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Title:
The relationship between attentional bias and body image disturbance

The Relationship Between Attentional Bias and Body Image Disturbance

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Abstract

Body image disturbance is a both a risk factor for, and a symptom of, many eating disorders and refers to the misperception of and dissatisfaction with one's own body. Some studies show that women with high body dissatisfaction direct more attention to low weight bodies, which can result in the overestimation of body size via body size adaptation. Therefore, attention may have a causal role in body image disturbance. In this thesis, I test the effects of attentional bias to bodies of different sizes on body size adaptation and body dissatisfaction using a training dot probe task (Chapter 2) and a training visual search task (Chapter 5). I test the association between body dissatisfaction and attentional bias to low weight bodies using an assessment version of the dot probe task (Chapter 3), a systematic review and meta-analysis (Chapter 4) that synthesises the results of Chapters 2 and 3 with 30 additional eligible studies, and an assessment version of the Attentional Response to Distal vs. Proximal Emotional Information (ARDPEI) task (Chapter 6). From this research, I conclude that gaze tracking studies do provide evidence for a positive association between body dissatisfaction and attentional bias to low weight bodies in women. Women with high (compared to low) body dissatisfaction direct more gaze towards low weight female body stimuli. However, reaction time measures do not provide evidence for this association and instead demonstrate poor reliability as measures of individual differences in attention. This thesis does not provide strong evidence for an effect of attentional bias to bodies of different sizes on body size adaptation or body dissatisfaction; however, given attention was measured using reaction times, future research using gaze tracking should be conducted to further explore the effect of attentional bias to bodies of different sizes on body size adaptation or body dissatisfaction.

Author Declarations and Statements of Originality

This thesis is being submitted to Macquarie University and the University of Bristol in accordance with the Cotutelle agreement dated 8th September 2017.

To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made in the thesis itself. Any views expressed in the dissertation are those of myself.

The research presented in this thesis was approved by the Macquarie University Human Research Ethics Committee (references : 52019573210821 & 52020573222184) and the University of Bristol School of Psychological Science Research Ethics Committee (reference: 109062)

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List of Abbreviations

AB	Attentional Bias
ARDPEI	Attentional Response to Distal versus Proximal Emotional Information
ARFID	Avoidant/Restrictive Food Intake Disorder
BD	Body Dissatisfaction
BMI	Body Mass Index
EEG	Electroencephalogram
ERP	Event-related Potential
OSFED	Other Specified Feeding or Eating Disorder
PSN	Point of Subjective Normality
RSVP	Rapid Serial Visual Presentation
SOA	Stimulus Onset Asynchrony
SSVEP	Steady-state Visual Evoked Potentials
TH1-4	Thesis Hypotheses 1-4

Chapter 1: General Introduction

In this first chapter, I provide an overview of eating disorders and explain why and how attentional bias modification should be explored as a novel intervention for treatment. In particular, I suggest that attention bias modification research should target attentional bias to low weight bodies as a method of reducing body image disturbance. At the end of the chapter, I provide an overview of the thesis, including the research aims, main hypotheses, and chapters.

1.1. Eating Disorders

Eating disorders are mental health conditions where a person experiences negative thoughts and emotions relating to their food and/or body, resulting in unhealthy eating behaviours (e.g. eating too much or too little; American Psychiatric Association, 2013; National Health Service, 2021). Common eating disorders include anorexia nervosa, bulimia nervosa, binge eating disorder, avoidant/restrictive food intake disorder (ARFID), and other specified feeding or eating disorder (OSFED; American Psychiatric Association, 2013; Hay et al., 2017). A systematic review of 94 studies showed that eating disorders are highly prevalent worldwide for both men and women, with point prevalence estimates increasing from 3.5% during 2000–2006 to 7.8% during 2013–2018 (Galmiche et al., 2019). The negative consequences of eating disorders are extreme, because they are associated with serious medical complications, reduced quality of life, and high mortality rates (Van Hoeken & Hoek, 2020). Current treatment options for eating disorders typically involve talking therapies such as cognitive behavioural therapy (Mulkens & Waller, 2021) and family-based treatment (Gorrell et al., 2019). However, relapse rates are high (Carter et al., 2012; Filipponi et al., 2022) and people needing urgent treatment are often faced with long waiting lists (Butterfly Foundation, 2020; National Health Service, 2023). To improve outcomes for people with eating disorders, it is important for researchers to explore and develop novel cost-effective interventions.

1.2. Attentional Bias Modification

An intervention that has promise for reducing eating disorder symptoms is attentional bias modification, which involves training people to shift their attention away from disorder-relevant stimuli using repeated computerised trials (Beard, 2011; MacLeod, 2012). Attentional bias modification originally stemmed from research showing that people with symptoms of anxiety direct more attention to threatening stimuli (e.g., emotionally threatening words; MacLeod et al., 1986; for a summary of measures of attentional bias see Table 4.1). Attentional bias was proposed to play a mechanistic role in the development and maintenance of anxiety (MacLeod et al., 1986; Mathews & MacLeod, 2002). Subsequent experiments supported this suggestion, showing that training participants to shift this attentional bias away from threatening stimuli led to reduced anxiety symptoms (Mathews & MacLeod, 2002). The most commonly used method of attentional bias modification is the training dot probe task, which involves a stimulus pair (one target and one control stimulus) being presented simultaneously on the screen for a brief time period (typically ≤ 500ms). After the stimulus pair disappears, a probe appears that the participant must respond to as quickly as possible. If the probe appears in the same location as the target stimulus over repeated trials then participants learn to direct more attention to target stimuli (Mathews & MacLeod, 2002). Attentional bias modification has since been shown to be effective at modifying attentional biases (Martinelli et al., 2022) and reducing symptoms of anxiety (Jones & Sharpe, 2017; Linetzky et al., 2015; Price, Wallace, et al., 2016). However, effects are small and current research is limited by small low quality trials (Cristea et al., 2015; Fodor et al., 2020).

Researchers have proposed that attentional bias modification could be adapted to the treatment of eating disorders (Renwick et al., 2013a, 2013b). People with eating disorders display attentional biases to food and body related stimuli (Ralph-Nearman et al., 2019; Stott et al., 2021), which could play a causal role in the development and maintenance of eating disorders (Renwick et al., 2013a, 2013b). If a causal pathway is evidenced, targeting these attentional biases and training patients to shift attention away from food and body related stimuli may be effective in the treatment of eating disorders. A number of studies have explored this causal pathway by using attentional bias modification to reduce eating disorder symptoms and associated cognitive processes in non-clinical samples (Engel et al., 2019; Matheson et al., 2019; Schmidt & Martin, 2021) and people with an eating disorder diagnosis (Cardi et al., 2015; Dikstein et al., 2023; Rowlands et al., 2022). The results are mixed—some studies found attentional bias modification led to effects in the therapeutic direction e.g., reduced anxiety and higher self-compassion (Cardi et al., 2015), reduced eating restraint and eating, weight, and shape concerns (Rowlands et al., 2022), and increased body and appearance satisfaction (Matheson et al., 2019; Schmidt & Martin, 2021). However, some studies found no effects of attention training (Dikstein et al., 2023; Engel et al., 2019; Matheson et al., 2019). The small sample sizes and substantial variations in methodology may be contributing to these inconsistent results. Further, many of the studies trained participants to shift attention away from eating disorder related words (e.g., Dikstein et al., 2023), which may have lower ecological validity when compared to pictorial stimuli. Therefore further research is justified to explore whether attentional bias modification can be used to reduce symptoms of eating disorders. If symptom reduction is demonstrated, then attentional bias modification could be used in treatment as an adjunct to traditional talking therapies. Attentional bias modification has the potential to offer many practical advantages beyond those offered by traditional talking therapies. For example, the tasks are relatively cheap, with low patient demands, and they have the potential to be completed by patients at home without a therapist present (Beard, 2011).

1.3. Body Dissatisfaction and Attentional Bias to Low Weight Bodies

A symptom of eating disorders that could be targeted using attentional bias modification is body dissatisfaction—defined as the negative subjective evaluations of one's body and constituting the attitudinal component of body image disturbance (Cash & Deagle, 1997). Body dissatisfaction is part of the diagnostic criteria for anorexia nervosa (American Psychiatric Association, 2013) and a risk factor for other eating disorders, including bulimia nervosa, binge eating disorder, and purging disorder (Stice et al., 2017), as well as later depressive episodes (Bornioli et al., 2021), risky health behaviours (Bornioli et al., 2019), dieting, and negative affect (Stice, 2002). In a systematic review of studies on non-clinical samples, Rodgers and DuBois (2016) found that body dissatisfaction was associated with multiple body-related attentional biases (see Chapter 4 for a discussion of this systematic review). Most studies recruited female majority samples and measured attentional bias using eye tracking (e.g., fixation duration) or the assessment version of the dot probe task, which is similar to the training dot probe described previously; however, the probe has an equal chance of replacing both the target and control stimulus. Attentional bias is assessed using reaction times—faster responses to target stimuli compared to control stimuli are thought to reflect an attentional bias to target stimuli (MacLeod et al., 1986)

A particular attentional bias identified by Rodgers and DuBois (2016) to be associated with body dissatisfaction was the attentional bias to low weight bodies[1]. The researchers found preliminary evidence showing that people with higher levels of body dissatisfaction attended more to low weight bodies. This finding is consistent with some studies on people with anorexia nervosa (Pinhas et al., 2014) and bulimia nervosa (Blechert et al., 2009) showing that people with eating disorders direct more attention to low weight bodies when compared to people without eating disorders. The research discussed so far only provides correlational evidence for this association; however, cognitive behavioural theories of eating disorders propose that the relationship between body dissatisfaction and attentional biases is bidirectional, creating a negative feedback loop and exacerbating body dissatisfaction (Williamson et al., 2004). Therefore, attentional bias to low weight bodies may be causing people to feel less satisfied with their bodies.

[1] Rodgers and DuBois (2016) and other researchers in their review used a variety of different terms to describe bodies of a smaller size. In this thesis, I use the term "low weight", except in Chapter 2 where I use the term "low fat" because the body stimuli have had their apparent fat mass modified, Chapter 3 where I use the term "thin" because the research article discusses thin-ideal internalisation, and Chapter 5 where I use "low body mass index (BMI)" because the body stimuli have had their BMI modified.

Social comparison theory (Festinger, 1954; Myers & Crowther, 2009) provides a social explanation for how attentional bias to low weight bodies may increase body dissatisfaction in women. According to the theory, individuals evaluate themselves against others by engaging in "upward comparisons" with those they consider more attractive, and in "downward comparisons" with those they consider less attractive. Upwards comparisons are thought to lead to negative emotions and downwards comparisons are thought to lead to positive emotions (Festinger, 1954; Myers & Crowther, 2009). Women are likely to make upward comparisons with low weight bodies, because this body size has been depicted by Western media as ideal for women (de Freitas et al., 2018; Malkin et al., 1999; Owen & Laurel-Seller, 2000; Spitzer et al., 1999; Sypeck et al., 2004) and is typically perceived as more attractive (Brierley et al., 2016; Crossley et al., 2012; Swami et al., 2010). Further, experimental evidence shows that presenting women with images of low weight bodies results in an increase in body dissatisfaction (Bould et al., 2018; Groesz et al., 2002; Moreno-Domínguez et al., 2019; Tiggemann & McGill, 2004), with evidence indicating that this effect on body dissatisfaction is at least partly mediated by self-reported tendency to make social comparisons (Tiggemann & McGill, 2004; Tiggemann & Slater, 2004; Tiggemann & Zaccardo, 2015). Therefore, women directing attention to low weight bodies may be making upward comparisons and thus increasing their feelings of body dissatisfaction.

1.4. Body Size Adaptation

Upward comparisons provide a social mechanism for the effect of attentional bias to low weight bodies on body dissatisfaction in women. However, there may also be a perceptual mechanism that has received less research attention. Amongst vision scientists, it has long been known that exposure to extreme stimuli can lead to temporary perceptual biases (Addams, 1834; Thompson & Burr, 2009). When people perceive a stimulus (e.g. a line tilted to left) they adjust to the sensory input, via a process called adaptation, which is when specific neurons temporarily reduce their sensitivity to the stimulus, leading to a skewed distribution of overall neuronal activity and a temporary perceptual shift of subsequently presented stimuli in the opposite direction (e.g. perceiving a vertical line as tilted to the to the right; Gibson & Radner, 1937). The resulting perceptual biases are referred to as "aftereffects" and occur both for lower-level properties of simple stimuli like motion, orientation, and colour, as well as higher-level properties of complex stimuli such as the identity of a face, or the perceived direction of gaze (Kohn, 2007; Thompson & Burr, 2009). Adaptation is thought to recalibrate perceptual norms in everyday life, meaning adaptation stimuli are perceived as more "normal" and stimuli in the opposite direction are perceived as more distinctive (Rhodes et al., 2013; Webster, 2015; Webster & MacLeod, 2011).

Importantly, people also display aftereffects when presented with bodies of different sizes. When individuals observe bodies with low (high) weight, they overestimate (underestimate) the size of subsequently presented body stimuli (Bould et al., 2018; Bould et al., 2020; Brooks, Baldry, et al., 2019; Brooks et al., 2016, 2018; Glauert et al., 2009; Hummel et al., 2012; Oldham & Robinson, 2016; Robinson & Kirkham, 2014; Sturman et al., 2017; Winkler & Rhodes, 2005). Body size adaptation studies find a consistent pattern of results, regardless of variations in body stimuli. For example, some studies adopt an approach high in ecological validity by using photographs of people who varied in weight (e.g. Oldham & Robinson, 2016; Robinson & Kirkham, 2014). Alternatively, some studies adopt approaches that are lower in ecological validity but higher in internal validity, for example by using photographs of people taken under standardised conditions that were digitally altered to reflect weight variations (e.g. Bould et al., 2018; Bould et al., 2020; Brooks, Baldry, et al., 2019; Brooks et al., 2016, 2018; Hummel et al., 2012; Sturman et al., 2017; Winkler & Rhodes, 2005) or computer generated bodies (e.g. Glauert et al., 2009). Studies have also varied in amount of skin exposed on the body stimuli, with some studies using body stimuli that were clothed with their torso covered (e.g. Brooks, Baldry, et al., 2019; Brooks et al., 2016, 2018; Hummel et al., 2012; Oldham & Robinson, 2016; Robinson & Kirkham, 2014; Sturman et al., 2017; Winkler & Rhodes, 2005), some studies using body stimuli that were clothed with their torso exposed (e.g. Bould et al., 2018; Bould et al., 2020), and some studies using body stimuli that were unclothed (e.g. Glauert et al., 2009). Body size adaptation studies also find a consistent pattern of results despite variations in measures of adaptation. For example, some studies present the participant with a body stimulus and ask the participant to either rate or categorise the body stimulus on size (e.g. Bould et al., 2018; Bould et al., 2020; Glauert et al., 2009; Oldham & Robinson, 2016; Robinson & Kirkham, 2014; Winkler & Rhodes, 2005). Some studies adopt techniques from psychophysics, such as the method of adjustment task where participants adjust a body stimulus until it appears "normal" or "average" sized (e.g. Brooks, Baldry, et al., 2019; Sturman et al., 2017) or the adaptive staircase task where the participant is presented with a body stimulus and they must decide if the body is larger or smaller than a comparison body stimulus (Brooks et al., 2016, 2018; Hummel et al., 2012). Despite these methodological variations, studies consistently find that exposure to low (high) weight bodies leads to the overestimation (underestimation) of the size of subsequently presented body stimuli, and effect sizes are typically medium-large (e.g. Cohen's *d* ranging from 0.53-2.1; Brooks et al., 2018). The consistency in findings despite methodological variations indicates that body size adaptation is a robust and well-evidenced phenomenon.

