with the EDE global score ($r$ = .84; Mond, Hay, Rodgers, & Owen, 2006). Internal consistency in the current study was .95.

***Negative Affect.*** This was assessed using 14 items from the Depression and Anxiety subscales of the Depression Anxiety Stress Scale (Henry & Crawford, 2005; Lovibond & Lovibond, 1995). Participants rated the applicability of each statement as having occurred in the past week on a 4-point Likert scale ranging from 0 (*did not apply to me at all*) to 3 (*applied to me very much, or most of the time*). The total mean subscale scores were multiplied by two for comparison to normative data. Internal consistency in the current study was .92.

***Clinical impairment.*** The 16 item Clinical Impairment Assessment (CIA; Bohn et al., 2008; Bohn & Fairburn, 2008) was used to assess psychosocial impairment caused by eating disorder psychopathology over the preceding 28 days, including: mood and self-perception; cognitive functioning; interpersonal functioning; and work performance. Items were scored on a 4-point Likert scale ranging from 0 (*not at all*) to 3 (*a lot*) and were summed to calculate a global impairment score. The CIA has demonstrated high internal consistency ($\alpha$ = .97; Bohn et al., 2008) and test-retest reliability ($r$ = .86, after a three-day interval; Bohn & Fairburn, 2008). Internal consistency in the current study was .94.

**Statistical Analyses**

Analyses were performed using IBM Statistical Package for the Social Sciences, Version 22 (IBM SPSS) and Mplus (PC) version 7.31. Normality distributions for state and trait variables across time and condition were examined prior to commencing analyses. Reflected inverse transformations were applied to state negative affect to account for severe positive skewness (Tabachnick & Fidell, 2013). Differences between groups on demographic and outcome variables at baseline were assessed using one-way analysis of variance (ANOVA). With respect to phase one, given no missing data, a 3 (Training Group) x 3 (Time) x 2 (Weight Concern Status) mixed analyses of variance (ANOVA) was conducted to assess immediate changes in state body dissatisfaction and negative affect between baseline,

post-induction (i.e., pre-training) and post-training, across the three groups and weight concern status. With respect to phase two, changes in bias were assessed using completer and intent to treat (ITT) analyses. First, completer analyses were conducted in SPSS using a 3 (Training Group: CBM-I for appearance, CBM-I for self-worth, CBM-I control) × 2 (Bias Type: target, foil) × 3 (Time: baseline, 1- and 2-week follow-up) mixed ANOVA design. Second, due to missing data, multiple imputation was conducted using Mplus software version 7.31 (Muthén & Muthén, 199-2010) to estimate missing values using Bayesian analysis (Rubin, 1987). Ten imputed data sets were specified and the parameter estimates were averaged over the set of 10 analyses. The ITT analyses were then conducted in Mplus to assess for differences in bias change between each intervention and the control condition. Following, group comparisons were collapsed and the trajectory of change between interpretation and general response bias were considered, to compare the specific interpretative consequences of CBM-I (indicated by responses to target items) to wider priming effects of training (indicated by responses to foil items), respectively. The impact of multi-session CBM-I on trait psychopathology was assessed using Linear Mixed Modelling (LMM), enabling inclusion of cases with missing data via maximum likelihood estimation. Post hoc analyses were conducted on significant main effects and interactions, observed during phase one and two, using Cohen's *d* between and within-group effect sizes and their 95% confidence intervals, where.2 = small, .5 = medium, and .8 = large (Cohen, 1988).

## Results

### Phase One (N=158, whole group)

#### Participant characteristics and baseline measures

As shown in **Table 1** the three groups did not differ on any baseline variables.

#### Changes in state outcomes

As shown in **Table 2**, all three variables were associated with a main effect of Time and Weight Concern Status. Across all three conditions, the induction significantly exacerbated body dissatisfaction and negative affect, while CBM-I significantly ameliorated these effects (see **Table 3**). There was no significant main effect of Training Group for any of the three dependent variables. Negative affect was associated with a significant three-way interaction between Time, Training Group and Weight Concern Status. No significant two-way or three-way interactions were observed for appearance or weight satisfaction.

Post hoc analyses were conducted on the significant three-way interaction for negative affect using Cohen's *d* within-group effect sizes and their 95% confidence intervals). Analyses revealed that the two intervention conditions were associated with significant reductions in negative affect for both low (CBM-I appearance *d* = -.72 [-1.25 to -.19]; CBM-I self-worth *d* = -.59 [-1.16 to -.03]) and high weight concerns (CBM-I appearance *d* = -.65 (-1.20 to -.10); CBM-I self-worth *d* = -.66 [-1.18 to -.14]). Meanwhile, the control condition was associated with reductions in negative affect for high (*d* = -.68 [-1.29 to -.08]), but not low concerns (*d* = -.21 [-.77 to .34]).

Table 1

*Descriptive Statistics at Baseline (T1)*

| Variable | Whole Sample (*N* = 158) | CBM-I Appearance (*n* = 56) | CBM-I Self-Worth (*n* = 55) | Control (*n* = 47) | *Main effect of Group* | |
|---|---|---|---|---|---|---|
| | Mean (SD) | Mean (SD) | Mean (SD) | Mean (SD) | *F(2,157)* | *p* |
| *Baseline Variables only* | | | | | | |
| Weight concern | 45.17 (23.21) | 44.17 (23.73) | 48.03 (19.22) | 43.01 (26.75) | .67 | .51 |
| Age | 19.91 (1.86) | 20.02 (1.92) | 19.87 (1.99) | 19.81 (1.68) | .16 | .85 |
| BMI | 23.00 (2.76) | 22.92 (2.51) | 23.41 (2.91) | 22.63 (2.86) | 1.04 | .36 |
| *Trait Variables* | | | | | | |
| Disordered eating | 2.30 (1.36) | 2.12 (1.32) | 2.50 (1.35) | 2.28 (1.40) | 1.10 | .34 |
| Negative affect | 1.66 (1.21) | 1.86 (1.39) | 1.53 (1.09) | 1.55 (1.11) | 1.47 | .23 |
| Clinical impairment | 30.05 (10.65) | 29.20 (11.31) | 30.75 (10.10) | 30.26 (10.60) | .30 | .74 |
| Appearance interpretation bias | -.12 (.83) | -.03 (.89) | -.22 (.82) | -.10 (.75) | .77 | .47 |
| Response bias (appearance-related foils) | .51 (.45) | .54 (.44) | .46 (.42) | .54 (.50) | .54 | .58 |
| Self-worth interpretation bias | .40 (.58) | .38 (.57) | .41 (.53) | .41 (.64) | .05 | .95 |
| Response bias (self-worth related foils) | .39 (.58) | .43 (.60) | .39 (.58) | .35 (.58) | .24 | .78 |
| *State Variables* | | | | | | |
| Appearance satisfaction | 49.89 (23.80) | 50.27 (23.54) | 47.02 (23.88) | 52.79(24.12) | .75 | .47 |
| Weight satisfaction | 50.07 (27.50) | 52.18 (29.26) | 44.36(25.24) | 54.23(27.33) | 1.91 | .15 |
| Negative affect | .68 (.22) | .69 (.22) | .66 (.23) | .69 (.22) | .36 | .70 |

*Note.* Measures: Weight concern = Weight concern scale; BMI = body mass index; Disordered eating = Global score on the Eating Disorder Examination-Questionnaire; Trait negative affect = Depression and Anxiety subscales of the DASS-21; Clinical impairment = Clinical Impairment Assessment–Questionnaire; State negative affect = Negative Affect subscale from PANAS.

Table 2

*Three-way ANOVA: Changes in Sate Variables between Baseline and Post-Induction*

| **State variables** | *df* | *F* | *p* |
|---|---|---|---|
| *Appearance satisfaction* | | | |
| Time | 2, 304 | 27.63 | **<.001** |
| Weight Concern Status | 1, 152 | 44.98 | **<.001** |
| CBM-I Training Group | 2, 152 | 1.20 | .30 |
| Time × Weight Concern Status | 2, 304 | 1.37 | .26 |
| Time × CBM-I Training Group | 4, 304 | 1.87 | .12 |
| Weight Concern Status × CBM-I Training Group | 2, 152 | 1.33 | .27 |
| Time × Weight Concern Status × CBM-I Training Group | 4, 304 | 1.95 | .10 |
| *Weight satisfaction* | | | |
| Time | 2, 304 | 29.81 | **<.001** |
| Weight Concern Status | 1, 152 | 71.94 | **<.001** |
| CBM-I Training Group | 2, 152 | 1.71 | .19 |
| Time × Weight Concern Status | 2, 304 | .60 | .55 |
| Time × CBM-I Training Group | 4, 304 | .53 | .71 |
| Weight Concern Status × CBM-I Training Group | 2, 152 | 1.09 | .34 |
| Time × Weight Concern Status × CBM-I Training Group | 4, 304 | 2.38 | .05 |
| *Negative affect* | | | |
| Time | 2, 304 | 55.25 | **<.001** |
| Weight Concern Status | 1, 152 | 55.38 | **<.001** |
| CBM-I Training Group | 2, 152 | .57 | .57 |
| Time × Weight Concern Status | 2, 304 | 1.76 | .18 |
| Time × CBM-I Training Group | 4, 304 | 1.10 | .36 |
| Weight Concern Status × CBM-I Training Group | 2, 152 | .53 | .59 |
| Time × Weight Concern Status × CBM-I Training Group | 4, 304 | 2.77 | **.03** |

*Note*. CBM-I = Cognitive bias modification targeting interpretation bias; Pre-training = Post-induction assessment of outcome variables. Time = Pre- and post-training; Weight concern status = Low and high weight concerns; CBM-I Training Group = CBM-I for appearance, CBM-I for self-worth, CBM-I control Significant values are in **bold**

Table 3

*Mean (standard error) state variables between baseline, post-induction/pre-training and post-training (N = 158)*

| | Changes between T1-T2 | | | Changes between T2-T3 | | |
|---|---|---|---|---|---|---|
| | *T1*<br>*M (SE)* | *T2*<br>*M (SE)* | *d*<br>*(95%CI)* | *T2*<br>*M (SE)* | *T3*<br>*M (SE)* | *d*<br>*(95%CI)* |
| Appearance satisfaction | 49.83 (1.73) | 41.16 (1.92) | **.38**<br>**(.16 to .60)** | 41.16 (1.92) | 49.25 (1.82) | **-.34**<br>**(-.57 to -.12)** |
| Weight satisfaction | 50.08 (1.81) | 40.82 (1.97) | **.39**<br>**(.17 to .61)** | 40.82 (1.97) | 48.38 (1.92) | **-.31**<br>**(-.53 to -.09)** |
| Negative affect | .68 (.02) | .63 (.02) | .20<br>(-.02 to .42) | .63 (.02) | .74 (.02) | **-.44**<br>**(-.66 to -.22)** |

*Note.* T1 = Baseline observations; T2 = Post-induction/pre-training; T3 = Post-training; CI = Confidence interval; Cohen's *d* .2 = small, .50 = medium, .80 = large (Cohen, 1988). Significant values are in **bold**.