Adaptation has also been shown to transfer between identities, resulting in misperceptions of one's own body size. Participants exposed to other bodies with low (high) weight have been shown to overestimate (underestimate) the size of their own body (Brooks et al., 2016; Hummel et al., 2012). These findings have led researchers to suggest that exposure to extreme body sizes may be leading some people to misperceive their own body size in everyday life (Brooks, Mond, et al., 2019; Challinor et al., 2017; Glauert et al., 2009; Hummel et al., 2012; Winkler & Rhodes, 2005). Individual differences in visual diet may be explained by differences in media consumption. Western media has a long history of presenting women as low weight (e.g. print media (de Freitas et al., 2018; Malkin et al., 1999; Owen & Laurel-Seller, 2000; Spitzer et al., 1999; Sypeck et al., 2004), television (Mastro & Figueroa-Caballero, 2018; Robinson et al., 2008; White et al., 1999), film (González et al., 2020), and video-games (Downs & Smith, 2010; Martins et al., 2009)). Further, social media platforms present women as low weight under popular hashtags such as #fitspo (Talbot et al., 2017) #thinspiration, #fitspiration, and #bonespiration (Carrotte et al., 2017). Visual diet can also be affected by geography, because body weight is clustered and (Dahly et al., 2013; El-Sayed et al., 2013), meaning the body sizes you see in person are dependent on your local community. Therefore, variations in visual diet may lead people to visually adapt to different body sizes and thus misperceive their own body size.

However, people with the same visual diet may also display individual differences in body size adaptation due to attentional bias. Attention increases the magnitude of aftereffects for a range of stimuli, including orientation, motion, and facial distortion (Rezec et al., 2004; Rhodes et al., 2011; Spivey & Spirn, 2000). Similar results have been shown for body stimuli, because individuals presented simultaneously with high and low weight body stimuli adapt to the body size they spend more time fixating on (Stephen, Sturman, et al., 2018). This has also been shown in experimental research, with people adapting to the body size they are instructed to look toward (Stephen, Hunter, et al., 2018). If women with high levels of body dissatisfaction direct more attention to low weight bodies (Rodgers & DuBois, 2016), then this may cause them to overestimate their own body size via body size adaptation. The overestimation of body size constitutes the perceptual component of body image disturbance (Cash & Deagle, 1997) and is positively associated with body dissatisfaction (Hagman et al., 2015; Manjrekar & Berenbaum, 2012; Moussally et al., 2017). Like body dissatisfaction, the overestimation of body size is a symptom of eating disorders, including anorexia nervosa and bulimia nervosa (American Psychiatric Association, 2013; Mölbert et al., 2017). Considering the societal expectations for women to have a low weight (Thompson et al., 1999), it is plausible that the tendency to overestimate one's body size may also contribute to heightened levels of body dissatisfaction in women. The overestimation of body size has been shown to correlate with body dissatisfaction in women with anorexia nervosa (Hagman et al., 2015). Further, changes in body size estimation have been shown to co-occur with changes in body dissatisfaction. For example, Bould et al. (2018) found that women who adapted to high weight bodies subsequently underestimated their own body size and reported reduced body dissatisfaction. Further, Preston and Ehrsson (2014) used virtual reality to give participants the illusion of owning a different body size. Participants who given an avatar with a smaller body size subsequently underestimated their own body size and reported reduced body dissatisfaction. Therefore, attentional bias to low weight bodies may be contributing to the overestimation of one's own body size and body dissatisfaction in women. The implication of this mechanism is that attentional bias modification could be effective at reducing body image disturbance by training women to shift attention away from low weight bodies.

Attentional bias to low weight bodies is thought to contribute to body image disturbance via social comparisons, according to social comparison theory (Festinger, 1954; Myers & Crowther, 2009), and via body size adaptation, according to perceptual theories (Brooks, Mond, et al., 2019; Challinor et al., 2017; Glauert et al., 2009; Hummel et al., 2012; Winkler & Rhodes, 2005). Both theories suggest that attentional bias modification could be effective at reducing body image disturbance by training women to shift attention away from low weight bodies. However, few studies have attempted to modify body size attentional biases. If attentional bias modification is effective at modifying body size attentional biases, then research will be able to explore the effects of body size attentional bias modification on body dissatisfaction, testing social comparison theory by evaluating the mediating role of self-reported social comparisons, and testing the perceptual mechanism by evaluating the mediating role of body size adaptation. In this thesis, I aimed to explore the perceptual mechanism, which has currently been less studied by researchers. I used attentional bias modification and tested the effects of body size attentional bias on body size adaptation and body dissatisfaction.

1.5. Thesis Overview

1.5.1. Research Aims

The overall aims of this thesis are to:

- test the association between body dissatisfaction and attentional bias to low weight bodies
- test the effects of body size attentional bias modification on body size adaptation and body dissatisfaction
- inform the development of computerized attentional bias modification tasks for the treatment of eating disorder symptoms

1.5.2. Main Thesis Hypotheses

Thesis Hypothesis 1 (TH1): Body dissatisfaction is positively associated with an attentional bias towards low weight bodies, so women with greater body dissatisfaction will direct more attention towards low weight bodies than women with lower body dissatisfaction.

Thesis Hypothesis 2 (TH2): Women trained to attend to low (high) weight body stimuli will increase their attention towards low (high) weight body stimuli.

Thesis Hypothesis 3 (TH3): Women trained to attend to low (high) weight body stimuli will perceive body stimuli as higher (lower) in weight after the training than before. This will lead them to reduce (increase) the size of an adjustable body stimulus to make it appear 'normal'.

Thesis Hypothesis 4 (TH4): Women trained to attend to low (high) weight body stimuli will increase (decrease) their body dissatisfaction.

1.5.3. Chapter Overview

This thesis includes five studies. In Chapter 2, I describe an experiment in which I trained 150 young adult women to attend to high versus low weight bodies using a training dot probe task. I evaluated the effects of the training on the participants' attention to high versus low weight bodies (TH2), body size adaptation (TH3), and body dissatisfaction (TH4). I also tested the pre-training association between body dissatisfaction and attentional bias to low weight bodies using an assessment version of the dot probe task (TH1). In Chapter 3, I describe a cross-sectional study in which I conducted an assessment version of the dot probe task with 300 young adult women. I tested the association between body dissatisfaction and attentional bias to low weight bodies (TH1), as well as the moderating effects of participant ethnicity and the ethnic congruence of the body stimuli. In Chapter 4, I describe a systematic review and meta-analysis in which I synthesise the results of 34 cross-sectional studies (including the pre-training data from Chapter 2 and data from Chapter 3) testing the association between body dissatisfaction and attentional bias to low weight bodies (TH1). In Chapter 5, I describe an experiment in which I trained 142 young adult women to attend to high versus low weight bodies using a training visual search task. I evaluated the effects of the training on the participants' attention to high versus low weight bodies (TH2), body size adaptation (TH3), and body dissatisfaction (TH4). I also tested the pre-training association between body dissatisfaction and attentional bias to low and high weight bodies using an assessment version of the visual search task (TH1). In Chapter 6, I describe a cross-sectional study in which I conducted an assessment version of the Attentional Response to Distal versus Proximal Emotional Information (ARDPEI) task with 200 young adult women. I tested the association between body dissatisfaction and engagement and disengagement bias to low weight bodies (TH1).

Chapters 2-6 are all presented as standalone research articles that have either been published, submitted for publication, or are ready for submission. At the start of each of these chapters I have included an addendum that introduces the research article, explaining how the article links to my other thesis chapters and tests my main thesis hypotheses (TH1-4). In Chapter 7, I discuss the findings from Chapters 2-6, including their strengths and limitations, and I make recommendations for future research. Small passages of text from Chapters 2-6 have been included in my general introduction (Chapter 1), general discussion (Chapter 7), and addenda to Chapters 2-6, and my supervisors have kindly given me feedback on these chapters. In Chapters 2-6, I refer to multiple hypotheses, and in some cases these hypotheses are numbered e.g. “Hypothesis 1”. The numbering of hypotheses in Chapters 2-6 is independent from the numbering of my main thesis hypotheses (TH1-4) which are only referred to in the thesis introduction (Chapter 1), general discussion (Chapter 7), and addenda to Chapters 2-6.

Chapter 2: The Effect of Attention on Body Size Adaptation and Body Dissatisfaction

2.1. Addendum to Chapter 2

Chapter 2 includes three experiments that I have published together as one research article. I conducted Experiments 1 and 2 as part of my Masters of Research (MRes) at Macquarie University. Therefore, these two experiments are non-examinable in this PhD thesis. I conducted Experiment 3 as part of my cotutelle PhD with Macquarie University and the University of Bristol. Therefore, Experiment 3 is examinable in this PhD thesis. Some small passages of text from my MRes thesis may be present in Chapter 2; however, these are only in relation to Experiments 1 and 2 and not Experiment 3. Experiments 1 and 2 were originally designed and preregistered to test TH2-4. I tested the effects of a training dot probe task on attention to high versus low weight bodies (TH2), body size adaptation (TH3), and body dissatisfaction (TH4). Experiment 1 was completed by participants in an online setting, whereas Experiment 2 was completed by participants in a laboratory setting. The training dot probe task has been used to effectively modify attentional bias to non-body emotional stimuli (Linetzky et al., 2015; Price, Wallace, et al., 2016) as well as to low weight bodies (Dondzilo et al., 2018). Therefore, this task was deemed appropriate method for testing whether attention to bodies of different sizes causes adaptation induced body size misperception and changes in body dissatisfaction.

The results of Experiments 1 and 2 show the training dot probe task did not lead to body size aftereffects or changes in body dissatisfaction. More surprisingly, I found the training dot probe was mostly ineffective as a method of modifying attentional bias (except to high weight bodies in a laboratory setting; Experiment 2). Based on these largely null results, I conducted exploratory analyses on the pre-training data to test TH1 and found, contrary to previous research (Dondzilo et al., 2017; Joseph et al., 2016; Moussally et al., 2016; Rodgers & DuBois, 2016), there was no evidence for an association between body dissatisfaction and attentional bias to low weight bodies. This gave me cause for concern about the reliability of the dot probe task as a method of training and measuring attentional bias.

Previous research has shown that reducing the stimulus onset asynchrony (SOA) of the dot probe task (i.e. the time period between the onset of the presentation of body stimuli and the onset of the probe presentation) improves the reliability of the dot probe task as a measure of attentional bias (Chapman et al., 2019). Therefore, to improve the reliability of my measures of attentional bias, I conducted Experiment 3 as part of my cotutelle PhD. This involved repeating Experiment 1 but reducing the stimulus onset asynchrony (SOA) of the dot probe task. Like Experiment 1, Experiment 3 involved testing TH2-4. I tested the effects of a training dot probe task on attention to high versus low weight bodies (TH2), body size adaptation (TH3), and body dissatisfaction (TH4). I also explored the association between body dissatisfaction and attentional bias to low weight bodies at pre-training (TH1). I published Chapter 2 as a research article in Royal Society Open Science and as a preprint on PsyArXiv. Since being published, I have made some very minor edits to the chapter to ensure it fits within the narrative and formatting of this thesis.

2.1.1. Citations

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2.1.2 Author Contributions

Thea House: Conceptualisation, data curation, formal analysis, investigation, methodology, project administration, software, validation, visualization, writing-original draft, and writing-review and editing.

Ian Stephen: Conceptualisation, investigation, methodology, project administration, resources, software, supervision, and writing-review and editing.

Ian Penton-Voak: Conceptualisation, methodology, resources, supervision, and writing-review and editing.

Kevin Brooks: Conceptualisation, methodology, resources, supervision, and writing-review and editing.

2.2. Abstract

Attentional bias to low fat bodies is thought to be associated with body dissatisfaction—a symptom and risk factor of eating disorders. However, the causal nature of this relationship is unclear. In three preregistered experiments, we trained 370 women to attend towards either high or low fat body stimuli using an attention training dot probe task. For each experiment, we analysed the effect of the attention training on 1) attention to subsequently-presented high versus low fat body stimuli, 2) visual adaptation to body size, and 3) body dissatisfaction. The attention training had no effect on attention towards high or low fat bodies in an online setting (Experiment 1), but did increase attention to high fat bodies in a laboratory setting (Experiment 2). Neither perceptions of a "normal" body size nor levels of body dissatisfaction changed as a result of the attention training in either setting. The results in the online setting did not change when we reduced the stimulus onset asynchrony (SOA) of the dot probe task from 500ms to 100ms (Experiment 3). Our results provide no evidence that the dot probe training task used here has robust effects on attention to body size, body image disturbance, or body dissatisfaction.

2.3. Introduction

Body image disturbance is a multifaceted construct associated with negative health consequences. The perceptual part of body image disturbance is called body size and shape misperception and presents when a person over- or under-estimates their body size (Challinor et al., 2017). The attitudinal part of body image disturbance is called body dissatisfaction and presents when a person has negative subjective evaluations for their own body (Cash & Deagle, 1997; Stice & Shaw, 2002). Given society's widespread adoption of the thin-ideal (Owen & Laurel-Seller, 2000; Sypeck et al., 2004; Thompson & Heinberg, 1999), the two constructs are likely related, because the overestimation of one's own body size might cause feelings of body dissatisfaction. Further, both constructs are associated with eating disorders. For example, the overestimation of one's body size is a symptom of anorexia nervosa (American Psychiatric Association, 2013), as well as a core feature of bulimia nervosa (Caspi et al., 2017; Mölbert et al., 2017). Body dissatisfaction is a risk factor for eating disorders such as anorexia nervosa and bulimia nervosa (Stice & Shaw, 2002), and possibly for binge eating disorder and purging disorder (Stice et al., 2017). Body dissatisfaction is also a symptom of anorexia nervosa (American Psychiatric Association, 2013). Therefore, both body dissatisfaction and body size and shape misperception are important constructs to consider in the design of eating disorder interventions.

A potential mechanism involved in the development and maintenance of body size and shape misperception is visual adaptation, which is a temporary perceptual shift—often referred to as an aftereffect—experienced after exposure to extreme stimuli (Kohn, 2007; Thompson & Burr, 2009). When applied to body size perception, exposure to low (high) fat body stimuli causes people to overestimate (underestimate) the body fat of subsequently presented body stimuli (Brooks, Mond, et al., 2019; Challinor et al., 2017). This has been studied by measuring the change in the body size that participants perceive to be "normal" (Brooks et al., 2016; Glauert et al., 2009; Winkler & Rhodes, 2005). In these experiments, participants who adapt to low (high) fat bodies perceive subsequently-seen bodies to be larger (smaller) than they really are, including stimuli that they would previously have seen as normal. As such, they need to reduce (increase) the size of bodies when selecting normal-looking stimuli post-adaptation. Importantly, the current perception of the body stimuli becomes distorted by adaptation, and not the representation of the body stored in memory (Ambroziak et al., 2019; Brooks et al., 2021). A possible negative consequence of body size adaptation is the misperception of one's own body size. Brooks et al. (2016) found that participants exposed to contracted (expanded) unfamiliar bodies for two minutes subsequently overestimated (underestimated) their own body size. Further, Salvato et al. (2020) found that participants exposed to images of low (high) fat unfamiliar body stimuli subsequently demonstrated a weak (strong) association between "thin" and "self" concepts on the Implicit Association Test.

Body size adaptation is also indirectly related to body dissatisfaction, with this relationship being mediated by visual attention. Eye tracking (Cho & Lee, 2013; Gao et al., 2014; Tobin et al., 2019; Withnell et al., 2019) and reaction time (Dondzilo et al., 2017; Joseph et al., 2016; Moussally et al., 2016) studies show that people with high body dissatisfaction attend more towards low fat body stimuli than people with low body dissatisfaction. Further, Stephen, Sturman, et al. (2018) demonstrated that people adapt to the body size they direct more attention towards. When presented with pairs of bodies, one low and one high in body fat, people with higher body dissatisfaction attended more towards low fat bodies, and this attentional bias resulted in an overestimation of the size of subsequently-presented body stimuli.

Cognitive behavioural theories suggest that an attentional bias towards low fat bodies is both a cause and a consequence of body dissatisfaction (Williamson et al., 2004). A possible causal pathway could be that directing more attention towards low fat bodies leads a person to overestimate their body size due to body size adaptation, and this overestimation increases feelings of body dissatisfaction. This suggestion is supported by Bould et al. (2018) who presented women with unfamiliar high fat body stimuli and found that the women proceeded to underestimate their own body size and report a decrease in body dissatisfaction. While these observations demonstrate that body size adaptation can influence a person's body dissatisfaction, such effects do not always materialise. For example, Stephen, Hunter, et al. (2018) presented participants simultaneously with high and low fat body stimuli, and told separate groups to fixate their eyes on one body type or the other. Participants told to fixate on high (low) fat bodies adapted to high (low) fat bodies; however, their body dissatisfaction did not change from pre- to post-adaptation. One possible explanation for the discrepancy in findings is that while Stephen and colleagues effectively manipulated overt attention, participants told to fixate on high (low) fat bodies may have been using their peripheral vision to covertly attend to low (high) fat bodies (Kulke et al., 2016). This may also explain why the body size aftereffects found by Stephen, Hunter, et al. (2018; d = 0.42 and d = 0.63) were smaller than those found in similar adaptation studies that presented participants with only one body type (e.g., d = 1.86 and d = 2.15; Brooks et al., 2018).

An alternative method of attention modification is the training dot probe task, which involves presenting participants with a pair of stimuli followed by a probe that the participants respond to as quickly as possible (MacLeod et al., 1986). While the pair of stimuli are visible the participant is free to attend (overtly or covertly) to either stimulus. During training, the probe replaces one stimulus type on 100% of the trials, which increases attention to this stimulus type. This change in attention is measured using participants' reaction times on an assessment version of the dot probe task completed at pre- and post-training where the probe has an equal chance of replacing each stimulus type. The training dot probe task has received considerable attention because, if therapeutic effects can be demonstrated, the task is relatively cheap, low in patient demands, and has the potential to be completed online without a therapist present (Kuckertz & Amir, 2015). Meta-analyses show that the training dot probe task has effectively trained participants to attend away from threatening stimuli (e.g. angry faces), resulting in reduced symptoms of anxiety (Linetzky et al., 2015; Price, Wallace, et al., 2016). However the effect sizes for symptom reduction are likely to be small (Fodor et al., 2020).

Dondzilo et al. (2018) used a training dot probe task to train women to attend toward low fat bodies. The training trials involved a low fat body stimulus presented alongside a neutral abstract art stimulus, and the probe always replaced the low fat body. The training increased participants' attention to low fat bodies, as demonstrated by faster reaction times for probes replacing low fat bodies at post-training than pre-training. Although the diversion of covert attention away from the low fat bodies may have been a possibility in the study by Stephen, Hunter, et al. (2018), this is unlikely to have been the case for participants in the study by Dondzilo et al. (2018). Eye movements are possible during the stimulus presentation in the dot probe task; however, the task is thought to be primarily a measure of covert attention (Bradley et al., 2000). The improved response speed displayed by participants suggests enhanced processing, which would have been unlikely if participants had been predominantly directing attention away from the low fat body stimulus. Therefore, the training dot probe task may be more effective at modifying attention than simple instructions not to look at a given stimulus type.

Here, we aimed to test the causal effect of attention to bodies of different sizes on body size adaptation and body dissatisfaction using a training dot probe task. For Experiment 1, we used an online dot probe task to train participants to attend towards either high or low fat body stimuli. We measured participants' attentional bias, body size adaptation, and body dissatisfaction before and after the attention training. We hypothesised that participants trained to attend to low (high) fat body stimuli would 1) increase their attention towards low (high) fat body stimuli, 2) perceive lower (higher) fat subsequently-presented body stimuli as "normal", due to visual adaptation, and 3) increase (decrease) their body dissatisfaction.

2.4. Experiment 1

This experiment was preregistered on the Open Science Framework (doi:10.17605/OSF.IO/TJPZB).

2.4.1. Participants

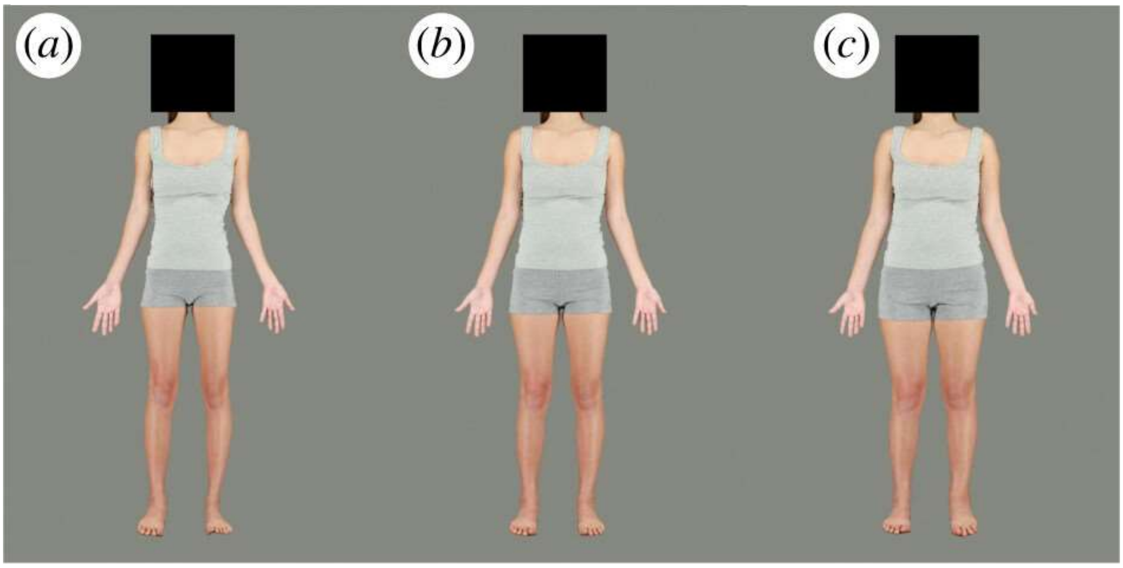
We conducted a power analysis (G*Power v. 3.1.9.2; Faul et al., 2007) using the effect size reported by Dondzilo et al. (2018; d = 0.49) which we reduced by a third to account for the inflation of published effect sizes (to d = 0.33). Based on the results, we recruited 150 participants (75 per condition) to provide the main analyses (one-sample t-tests) with 80% power to detect an effect for the primary outcome (change in attentional bias (ΔAB)) at an alpha level of 5%. We recruited White/European origin women aged 18–35 years (M_{age} = 23.95, s.d. = 5.22; M_{BMI} = 25.71, s.d. = 9.62). We placed no restrictions on the participant's country of residence. Sixty-six participants were recruited and reimbursed with £7.50 (GBP) via Prolific (www.prolific.co) and 84 participants were recruited and reimbursed with course credit via Macquarie University's study sign-up system. Participants were pseudorandomly allocated to each training condition to maintain even sample sizes across conditions.

2.4.2. Stimuli

Twenty photographs of White/European origin women (M_{age} = 21.15, s.d. = 3.60; M_{BMI} = 20.15, s.d. = 1.23) were obtained from an existing database (Stephen et al., 2016). Each woman was photographed under standardized lighting conditions, with camera settings held constant, and wearing standard grey, tight-fitting singlets and shorts. Each target identity was transformed to produce a series of 13 frames, in which frame 0 was reduced by 12kg of apparent body fat mass, increasing in steps of 2kg of apparent fat mass per frame such that frame 6 was the original image, and frame 12 was increased by 12kg of apparent fat mass (Brierley et al., 2016). These transforms have been used effectively to induce body size aftereffects in previous studies (Stephen et al., 2016; Stephen, Hunter, et al., 2018). The face of each target identity was obscured with a black square and the background was edited to a uniform grey (Figure 2.1). The stimulus size depended on the participant's device screen size; however, the experiment was always presented in a display with a 4:3 aspect ratio and therefore the stimulus aspect ratios were the same for each participant. For the dot probe task, the body stimulus size was 30% of the display's width and 60% of the display's height. For the method of adjustment task, the body stimulus size was 35% of the display's width and 70% of the display's height.

Figure 2.1.

Example body stimuli; (a) shows the version of the target identity with lowest fat mass (Frame 0); (b) shows the unmanipulated version of the target identity (Frame 6); (c) shows the version of the target identity with the highest fat mass (Frame 12).

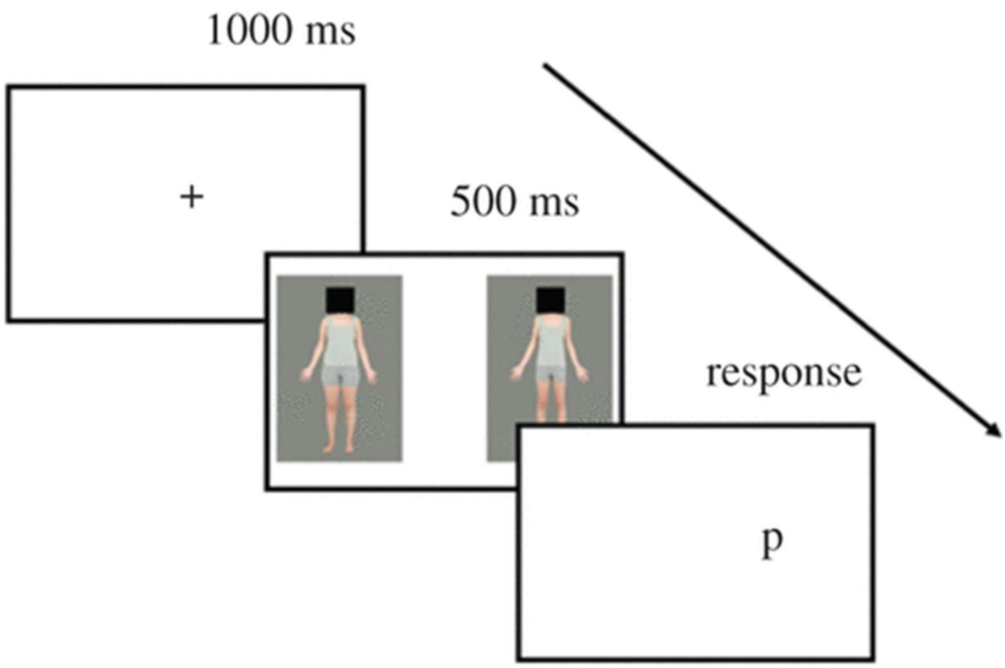


2.4.3. Measures

2.4.3.1. Dot Probe Task. The dot probe task was adapted from Dondzilo and colleagues (Dondzilo et al., 2017, 2018). Following a 1000ms fixation, two body stimuli were simultaneously presented for 500ms. Body stimulus pairs consisted of the lowest and highest body fat frames (Frame 0 and Frame 12) of the same target identity with left/right position randomised. The centre of each body stimulus was located on the midpoint of the display's y-axis and 25% of the display's width away from the midpoint on the x-axis. Immediately after presentation of body stimuli, a random probe (either the letter "p" or "q") appeared in the position previously occupied by one of the pair. Participants were instructed to identify the letter as quickly and accurately as possible, by pressing the appropriate keys ("p" or "q") on the keyboard. Once a response had been made, the next trial would begin immediately (Figure 2.2).

Figure 2.2.

Example dot probe trial. Each dot probe trial started with a 1000ms fixation, followed by one high and one low fat body stimulus presented for 500ms. Then, a probe appeared (the letter 'p' or 'q') on either the left or right side of the screen. Participants had to identify the letter as quickly and accurately as possible. In this example trial, the probe (p) appeared in the same location as the low fat body stimulus.



For training dot probe trials, the location of the probe was dependent on the experimental condition. For participants trained to attend to high fat body stimuli, the probe replaced the high fat body stimulus on 100% of the training trials (vice versa for low fat training). Participants completed 360 training dot probe trials, presented in 6 blocks of 60 trials with a 15s break between each block. The training dot probe task used a set of 10 target identities presented in a randomized order for each participant.

To measure the change in attentional bias (ΔAB), participants completed 80 pre-training and 80 post-training dot probe trials. The probe location was randomized so that the probe had an equal probability of replacing each body stimulus. The body stimuli were a different set of 10 target identities to the training dot probe trials and were presented in a randomized order for each participant. To calculate the pre- and post-training attentional bias scores, we followed the approach of Dondzilo et al. (2017, 2018) and excluded trials if the participant responded incorrectly, or if their reaction time was less than 200ms or more than 2.5 standard deviations above the participant's mean reaction time on the pre- and post-training dot probe trials. The mean reaction times of the remaining trials were substituted into the following formula (MacLeod & Mathews, 1988):

Attentional bias score = ([LPRT – LPLT] + [RPLT – RPRT])/2

For this formula, 'L' refers to the left side of the screen, 'R' refers to the right side of the screen, 'P' refers to the probe, and 'T' refers to the target stimulus (for the purposes of our research the target stimulus was always the low fat body). Therefore, the 'LPRT' refers to the mean response time when the probe (P) was located on the left (L) side but the low fat body stimulus (T) was located on the right (R) side, and so on. A positive attentional bias score represents an attentional bias to low fat body stimuli and a negative attentional bias score represents an attentional bias to high fat body stimuli. ΔAB was calculated by subtracting the pre-training dot probe attentional bias score from the post-training dot probe attentional bias score. Therefore, a positive (negative) ΔAB meant that participants directed more attention toward low (high) fat body stimuli after the training than before.