**Phase two (N=74, high weight concern group only)**

**Participant characteristics**

The women had a mean age of 20 years (SD = 2.11), a mean BMI that fell within the normal range (*M* = 24.00, *SD* = 2.75) and reported greater eating disorder psychopathology (EDE-Q; *M* = 3.23, *SD* = 1.08), negative affect (DASS-21; *M* = 1.98, *SD* = 1.26) and clinical impairment (CIA; *M* = 36.66, *SD* = 10.24), relative to the unselected sample in phase one (see **Table 1**). A majority of women indicated a discrepancy between their current and ideal body weight, with dissatisfaction applying to both circumstances of being either under (*N* =3) or over (*N* = 71) one's ideal weight (M = -7.26, SD = 4.23, *Min* = -7.26, *Max* = 5kg). Prior to the intervention, 74% of women reported binge eating behaviours, while a majority reported engaging in one or more compensatory weight control behaviours (driven exercise, 80%; laxative misuse 8%; self-induced vomiting, 16%). Overall, 67% endorsed eating disorder psychopathology above the clinical cut-off for young adult women (i.e., ≥2.77 on EDE-Q global, Mond et al., 2006). Furthermore, the participants' degree of impairment caused by eating disorder psychopathology was considerably greater than the cut-point associated with eating disorder diagnostic status (i.e., 16; Bohn et al., 2008; M = 36.66, SD = 10.25).

**Impact of CBM-I on modifying bias**

**Completers**. As shown in **Table 4,** there were no main effects of Time, Bias Type or Training group nor two- or three-way interactions associated with the self-worth bias indices. Appearance bias indices (see **Table 4**) were associated with significant main effects of Bias Type and Training Group, but not Time. Accompanying the effects were significant interaction between Time and Bias Type (changes in targets and foils differed over time), Time and Training Group (changes in bias differed between the groups over time), and Bias Type and Training Group (interpretation bias [targets] and general response bias [foils] indices differed between training groups). No significant three-way interaction between

Time, Training Group and Bias Type was observed, indicating no significant difference in the trajectory of interpretation and response bias between the three training groups over time.

Post hoc analyses on the Time and Bias Type interaction revealed that changes in interpretation bias (targets) were significantly greater than general response bias (foils; T1, *d* = -11.00 [-12.44 to -9.57]; T2, *d* = -7.79 [-8.84 to -6.74]; T3, *d* = -7.59 [-8.61 to -6.56]). The Time and Training Group interaction indicated a significant increase in positive bias in CBM-I for appearance (*d* = -3.50 [-.4.46 to -.2.53]) and CBM-I for self-worth (*d* = -1.2 [-1.83 to -.57]); while CBM-I control was associated with significant reductions in positive bias (*d* = 1.07 [.33 to 1.82). The Bias Type and Training Group interaction revealed interpretations bias was significantly greater in CBM-I for appearance, relative to CBM-I for self-worth (*d* = 3.62 [2.66 to 4.58]) and CBM-I control (*d* = 3.33 [2.33 to 4.32]).

**Intent to Treat.** As shown in **Table 5**, the ITT analyses revealed a similar pattern of results to the completer analyses for self-worth bias indices, however a dissimilar pattern emerged for appearance bias. Overall, there were no significant differences between the interventions and the control condition with respects to change in interpretation and general response bias. Further, when group comparisons were collapsed, the rate of change did not differ between target and foils, indicating no significant difference in the trajectory of interpretation vs. general response bias, respectively.

**The impact of CBM-I on trait variables.** Results from the linear mixed model analyses are presented in **Table 6**, demonstrating that the three trait outcome variables were associated with a main effect of Time, but no main effect of Training Group or Time and Training Group interaction. Post-hoc analyses conducted on main effects of Time were moderate between T1 and T3 for all outcome variables, ranging from .33 to .53, as well as T1 and T2 for clinical impairment (*d* = .46).

Table 4

*Three-way mixed ANOVA: Impact of CBM-I Bias on bias between Baseline, 1- and 2-week Follow-ups*

| | | *df* | *F* | *p* |
|---|---|---|---|---|
| *Change in Bias for Appearance* | | | | |
| | Time | 2, 114 | 1.83 | .16 |
| | Bias Type | 1, 57 | 86.69 | **<.001** |
| | CBM-I Training Group | 2, 57 | 4.40 | **.02** |
| | Time × Bias Type | 2, 114 | 4.09 | **.02** |
| | Time × CBM-I Training Group | 4, 114 | 2.54 | **.04** |
| | Bias Type × CBM-I Training Group | 2, 57 | 5.38 | **.01** |
| | Time × Bias Type × CBM-I Training Group | 4, 114 | 1.53 | .20 |
| *Change in Bias for Self-Worth* | | | | |
| | Time | 2, 114 | .12 | .89 |
| | Bias Type | 1, 57 | 3.60 | .06 |
| | CBM-I Training Group | 2, 57 | .24 | .79 |
| | Time × Bias Type | 2, 114 | 1.03 | .36 |
| | Time × CBM-I Training Group | 4, 114 | .31 | .87 |
| | Bias Type × CBM-I Training Group | 2, 57 | .26 | .78 |
| | Time × Bias Type × CBM-I Training Group | 4, 114 | 1.15 | .34 |

*Note*. CBM-I = Cognitive bias modification targeting interpretation bias; Time = Baseline, 1- and 2-week Follow-ups; Bias Type = Target and Foils; CBM-I Training Group = CBM-I for appearance, CBM-I for self-worth, CBM-I control; Significant values are in **bold**.

Table 5

*The Trajectory of Bias Change between the Interventions and Control Condition using Intent-To-Treat Analyses*

| | Appearance vs. Control | | | Self-Worth vs. Control | | |
|---|---|---|---|---|---|---|
| | E | SE | *p* | E | SE | *p* |
| Appearance related bias indices | | | | | | |
| Targets | .01 | 1.13 | .99 | -.27 | .32 | .40 |
| Foils | -.15 | .07 | .05 | -.11 | .07 | .15 |
| Self-worth related bias indices | | | | | | |
| Targets | -.03 | .07 | .68 | -.08 | .08 | .34 |
| Foils | -.05 | .16 | .76 | -.04 | 1.36 | .97 |
| | Collapsed Group (Appearance and Control) | | | Collapsed Group (Self-Worth and Control) | | |
| Change in IB vs. GRB | E | SE | *p* | E | SE | *p* |
| Appearance targets vs. foils | 2.24 | 6.72 | .74 | -1.20 | 3.28 | .71 |
| Self-worth targets vs. foils | -.05 | 6.59 | 1.0 | -.32 | 17.25 | .99 |

*Note*. Appearance = CBM-I for appearance; Control = CBM-I control; Self-worth = CBM-I for self-worth; IB = Interpretation bias; GRB = General response bias; E = Estimate; SE = S.

Table 6

*Mixed model analyses of trait variables with collapsed with-in group effect sizes (N = 74)*

| | Training Group | Time | Time × Training Group | Time | Collapsed Within-group ES (95% CI) |
|---|---|---|---|---|---|
| Disordered eating | *F*(68.58) = .03 | *F*(59.53) = 18.45** | *F*(59.53) = 1.83 | 1 vs 2 | .32 (-.01 to .64) |
| | | | | 2 vs 3 | .19 (-.13 to .52) |
| | | | | 1 vs 3 | **.52 (.19 to .85)** |
| Negative affect | *F*(71.56) = .80 | *F*(62.16) = 8.41* | *F*(62.23) = .20 | 1 vs 2 | .27 (-.05 to .59) |
| | | | | 2 vs 3 | .08 (-.24 to .40) |
| | | | | 1 vs 3 | **.33 (.01 to .66)** |
| Clinical impairment | *F*(72.10) = .10 | *F*(61.19) = 14.86 | *F*(61.19) = .44 | 1 vs 2 | **.46 (.13 to .78)** |
| | | | | 2 vs 3 | .10 (-.22 to .42) |
| | | | | 1 vs 3 | **.53 (.20 to .86)** |

*Note*. Time 1 = Baseline; Time 2 = 7-day follow-up; Time 3 = 14-day follow-up; ES = Effect size (Cohen's *d*); CI = Confidence interval; Cohen's *d* .2 = small, .50 = medium, .80 = large (Cohen, 1988); Significant values are in **bold**.

## Discussion

The aim of the current study was to conduct a randomised controlled trial (RCT) to examine the immediate and long-term effects of multi-session CBM-I on eating disorder-related biases and symptomatology in body dissatisfied women, at risk of developing an eating disorder. After one laboratory-based session of CBM-I for appearance and self-worth, both women with low and high weight concerns showed a significant reduction in negative affect; while the control condition only led to reductions in those with high concerns. No such improvements were observed in appearance or weight satisfaction. Following five days of home practice, CBM-I for appearance and CBM-I for self-worth were associated with significant increases in positive appearance-related interpretations of ambiguity in those who completed the intervention; while the CBM-I control condition significantly reduced positive bias. These effects were not observed in the intent-to-treat analyses (ITT), with all three CBM-I approaches having no impact on either interpretation or general response bias. No changes to self-worth related bias were observed in either the completer or ITT samples.