2.4.3.2. Point of Subjective Normality. To measure body size adaptation, participants completed a modified version of the method of adjustment task (Stephen et al., 2016). In a given trial, participants were presented with one of the 13 frames, selected at random, for a single target identity, centred on the display. Participants could cycle through the 13 frames for the target identity by pressing 'p' on the computer keyboard to move to the next highest body fat frame and pressing 'q' on the keyboard to move to the next lowest body fat frame. The sequence was looped so participants were able to manipulate the target identity's body size by continually cycling through the 13 frames. Participants were presented with 10 target identities at both pre- and post-training.

Participants were asked to manipulate the appearance of each body and select the image that they thought represented a normal-sized body. We did not specify the definition of a normal-sized body to participants, allowing them to use their own interpretation. The body stimuli were the same 10 target identities used in the pre- and post-training dot probe trials and therefore were a different set to those used in the training dot probe trials. Body stimuli were presented in a randomized order for each participant. The mean fat mass chosen as 'normal-sized' for the 10 target identities was used to calculate point of subjective normality (PSN) scores. Change in PSN (ΔPSN) was calculated by subtracting the pre-training PSN score from the post-training PSN score. A positive (negative) ΔPSN meant that the body size participants perceived to be 'normal' was higher (lower) after the training than before.

2.4.3.3. Body Dissatisfaction. Body dissatisfaction was measured using a modified version of the body shape satisfaction scale (Pingitore et al., 1997). The scale required participants to rate their satisfaction with 18 parts or features of their body, including their waist, stomach and thighs. Participants were asked to respond based on their feelings 'at this moment' to specifically measure state, rather than trait, body dissatisfaction (Thompson, 2004). Responses were measured using a slider scale rather than a Likert scale to minimize the likelihood that participants would remember and reproduce their pre-training responses when completing the post-training scale. The position of the slider represented unseen response options ranging from 0 to 100 (0 being 'Very satisfied' and 100 being 'Very dissatisfied'). Body dissatisfaction scores were calculated by summating the responses for all 18 items; therefore, possible body dissatisfaction scores ranged between 0 and 1800 with higher scores indicating greater body dissatisfaction. All participants completed the body shape satisfaction scale pre- and post-training. Cronbach alpha values for this version of the experiment were 0.94 at pre-training and 0.96 at post-training, indicating excellent internal consistency for the scale. Change in body dissatisfaction (ΔBD) was calculated by subtracting pre-training body dissatisfaction scores from post-training body dissatisfaction scores. A positive (negative) ΔBD meant that participants' body dissatisfaction increased (decreased) after training.

2.4.4. Procedure

Participants signed up to the experiment remotely using their chosen recruitment platform (Prolific or Macquarie University's study sign-up system), which directed participants to the experiment via a hyperlink. The experiment was hosted on the Gorilla Experiment Builder (www.gorilla.sc; Anwyl-Irvine et al., 2020). We specifically used the Gorilla Experiment Builder to host the experiment because although the platform has a reaction time recording latency of around 80ms, this latency is relatively consistent for all operating systems and device types (Anwyl-Irvine et al., 2021). The platform also has very good temporal precision for recording reaction times (approximately equal to 8.25ms) and is often more precise than other online experiment platforms (Anwyl-Irvine et al., 2021). The Gorilla Experiment Builder has previously replicated the findings of similar reaction time studies using a variety of online settings, equipment and Internet connection types (Anwyl-Irvine et al., 2020). Participants could only access the experiment if they used a laptop or desktop computer, and not a smartphone or tablet, to ensure they were able to make keyboard responses. The experiment took approximately 45 minutes to complete, and all experimental instructions were presented on the computer screen. The experiment expired after 90 minutes to minimize the likelihood of participants taking breaks during the experiment.

Participants were first asked to confirm whether they had previously completed the experiment via an alternative platform (Prolific or Macquarie University's study sign-up system), or whether they had previously completed other experiments presented in this paper. Participants were then asked to provide demographic information, including their height and weight so we could calculate self-reported body mass index (BMI; kg/m^2). Participants then completed the pre-training body dissatisfaction questionnaire followed by three practice PSN trials and the 10 pre-training PSN trials. Body stimuli for the practice PSN trials were three target identities selected at random for each participant from the pre- and post-training PSN target identities. Participants then completed 10 practice dot probe trials (which were identical to the pre- and post-training dot probe trials), followed by the 80 pre-training dot probe trials, followed by the 360 training dot probe trials. Participants then completed the post-training body dissatisfaction questionnaire, followed by the 80 post-training dot probe trials and the 10 post-training PSN trials interwoven in the same block, i.e. one PSN trial, then eight dot probe trials, then one PSN trial and so on. The interwoven order was counterbalanced so that half of participants started with one PSN trial (followed by eight dot probe trials, and so on) and half of participants started with eight dot probe trials (followed by one PSN trial, and so on). We used this interwoven order because the post-training dot probe trials directed participants' attention towards both high and low fat body stimuli, which could potentially reduce adaptation induced by the training dot probe trials. We aimed for the interwoven order to minimize order effects and increase the likelihood of detecting an effect for body size adaptation.

2.4.5. Data Analysis

Data were initially screened at a participant level. No participants reported previously completing the experiment via an alternative platform or completing one of the other experiments presented in this paper. One participant had missing data and six participants responded correctly on fewer than 60% of either the pre- or post-training dot probe trials, so we excluded these participants and recruited seven replacement participants.

The following analyses were conducted on R v. 4.0.5 (R Core Team, 2020). First, to check whether our results replicated previous cross-sectional dot probe studies reporting a positive relationship between body dissatisfaction and attentional bias towards low fat bodies, we conducted correlation analysis on the pre-training attentional bias scores and pre-training body dissatisfaction scores collapsed across conditions. Next, to test our hypotheses, we conducted six confirmatory frequentist one-sample t-tests to compare participants' ΔAB, ΔPSN and ΔBD against a value of 0 separately for each condition (high fat and low fat). We specifically chose not to compare attentional bias scores between participants, because doing so could introduce reaction time noise from participants using different devices and Internet connection types. Due to the non-normal distribution of many variables in this study, we used bootstrapping of the mean to estimate *p*-values and 95% confidence intervals (Wright et al., 2011). Bootstrapped statistics were bias-corrected accelerated and computed using the R package wBoot with 2000 iterations (Weiss, 2016). We used the Holm–Bonferroni method to assess the results of the six tests (Holm, 1979); therefore, our lowest alpha criterion was 0.008 (0.05/6).

To further test our hypotheses, we conducted six exploratory Bayesian one-sample t-tests using the R package BayesFactor to determine the likelihood of the alternative hypotheses in relation to their corresponding null hypotheses for each condition (Cauchy prior, r = 0.707; Morey & Rouder, 2018). Unlike frequentist one-sample t-tests, Bayesian one-sample t-tests can be used to determine whether there is evidence for the null hypothesis or whether the data are too insensitive to interpret (Dienes, 2014). For each test, the alternative hypothesis assumed that the true mean of the sample was not equal to zero, while the null hypothesis assumed that the true mean of the sample was equal to zero. A Bayes factor between 3 and 10 was interpreted as moderate evidence for the alternative hypothesis, a Bayes factor between 1 and 3 was interpreted as anecdotal evidence for the alternative hypothesis, a Bayes factor between 1/3 and 1 was interpreted as anecdotal evidence for the null hypothesis, and a Bayes factor between 1/3 and 1/10 was interpreted as moderate evidence for the null hypothesis (Jeffreys, 1961; Lee & Wagenmakers, 2014). Lastly, we conducted exploratory sensitivity analyses and ran the one-sample t-tests without bootstrapping of the mean and with outliers removed from the data. Following the approach used by Dondzilo et al. (2017), outliers were defined as values more than three standard deviations above or below the mean.

2.4.6. Results

The correlation analyses on the pre-training data provided no clear evidence to suggest that attentional bias scores correlated with body dissatisfaction scores ($r_{148} = 0.05$, $p = .575$). The results of the frequentist and Bayesian one-sample t-tests are presented in Table 2.1. The frequentist one-sample t-tests provide no clear evidence to suggest that participants' ΔAB, ΔPSN or ΔBD differed from 0 for either condition. All Bayes factors demonstrated moderate evidence for the null hypothesis, except for ΔPSN in the low fat condition which only provided anecdotal evidence for the null hypothesis. These results remained consistent when we reran the one-sample t-tests without bootstrapping of the mean and when we removed outliers from the data (see Appendices 2.1-2.6).

Table 2.1.

Experiment 1 results for the one-sample t-tests and Bayes factors (BF_{10}) comparing change in attentional bias (ΔAB), change in point of subjective normality (ΔPSN), and change in body dissatisfaction (ΔBD) against a value of 0 for each attention training condition (Cauchy prior, r = 0.707). Bootstrap resampling was used to estimate p-values and 95% confidence intervals. N = 150 (75 participants per condition). CI = Confidence interval.

	ΔAB						ΔPSN						ΔBD					
Condition	*M* [95% CI]	*SD*	*t*	*p*	*d*	BF_{10}	*M* [95% CI]	*SD*	*t*	*p*	*d*	BF_{10}	*M* [95% CI]	*SD*	*t*	*p*	*d*	BF_{10}
High Fat	1.46 [-12.24, 14.28]	58.35	0.22	.849	0.03	0.13	-0.20 [-0.78, 0.37]	2.54	-0.68	.504	0.08	0.16	-35.84 [-128.50, 1.35]	247.13	-1.26	.066	0.15	0.27
Low Fat	8.28 [-3.53, 21.22]	58.00	1.24	.166	0.14	0.26	-0.41 [-0.95, 0.10]	2.37	-1.50	.110	0.17	0.37	-9.85 [-39.53, 8.87]	103.49	-0.82	.299	0.10	0.18

2.4.7. Discussion

The results for Experiment 1 showed that participants trained to attend to low (high) fat body stimuli did not exhibit a greater attentional bias to low (high) fat body stimuli, perceive lower (higher) fat body stimuli as 'normal', or exhibit higher (lower) body dissatisfaction as a result of the attention training. These results do not support Hypotheses 1–3 and indicate that the training dot probe task did not effectively modify participants' attention towards high or low fat body stimuli. Because the training dot probe task failed to modify attention, we cannot determine whether attention to low or high fat bodies is likely to have a causal effect on body size adaptation or body dissatisfaction. One possible explanation for the failure of the training dot probe task to modify attention is that the experiment was completed by participants online and therefore we had little control over the experiment setting. Factors such as noise, distractions, screen size, and the absence of an experimenter may have prevented some participants from fully engaging in the experiment. A commonly discussed advantage of attentional bias modification tasks is they can be completed by patients online in a home setting; however, some research suggests that the tasks may be more effective at manipulating attention in a laboratory setting (Kuckertz & Amir, 2015).

2.5. Experiment 2

To test whether the effects of the training dot probe task were influenced by the experiment setting, we repeated Experiment 1 in a laboratory setting and compared the results to Experiment 1. In addition to our original three hypotheses, we hypothesized that (4) participants trained in a laboratory setting would show greater changes in attentional bias, body size adaptation, and body dissatisfaction than participants trained online. The experiment methodology was almost identical to Experiment 1; however, we introduced minor methodological changes to adapt the experiment to a laboratory setting. The experiment was preregistered with Experiment 1 on the Open Science Framework (doi:10.17605/OSF.IO/TJPZB).

2.5.1. Participants

An a priori power analysis (G*Power v. 3.1.9.2; Faul et al., 2007) showed we had 80% power for our main analyses (one-sample t-tests) to detect a medium effect size for our primary outcome (ΔAB) at an alpha level of 5% with a sample size of 70 participants. Participants were 70 White/European origin women aged 18–35 years (35 participants per condition; M_{age} = 21.07, s.d. = 3.50; M_{BMI} = 23.63, s.d. = 5.13). We placed no restrictions on the participant's country of residence. Participants were recruited using advertisements on Macquarie University's study sign-up system, flyers posted around the local area, social media posts to local psychology groups, and through friends of the researchers. Participants could choose to be reimbursed with either course credit or $20 (AUD).

2.5.2. Stimuli

The experiment was presented on a 35.3 × 26.5 cm display with a resolution of 1292 × 969 pixels. Participants viewed the experiment at an approximate distance of 60cm; therefore, the stimuli sizes were approximately the same for all participants (dot probe tasks: 10.58 × 15.89cm, 387 × 581 pixels, 10.08 × 15.09° degrees of visual angle; method of adjustment tasks: 12.33 × 18.51cm, 451 × 677 pixels, 11.73 × 17.54°).

2.5.3. Measures

2.5.3.1. Body Dissatisfaction. We used the same modified version of the body shape satisfaction scale as Experiment 1 (Pingitore et al., 1997). Cronbach alpha values were 0.95 at both pre-training and post-training, which demonstrates the scale had excellent internal consistency.

2.5.4. Procedure

The procedure was almost identical to Experiment 1; however, participants completed the experiment using Google Chrome on a desktop computer (ASUS ET2322; 60 Hz) with a USB port keyboard (125 Hz) in the presence of an experimenter in the Department of Psychology, Macquarie University. Height and weight were measured with a tape measure and a Tanita SC-330 body composition analyser to calculate each participant's BMI.

2.5.5. Data Analysis

Data screening and analysis were identical to Experiment 1, except in the following respects. One participant reported having previously completed Experiment 1; therefore, we excluded this participant and recruited a replacement participant. No participants needed to be excluded for having missing data or responding correctly on less than 60% of either the pre- or post-training dot probe trials. To test Hypothesis 4, we tested whether effect sizes for each variable (ΔAB, ΔPSN and ΔBD) separated by condition were larger for the laboratory setting (Experiment 2) than the online setting (Experiment 1). We conducted bootstrap resampling using the R package bootES with 2000 samples to estimate 95% confidence intervals for each effect size (Cohen's *d*; Kirby & Gerlanc, 2013). We inferred there being evidence for Hypothesis 4 if the effect sizes in Experiment 2 were larger than their corresponding effect sizes in Experiment 1 with non-overlapping 95% confidence intervals.

2.5.6. Results

The correlation analyses on the pre-training data provided no clear evidence to suggest that attentional bias scores correlated with body dissatisfaction scores ($r_{68} = -0.09$, $p = .440$). The results of the frequentist and Bayesian one-sample t-tests are presented in Table 2.2. For participants in the high fat condition, the results of the frequentist one-sample t-tests provide strong evidence for participants increasing their attention to high fat bodies as a result of the attention training, and the

Bayes factor provides moderate support for this hypothesis. However, the frequentist one-sample t-tests provided no clear evidence to suggest these participants' ΔPSN or ΔBD differed from 0. The Bayes factors' support for the null hypothesis was anecdotal for ΔPSN and moderate for ΔBD. For participants in the low fat condition, the frequentist one-sample t-tests provide no clear evidence to suggest participants' ΔAB, ΔPSN or ΔBD differed from 0. The Bayes factors' support for the null hypothesis was anecdotal for ΔPSN and moderate for ΔAB and ΔBD. These results remained consistent when we reran the one-sample t-tests without bootstrapping of the mean and when we removed outliers from the data (see Appendices 2.1-2.6).

Table 2.2.