Our findings are consistent with Matheson and colleagues (2018), with respect to completer analyses, who found that CBM-I for appearance effectively modified the targeted bias (interpretation bias for appearance), while CBM-I for self-worth was associated with null effects. However, ITT disconfirmed this effect of CBM-I for appearance, while CBM-I for self-worth was again associated with null effects. This change in pattern of results is not surprising given the fragile significance value ($p$ = .04) associated with the Time and Training Group interaction for appearance bias indices. The current study is the first to report on completer and intent to treat (ITT) effects associated with multi-session CBM-I in eating disorder psychopathology. This approach preserves the strengths of randomisation and best reflects predicted treatments effects in real-world clinical settings (Gupta, 2011) and therefore future research is encouraged to employ this approach when analysing RCT data.

The current multi-session protocol design was based on a previous method by Cardi and colleagues (2015), consisting of five sessions of CBM-I. Our findings are inconsistent with Cardi et al., who found this training dose to be sufficient in eliciting bias and symptom change. This discrepancy may relate to the conditions under which CBM-I was administered. Specifically, Cardi et al utilised a laboratory-based setting, while the current approach integrated CBM-I into real-world settings. Furthermore, our findings are inconsistent with CBM-I reviews, which have found multi-session approaches to be largely effective in ameliorating interpretation biases associated with mood disorders (Menne-Lothmann et al., 2014). This is likely due the current training dose, which was lower than the studies discussed by Menne-Lothmann and colleagues. Specifically, of the 8 studies utilising multisession protocol, 6 studies implemented ≥6 CBM-I sessions, all of which were conducted in laboratory settings. Taken together, these findings give support to multi-session CBM-I when conducted in a controlled experimental setting, however the intervention appears to lack the robustness required for real-world application. Thus, the next logical step is to determine whether increasing the number of home practices elicits bias change.

Both the current study and Matheson et al. have failed to replicate the effects observed by Yiend and colleagues (2014), who found CBM-I for self-worth to be an effective method for increasing positive self-worth related interpretations. Matheson and colleagues assessed the immediate effects of single session CBM-I on bias and symptomatology in unselected sample, while the current research investigated the long- term effects of multisession CBM-I in body dissatisfied women using an RCT design. Matheson and colleagues suggested that their failure to replicate Yiend et al. findings was likely due to discrepancies in the studies sample demographics, namely age (19 vs. 29 years) and clinical severity (unselected vs. subclinical sample). Specifically, training material was considered

somewhat unrepresentative of younger female life domains, while the adaptive interpretation styles of the unselected sample were likely to be less amenable to intervention effects.

The current study addressed one of these key limitations by applying the self-worth protocol to a subclinical sample. Subsequently, we observed symptom change in eating disorder psychopathology, negative affect and clinical impairment; however there continued to be no impact on bias. It is not uncommon in CBM studies to find change in symptomatology and not bias, or vice versa. For instance, Glashouwer and colleagues (2016) used a mirror exposure task to modify attentional biases in body dissatisfied women, only to find that attentional patterns continued to prioritise self-defined unattractive body parts, while dispositional body dissatisfaction was largely improved; although dissatisfaction did not fully remit. Taken together, these findings suggest that extinguishing bias may not be a requisite for ameliorating symptomatology.

At the end of the intervention, all three CBM-I conditions comparably influenced eating disorder psychopathology, negative affect and clinical impairment. Notably, the active control condition, which trains benign interpretations of procedural and declarative scenarios, was equally effective at ameliorating state and trait levels of psychopathology in women with high body concerns. This finding is inconsistent with previous research using high-risk samples, which have found interventions to be significantly superior in reducing global EDE-Q scores relative to active control conditions (Aspen et al., 2015; Barr Taylor et al, 2006; Gledhill et al., 2017; Pennesi & Wade, 2018); thus, suggesting that the current control condition may possess therapeutic properties.

A potential explanation for these intervention effects is the relationship between self-efficacy (an individual's perceived ability to accomplish) and eating disorders; with poorer self-efficacy associated with greater psychopathology (e.g. Bardone-Cone et al., 2010). Investigations into self-efficacy and eating disorder interventions has shown that baseline

levels and early change in self-efficacy have shown to predict drop-out and end of treatment symptom severity, respectively (Keshen, Helson, Town, & Warren, 2017). More generally, research has investigated the effects of gaming on self-efficacy (Gee, 2007; Starks, 2014), with findings proposing that games using point-based systems encourage the perception of accomplishment and progress (e.g., move to the next level), thus increasing self-efficacy. The combined performative nature of CBM-I (i.e., choose correct letter to complete fragmented word) with the benign valence of training items (i.e., unrelated to appearance or self-worth) is likely to increase the task's game-like qualities. Therefore, it is possible that the repeated completion of CBM-I control scenarios led to increased self-efficacy and therefore reduced symptom severity. As such, future research should seek to incorporate measure of self-efficacy to determine whether there is relationship between CBM-I and self-efficacy in eating disorder populations.

This study has several limitations, additional to those already mentioned. First, a key limitation not addressed was the content specificity (matching training material to the concerns of the sample; Savulich et al., 2015) relating to the self-worth protocol. In light of the current findings, content specificity may have greater implications for bias change than clinical severity. Therefore, future research should seek to modify the current self-worth training materials to better reflect the concerns of young females at risk of developing an eating disorder and examine whether this reviewed protocol is effective at ameliorating self-worth related bias and psychopathology. Second, participants were undergraduate females aged between 17 and 25 years with a BMI ranging between healthy and overweight; thus, findings cannot be generalised beyond this population. Third, these findings are preliminary with respects to symptomatology and require replication. The current protocol incorporated two follow-up assessments, however further work with longer follow-up (i.e., 1- and 3-month) is required to explore these outcomes in CBM-I.

The current study is the first to examine multi-session effects of CBM-I in eating disorder psychopathology using a RCT design in a real-world setting. Given that trait psychopathology was impacted following five days of CBM-I home practice, the moderating effects of number of training sessions should be explored. Specifically, the eating disorder field would benefit from determining whether >6 CBM-I sessions elicits a more pronounced improvement in bias and symptomatology, and whether these changes persist over longer periods of time. In turn, it will be made clearer whether CBM-I warrants integration into multimodal eating disorder interventions.

# CHAPTER 8

# General Discussion

## Summary of Findings

The current body of research sought to the extend on the preliminary research into the use of Cognitive Bias Modification (CBM) on two influential risk factors for eating disorder psychopathology, body dissatisfaction and negative affect. The initial experiment comparatively examined Cognitive Bias Modification for attention (CBM-A) to two interventions also thought to target implicit cognitive distortions: evaluative conditioning and the visual spatial task, Tetris. This represented the first study to assess the conditioning paradigm independent of programme developers, as well as the first application of Tetris to eating disorder psychopathology. The CBM-A and Tetris conditions commensurately improved body dissatisfaction, distress about feelings and negative affect in the unselected sample. Further, the study did not replicate the robust effects of the conditioning paradigm (Martijn et al., 2010; Aspen et al., 2015). A deviation from the original study design suggests that evaluative conditioning is best administered in accordance with the original protocol, with a substantial gap between the taking of pictures used as stimuli in the experimental paradigm and the conduct of the paradigm.

To date, eating disorder CBM studies have largely focused on modifying attention for appearance-related stimuli, while less is known about self-worth related stimuli. Only one study has examined self-worth related bias in eating disorder psychopathology, which was in the context of modifying interpretation bias (CBM-I; Yiend et al., 2014). Given the efficacy of this approach, the current study extracted the relevant stimuli from the CBM-I training material and incorporated the stimuli into a CBM-A paradigm. Therefore, the next study extended on the preceding finding and comparatively examined CBM-A for appearance to Tetris and two additional CBM approaches: CBM-A for self-worth and CBM-I for self-worth. Further, the study sequentially examined the causal and intervention effects of training attention and interpretations towards negative and positively valanced stimuli, respectively.

Training attention and interpretations consistent with negative appearance and self-worth induced body dissatisfaction, but not negative affect. These effects were not counteracted by retraining attention or interpretations towards a positive alternative. The effects of three interventions (CBM-A for appearance, CBM-I for self-worth and Tetris) were moderated by dispositional body dissatisfaction and negative affect, suggesting that more pronounced effects pertaining to bias and symptom change may be observed in samples with greater psychopathology, relative to the unselected sample.

The modification of interpretation bias is a core criteria of eating disorder treatments and therefore the scope of the final two studies focused exclusively on CBM-I. Further, a major gap identified by the current research was the absence of an appearance-based CBM-I protocol for use in at-risk and eating disorder populations. The CBM-A for self-worth paradigm used in **Chapter 5** was developed with relative ease, however given the nature of the CBM-I protocol, the development of a new appearance-based CBM-I protocol was far more laborious. Our final two studies comparatively examined the newly developed appearance-based protocol to the existing for self-worth protocol, both within single- and multi-session protocol designs. Further, these two studies addressed several methodological shortcomings of the initial two studies, including the inclusion of pre- and post-assessments of bias and the use of a control condition. Following a single session of CBM-I, the appearance-based protocol increased positive-appearance related interpretations of ambiguity, as well as appearance satisfaction. These effects pertaining to bias were replicated in the completer analyses of the next study, which was the first to use a randomised controlled trial (RCT) design with multi-session CBM-I in risk for eating disorders. Intent-to-treat analyses did not replicate these effects, with no significant differences emerging between the interventions and the control condition. Moderate and sustainable effect sizes were also

produced by the three conditions with respects to reducing eating disorder psychopathology ($d$ = .52), negative affect ($d$ = .46) and clinical impairment ($d$ = .53) at 2-week follow up.

At the time of commencing this thesis seven studies had investigated the impact of CBM on eating disorder psychopathology. However, in the three years taken to complete the thesis, the body of CBM studies has grown to 13 investigations; thus, allowing us to conduct the first systematic review regarding the use of CBM-A and CBM-I in at risk and eating disorder populations. The review highlighted the relatively large and consistent effects associated with CBM-I, with appearance-based paradigms proving most effective. Meanwhile, pictorial-based CBM-A paradigms that were tailored to individual differences were profoundly more effective than word-based approaches. Lastly, the review partially supported the findings of our last study, demonstrating that multi-session CBM-I was effective at modifying symptomatology, while effects on bias were equivocal.