Experiment 2 results for the one sample t-tests and Bayes factors (BF_{10}) comparing change in attentional bias (ΔAB), change in point of subjective normality (ΔPSN), and change in body dissatisfaction (ΔBD) against a value of 0 for each attention training condition (Cauchy prior, r = 0.707). Bootstrap resampling was used to estimate p-values and 95% confidence intervals. N = 70 (35 participants per condition). CI = Confidence interval.

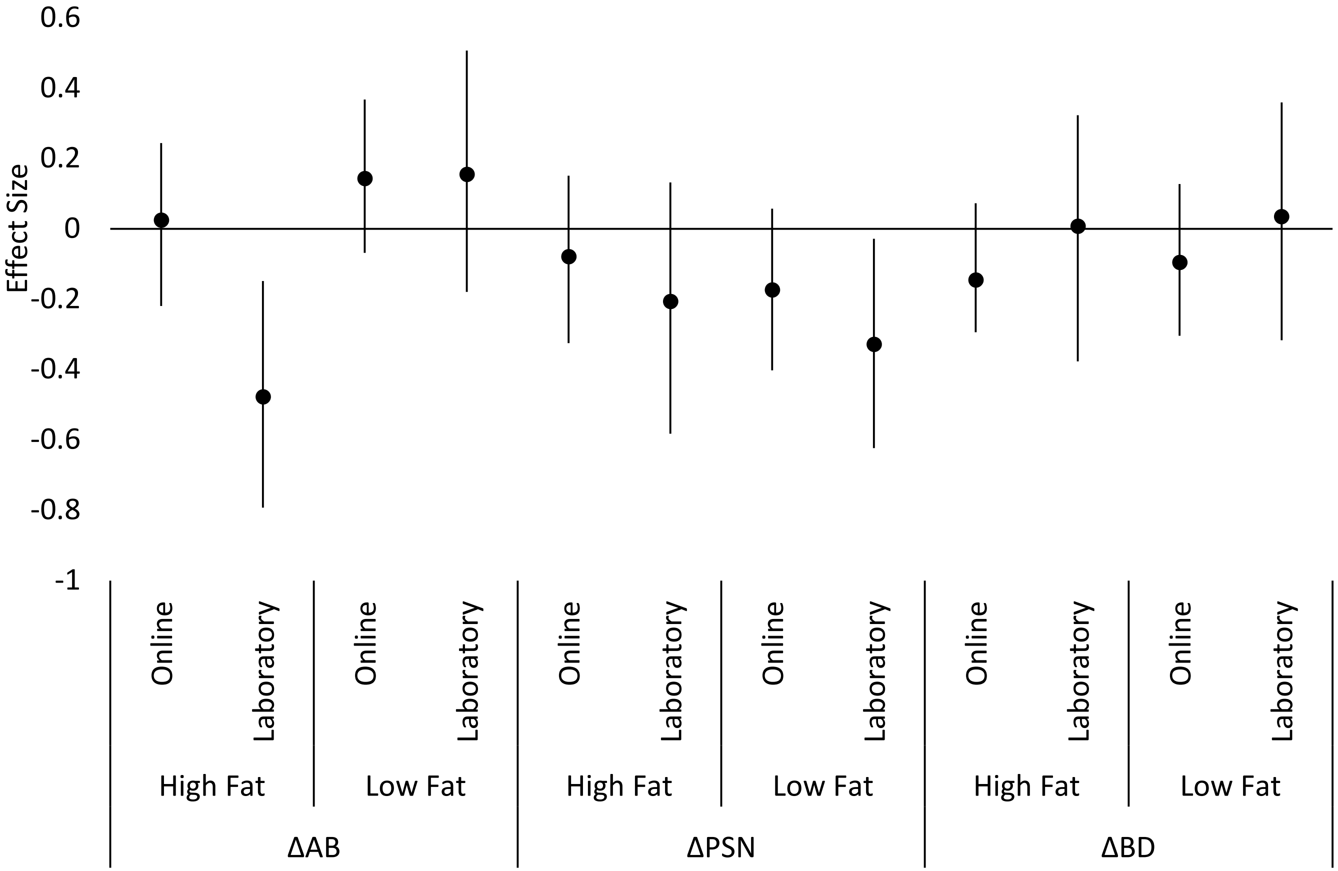
	ΔAB						ΔPSN						ΔBD					
Condition	*M* [95% CI]	*SD*	*t*	*p*	*d*	BF_{10}	*M* [95% CI]	*SD*	*t*	*p*	*d*	BF_{10}	*M* [95% CI]	*SD*	*t*	*p*	*d*	BF_{10}
High Fat	-22.76 [-39.77, -8.21]	47.71	-2.82	<.001	0.48	5.22	-0.51 [-1.34, 0.28]	2.49	-1.22	.209	0.21	0.36	0.54 [-20.32, 23.54]	69.06	0.05	.997	0.01	0.18
Low Fat	6.31 [-6.05, 21.10]	40.75	0.92	.301	0.16	0.27	-0.89 [-2.02, -0.12]	2.71	-1.94	.018	0.33	0.97	2.23 [-17.46, 23.12]	64.06	0.21	.854	0.04	0.18

The effect sizes and their bootstrapped 95% confidence intervals for each variable and condition are presented in Figure 2.3 with their corresponding effect sizes from Experiment 1. When looking at each variable and condition, the 95% confidence intervals for the online setting (Experiment 1) and laboratory setting (Experiment 2) overlapped, demonstrating no clear evidence that the experiment setting influenced the size of effects of the training dot probe task on ΔAB, ΔPSN, or ΔBD. A near exception was ΔAB in the high fat condition where the 95% confidence interval overlap between the online and laboratory setting was only marginal. The ΔAB effect size for the high fat condition in the laboratory setting was medium in size (Cohen, 1988) and the 95% confidence intervals did not overlap with zero, supporting the suggestion that this training dot probe task effectively increased attention towards high fat bodies. By contrast, the ΔAB effect size for the high fat condition in the online setting was very small in size and had 95% confidence intervals overlapping zero. These results could point to a possible effect of experiment setting, with larger ΔAB effects for the high fat condition in the laboratory setting than the online setting; however, given that there was still an overlap between the 95% confidence intervals for the laboratory and online effect sizes, there is little evidence for this effect.[2] These results remained consistent when we removed outliers from the data (see Appendices 2.1-2.6).

[2] We are aware that our preregistered inference criteria of non-overlapping 95% confidence intervals for Hypothesis 4 may be quite conservative. For ΔAB in the high fat condition, the 95% confidence interval overlap for the online and laboratory experiment was less than half the average margin of error (proportion overlap = 0.25). This implies the *p*-value for the difference between effect sizes would be between .01 and .05 (Cumming & Finch, 2005), which could be interpreted as evidence for an effect of experiment setting. However, this evidence would be weak at best (Sterne & Smith, 2001) and unlikely to affect our overall conclusions.

Figure 2.3

Effect sizes (Cohen's d) for change in attentional bias (ΔAB), change in point of subjective normality (ΔPSN), and change in body dissatisfaction (ΔBD) separated by attention training condition for the online setting (Experiment 1) and the laboratory setting (Experiment 2). Bootstrap resampling was used to estimate 95% confidence intervals.



2.5.7. Discussion

The results for Experiment 2 showed that participants trained to attend towards low fat body stimuli did not exhibit a greater attentional bias to low fat body stimuli, perceive lower fat body stimuli as 'normal', or exhibit higher body dissatisfaction as a result of the attention training. These results do not support Hypotheses 1–3 and indicate that the training dot probe task did not effectively modify participants' attention to low fat body stimuli. By contrast, participants trained to attend to high fat bodies did increase their attention to high fat bodies, in support of Hypothesis 1. However, participants in this condition did not perceive higher fat body stimuli as 'normal' or exhibit lower body dissatisfaction as a result of the training, and therefore these results do not support Hypotheses 2 and 3. The training dot probe task appeared to increase participants' attention to high fat body stimuli, but this increase in attention did not lead to a change in perceptions of a 'normal' body size or body dissatisfaction.

The results for this experiment indicate that the training dot probe task was effective at modifying attention towards high fat bodies in a laboratory setting, unlike the online training dot probe task conducted in Experiment 1. However, the overlapping 95% confidence intervals around the effect sizes did not provide convincing evidence for an effect of experiment setting and therefore did not support Hypothesis 4. As a result, we are cautious to dismiss the null findings of Experiment 1 as being a consequence of the online setting. Another potential factor contributing to the null findings of Experiment 1 was the stimulus onset asynchrony (SOA) during the dot probe task (i.e. the time period between the onset of the presentation of body stimuli and the onset of the probe presentation). For Experiments 1 and 2, we used a 500ms SOA to be consistent with other dot probe studies that have successfully modified participants' attention towards low fat bodies (Dondzilo et al., 2018, 2020). However, a short SOA (100ms) may increase the reliability of the dot probe task, because participants would be less able to make covert and overt shifts in attention during the stimulus presentation. Shorter SOAs are thought to increase the reliability of the dot probe task as a measure of attentional bias, because participants who have their attention captured initially by the target stimulus do not have time to redistribute their attention away from the target stimulus before the probe onset (Chapman et al., 2019).

2.6. Experiment 3

To test whether the effects of the training dot probe task are influenced by SOA length, we repeated Experiment 1 using a shorter SOA. Due to restrictions on face-to-face data collection in response to the Coronavirus pandemic, we chose to conduct Experiment 3 in an online setting and compare the results with Experiment 1. The experiment was identical to Experiment 1 except that the SOA during the pre-training, training, and post-training dot probe tasks was reduced from 500ms to 100ms. Therefore, each dot probe trial started with a 1000ms fixation, followed by the stimulus pair (high vs. low fat body) presented for 100ms, followed by the probe (p or q).

By shortening the SOA of the dot probe task, we aimed to increase the reliability of the task as a measure of attentional bias by restricting participants from making shifts in covert and overt attention during the stimulus presentation (Chapman et al., 2019). However, a 100ms SOA during the training dot probe trials may also influence the likelihood of participants adapting to their target stimulus. Timescales for body size aftereffects are currently unknown; however, aftereffects generally decay faster after shorter adaptation periods (Webster, 2015). Therefore, a 100ms SOA may preclude body size aftereffects. On the other hand, a training dot probe task with a 500ms SOA might only train participants to shift their attention towards the target stimulus during the later stages of the stimulus presentation, meaning that participants could still attend to the opposing stimulus in the earlier stages of the stimulus presentation. If this is the case, then a 100ms SOA might actually increase the likelihood of body size aftereffects, because participants only have time to attend towards one stimulus prior to probe onset and will spend more time attending towards the target stimulus relative to the opposing stimulus. Therefore, in addition to our original three hypotheses, we hypothesized that (5) participants completing the experiment with a 100ms SOA would demonstrate a larger change in attentional bias, body size adaptation, and body dissatisfaction than participants completing the experiment with a 500ms SOA. This experiment was preregistered on the Open Science Framework (doi:10.17605/OSF.IO/5NS2G).

2.6.1. Participants

We recruited 150 White/European origin women aged 18–35 years (75 participants per condition; M_{age} = 20.51, s.d. = 3.53; M_{BMI} = 23.63, s.d. = 5.75) and placed no restrictions on the participant's country of residence. We recruited all participants via the Macquarie University's study sign-up system and reimbursed participants with course credit.

2.6.2. Measures

2.6.2.1. Body Dissatisfaction. We used the same modified version of the body shape satisfaction scale as the previous experiments (Pingitore et al., 1997). Cronbach alpha values were 0.94 at pre-training and 0.96 at post-training, indicating excellent internal consistency for the scale.

2.6.3. Data Analysis

Data screening and analysis procedures were identical to Experiment 1. One participant reported having previously completed Experiment 2, one participant had missing data, and two participants responded correctly on < 60% of either the pre- or post-training dot probe trials, so we excluded these participants and recruited four replacement participants. To test Hypothesis 5, we analysed the effect of SOA by comparing ΔAB, ΔPSN, and ΔBD for Experiment 1 (SOA = 500ms) and Experiment 3 (SOA = 100ms). We conducted three frequentist 2 × 2 between-participants ANOVAs—one ANOVA for each dependent variable (ΔAB, ΔPSN, and ΔBD). For each ANOVA, the first independent variable was the attention training condition (high vs. low fat). The second independent variable was the SOA of the body stimuli during the dot probe tasks (500ms vs. 100ms). We inferred there being evidence to support Hypothesis 5 if the interaction for each ANOVA had a $p < 0.05$ and participants trained with a 100ms SOA to attend towards low (high) fat bodies demonstrated a higher (lower) ΔAB, a lower (higher) ΔPSN, and a higher (lower) ΔBD than participants trained with a 500ms SOA. We also conducted three Bayesian versions of each ANOVA. Bayes factors were computed using the R package BayesFactor (Morey & Rouder, 2018) to compare the interaction models against the null intercept-only models. We used the same criteria as described previously to evaluate whether each Bayes Factor provided support for the null intercept-only model or the interaction models (Jeffreys, 1961; Lee & Wagenmakers, 2014).

2.6.4. Results

The correlation analyses on the pre-training data provided no clear evidence to suggest that attentional bias scores correlated with body dissatisfaction scores ($r_{148} = -0.01$, $p = .886$). The results of the frequentist and Bayesian one-sample t-tests are presented in Table 2.3. The frequentist one-sample t-tests provide no clear evidence to suggest that participants' ΔAB, ΔPSN, or ΔBD differed from 0 for either condition. All Bayes factors demonstrated moderate evidence for the null hypothesis. These results remained consistent when we reran the one-sample t-tests without bootstrapping of the mean and when we removed outliers from the data (see Appendices 2.1-2.6).

Table 2.3.

Experiment 3 results for the one sample t-tests and Bayes factors (BF_{10}) comparing change in attentional bias (ΔAB), change in point of subjective normality (ΔPSN), and change in body dissatisfaction (ΔBD) against a value of 0 for each attention training condition (Cauchy prior, r = 0.707). Bootstrap resampling was used to estimate p-values and 95% confidence intervals. N = 150 (75 participants per condition). CI = Confidence interval.

	ΔAB						ΔPSN						ΔBD					
Condition	*M* [95% CI]	*SD*	*t*	*p*	*d*	BF_{10}	*M* [95% CI]	*SD*	*t*	*p*	*d*	BF_{10}	*M* [95% CI]	*SD*	*t*	*p*	*d*	BF_{10}
High Fat	-9.24 [-23.42, 8.68]	71.78	-1.12	.306	0.13	0.23	-0.23 [-0.73, 0.25]	2.20	-0.91	.353	0.11	0.19	3.52 [-13.18, 20.83]	80.22	0.38	.735	0.04	0.14
Low Fat	-18.06 [-57.05, 1.79]	115.28	-1.36	.073	0.16	0.31	-0.12 [-0.62, 0.44]	2.33	-0.46	.724	0.05	0.14	11.51 [-5.93, 30.44]	79.63	1.25	.212	0.15	0.27

The results of the frequentist 2 × 2 ANOVAs for ΔAB, ΔPSN, and ΔBD did not provide evidence for an interaction effect between SOA and condition (Table 2.4). Therefore, the results do not support Hypothesis 5. There was some evidence for a main effect of SOA on ΔAB with participants demonstrating a more negative ΔAB with a 100ms SOA than a 500ms SOA. These results indicate that participants may have been more likely to increase attention to high fat bodies with a 100ms SOA when compared with a 500ms SOA, regardless of attention training condition. However, the partial eta squared for the SOA main effect was small and the *p*-value increased substantially when outliers were removed (to $p = 0.225$; see Appendices 2.1-2.6), indicating that this result may have been driven by a small number of participants.