## Integration with Recent Research

### Cognitive bias modification targeting attention (CBM-A)

The majority of CBM studies has focused on manipulating selective attention for appearance-related stimuli using the modified dot probe task. The current pilot study is the first to report impacting risk for eating disorders using a positive appearance-based protocol, with previous investigations finding null effects on bias (Allen et al., 2018) and symptomatology (Allen et al., 2018; Smith & Rieger, 2009). Of note, we failed to replicate these effects in a follow-up study; finding only trends in CBM-A for improving all three dependent variables but no significant changes. These null effects may be, in part, due to the power of the second investigation ($N$ = 67) compared to that of the initial study ($N$= 91), particularly for subgroup analyses of CBM-A (study one, $n$ = 30 versus study two, $n$ = 17).

The effects of training attention towards self-worth related stimuli had not been investigated until now. Directing attention towards negatively valanced stimuli was effective

at inducing body dissatisfaction. This finding extends on a previous investigation, which found this attentional pattern to be associated with heightened negative affect, but not body dissatisfaction (Smith & Rieger, 2006). Alternatively, the redirection of attention towards positive self-worth related terms did not counteract these effects. In light of the null effects associated with the CBM-I for self-worth protocol, it is not surprising that the CBM-A form of training was ineffective, given that the target stimuli were extracted from the CBM-I protocol. This finding further highlights the key issue of content specificity and suggests that the self-worth protocol was not age-appropriate for the current younger sample.

A major limitation of the initial investigations was the omission of pre- and post-assessments of bias. This oversight in methodology meant that the obtained null or significant effects in symptomatology could not be explained by bias change or lack thereof. Numerous overviews have been conducted on the use of CBM in affective disorders, of which several highlights that symptomatology change is typically indicative of bias change (Jones & Sharpe., 2018; Mogoaşe et al., 2014; Menne-Lothmann et al., 2014). While this may be true for attentional and interpretation biases pertaining to affective disorders, the relationship between eating disorder-related bias and symptomatology is far more trivial. Specifically, of the 4 studies to assess both bias and symptomatology 1 study found changes in bias but not symptomatology (Allen et al., 2018), 1 study found the opposite (Smith & Rieger, 2009), 1 study found changes in both (Gledhill et al., 2017) and 1 found changes in neither (Loughnan et al., 2015). Overall, there is preliminary support for the use of positive appearance-based CBM-A protocols within at risk eating disorder populations; however, no firm conclusions can be made until the protocol is tested using a sound methodological design.

**Cognitive bias modification targeting interpretations (CBM-I)**

In comparison to other psychopathologies, the use of CBM-I in eating disorder psychopathology has been overlooked, with only six extant studies. The word completion

task is the most widely used and ecologically valid tool for assessing and modifying interpretation bias (Menne-Lothmann et al., 2014). To our knowledge, an appearance-based protocol using the work completion paradigm had not been developed prior to this thesis and therefore is a unique and important contribution of the current research. In addition to developing this standardised protocol, results pertaining to the new intervention are consistent with others who have found appearance-based protocols to be largely effective at eliciting bias (*d* ranging between -1.66 and 1.34) and symptom (*d* = -.80) change in at risk and eating disorder populations following single- (Williamson et al., 2000) and multi-session (Summers & Cougle, 2018) CBM-I. While the efficacy of the new protocol was reflected in a single session protocol, as well as in completer analyses of multi-session training, these effects were not mirrored in intent to treat analyses and therefore the robustness of the protocol remains uncertain. Although the current training dose (5 sessions) has previously proven sufficient at eliciting bias change (Cardi et al., 2015), individuals' real-world settings are likely to differ from the quiet and undisturbed laboratory environment used by Cardi and colleagues. Therefore, future research should determine whether additional sessions compensate for the environmental noise created by real-world settings.

The self-worth based protocol proved ineffective at eliciting change in non-clinical and subclinical samples when used in single session and multi-session designs. This is inconsistent with previous observations by Yiend et al., who found the approach to be largely effective at increasing positive interpretations of ambiguity pertaining to self-worth (*d* = 1.20), as well as reducing intrusive throughs related to weight and shape (*d* = .53). To our knowledge this was the first attempt to replicate the effects of the self-worth paradigm, however given that the protocol was originally designed for an older demographic ($M_{age}$ = 29) likely rendered the training unsuitable for the current samples ($M_{age}$ = 19-20). Specifically, life domains of older populations tend to centre on full time careers, long-term

partnerships or marriage and children, while the concerns of emerging adulthood (18-25 years) typically relate to appearance, academic studies, casual employment, dating and travel (Arnett, 2014). Given the relative success associated with self-worth based protocols, future research should to develop and assess an age appropriate protocol for younger samples.

The final study, an online CBM-I randomised controlled trial in subclinical eating disorder psychopathology, was implemented following the relative success associated with single session appearance and self-worth based approaches (Matheson et al., 2018; Yiend et al., 2018). To our knowledge this is the first study, within the eating disorder field, to investigate multi-session CBM-I in a RCT in a real-world setting. This methodology has however been utilised in affective disorder research, with similar effects observed to the current thesis. Similarly, Salemink and colleagues (2014) found an online multi-session CBM-I intervention to be effective at modifying threat-related bias in anxious individuals, relative to control forms of training (50:50 positive and negative interpretations; 100% neutral interpretations); however, the intervention was comparably effective to two control conditions with respect to improving affective symptomatology. This consistency in effects gives support to the notion that control CBM-I trainings carry therapeutic properties and therefore warrant further exploration within CBM literature.

In sum, findings from this thesis support the effectiveness of the newly developed appearance-based CBM-I protocol, as well as the feasibility of delivering online CBM-I to subclinical populations. The null effects associated with the appearance-based protocol in the intent-to-treat analyses suggests that five sessions may be insufficient in eliciting bias change in a subclinical sample and therefore future research should conduct addition trials in order to assess the impact of >5 trainings on eating disorder psychopathology.

**Novel interventions**

Evaluative conditioning has been described as a robust intervention for reducing state and trait body dissatisfaction in at risk eating disorders populations (Martijn et al., 2010; Aspen et al., 2015); however, the program and efficacy have yet to be replicated independent from the program developers. Despite the current null effects, the approach should not be deemed ineffective, due to a key deviation from the original methodology. Specifically, the current approach did now allow for an 8-day interlude between participants having their photo taken in tight fitted clothing and administering the intervention. Due to the lack independent studies, it remains unclear whether the conditioning paradigm is as robust as previously reported and therefore exact replications of the original methodology are required. Further, while the laboratory-based effects appear promising, the feasibility of incorporating this form of intervention into real-world settings is warranted. Therefore, future research should harness the growing popularity of smartphone technology and seek to transfer laboratory technology to these modalities, which enable the intervention to be field-tested.

The relationship between the popular computer game, Tetris and risk for eating disorders proved to be a unique and enlightening avenue of research. The effects of Tetris on psychopathology have been widely explored in addiction and trauma, but yet to be investigated within at risk or eating disorder populations. To date, the visuospatial task has proven effective at reducing food related-biases and cravings, as well as intrusive trauma flashbacks and distress caused by these intrusions. Our results support the notion that Tetris interferes with the consolidation of previously viewed visually distressing stimuli, given that individuals' whom underwent a negative body image induction and then played Tetris, experienced significant reductions in psychopathology. Given that these effects were not observed in the absence of the induction and therefore not administered under heightened

distress, suggests that mechanisms for psychological change are implicated by the Tetris effect.

Overall, the use of novel interventions in the prevention and intervention of risk and eating disorder psychology remains equivocal. However, in light of the current scope and methodological shortcomings these interventions warrant continued exploration in more rigorous experimental designs.

## Directions for Future Research

### Scientific Rigour in CBM

Modification methods have been described as an easy and cost-effective method for ameliorating cognitive dysfunction (Bowler et al., 2012). Despite this perceived ease of application, the eating disorder field has been slow to adopt these methods, with CBM research remaining sporadic and underdeveloped. More frequent and refined assessments of CBM are required to determine whether these interventions are effective and warrant dissemination in the prevention and intervention of eating disorders. Fundamental methodological features include pre- and post-assessments of bias and symptomatology. It is not uncommon for immediate and short-term effects to be assessed by trait inventories (i.e., administering the inventory twice in the same testing session). State inventories are better suited to single session CBM (i.e., 45minutes), given that these measures can be completed quickly and are sensitive to small fluctuations in symptomatology (Heinberg & Thompson, 1995). Meanwhile, the enduring and sustainable effects of an intervention are best assessed by trait inventories (e.g., Zuckerman, 1983; Kantor, Endler, Heslegrave, Kocovski, 2001). Therefore, in future endeavours, authors should be cautious in their selection of inventories and ensure that immediate and long-term effects of single and multi-session CBM are accurately captured through use of state and trait inventories, respectively.

Additional methodological considerations include training stimuli modality and content specificity. To date, CBM-A studies have focused exclusively on either pictorial (Gledhill et al., 2017; Smeets et al., 2011) or verbal stimuli (Allen et al., 2018; Engel et al., 2006; Loughnan et al., 2015; Smith & Rieger, 2006, 2009), with pictorial-based paradigms eliciting greater bias and symptom change than word-based approaches. A comparative investigation into the differential impact of stimuli modalities has yet to be conducted in the current field and therefore offers a new and necessary avenue of research. With respects to interpretation bias, the use of pictorial or visual stimuli is less common, particularly in the modification of biases (Schoth & Liossi, 2017). Several studies have successfully used ambiguous video clips to assess interpretation biases pertaining to social anxiety (Amir Beard, & Bower, 2005; Elwood, Williams, Olatunji, & Lohr, 2007; Wenzel, Finstrom, Jordan, & Brendle, J. R 2005). During the task, participants are presented with vignettes featuring social interactions between two or more individuals. To assess for bias, individuals may be asked to rate the valance of the situation and the perceived level of threat, as well as predict an outcome and the likelihood of it happening (Schoth & Liossi, 2017). To our knowledge, this method has yet to be used within eating disorder research; however as per other CBM paradigms this method appears to be adaptive to other psychopathologies. An example of a vignette for at risk or eating disorder samples may be the footage of an individual in a clothing store who has been overlooked by a shop assistant. Researchers may adopt the abovementioned methods for assessing bias, while modification techniques may include supplementing vignettes with word completion tasks or standardised self-imagery accompanied with feedback pertaining to interpretation accuracy. Given the high ecological validity of video clips (Schoth & Liossi, 2017), this modality is worth exploring in the assessment and modification of eating disorder-related interpretation biases.