Table 2.4.

The results of the three frequentist 2x2 between-participants ANOVAs testing the effects of stimulus onset-asynchrony (SOA; 100ms vs. 500ms) and attention training condition (high fat vs. low fat) in the online experiments on change in attentional bias (ΔAB), change in point of subjective normality (ΔPSN), and change in body dissatisfaction (ΔBD). N = 300.

		ΔAB			ΔPSN			ΔBD		
Predictor	*df*	*F*	*p*	η_p^2	*F*	*p*	η_p^2	*F*	*p*	η_p^2
SOA	1	4.08	.044	0.01	0.22	.639	0.00	3.27	.072	0.01
Condition	1	0.01	.913	0.00	0.03	.853	0.00	1.02	.313	0.00
SOA x Condition	1	0.73	.394	0.00	0.34	.558	0.00	0.29	.592	0.00

The results of the three Bayesian 2 × 2 between-participants ANOVAs demonstrate strong support for the null intercept-only model when compared with the interaction model for ΔAB, ΔPSN, and ΔBD (Table 2.5). When compared with the remaining main effect models, support for the null intercept-only model ranged from strong to anecdotal. Overall, the results of the frequentist and Bayesian ANOVAs indicate that SOA had no effect on ΔAB, ΔPSN, or ΔBD.

Table 2.5.

Bayes factors (BF_{10}) for the three Bayesian 2x2 between-participants ANOVAs testing the effects of stimulus onset-asynchrony (SOA; 100ms vs. 500ms) and attention training condition (high fat vs. low fat) in the online experiments on change in attentional bias (ΔAB), change in point of subjective normality (ΔPSN), and change in body dissatisfaction (ΔBD). Models are compared against the null intercept-only model. N = 300.

Model	ΔAB	ΔPSN	ΔBD
SOA	0.89	0.14	0.60
Condition	0.13	0.13	0.21
SOA + Condition	0.11	0.02	0.13
SOA + Condition + SOA x Condition	0.03	0.00	0.02

2.6.5. Discussion

The results for Experiment 3 did not support Hypotheses 1-3. As a result of the training, participants trained to attend to low (high) fat body stimuli did not increase their attention to low (high) fat body stimuli, perceive lower (higher) fat body stimuli as 'normal', or report an increase (decrease) in body dissatisfaction. Because the training dot probe task did not modify attention, we cannot determine whether attention to low or high fat bodies is likely to affect body size adaptation or body dissatisfaction. We aimed to increase the reliability of this dot probe task by using a shorter SOA (100ms) to restrict participants from making covert and overt shifts in attention during the stimulus presentation (Chapman et al., 2019). However, when we compared the results of Experiment 3 to Experiment 1, the results did not support Hypothesis 5. Participants trained with a 100ms SOA to direct attention to low (high) fat bodies did not demonstrate a higher (lower) ΔAB, a lower (higher) ΔPSN, or a higher (lower) ΔBD than participants trained with a 500ms SOA. Therefore, shortening the SOA from 500ms to 100ms did not influence the effects of the training dot probe task.

2.7. General Discussion

We conducted three experiments to investigate whether a dot probe attention training task influenced participants' attention to high versus low fat bodies, body size adaptation, and body dissatisfaction. We found evidence to suggest that the dot probe task was effective at modifying attention to high fat bodies for participants in a laboratory setting (Experiment 2). However, participants in this condition did not perceive bodies as smaller as a result of the attention training, i.e. they did not adapt to the high fat body stimuli. Neither did the training lead to a reduction in body dissatisfaction. Therefore, it appears the training dot probe task increased participants' attention towards high fat body stimuli, but this increase in attention did not lead to body size aftereffects or changes in body dissatisfaction.

The lack of change in body dissatisfaction for this condition is perhaps unsurprising, because body size adaptation may be necessary to induce changes in body dissatisfaction. This suggestion is supported by studies showing the co-occurrence of body size aftereffects and changes in body dissatisfaction. For example, Bould et al. (2018) presented women with unfamiliar high fat body stimuli and found that the women proceeded to underestimate their own body size, indicating that they adapted to the high fat body stimuli. The participants also reported reduced body dissatisfaction, which may have been a consequence of the body size adaptation. On the other hand, Stephen, Hunter, et al. (2018) found participants adapted to the high fat bodies without reporting reduced body dissatisfaction. Therefore, body size aftereffects might be necessary but not sufficient to induce changes in body dissatisfaction.

The lack of body size aftereffects for this condition is more surprising, because Stephen, Hunter, et al. (2018) found body size aftereffects were dependent on the body size the participants were told to look towards. We used the same body stimuli as Stephen, Hunter, et al. (2018) and therefore expected to see similar body size aftereffects. One possible explanation for this discrepancy is that fixations are required to sufficiently induce measurable body size aftereffects. Stephen, Hunter, et al. (2018) used eye tracking to confirm they modified participants' overt attention and found that participants fixated more on the body size they were told to look towards. By contrast, the dot probe task can be completed without eye movements and therefore is thought to measure covert attention (Bradley et al., 2000). The dot probe task for Experiment 2 used a 500ms SOA, which is sufficient for participants to make saccades and, as these were not measured, we cannot completely rule eye movements out. However, our comparison of Experiment 1 and 3 indicated there was no effect of SOA (500ms vs. 100ms) on ΔAB and, given that we know eye movements are not possible using a 100ms SOA (Carpenter, 1988), it seems unlikely that they were driving the increase in attention to high fat bodies in Experiment 2. Therefore, participants' fixation durations over the course of the training could have been insufficient to cause measurable body size aftereffects.

If fixations are required to induce body size aftereffects, this would imply that body size aftereffects, like motion aftereffects, are retinotopic, i.e. they only occur when the adaptation and test stimuli appear on the same place on the retina (Boi et al., 2011; Knapen et al., 2009). In our experiments, the adaptation stimuli were presented on the left and right side of the training dot probe display, whereas the test stimuli were presented in the centre of the display for the pre- and post-training method of adjustment tasks. Therefore, if participants did not make fixations towards the body stimuli during the training dot probe task, then the adaptation and test stimuli would have probably appeared in different places on the retina, which may have prevented adaptation. However, evidence suggests that body size aftereffects are not retinotopic and instead, like face aftereffects (Leopold et al., 2001), they use an object-centred frame of reference (Brooks et al., 2018). Brooks et al. (2018) found that people displayed body size aftereffects even when the orientation of the adaptation and test stimuli differed, indicating that body size aftereffects are unlikely to be localized to a specific point on the retina and are instead likely to be processed by cells with larger receptive fields. Therefore, body size aftereffects are possible even when adaptation and test stimuli appear at different points on the retina, meaning body size aftereffects should have been possible without participants fixating on the adaptation stimuli.

Another possible explanation for this discrepancy is the difference in timescales for the adaptation periods. The training dot probe task for Experiment 2 presented the body stimuli for

500ms per trial and participants completed 360 training trials; therefore, the adaptation stimuli were presented for a total time of three minutes. However, this adaptation period was not continuous and instead was interrupted by periods where the body stimuli were not presented on the screen, e.g. during the fixation and response periods, and the five 15 second breaks. Therefore, the entire duration of the training dot probe task was longer than 3 minutes, and most participants took approximately 15 minutes to complete the task. By contrast, Stephen, Hunter, et al. (2018) presented body stimuli to participants continuously for a 2 minute adaptation period, and during the post-adaptation test phase, participants were presented with 'top-up' adaptation stimuli to maintain their adaptation. Timescales for body size aftereffects are currently unknown; however, aftereffects generally decay over time unless a person is re-exposed to the adaptation stimulus (Webster, 2015). Therefore, unlike the body size aftereffects induced by Stephen, Hunter, et al. (2018), any body size aftereffects induced by our training dot probe task could have decayed by the time participants completed the post-training measures.

Excepting participants trained to attend to high fat body stimuli in the laboratory setting (Experiment 2), the additional results obtained from our three experiments indicated that the training dot probe task was not successful in effectively altering participants' attention towards either high or low fat body stimuli. These participants also did not perceive lower (higher) fat body stimuli as 'normal' or report an increase (decrease) in body dissatisfaction as a consequence of the training. These findings align with our expectations, as we hypothesised that changes in attention to high and low fat body stimuli were necessary for the occurrence of body size aftereffects and alterations in body dissatisfaction. Since the training dot probe task did not alter participants' attention in these conditions, it is not surprising that no changes were observed in body size aftereffects or levels of body dissatisfaction.

The absence of a change in attention contrasts with previous dot probe attention training studies. For example, Dondzilo et al. (2018, 2020) used a dot probe task to effectively train participants to direct attention towards or away from low fat bodies. The discrepancy in results is consistent with the finding that effect sizes are smaller for preregistered studies than non-preregistered studies (Schäfer & Schwarz, 2019). Although we adjusted for the inflation of effect sizes in our a priori power analyses, this adjustment may not have been sufficient for our experiments to detect small effect sizes, especially if the effects were too small to be detected using the temporal precision of our experiment platform (approximately equal to 8.25ms; Anwyl-Irvine et al., 2021). Alternatively, another possible reason for the discrepancy is that, in their dot probe task, Dondzilo et al. (2018) showed the low fat body next to abstract art. In contrast, we showed the low fat body next to a high fat body. Therefore, instead of training participants to attend towards/away from low fat bodies, Dondzilo et al. (2018) may have modified participants' attention towards/away from bodies in general. In our experiments, the apparent fat of the training body stimuli differed by 24kg; however, this may not have been a sufficiently extreme visual contrast to capture the participants' attention. More extreme body stimuli may be required to capture attention and may also be a more realistic representation of the range of body sizes in the general population.

When evaluating our body stimuli, we should also consider the results of the correlation analyses on the pre-training data, which were also discrepant with previous cross-sectional dot probe studies (Dondzilo et al., 2017; Joseph et al., 2016; Moussally et al., 2016). In contrast with the aforementioned studies, we did not find evidence to support the positive association between body dissatisfaction and attentional bias towards low fat bodies. Two of these studies used similar stimulus pairs to the present experiments i.e. one small and one large body size; however, the BMI of these stimulus pairs were more extreme than the stimuli used in the present experiments (Joseph et al., 2016; Moussally et al., 2016). Therefore, it is possible that the restricted BMI range of our body stimuli prevented us from sufficiently modifying attentional bias. However, our results are more in line with a study by Glauert et al. (2010) who conducted a similar dot probe task using body stimuli with a more extreme BMI range, estimated as 11.7 and 30.4 units. They found no evidence for a relationship between body dissatisfaction and attentional bias towards low fat bodies. In a subsequent systematic review, Rodgers and DuBois (2016) suggested that Glauert et al. (2010) did not find a relationship because the body stimuli were unrelatable. Glauert and colleagues used unclothed body stimuli that appeared emaciated and far thinner than we would expect to see in mainstream media, and therefore they were considered less likely to attract attention from people with high body dissatisfaction. Therefore, it is possible that future dot probe research may be more effective at modifying attention using body stimuli representing a BMI range that is less restricted than the body stimuli used in the present experiments, but not quite as extreme as the body stimuli used by Glauert et al. (2010).

Another potential explanation for these contrasting results is the poor reliability of the dot probe task as a measure of attentional bias. The dot probe task has previously been shown to have poor internal consistency and test–retest reliability (Chapman et al., 2019; Price et al., 2015; Rodebaugh et al., 2016; Schmukle, 2005), which may explain why studies using the dot probe task report inconsistent results for the relationship between body dissatisfaction and attentional bias towards low fat bodies. By contrast, studies that have used eye tracking measures consistently report a positive relationship (Cho & Lee, 2013; Gao et al., 2014; Tobin et al., 2019; Withnell et al., 2019). Given the dot probe task has poor reliability as a measure of attentional bias, we should interpret our results for ΔAB with caution. It is possible, for example, that the results indicating that participants increased their attention to high fat bodies in the laboratory setting (Experiment 2) were a Type 1 error. If the attention training did not actually modify attention in this condition, this would provide an additional explanation for the absence of body size aftereffects and change in body dissatisfaction.

On the other hand, it is also possible that the five remaining null results for ΔAB were Type 2 errors. Therefore, the attention training may have worked; however, the dot probe task was not reliable enough to detect changes in attentional bias. This suggestion is supported by recent research using event-related potentials (ERPs), which are a more reliable measure of attentional bias than the dot probe task (Reutter et al., 2017) and are more consistently modulated by attention training dot probe tasks (Carlson, 2021). However, we think this interpretation is less likely, given that our experiments produced five null results out of six for ΔAB and Bayesian analyses demonstrated moderate support for each of the five null hypotheses. The dot probe task used here was clearly ineffective at producing a reliable change in attention to high and low fat bodies, and this is probably the reason for the absence of body size aftereffects and change in body dissatisfaction.

2.8. Conclusion

In conclusion, the body size training dot probe task was ineffective at inducing body size aftereffects and changes in body dissatisfaction. Given the training dot probe task seemed largely ineffective at modifying attention, it is unsurprising that the task did not elicit the predicted body size aftereffects or changes in body dissatisfaction. The only exception was participants trained in a laboratory setting to attend to high fat bodies (Experiment 2). These participants increased attention to high fat bodies, as measured on the dot probe task; however, this change in attentional bias did not lead participants to perceive higher fat body stimuli as more 'normal' or report reduced body dissatisfaction. These findings could be explained by the need for fixations to elicit body size aftereffects, the short duration of any elicited body size aftereffects, the restricted BMI range of our body stimuli, or the poor reliability of dot probe task as a measure of attentional bias. Together, our findings suggest the training dot probe task used in the present research is unlikely to be an effective method for modifying body image disturbances in young adult women of White/European origin. Future research using training dot probe tasks to modify attention should avoid additionally using the dot probe task to measure change in attentional bias. Instead, researchers should use more reliable measures of attentional bias (e.g. ERPs) to assess the effectiveness of the attention modification.

Chapter 3: The Relationship between Body Dissatisfaction and Attentional Bias to Thin Bodies in Malaysian Chinese and White Australian Women: A Dot Probe Study.

3.1. Addendum to Chapter 3

The results of Chapter 2 mostly did not support the thesis hypotheses (TH1-4), except that participants trained to attend to high weight bodies in a laboratory setting did increase their attention to high weight bodies (Experiment 2). Reducing the stimulus onset asynchrony (SOA; Experiment 3) of the dot probe task did not influence my results. To the best of my knowledge, the three experiments in Chapter 2 were the first published studies to evaluate the effects of a body size training dot probe task on body size adaptation and body dissatisfaction. Therefore, I am unable to make direct comparisons between the null findings for body size adaptation and body dissatisfaction and previous literature. However, the lack of training effects on attentional bias contrasts with previous literature (Dondzilo et al., 2018, 2020), as does the lack of association at pre-training between body dissatisfaction and attentional bias to low weight bodies (Dondzilo et al., 2017; Joseph et al., 2016; Moussally et al., 2016; Rodgers & DuBois, 2016). It is possible that the association between body dissatisfaction and attentional bias to low weight bodies is not robust as suggested by previous research.

The results of Chapter 2 are limited for a number of reasons. First, participants completed 80 assessment dot probe trials at pre-training. I did not use more trials, because participants were also completing training and post-training dot probe trials and I was concerned that participant fatigue and boredom may reduce data quality. However, this number of assessment dot probe trials is less than other studies that have found evidence for an association between body dissatisfaction and attentional bias to low weight bodies (320 trials, Dondzilo et al., 2017; 144 trials, Joseph et al., 2016; 160 trials, Moussally et al., 2016). Second, in Chapter 2, my analyses on the pre-training data were exploratory and were not preregistered. Third, in Chapter 2, I discussed how the dot probe task has poor reliability as a measure of attentional bias to non-body stimuli (Chapman et al., 2019; Price et al., 2015; Rodebaugh et al., 2016; Schmukle, 2005). However, it is currently not standard practice in psychology to report on the psychometric properties of cognitive behavioural tasks (Parsons et al., 2019). To the best of my knowledge, the assessment dot probe task has not been robustly evaluated for internal consistency as a measure of attentional bias to low weight bodies. Fourth, previous research using the assessment version of the dot probe task has typically involved presenting participants from Western countries with body stimuli involving White people (Dondzilo et al., 2017; Joseph et al., 2016; Moussally et al., 2016; Rodgers & DuBois, 2016), and therefore findings may not generalise to other participant populations and non-White body stimuli (Henrich et al., 2010).

In Chapter 3, I aimed to address these limitations with Chapter 2 and test TH1 by further exploring the association between body dissatisfaction and attentional bias to low weight bodies using the assessment dot probe task. I increased the number of assessment dot probe trials to 320, preregistered my analyses testing the association between body dissatisfaction and attentional bias to low weight bodies, evaluated the internal consistency of the assessment dot probe task, and recruited participants from a Western and non-Western country, testing the moderating effects of participant ethnicity and the ethnic congruence of the body stimuli.

Chapter 3 includes one study that I conducted as part of this cotutelle PhD with Macquarie University and the University of Bristol. I collected data on participants recruited in Australia and author Noelle Wen-Yi Samuel collected data on participants recruited in Malaysia. Noelle Wen-Yi Samuel completed an undergraduate thesis using the Malaysia data; however, Chapter 3 involves new analyses combining both datasets with additional moderation analyses. I submitted the chapter as a research article to Royal Society Open Science and uploaded the article as a preprint on PsyArXiv. Since submitting the chapter for publication, I have made some very minor edits to ensure the chapter fits within the narrative and formatting of this thesis.

3.1.1. Citations

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3.1.2. Author Contributions

Thea House: Conceptualization, methodology, software, formal analysis, investigation (Australia), data curation, writing - original draft, and writing - review and editing.

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3.2. Abstract

Studies suggest that an attentional bias to thin bodies is common amongst those with high levels of body dissatisfaction, which is a risk factor for, and symptom of, various eating disorders. However, these studies have predominantly been conducted in Western countries with body stimuli involving images of White people. In a preregistered study, we recruited 150 Malaysian Chinese women and 150 White Australian women for a study using standardised images of East Asian and White Australian bodies. To measure attentional bias to thin bodies, participants completed a dot probe task which presented images of women who self-identified their ethnicity as East Asian or as White Australian. Contrary to previous findings, we found no evidence for an association between body dissatisfaction and attentional bias to thin bodies. This lack of association was not affected by participant ethnicity (Malaysian Chinese vs. White Australian) or ethnic congruency between participants and body stimuli (own-ethnicity vs. other-ethnicity). However, the internal consistency of the dot probe task was poor. These results suggest that either the relationship between body dissatisfaction and attentional bias to thin bodies is not robust, or the dot probe task may not be a reliable measure of attentional bias to body size.

3.3. Introduction

Body dissatisfaction—the negative subjective evaluation of one's body—is typically thought of as the attitudinal manifestation of body image disturbance (Cash & Deagle, 1997). Body dissatisfaction is a risk factor (Stice & Shaw, 2002) and symptom (American Psychiatric Association, 2013) of eating disorders, such as anorexia nervosa, making it a potential target for therapeutic intervention. High levels of body dissatisfaction are associated with multiple appearance-related attentional biases (Rodgers & DuBois, 2016). For example, eye-tracking studies consistently show that women reporting high levels of body dissatisfaction, in comparison to women with low levels of body dissatisfaction, spend more time fixating on thin women (Cho & Lee, 2013; Gao et al., 2014; Stephen, Sturman, et al., 2018; Tobin et al., 2019; Withnell et al., 2019). This association can be explained by the tripartite model of body image, which suggests that sociocultural pressures lead women to internalise the thin-ideal and compare their body to others, and as a result women feel less satisfied with their own body (Thompson et al., 1999). Sociocultural pressure (from, for example, Western media) has a long history of presenting thinness as aspirational for women (de Freitas et al., 2018; Malkin et al., 1999; Owen & Laurel-Seller, 2000; Spitzer et al., 1999; Sypeck et al., 2004). The thin-ideal is reflected in women's body size preferences: women consistently rate thinner bodies as more attractive (Crossley et al., 2012; Swami et al., 2010).

The effects of appearance comparisons can be further explained by social comparison theory, which states that people evaluate themselves by making upward social comparisons to people they perceive as more attractive and downward social comparisons to people they perceive as less attractive (Festinger, 1954; Myers & Crowther, 2009). Upward comparisons are proposed to increase negative emotions, whereas downward comparisons are proposed to increase positive emotions. In support of this, ecological momentary assessment studies have found upward social comparisons to be associated with increased body and appearance dissatisfaction (Fardouly et al., 2017; Rogers et al., 2017). Further support comes from experimental research showing that viewing thin bodies can lead to increased body dissatisfaction (Bould et al., 2018; Groesz et al., 2002; Moreno-Domínguez et al., 2019; Tiggemann & McGill, 2004), particularly among people at risk of developing an eating disorder (Ferguson, 2013; Hausenblas et al., 2013). Therefore, attentional bias to thin bodies may exacerbate body dissatisfaction in women.

While eye-tracking studies support the positive association between body dissatisfaction and attentional bias to thin bodies (Cho & Lee, 2013; Gao et al., 2014; Stephen, Sturman, et al., 2018; Tobin et al., 2019; Withnell et al., 2019), evidence is less consistent when the dot probe task is used to measure attentional bias. The dot probe task presents participants simultaneously with a target stimulus (e.g. a thin body) alongside a control stimulus (e.g., a non-thin body or a non-body object). Participants respond to a probe replacing one of the stimuli, and faster reaction times to probes replacing target stimuli compared to control stimuli are interpreted as an attentional bias towards target stimuli (MacLeod et al., 1986). Some dot probe studies have found support for a positive association between body dissatisfaction and attentional bias to thin bodies (Dondzilo et al., 2017; Joseph et al., 2016; Moussally et al., 2016), whereas other studies found no such evidence (Glauert et al., 2010; House, Stephen, et al., 2022; Moussally et al., 2016). However, findings from these studies are potentially limited by their small sample sizes (Glauert et al., 2010; Moussally et al., 2016) and reduced number of dot probe trials (House, Stephen, et al., 2022). Further, many of the dot probe tasks used a stimulus-onset asynchrony (SOA; the interval between the onset of the stimulus pair and the onset of the probe) of ≥ 500ms (Dondzilo et al., 2017; Joseph et al., 2016). Chapman et al. (2019) found that shorter SOAs (<300ms) improved the reliability of the dot probe task, possibly because participants had less time to redistribute their attention before responding to the probe. However, evaluation of the reliability of dot probe studies is made difficult by the general lack of reporting on the psychometric properties of cognitive-behavioural tasks (Parsons et al., 2019).

Another common feature of the discussed dot probe studies (Dondzilo et al., 2017; Glauert et al., 2010; House, Stephen, et al., 2022; Joseph et al., 2016; Moussally et al., 2016) is that they all presented White body stimuli to people in Western countries. Although body image disturbance was once considered culturally bound to Western societies, the globalisation of Western media is thought to have contributed to body dissatisfaction and adoption of the thin-ideal in many non-Western countries (Boothroyd et al., 2020; Swami et al., 2010). This is particularly relevant in Malaysia, a newly industrialised country in South East Asia where recent findings suggest over 50% of adults experience eating disorder symptoms (Chua et al., 2022). Body image disturbance is common in Malaysia—prevalence studies estimate that 48.1% of undergraduate women want to be thinner (Kamaria, et al., 2016) and 88% of female adolescents have body shape concerns (Khor et al., 2009). Cross-cultural body image research highlights some commonalities between Malaysian and Western populations; however, findings are somewhat piecemeal. People in urban areas of Malaysia reported a similar preference for low body mass index (BMI) bodies as people in Britain, while people in rural areas of Malaysia preferred higher BMI bodies (Swami & Tovée, 2005). In one study, Malaysian Chinese women from urban areas of Malaysia reported greater body dissatisfaction than Australian women (Mellor et al., 2013). In another study, Australian women reported higher body dissatisfaction than Malaysian women, although effect sizes were very small (Shagar et al., 2021). Shagar et al. (2019) tested the tripartite model of body image in Australian and Malaysian women. Although there were some differences between populations, the theoretical framework of the tripartite model of body image could be applied similarly to both.

In the present study, we used a dot probe task to examine the association between body dissatisfaction and attentional bias to thin bodies. We recruited a sample of Western (White Australian) and non-Western (Malaysian Chinese) women and presented them with both White Australian and East Asian body stimuli. To overcome limitations from previous dot probe research, we recruited a relatively large sample size with enough statistical power to detect an association separately in both populations of women. We also used a relatively high number of trials for the dot probe task. Based on the findings of Chapman et al. (2019), we aimed to increase the reliability of the dot probe task by using a short SOA (100ms). We also evaluated the reliability of the dot probe task by estimating the task's internal consistency. We hypothesised that body dissatisfaction would be positively associated with attentional bias towards thin bodies, so women with higher body dissatisfaction would have a greater attentional bias towards thin bodies. We also explored the moderating role of participant ethnicity (White Australian vs. Malaysian Chinese) and the ethnic congruence between participants and body stimuli (own-ethnicity vs. other-ethnicity). The study protocol was preregistered on the Open Science Framework (https://osf.io/yt5fh/) with variations from the protocol explained in Appendix 3.1.

3.4. Materials and Methods

3.4.1. Participants and Recruitment

We aimed to recruit 150 Malaysian Chinese and 150 White Australian participants, giving over 90% power to detect an effect size of r = .26 in each group (we reduced the effect size reported by Dondzilo et al. (2017) by 33% to account for the inflation of published effect sizes (Schäfer & Schwarz, 2019)). Two Malaysian Chinese participants and one White Australian participant responded correctly on fewer than 60% of the dot probe trials. We excluded these participants and recruited replacement participants to reach our target sample size for each group. Participants were required to be 18-35 years old, female, and either White Australian (Australian sample) or Malaysian Chinese (Malaysian sample). We recruited White Australian participants via Macquarie University's study signup system and reimbursed participants with course credit. For the Malaysian Chinese sample, 83 participants were recruited via University of Nottingham Malaysia's study signup system (reimbursed with course credit) and 67 participants were recruited via social media adverts and snowball sampling (reimbursed with RM5 (approximately US $1.20)).

3.4.2. Measures

3.4.2.1. Demographics. To ensure participants met our eligibility criteria, we used a demographics questionnaire (see Appendices 3.2-3.3) that asked participants to report their ethnicity, gender, and age in years. We also asked participants to state their height and weight, so that we could calculate their body mass index (BMI; kg/m^2).

3.4.2.2. Body Dissatisfaction. We measured body dissatisfaction using a modified version of the Body Shape Satisfaction Scale (Pingitore et al., 1997). We asked participants to rate their satisfaction with 16 features of their body (e.g., waist, hips, and thighs) using a Likert scale ranging from 1-7 (1 representing "Very dissatisfied" and 7 representing "Very satisfied"; see Appendix 3.4). Responses for each item were reverse scored and a single body dissatisfaction score calculated for each participant by summing responses for all items. Scores could range from 16 to 112, with higher scores representing greater body dissatisfaction. The questionnaire was originally developed in the English language and we presented it in English for both White Australian and Malaysian Chinese participants. English is widely spoken in Malaysia as a second language (Education First, 2022) and in most universities is the primary language of instruction. The majority of Malaysian Chinese participants were studying at a British branch university campus where overall English proficiency level is high (e.g., for undergraduate studies, the university requires a minimum score of 6.0 in the

International English Language Testing System (IELTS) or equivalent). The questionnaire was also evaluated for appropriateness to local contexts by authors HKW and NWS who are Malaysian Chinese and multilingual, speaking English, Mandarin, and Malay proficiently. The 16 item version of the questionnaire has shown high internal consistency and convergent validity in studies on Australian women (Lonergan et al., 2019; Purton et al., 2019; Stephen, Hunter, et al., 2018). An earlier 10 item version of the questionnaire has also demonstrated test-retest reliability, and concurrent and predictive validity in female adolescents in the United States (Mond et al., 2011; Neumark-Sztainer et al., 2006; Paxton et al., 2006). In our sample, Cronbach's alpha for the scale demonstrated excellent internal consistency for both Malaysian Chinese women ($\alpha = 0.94$) and White Australian women ($\alpha = 0.91$).

3.4.2.3. Stimuli. Body stimuli were obtained from previous research conducted on women recruited in Australia. These women self-identified as either East Asian or White Australian and had given written consent for us to use their photographs for future research. (Gould-Fensom et al., 2019). Body stimuli selected for the present study consisted of ten East Asian identities and ten White Australian identities, matched for BMI. For each identity, the Spherize tool in Photoshop was used to create versions simulating higher and lower BMIs (Gould-Fensom et al., 2019). This involved horizontal expansion or compression respectively, which was maximal (50%) around the navel, but diminished towards the neck and ankles. We added a black square to cover each face to prevent any influence of facial characteristics (Figure 3.1). We defined the body stimuli based on the congruence between stimulus ethnicity and participant ethnicity, so own-ethnicity body stimuli involved East Asian stimuli presented to Malaysian Chinese participants and White Australian stimuli presented to White Australian participants. Other-ethnicity body stimuli involved East Asian stimuli presented to White Australian participants and White Australian stimuli presented to Malaysian Chinese participants.