Matching training material with the concerns of a sample has been termed 'content specificity' and has shown to implicate the efficacy of CBM (e.g. Matheson et al., 2018; Savulich et al., 2015). Traditionally, terms that denote the thin ideal (i.e., *thin*, *slim* or *skinny*) have been incorporated into CBM interventions for at risk and eating disorder samples (Allen et al., 2018; Engel et al., 2006; Loughnan et al., 2015; Smith & Rieger, 2009). The therapeutic value of paradigms that utilise stimuli of this nature are questionable, given that images of the thin ideal have shown to increase selective attention for appearance-related stimuli (e.g., Tobin et al., 2018), as well as induce body dissatisfaction and negative affect (e.g., Atkinson & Wade, 2012; Groesz et al., 2002; Juarascio et al., 2011; Tiggemann & McGill, 2004; Wade et al., 2009). In the wider literature, CBM training stimuli have been assessed using the Self-Assessment Manikan affective rating system (Lang, 1980), which captures the pleasure, arousal and dominance levels of stimuli; few eating disorder CBM studies have reported on this practice. While the Manikin rating scale offers a valid and robust assessment of the various dimensions of affect, this tool may inadvertently reinforce the use of disorder-salient stimuli. That is, thin ideal-related stimuli are likely to score high on pleasure, arousal and dominance in at risk and eating disorder samples and therefore researchers may be inclined to incorporate these stimuli into intervention paradigms due to positive endorsements. Further, it is important to consider the content specificity pertaining to diagnostic concerns. Due to the transdiagnostic nature of eating disorders (Fairburn, 2008a; Fairburn e al., 2003), content specificity is likely to be consistent across the various disorders (i.e., importance of controlling weight, shape and eating); however, there will be concerns pertaining to specific diagnoses (i.e., binge/purge behaviours that occur in binge-purge eating disorders). Previous reviews support this notion, with findings suggesting higher sensitivity to food-related biases in anorexia nervosa and weight and shape in bulimia nervosa (Faunce, 2002; Lee & Shafran, 2004). Overall, effective preventative approaches for eating disorders

focus less on the thin ideal and more on the development of balanced eating and exercise, self-efficacy, weight/shape acceptance and a positive body image (Watson et al., 2016). Thus, future research should seek to reassess CBM-A training stimuli and ensure that intervention protocols incorporate stimuli that reflect evidence-based principles, rather than endorsing the thin ideal.

**Tailoring CBM**

In refining assessment and modification protocols, we can be more confident in adapting these methods to meet individual differences and diagnostic concerns. To date, only one study has attempted to tailor training stimuli to be of personal relevance to at risk and eating disorder samples (Gledhill et al., 2017). Preliminary findings suggest that individualising CBM led to large and sustainable reductions in individual biases and symptomatology. The principles used by Gledhill and colleagues closely resemble those of case formulation; a theoretically informed process that uses assessment data to determine what factors contribute to the onset and perpetuation of psychopathology (Persons & Davidson, 1999). Through an initial assessment, Gledhill et al. established individuals' degree of eating disorder psychopathology and categorical boundaries pertaining to thinness and fatness. From this data, the researchers determined which training stimuli would be of personal relevance to the individual and incorporated these stimuli into the intervention, thus increasing the relatability and ecological validity of training.

The next logical step in research would be to use eating disorder case formulations to inform cognitive bias protocols. Case formulations offer contextual information regarding the types of stimuli and situations that maintain psychopathology, not captured by cognitive bias assessment paradigms. Using case formulations to tailor interventions is common in evidence-based practice, with research indicating that adapting therapeutic protocols to meet individual and diagnostic concerns may significantly reduce psychopathology associated with

various disorders, relative to rigid manualised protocols (e.g., Chen et al., 2017, Ehde, Dillworth, & Turner, 2014; Johansson et al., 2012; Mitchell et al., 2011; Persons, 2008). Therefore, an avenue of research would be to use eating disorder case formulations to hypothesise which cognitive biases warrant further assessment within bias protocols. This dual assessment process is likely to increase the reliability and validity of CBM and ensure that the appropriate biases are being targeted.

**Moving from Laboratory to the Living Room**

Successful dissemination of CBM without considering the feasibility of integrating the intervention into clinical practice is a costly endeavour. While it is important to narrow the research scope to examine the impact of specific factors on CBM efficacy (i.e., stimulus modality, content specificity, case formulation), it is equally important to broaden the lens beyond a laboratory setting to determine whether this approach carries the therapeutic value necessary for integration into existing eating disorder interventions. We consider three potential avenues.

The first is using CBM within the general community. Several studies have demonstrated the feasibility of administering CBM in real-world settings, using various modalities (i.e., online survey systems and smartphone apps; See, MacLeod & Russell, 2009; Matheson et al., 2018; Salemink et al., 2014; Schmidt, Kusber, & Martin, 2018). In addition to feasibility, multi-session CBM-A (See et al., 2009; Schmidt et al., 2018; Yang et al., 2017) and CBM-I (Matheson et al., 2018; Salemink et al., 2014; Yang et al., 2017) have proven effective at reducing bias and psychopathology in non-clinical and clinical samples. Only two studies have applied CBM to eating disorder psychopathology within a real-world setting (Matheson et al., 2018; Schmidt et al., 2018). While Matheson and colleagues used an online survey system to modify interpretation bias and symptomatology (see **Chapter 6**), Schmidt and colleagues were the first to use a smartphone app ('Psych Me Up') to influence

attentional bias and body dissatisfaction. The intervention, which trained attention towards positive social cues while directing attention away from negative cues, did not influence body (*d* = -.48 [-1.11 to .15]) or appearance dissatisfaction (*d* = -.40 [-1.03 to .22]) and its influence on attentional bias was not investigated. While an innovative study, common methodological shortcomings impede the evaluation of the smartphone app as an effective form of CBM-A (i.e., absence of a pre- and post-bias measure). Further, the use of a social-based paradigm in body dissatisfaction is dubious, with appearance-based paradigms proving most effective within this sample (see **Chapter 2** for review). Although Psych Me Up is an innovative and accessible form of attentional retraining, it was not designed for at risk and eating disorder samples. Therefore, researchers would be best to adopt this technology platform and develop a smartphone app that is specific to eating disorder salient bias and symptomatology.

The second avenue of research is the use of psychotherapeutic techniques to modify cognitive bias. A small body of literature points to the use of Cognitive Behavioural Therapy (CBT) techniques in modifying eating-disorder salient biases (Glashouwer et al., 2016; Shafran et al., 2008). This is not surprising given that targeting maladaptive thought processes has been the core criteria of successful CBT approaches for the prevention and treatment of eating disorders (Fairburn, 2008a, b). Findings from the two extant studies yield mixed results, with one study finding 20-session CBT to be effective at improving eating disorder-salient attentional bias and symptomatology (Shafran et al., 2008), while the other found positive mirror exposure improved symptomatology but not bias. Methodological shortcomings should be considered in the interpretation of these findings. Specifically, with respect to Shafran and colleagues' study, given the multimodal nature of CBT and the exclusion of an active treatment comparison condition it remains unclear which component(s) was responsible for bias change and whether the bias change was specific to CBT, respectively. More refined study designs are required to disentangle these effects and

determine which CBT techniques implicate bias change and whether these techniques are commensurately effective to CBM.

Conversely, rather than adopting one approach in preference to the other, a third possibility is the use of CBM in conjunction with psychotherapy (Macleod, Koster, & Fox, 2009). In isolation, the two interventions offer unique therapeutic qualities; however, combining the two approaches may enhance therapeutic outcomes. Conventional psychotherapies for eating disorders involve explicitly challenging individuals' unhelpful thinking styles and behaviours to improve emotive states and wellbeing. Although this process is comprehensive, it can be time consuming and laborious for clients. Further, changing distortions at this cognitive level requires frequent use and repetition of CBT techniques for new and adaptive thinking styles to become intuitive. Alternatively, CBM paradigms target implicit distortions and therefore require fewer cognitive resources, thus rendering CBM less laborious than CBT. Further, technological advancements have allowed for the inclusion of gaming elements in CBM (i.e., reward systems). Gamified versions have shown to increase client motivation and overall enjoyment in those with anxiety, while leaving evidence-based CBM paradigms intact (Boendermaker, Boffo, & Wiers, 2015; Boendermaker, Prins, & Wiers, 2015). A related benefit of the performative nature of CBM is the potential relationship between perceived accomplishment (e.g., the correct detection of probes and selection of letters for word fragments) and increased self-efficacy (Salemink et al., 2014). Given that the gold-standard psychotherapy for eating disorder is associated with high attrition and low retention and remission rates (e.g., Waller et al., 2014), the unique therapeutic properties offered by CBM may bolster the effects of CBT, by increasing client self-efficacy and motivation, thus ameliorating attrition and remission rates. To date, the degree to which CBM enhances evidence-based ED interventions is unknown. Therefore,

future research should seek to conduct a randomised controlled trial comparing CBM, CBT and a combined approach (CBM +CBT) in ED psychopathology.

## Limitations

The current thesis findings should be interpreted in the context of limitations additional to those already mentioned.

### Sample Characteristics

Participants were undergraduate females aged between 17 and 25 years with a BMI ranging between healthy and overweight; thus, findings cannot be generalised beyond this population. While research in CBM remains in its infancy, applying the protocol to a homogenous sample is recommended and therefore future research should seek to extend these findings by applying the intervention to other demographics, including males, older individuals and those with differing ethnicities.

### Assessments of Bias

As previously discussed, a major limitation of the first two studies was the omission of pre- and post-assessments of attentional bias; a methodological shortcoming that was addressed in the latter studies and enhanced the evaluation of CBM. Another limitation worth noting is the convergent validity of the newly developed appearance-based CBM protocol to other assessments of appearance-related interpretation bias (e.g., Martinelli, Holzinger, & Chasson, 2014). A notable strength of the protocol is that it used an assessment (similarity ratings task) and modification (ambiguous scenarios) framework that has been widely validated within eating disorders (Yiend et al., 2014), as well as other psychopathologies (Bowler et al., 2012; Matthews & Mackintosh, 2000; Lee et al., 2016; Savulich et al., 2017; Yiend, Mackintosh, & Mathews, 2005). Further, due consideration was taken in the development of assessment and training stimuli, with a pilot study conducted to ascertain content specificity of appearance-related stimuli in young females. Despite these strengths,

the convergent validity of the newly developed protocol remains unclear and therefore future research should incorporate other measures of appearance-related interpretation bias, to ensure that the correct construct is being captured (Carlson & Herdman, 2010).

### Control conditions

A key theme emerging across the four studies was the need for refinement of an appropriate control condition. The initial studies did not incorporate a control condition, thus limiting conclusions regarding the absolute effects of the interventions. The second half of the thesis refined the methodological design to include an active control condition in the single and multi-session protocols. The use of an active control condition is common in CBM studies, particularly when assessing intervention effects (Salemink et al., 2014). In addition to the current study, others have found intervention and control protocols to be equally effective at ameliorating psychopathology (Amir and Taylor, 2012, Boettcher et al., 2012, Carlbring et al., 2012; Salemink et al., 2014). These effects may be attributed to placebo and demand effects, increased self-efficacy and/or regular contact with and support from a professional. Therefore, given the therapeutic properties associated with the current CBM-I control condition, future research would benefit from the inclusion of both an active and inactive (i.e., assessment only) control condition.

## Conclusions

The current thesis has explored the efficacy of CBM at ameliorating cognitive biases associated with risk for eating disorder psychopathology. Further, due consideration was given to CBM effectiveness, as well as feasibility of dissemination and integration into clinical practice. Overall, the current findings give support for CBM interventions when conducted in an experimental setting; however, the interventions appear less robust when applied to real-world settings. Further, we note that other novel interventions such as Tetris and control conditions for CBM-I were commensurately effective to intervention CBM in

reducing psychopathology. Numerous methodological shortcomings need to be addressed in CBM study designs to evaluate and uncover the true therapeutic potential of this emerging intervention.

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# APPENDIX A

## Cognitive Bias Modification Appearance Stimuli

## Dot Probe Appearance Word Pairs

| Negative | Positive | Negative | Positive/Neutral |
|---|---|---|---|
| ample | clean | tubby | toned |
| blubber | healthy | bulging | vibrant |
| swollen | elegant | gigantic | youthful |
| corpulent | colourful | enormous | graceful |
| overfed | stylish | chunky | smooth |
| fulsome | groomed | plum | lean |
| burly | fresh | meaty | light |
| bulky | toned | potbellied | glamourous |
| bloated | healthy | wobbly | trendy |
| unfit | agile | thickset | straight |
| massive | glowing | lard | rosy |
| vast | long | dense | blush |
| fleshy | strong | portly | active |
| heavy | shiny | fatty | fancy |
| obese | classy | stumpy | nimble |
| paunchy | slender | overweight | immaculate |
| sizeable | muscular | unshapely | eccentric |
| gross | sharp | flabby | classy |
| large | trendy | round | limber |
| oversized | appealing | chubby | slight |
| blimp | clear | stuffed | angular |
| flaccid | radiant | overindulged | conservative |
| rotund | gentle | fat | fit |
| beefy | vivid | huge | tidy |
| weighty | refined | inflated | striking |
| stout | usual | full | neat |
| hefty | glossy | thick-bodied | well-dressed |
| immense | smaller | | |
| saggy | clear | | |
| toneless | athletic | | |
| big | fit | | |
| humungous | beautiful | | |
| broad | slick | | |

## Dot Probe Self-Worth Word Pairs

| Negative | Positive/Neutral | Negative | Positive/Neutral |
|---|---|---|---|
| vile | busy | malevolent | persistent |
| repulsive | fortunate | invisible | concerned |
| repugnant | practical | untrustworthy | conscientious |
| putrid | loving | failure | pleased |
| filthy | happy | deceitful | impressed |
| poisonous | forgetful | phoney | polite |
| grotesque | competent | bad | joy |
| disgusting | overlooked | false | tired |
| despicable | unfamiliar | unwanted | attached |
| horrible | learning | persecution | sentimental |
| disgraceful | considerate | freakish | sociable |
| evil | away | uncontrolled | unnoticeable |
| dirty | upset | stupid | normal |
| distasteful | neighbourly | disconnected | nonathletic |
| worthless | fortunate | manipulative | entertaining |
| nothing | unlucky | demanding | organised |
| inhuman | excited | possessive | attractive |
| decaying | resigned | superficial | celebratory |
| unfeeling | organised | selfish | rushing |
| twisted | annoyed | immature | sensible |
| rubbish | unlucky | needy | happy |
| contaminated | entertaining | weak | away |
| nasty | smart | lazy | right |
| disembodied | encouraging | slothful | mistaken |
| smelly | caring | impulsive | inspiring |
| punished | sensible | complaining | passionate |
| disliked | released | shallow | relaxed |
| defective | respected | chaotic | delayed |
| numb | calm | babyish | patient |
| degraded | cautious | wrong | human |
| doomed | daring | bothersome | overloaded |
| paralysed | engrossed | right | light |
| ugly | right | vindicated | diplomatic |

## Similarity Ratings Task for Appearance Interpretation Bias

**Version one**

1. The hairstyle

   Your friend tells you that she likes your new hairstyle. You were unsure about the hairstyle at first because it looks very different from what you are used to. It is a lot **darker**.

   Do you have a new hair style? Y- - (Yes)

   **Target Positive:** The new hairstyle suited you.
   **Target Negative:** your friend lied about liking the new hairstyle.
   **Foil Positive:** The hairdresser was nice to you.
   **Foil Negative:** The hairdresser was rude to you.

2. The Bedroom Mirror

   You wake up for work and have a shower. Before putting on your clothes you pass by your bedroom mirror. In the mirror you see your **reflection**.

   Did you have a bath? N- (No)

   **Target Positive:** your body's appearance was beautiful.
   **Target Negative:** you could look at your body's reflection.
   **Foil Positive:** Your work clothes were clean and ready to be worn.
   **Foil Negative:** Your work clothes were in the wash basket.

3. Company Website

   Your company is updating their website and a photographer has taken images of the staff. Your boss tells you that an image of you is on the main **page**.

   Are the photos for a leaflet? N- (No)

   **Target Positive**: You were pleased to have your picture on the main webpage
   **Target Negative:** You did not want your picture on the main webpage.
   **Foil Positive:** You thought the photographer was in a good mood.
   **Foil Negative:** You thought the photographer was in a bad mood

4. Friend's Boxing Class

   Your friend invites you to her boyfriend's amateur boxing class. You are unsure whether you will go, as you haven't exercised in a while. You decide that you are **going.**

   Is the class run by your friend's boyfriend? Y- - (Yes)

   **Target Positive**: your level of fitness was enough for the class
   **Target Negative:** your level of fitness was embarrassing.
   **Foil Positive:** You thought your friend did well at boxing

**Foil Negative:** You thought your friend did poorly at boxing

5. Running Group

   You are in a running club that runs every Saturday morning. This week, on Friday night, you go to a friend's birthday drinks, which goes on late into the night. You think you will probably not attend the running session next day, even though it means you might fall **behind**.

   Are you a part of a walking group? N- (No)

   **Target Positive**: You know it is important to rest after a good night out.
   **Target Negative:** you will put on weight if you miss a running session.
   **Foil Positive:** The running group is very understanding.
   **Foil Negative**: The running group does not approve of taking time off.

6. New Surfer

   Your friends have invited you to go surfing for the first time. You are standing on the board in your bikini when you see two of your friends smiling and laughing in your **direction**.

   Are your family going surfing? N- (No)

   **Target Positive:** Your friends are happy that you are trying something different.
   **Target Negative**: Your friends think you look overweight on the surf board in your bikini.
   **Foil Positive:** The weather was pleasant.
   **Foil Negative:** the weather was unpleasant.

7. Dating a Friend

   Your single male friend has been overly attentive to you lately. You hear that he went on a date with another girl who, compared to you, looks very **different**

   Did he go on a date? Y- - (Yes)

   **Target Positive:** your friend is attracted to you.
   **Target Negative:** You friend is giving you attention out of pity.
   **Foil Positive**: your friend is very handsome.
   **Foil Negative**: your friend is a bit sloppy.

8. Your Sister's Wardrobe

   Your sister is cleaning out her wardrobe to make room for new clothes. She has several dresses that she gives you, however you're unsure whether they will fit. She has a different body **type**.

   Were you given dresses? Y- - (Yes)

   **Target Positive:** You think that some of the dresses will look lovely on you.
   **Target Negative:** You think that your sister is purposely giving you clothes that you won't fit into.

**Foil Positive:** You sister has good fashion sense.
**Foil Negative:** You sister has terrible fashion sense.

9. No Make-Up

   You wake up to make breakfast and find that there is no milk in the fridge. You immediately go to the store in your track pants and with no make-up. When you approach the counter the shop assistant is **looking**.

   Did you buy milk? Y- - (Yes)

   **Target Positive:** The shop assistant was getting ready to help you pay for your goods
   **Target Negative:** the shop assistant was disgusted by your appearance.
   **Foil Positive:** the shop assistant was having a good morning.
   **Foil Negative:** the shop assistant was having a bad morning.

10. Summer Is Coming

    While listening to the radio you hear the weather forecast predicting a hot spell in the coming week. You consider your summer wardrobe and realise your summer clothes show more of your **figure**.

    Did you watch TV? N- (No)

    **Target Positive**: You think it will be nice to wear summer dresses and get some sun on your skin.
    **Target Negative:** You think people will be offended by your body in summer clothing.
    **Foil Positive:** You think this summer's fashion trends are lovely.
    **Foil Negative:** You think this summer's fashion trends are not very nice.

**Version two**

1. New Sunglasses

   You have just bought new pair of sunglasses. You spent a long time trying to decide which pair suited you best. You meet your brother for lunch and he comments on your new **glasses**.

   Did you buy a hat? N- (No)

   **Target Positive:** You thought the glasses looked good on you.
   **Target Negative:** Your brother thought the glasses were ugly on you.
   **Foil Positive:** Your brother was attentive to you at lunch.
   **Foil Negative:** Your brother was preoccupied at lunch.

2. Four Mirrors

   You are trying on a pair of jeans in the department store change room. All four walls of the changing room are covered in mirrors. Everywhere you look you can see **yourself**.

   Were you trying on jeans? Y- - (Yes)

**Target Positive:** The mirrors flattered your body.
**Target Negative:** You hated seeing your body in the mirrors.
**Foil Positive:** The changing room was spacious.
**Foil Negative:** The changing room was cramped.

3. Family Christmas Card

   Every year your mother organises a family portrait to use for Christmas cards. The photographer places you front and centre. You start to think about how many people will see the **card.**

   Is the card for celebrating Easter? N- (No)

   **Target Positive:** People will enjoy seeing your photo on the Christmas card.
   **Target Negative:** People will dislike your appearance in the photo.
   **Foil Positive:** The photographer was kind.
   **Foil Negative:** The photographer was rude.

4. Scavenger Hunt

   You and your colleagues are competing in a scavenger hunt. Your colleagues inform you that you'll need to run during the activity. You're unsure how you'll perform, as you haven't exercised in a **while.**

   Are you competing with colleagues? Y- - (Yes)

   **Target Positive:** Your fitness will be an asset to the team.
   **Target Negative:** Your lack of fitness will be a burden on the team.
   **Foil Positive:** The scavenger hunt sounded well organised.
   **Foil Negative:** The scavenger hunt sounded poorly organised.

5. Self-Care at Home

   You have been overly stressed recently and are in need of self-care. You attend weekly gym classes, however you consider missing this week's sessions so you can spend more time at **home**.

   Are your gym classes weekly? Y- - (Yes)

   **Target Positive:** You think it is important to rest your body when you're stressed.
   **Target Negative:** You will look fat after missing a week of gym.
   **Foil Positive:** the gyms class is well equipped.
   **Foil Negative:** the gym class is poorly equipped.

6. Rock Climbing Harness

   Your boyfriend organises for the two of you to go indoor rock climbing. When you arrive you are fitted for a harness. You start to think about how your body looks in the **harness**.

Are you going sky diving? N- (No)
**Target Positive:** The harness makes you feel supported.
**Target Negative:** The harness makes your fat bulge.
**Foil Positive:** The rock climbing was good value for money.
**Foil Negative:** The rock climbing was not worth the money.

7. Single Son

   You are visiting your mum and when you arrive two of her friends are over for coffee. You are chatting with the women when one suggests you meet her son, mentioning that he is currently **single**.

   Did you visit your dad? N- (No)

   **Target Positive:** You were excited at the prospect of meeting someone new.
   **Target Negative:** You were fearful that the son would find you unattractive.
   **Foil Positive:** Your mum's friends were celebrating their children's achievements.
   **Foil Negative: Y**our mum's friends grumbling about their children.

8. One Size Fits All

   You find a knitted jumper that you really like. You're unsure whether it will fit. You ask the shop assistant for other sizes but she advises that one size fits **all**.

   Did you go shopping? Y- - (Yes)

   **Target Positive:** You were reassured that the jumper would fit your body shape.
   **Target Negative:** You were worried the oversized jumper would make you look fat.
   **Foil Positive:** The jumper was well made.
   **Foil Negative:** The jumper was damaged.

9. Forgetful Make-Up

   You plan to swim laps before going on a dinner date. You are getting ready at the gym when you realise you forgot to pack make-up. You think about how you will look without your make-up **done**.

   Did you remember your make-up? N- (No)

   **Target Positive:** You think that you look good even without make-up.
   **Target Negative:** You think you need make-up to look good.
   **Foil Positive:** The swimming pool was calm and quiet.
   **Foil Negative:** The swimming pool was overcrowded.

10. Hawaiian Party

    Your sister is having a Hawaiian themed 30th birthday party. You are apprehensive about the party as your sister has organised your outfit. She has asked that you wear a bikini and grass **skirt**.

Is your sister turning thirty? Y- - (Yes)

**Target Positive:** You think that it will be fun to dress up in a bikini and grass skirt.
**Target Negative:** You think your body will look awful in the costume.
**Foil Positive:** the party will be well attended
**Foil Negative:** the party will be expensive.

**Positive Appearance Word Completion Scenarios**

1. You and a friend are shopping for new clothes. You see a dress you like and decide to try it on. You are apprehensive about buying the dress because you are unsure whether it suits you. Your friend advises you to buy it. You think this means you look

   -ttr-ct-v- (attractive).

   Are you flattered by your friend's encouragement? Y—(Yes)

2. Your partner compliments you on an outfit you are planning to wear to an upcoming wedding. Originally, you were hesitant to wear this this particular outfit as you were unsure how people would react. Now you believe the outfit makes you look

   b---t-f-l (beautiful).

   Do you believe your appearance will be well received at the wedding? Y—(Yes)

3. Your friend's birthday is coming up and you need to buy him a present. You go to the menswear department to see what you can buy. The male shop assistant advises you that he will attend to you next. You think this means you look

   -pp--l-ng (appealing).

   Was the male shop assistant offering help because you looked needy? N- (No)

4. You agree to play five aside football with some friends after work. People are chosen to make up different teams. Out of your friends, you can't help noticing that you are the last to be picked to join a team. You know this confirms you are

   -thl-t-c (athletic).

   Is it a coincidence that you were picked last? Y-- (Yes)

5. You go to a fancy dress party in a bright sparkly orange costume that glows in the dark. Most people cannot guess who you are. However you still get lots of attention and comments about the costume. You sense that to other people, you look

   c-nf-d-n- (confident).

   Did others think your orange costume was a failure? N- (No)

6. It is the weekend and you have had several late nights at work. You turn off the alarm in order to stay in bed and get more sleep. You will attend a family event later that day where an anniversary will be celebrated. You decide that you need to look

   r-j-v-n-t-d (rejuvenated).

Are you better for having slept in? Y-- (Yes)

7. You have spent most of your day off shopping. You finally find the new coat you were looking for. It seems expensive. You think about how it looks on you. You realise that you are feeling

   gl-m-r--s (glamorous).

   Were you right to make the decision to buy the coat? Y-- (Yes)

8. You are on your way to the work cafeteria for lunch. A colleague from your department walks past you in the corridor. You smile and say hello, but they don't respond. You assume you look

   b--bl- (bubbly).

   Did your colleague dislike you for appearing happy? N- (No)

9. Last summer you bought a skirt and it became your favourite item to wear. You received many compliments when you wore the skirt. You try it on again for the first time this season. You feel you look

   v-b- -nt (vibrant).

   Does it matter that you are wearing a dress from last season? N- (No)

10. Your best friend talks to you about someone who they think you might be romantically interested in. Your friend convinces you to go on a date with this person. As you sit at the bar waiting, you see your reflection in a mirror. You think you look very

    -ll-r-ng (alluring).

    Do you feel you are going to make a good first impression? Y-- (Yes)

11. You have been invited to a friend's housewarming party. You arrive alone and do not know many people. Lots of people come up to talk to you. You think this means you are

    p-p-l-r (popular).

    Are you rejected by the people at the party? N- (No)

12. You are meeting a friend for coffee who you haven't seen for a while. Halfway through the meeting, your friend says that you look different compared to the last time they saw you. You attribute this change in your appearance to being more

    -ct-v- (active).

Are you pleased that you have been exercising? Y-- (Yes)

13. You sit down on the bus with several large bags of shopping. It is a bit of a squeeze to fit you and your shopping on the seat without obstructing the passageway for other passengers. Despite the lack of room, another passenger chooses to sit next to you. You think this means you appear

    c-mf-rt--l- (comfortable).

    Is the other passenger happy to sit next to you? Y-- (Yes)

14. Your group of friends have organised a girls night out. You and a friend take a photo together and post the image on social media. Later in the night, people have written comments on the photo. The comments confirm that you look

    r-d—nt (radiant).

    Were you comfortable about putting the image up for people to see? Y-- (Yes)

15. You have put aside some time to go shopping for new work clothes. You are trying on clothes in a department store, when the sales assistant asked if you needed any help with sizing. You realise that this is because you look

    -ppr--ch-bl- (approachable).

    Do you think the shop assistant was judging you? N- (No).

16. You've been invited to your high school reunion. You take some time to reflect on your high school years. You think about how much you have changed since then. Compared to your younger self, you now appear more

    c-nf-d-n- (confident).

    Will your high school friends accept you? Y-- (Yes)

17. You arrive to check into a hotel but there is a crowd of people around the reception, with no organised queue. You find it hard to attract the attention of the staff. You notice that other guests have a much easier time getting a staff member's attention. You think that you appear

    fr--nd-y (friendly).

    Are you insignificant to the staff on reception? N- (No)

18. You have planned a long session in the gym but your housemate has recorded a new movie from TV the night before. You decide to stay in instead and watch the movie with them. You think this will make you more

    r-s--d (rested).

    Are you pleased you gave up on the gym? Y-- (Yes)

19. Your friend is getting married and so far the day has gone very well. You are at the formal reception after the Church ceremony. As you are making your way over to the marquee, you fall over and have to brush some dirt off your dress. Afterwards you think you look

    -l-g-nt (elegant).

    Do the other guests find you dirty? N- (No)

20. You are doing your weekly food shopping. You have just finished in the fruit and vegetable aisle. As you are walking to another aisle several people glance at the groceries in your trolley. You decide that your food choices make you

    h--lt-y (healthy).

    Do you feel good about your food choices? Y-- (Yes)

21. You are dining at a friend's house. You are asked by your friend to help move more chairs into the dining room. You start to worry about your ability to lift heavy things. You have been asked because you are

    st--n- (strong).

    Did your friend think you were weak? N- (No)

22. Your friend asks you if you are romantically interested in a colleague at work. You think back to your interactions with this colleague. You conclude that whenever you are with this colleague you look

    h--p- (happy).

    Is it possible that your colleague is attracted to you? Y-- (Yes)

23. You are having coffee at your local café with a group of friends. You and your friends are chatting and laughing about the weekend events. You notice that those passing by

seem to take particular notice of you and you wonder why. You decide that this attention is because you are

sm-l--g (smiling).

Do you relish in the attention? Y-- (Yes)

24. After exercising at the gym, you decide to shower before having coffee with a friend. While in the change room you get a glimpse of your body in a mirror. You think to yourself that since joining the gym your body appears

    t-n-d (toned).

    Do you believe your appearance is quite nice? Y-- (Yes)

25. 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 (fit).

    Are you surprised by your level of fitness? N- (No)

26. You are at a bar to celebrate a friend's recent promotion. You find yourself on the dance-floor. While you are dancing, you see two of your friends talking and smiling in your direction. They must think you look

    h--p- (happy).

    Do you believe you look happy? Y-- (Yes)

27. It is spring and it is warming up. You think of the hot weather that is to come and what it will be like to spend a day at the beach. You think about the new bathing suit you bought, which made you look

    -pp--l-ng (appealing).

    Do you like how your body looks in the bathing suit? Y-- (Yes)

28. An acquaintance approaches you as you are leaving the hairdressers with a new hairstyle. You feel uneasy about the cut because it is very different from your usual style. While you are talking, you find her staring at your hair. You think you look

    -ttr--t-v- (attractive).

    Do you think she disliked your new hairstyle? N- (No)

29. Prior to visiting a friend in hospital you think to yourself that you have put on weight. While visiting your friend she tells you she received more bad news about her terminal illness. You start to reflect on your own health and well-being. You consider yourself

    h--lt-y (healthy).

    Is the health of your body more important than its appearance? Y-- (Yes)

30. You belong to an amateur dramatics society. You are offered the leading female role in the next production. You imagine yourself in costume, on stage in front of the audience. You sense that you will look

    st-n--ng (stunning).

    Will you appear uncomfortable on stage? N- (No)

31. You arrive home from a long day out. It is late and you decide to get ready for bed. You take off your make-up and moisturise your face. You look at your reflection in the mirror. You decide that you look

    n-t-r-l (natural).

    Is it difficult to look at your reflection in the mirror? N- (No)

32. You have decided to do a spring clean. You are cleaning out a cupboard when you find photo albums. You start to look through the photos and start to compare yourself to the old photos. You come to think that you still look

    y--thf-l (youthful).

    Are you worried about how your appearance might have deteriorated? N- (No)

33. You have just come back from a holiday. You tell your colleagues about your experience. You think about how you looked before you went on holiday. You decide that you now looked

    r-fr--h-d (refreshed).

    Do you prefer to look rested? Y-- (Yes)

34. You have been stressed lately. You find yourself thinking about what has been causing you to worry. You decide to go for a bike ride. You arrive home and sense that you appear more

    -n-rg-t-c (energetic).

    Does your appearance improve with exercise? Y-- (Yes)

35. You and a group of friends are waiting in line for a new bar. You see that people behind you are being let in before you. Eventually you and your friends are let in. You think that you have been

    -cc-pt-d (accepted).

    Does the security guard find you repulsive? N- (No)

36. Tonight you are going on a date. You are getting ready, when you notice several blemishes on your face. You find yourself staring at the blemishes in the mirror. You conclude that even with these imperfections you look

    r-f-n-d (refined).

    Do you remain largely unaffected by the blemishes? Y-- (Yes)

37. You are giving a talk to over 500 people and are looking at the audience from the podium. You start to feel nervous and your hand shakes as several members of the audience look at you intensely. You imagine how yourself and decide you look

    -mpr-ss-v- (impressive).

    Do the audience think you look out of place? N- (No)

38. A friend calls and invites you to a backyard barbeque. You decline and tell them you have to stay in to work on a report. Your friend points out that you will work better after a break and you reluctantly go. Halfway through the night you start to feel

    r-v-t-l-z-d (revitalized).

    Are you pleased that you decided to go out? Y-- (Yes)

39. You have just completed a difficult gym class and are running late for dinner with friends so decide not to shower. You are worried what your friends will think of your appearance. You conclude from your friends' reactions that you appear

    f-n- (fine).

    Were your friends offended by your appearance? N- (No)

40. You need to buy a new bathing suit for an upcoming holiday and go to your favourite store. You are unsure which style will suit your body best but decide that one particular bathing suit makes you look

    t-n-d (toned).

Do you feel good in your new bathing suit? Y-- (Yes)

41. You are walking down the street when a stranger approaches you. They ask about your outfit and where you bought your jacket. You think this means you look

    f-sh--n-bl- (fashionable).

    Do you believe the way you dress is pleasing to others? Y-- (Yes)

42. You have been asked to fill in for your friend's netball team. You are apprehensive as you haven't exercised in a while. You play all four quarters of the game and afterwards people comment on your performance. You start to think that you are in

    g--d sh-p- (good shape)

    Does your friend regret asking you to play? N- (No)

43. Your workplace is having their 'Annual Gala Ball '. You buy an expensive dress for the occasion. Other guests comment on the effort you have made in getting ready and you sense you are

    gl-w-ng (glowing).

    Are you proud of your appearance? Y-- (Yes)

44. It is a nice day so you decide to take your dog for a walk along the beach. As you are walking along the water you smile and say hello to a stranger, but they don't respond. You think that to strangers, you look

    c-nt-nt (content).

    Is your positive appearance offensive to others? N- (No)

45. Your friend recently got married and has posted photos from the wedding on social media. You find yourself looking through the photos. You come across several of yourself and think that you look

    l-v-ly (lovely).

    Did you like how you looked in the photos? Y-- (Yes)

46. Recently you have spent long hours studying. You had planned to go to an early morning gym session but you think about the long day ahead and decide to sleep in instead. You believe this will make you feel

-n-rg-s-d (energised).

Are you pleased you gave up on the gym? Y-- (Yes)

47. You just started a new job and every Friday a group goes to the local bar for a drink. You arrive alone and do not know many people. People start to introduce themselves to you and you feel

    -nth-s--st-c (enthusiastic).

    Are people offended by your presence? N- (No)

48. A group of important people are visiting your office. Your boss unexpectedly asks you to give a brief presentation. While you are giving the talk, you sense that several members of the group are appraising you. You think you appear

    s-ph-st-c-t-d (sophisticated).

    Did you come across confident to the audience? Y-- (Yes)

49. You are travelling home on the train. There are no free seats and you need to stand very close to others for the entire trip. Another passenger comments on the space between you. You can tell that they are

    -t –se (at ease).

    Are you taking up too much space on the train? N- (No)

50. Your friend invites you to a get together at their house. They suggest you bring your bathing suit as they have recently installed a heated pool. You think about your body in a bathing suit. You decide that you will look

    pl--s-ng (pleasing).

    Will you disgust your friends by wearing a bathing suit? N- (No)

51. You have had a long day at work and are due to meet friends for dinner. Your make-up has worn off and you don't have time to reapply. You look at your face in the bathroom mirror. You think to yourself that your appearance is

    g--d (good).

    Is your appearance poorer for not having reapplied make-up? N- (No)

52. You are getting dressed when you notice that your jeans have a hole in them. You are apprehensive about having to shop for a new pair. You imagine your body in the old pair of jeans and consider the jeans to be

    fl-tt-r-ng (flattering).

    Are you likely to find another pairs of jeans that will flatter your body? Y-- (Yes)

53. You are having dinner with a friend and bump into your ex-partner. You find yourself thinking back to your relationship. Since having broken up, you now look more

    s-t-sf--d (satisfied).

    Is your confidence reflected in your appearance? Y-- (Yes)

54. You have booked an appointment to have a bra fitting. During the appointment, the shop assistant comments on your sizing. You select several bras to purchase. Later you think your body is

    b---t-f-l (beautiful).

    Was the shop assistant negatively judging your body? N- (No)

55. You are visiting your parents for dinner. During the meal your dad compliments you on your appearance. You think back to when you saw him last. Compared to then you consider yourself to look

    f-tt-r (fitter).

    Is your appearance well received by your family? Y—(Yes)

56. You go to your local café and read through some work reports. You order a coffee. While reading your reports you notice that the barista keeps looking in your direction. You think you this means you are

    g--d l--k-ng (good looking).

    Did the barista find you hideous? N- (No)

57. Your friend is a part of a painting society. They have asked that you stand in as a clothed-model for their next session. You are apprehensive about being on display. You imagine yourself in front of the painters and sense that you will look

    d-zz- -ng (dazzling).

Are your surprised to be asked to model? N- (No)

58. You have been trying to master a difficult yoga pose. Although you find the position challenging, you refuse to give up on it. You sense that your body is getting

    p-w-rf-l (powerful).

    Was the time and effort you put into the yoga pose worth it in the end? Y-- (Yes)

59. You have had a stressful week at work. You are apprehensive about going go to a musical festival with your friends. You arrive and the venue is amazing. During the night you find your body starting to feel

    r-l-x-d (relaxed).

    Do you appear less stressed for going to the event? Y-- (Yes)

60. You are meeting friends for breakfast. You arrive first and are waiting to be seated. You find it hard to attract the attention of the waiter. You notice that when your friend arrives you are served immediately. You think you appear

    gr-c---s (gracious).

    Do you believe you were overlooked because of your appearance? N- (No)

61. You arrive home late from a day of running errands. You decide to order take-out. You enter the restaurant to purchase your food. You smile at the shop assistant and notice that they look you up and down. To the shop assistant, you think you appear

    pl--s-nt (pleasant).

    Does the shop assistant find you repulsive? N- (No)

62. Your mother was cleaning out the garage and came across your high school yearbooks. She drops them off to your house for you to have. You find yourself looking through the images of yourself. You consider your younger self to look

    l-v-ly (lively).

    Do you still resemble your younger self? Y-- (Yes)

63. A colleague mentions to you that they have joined a new gym. They suggest that you join then in one of the gym classes. Your colleague suggested for you to join the gym because you look

    sp-r-y (sporty).

Was your colleague suggesting that you appear out of shape? N- (No).

64. Your colleague just came back from holiday and tells you enthusiastically about her experiences. While you listen to her, you think of your own last vacation. Usually when you return from vacation now, you feel

    r--en-rg-z-d (re-energized).

    Is your body in need of a rest? Y-- (Yes)

65. You are having lunch with two of your friends. You arrive and one friend asks whether you got enough sleep last night. You think about think about it and assume you must look

    r-st-d (rested).
    Do you appear poorly because of last night's sleep? N- (No)

66. You have recently taken up swimming. You have just completed several laps when you decide to take a break. Another swimmer says something about your swimming style that you don't quite hear. Later you think that you appear

    -g-le (agile).

    Did the other swimmer take special notice of your swimming technique? Y-- (Yes)

67. You are running late to work. You enter the office kitchen to make yourself a coffee. One of your colleagues asks whether you are wearing any make-up. You think to yourself that your skin appears

    cl- -r (clear).

    Are you offended by your colleague's question? N- (No)