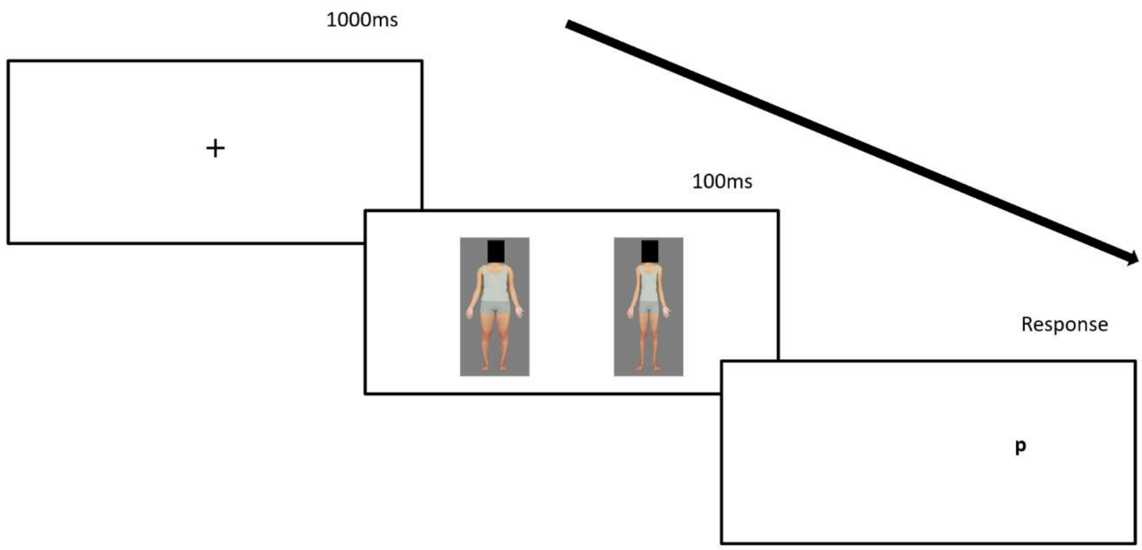
Figure 3.1.

Example body stimuli depicting expanded (left) and contracted (right) versions of the same identities. Body stimuli on the top row are of a woman identifying as White Australian, while those on the bottom row are of a woman identifying as East Asian.

3.4.2.4. Dot Probe Task. Attentional bias was measured using a modified dot probe task (MacLeod & Mathews, 1988). Each trial started with a 1000ms presentation of a fixation cross, followed by a body stimulus pair (one expanded and one contracted stimulus from the same identity) presented for 100ms (left/right side randomised; Figure 3.2). The stimulus pair disappeared, and a probe (either the letter “p” or “q”) appeared. The probe location was randomised, which meant it was equally likely that the probe could replace each body type. We asked participants to identify the letter as accurately and as quickly as they could, by pressing the corresponding keyboard button (either “p” or “q”).

Figure 3.2.

Example dot probe trial where the body stimuli involved an expanded and a contracted version of the same East Asian woman. In this example, the probe (letter "p") replaced the contracted target body.



The dot probe task consisted of 320 trials divided into four blocks of 80, with a 30-second break between each block. Two blocks presented participants with own-ethnicity body stimuli while the other two presented participants with other-ethnicity body stimuli. The block order, and order of stimulus presentation within each block, was randomised for each participant. To compute attentional bias scores, we followed previous dot probe studies and excluded trials when the participant responded incorrectly or when their reaction time was < 200ms or > 2.5 standard deviations greater than their mean reaction time (Dondzilo et al., 2017). Mean response times for the remaining trials were used to generate attentional bias scores using the following formula (MacLeod & Mathews, 1988):

Attentional bias score = ([LPRT–LPLT]+ [RPLT–RPRT])/2

Here, 'L' refers to the left side of the screen, 'R' refers to the right side of the screen, 'P' refers to the probe, and 'T' refers to the target stimulus (which for this study was the contracted body stimulus). For example, 'LPRT' is the mean reaction time for trials when the probe (P) appeared on the left (L), the contracted body stimulus target (T) appeared on the right (R), and so on. Attentional bias scores were interpreted so that positive scores reflected a bias towards contracted bodies while negative scores reflected a bias towards expanded bodies.

3.4.3. Procedure

Participants provided informed consent and completed the study online via Gorilla (https://gorilla.sc/; Anwyl-Irvine et al., 2020). The demographics questionnaire was completed first, followed by the Body Shape Satisfaction Scale, followed by 10 practice dot probe trials that were identical to the main dot probe trials, except that participants were presented with a green tick for responding correctly and a red cross for responding incorrectly. Body stimulus identities for the practice trials were chosen randomly for each participant. Participants then completed the main dot probe task, followed by a debrief.

3.4.4. Data Analysis

We used R (version 4.2.1; R Core Team, 2020) for all analyses. We conducted preliminary analyses to assess group differences between Malaysian Chinese and White Australian participants for body dissatisfaction, age, BMI, and attentional bias scores (separately for own-ethnicity and other-ethnicity body stimuli). Due to some variables being non-normally distributed, we assessed group differences using bootstrapped independent t-tests and the MKinfer R package (Kohl, 2022). Bootstrapped statistics were bias-corrected and accelerated, using 5000 iterations. We then conducted three preregistered linear mixed effects models using the lme4 R package (Bates et al., 2015). Residuals demonstrated minor deviations from normal distributions; however, linear mixed effects models are generally robust to these deviations (Schielzeth et al., 2020).

For model 1, we ran a random intercepts model using the restricted maximum likelihood approach to predict attentional bias from the fixed effect of body dissatisfaction, including age and BMI as confounding fixed effects and participant ID as a random effect. We centred the variables body dissatisfaction, age, and BMI using group mean centring separately for Malaysian Chinese and White Australian participants. We estimated *p*-values using the Satterthwaite's degrees of freedom method with the lmerTest R package (Kuznetsova et al., 2017) and inferred support for our hypothesis if body dissatisfaction had a positive coefficient ($p < .05$). For model 2 we explored the moderating role of participant ethnicity by dummy coding this variable (Malaysian Chinese = 0 and White Australian = 1) and adding it to model 1 as a fixed effect to interact with body dissatisfaction. We inferred evidence for a moderating role of participant ethnicity if there was an interaction between body dissatisfaction and participant ethnicity ($p < .05$). For model 3 we explored the moderating role of ethnic congruency by dummy coding this variable (other-ethnicity = 0 and own-ethnicity = 1) and adding it to model 2 as a fixed effect to interact with body dissatisfaction. We inferred evidence for a moderating role of ethnic congruency if there was an interaction between body dissatisfaction and ethnic congruency ($p < .05$). We aimed to explore significant interactions using follow-up simple slope analyses.

We conducted three additional exploratory analyses that were not pre-registered. First, to further understand null results, we conducted Bayesian bivariate correlations to test the relationship between body dissatisfaction and attentional bias to contracted bodies. This was done separately for each participant group and ethnic congruency condition. Due to the non-normal distribution of some variables, we conducted Spearman's rank-order correlations. We calculated Bayes factors using the correlation R package (Makowski et al., 2020) to evaluate the likelihood of the data under the alternative hypotheses ($r \neq 0$) in relation to the null hypotheses ($r = 0$). We interpreted Bayes factors using the JASP classification scheme, so Bayes factors greater than 1 would provide support for the alternative hypothesis and Bayes factors smaller than 1 would provide support for the null hypothesis (Kelter, 2020).

Second, we explored the internal consistency of the dot probe task using the splithalf R package (Parsons, 2021), which estimates split half reliability statistics for cognitive tasks. To use the package, we coded dot probe trials as congruent when the contracted body stimulus appeared on the same side of the screen as the probe. We coded trials as incongruent when the contracted body stimulus appeared on the opposite side of the screen to the probe[3]. We then used splithalf to calculate the average Spearman-Brown corrected correlation coefficients for 5000 random splits. We estimated reliability statistics separately for each participant group and ethnic congruency condition. Third, to test the robustness of our results, we conducted a sensitivity analysis and reran all main analyses without outliers to assess whether the results were driven by extreme values. Following the approach of previous dot probe research, we defined outliers as values over 3 standard deviations above or below the mean (Dondzilo et al., 2017).

3.5. Results

We excluded dot probe trials where participants responded incorrectly (4.39% of dot probe trials for Malaysian Chinese participants and 6.60% of dot probe trials for White Australian women). For remaining trials, we excluded trials when the participant's reaction time was < 200ms (0.05% of correct trials for Malaysian Chinese participants and 0.10% of correct trials for White Australian participants) or > 2.5 standard deviations greater than the participant's mean reaction time (2.06% of correct trials for Malaysian Chinese participants and 2.25% of correct trials for White Australian participants). Participant characteristics are presented in Table 3.1 alongside the results of the bootstrapped independent t-tests. The results of the preregistered linear mixed effects models are presented in Table 3.2. Model 1 found no evidence for an association between body dissatisfaction and attentional bias to contracted bodies. Model 2 found no evidence for an interaction between body dissatisfaction and participant ethnicity on attentional bias to contracted bodies. Model 3 found no evidence for an interaction between body dissatisfaction and ethnic congruency on attentional bias to contracted bodies. As we found no evidence for moderating effects, we did not conduct follow-up simple slope analyses.

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[3] The splithalf package assumes attentional bias scores were calculated by subtracting mean reaction times on congruent trials from mean reaction times on incongruent trials. This is a simplified calculation compared to the attentional bias score used in our preregistered main analyses, because it involves two categories of trials (incongruent and congruent) rather than four (LPRT, LPLT, RPLT, and RPRT). However, for the two methods of calculation the scores were almost perfectly correlated and our main analyses produced almost identical results for each (see Appendices 3.11-3.14).

Table 3.1.

The descriptive statistics for the participant characteristics. Bootstrapped independent t-tests were used to compare participants on each characteristic. Statistics were bias-corrected and accelerated and used 5000 iterations.

	Malaysian Chinese (*N* = 150)		White Australian (*N* = 150)			
	Mdn	*IQR*	*Mdn*	*IQR*	*t*	*p*
Age (years)	22.00	5.00	18.00	4.00	-3.41	< .001
Body mass index (BMI)	19.72	4.12	22.51	6.33	5.60	< .001
Body dissatisfaction	64.00	21.50	64.00	24.00	0.62	.540
Attentional bias score to own-ethnicity body stimuli	1.46	28.14	2.17	27.80	0.93	.348
Attentional bias score to other-ethnicity body stimuli	0.01	22.74	-0.67	27.52	-2.06	.011

Note. We have reported the median (*Mdn*) and interquartile range (*IQR*) due to the non-normal distribution of some variables.

Table 3.2.

The results of the three linear mixed effects models with the outcome variable as attentional bias score (N = 300).

	Model 1			Model 2			Model 3		
Effect	*β*	95% CI	*p*	*β*	95% CI	*p*	*β*	95% CI	*p*
Body dissatisfaction	0.06	-0.03, 0.15	.169	0.09	-0.02, 0.21	.118	0.11	-0.04, 0.25	.140
Age	-0.02	-0.10, 0.06	.605	-0.02	-0.10, 0.06	.605	-0.02	-0.11, 0.06	.606
Body mass index (BMI)	0.00	-0.09, 0.09	.982	0.00	-0.09, 0.09	.950	0.00	-0.09, 0.09	.950
Participant ethnicity	-	-	-	-0.09	-0.25, 0.07	.281	-0.09	-0.25, 0.07	.282
Body dissatisfaction * participant ethnicity	-	-	-	-0.07	-0.23, 0.09	.413	-0.07	-0.23, 0.09	.414
Ethnicity congruency	-	-	-	-	-	-	-0.01	-0.18, 0.15	.861
Body dissatisfaction * ethnic congruency	-	-	-	-	-	-	-0.03	-0.19, 0.13	.736

CI = confidence interval

The Bayesian correlation analyses found moderate support for the null hypothesis for each participant group and ethnic congruence condition (White Australian own-ethnicity trials: *r* = 0.01, BF_{10} = 0.19; White Australian other-ethnicity trials: *r* = 0.08, BF10 = 0.29; Malaysian Chinese other-ethnicity trials: *r* = -0.02, BF_{10} = 0.19). The only exception was for Malaysian Chinese own-ethnicity trials where the result supported the alternative hypothesis; however, this support was only weak (*r* = 0.18, BF_{10} = 1.77). In split-half reliability analyses, the dot probe task demonstrated poor internal consistency for Malaysian Chinese participants (own-ethnicity trials: Spearman Brown coefficient = 0.01 [95% CI = -0.53, 0.49]; other-ethnicity trials: Spearman Brown coefficient = 0.50 [95% CI = 0.01, 0.75]) and White Australian participants (own-ethnicity trials: Spearman Brown coefficient = -0.23 [95% CI = -0.67, 0.17]; other-ethnicity trials: Spearman Brown coefficient = -0.06 [95% CI = -0.36, 0.24]). Lastly, the removal of outlier participants (7 Malaysian Chinese participants and 5 White Australian participants) did not substantially change our results (see Appendices 3.5-3.7).

3.6. Discussion

The results of this study did not support our pre-registered hypothesis. We found no evidence for an association between body dissatisfaction and attentional bias to thin bodies, as measured on a dot probe task. To the best of our knowledge, this is the first dot probe study to explore the association between body dissatisfaction and attentional bias to thin bodies in a non-Western population using non-White body stimuli. We did not find evidence for a moderating role of participant ethnicity (Malaysian Chinese vs. White Australian) or ethnic congruency between participants and body stimuli (own-ethnicity vs. other-ethnicity). The absence of association between body dissatisfaction and attentional bias to thin bodies contrasts with certain dot probe studies that report a positive association (Dondzilo et al., 2017; Joseph et al., 2016; Moussally et al., 2016). However, the results are consistent with other dot probe studies that found no evidence for an association (Glauert et al., 2010; House, Stephen, et al., 2022; Moussally et al., 2016).

One possible reason for not finding an association between body dissatisfaction and attentional bias is that our expanded and contracted body stimuli were not visually contrasting enough to produce measurable differences in attention. In their dot probe task, Dondzilo et al. (2017) used control stimuli that did not involve bodies, which may have meant their thin body stimuli were more likely to capture the attention of participants. However, other studies using larger bodies for control stimuli have also reported a positive association between body dissatisfaction and thin bodies. For example, Joseph et al. (2016) used thin body stimuli with an estimated BMI of 18 kg/m^2 and larger body control stimuli with an estimated BMI of 36 kg/m^2. Moussally et al. (2016) used thin body stimuli with an estimated BMI of 15.67 kg/m^2 and larger body control stimuli with an estimated BMI of 30.63 kg/m^2. Our method of body stimuli creation did not enable us to estimate stimulus BMI, but our body stimuli do appear to be of a comparable size to those used by Joseph et al. (2016) and Moussally et al. (2016). Therefore, it appears unlikely that our results were caused by using target and control stimuli that are too visually similar. In fact, extreme body sizes may reduce validity. Glauert et al. (2010) presented extremely thin body stimuli (estimated BMI = 11.7 kg/m^2) alongside larger body control stimuli (estimated BMI = 30.4 kg/m^2) and found no evidence for an association between body dissatisfaction and attentional bias to thin bodies. Researchers have proposed that the null findings reported by Glauert et al. (2010) may be due to the thin body stimuli being so emaciated that they did not attract as much attention due to low ecological validity (Joseph et al., 2016). Our thin body stimuli were less extreme than those used by Glauert et al. (2010), and hence should have been effective in capturing attention.

Another possible explanation for our results is that participants completed the study online in a location of their choosing rather than in a controlled laboratory setting, and may have experienced reduced motivation and more distractions. Dot probe studies reporting positive associations between body dissatisfaction and attentional bias to thin bodies were all delivered in a laboratory (Dondzilo et al., 2017; Joseph et al., 2016; Moussally et al., 2016). Therefore, a laboratory setting may be necessary to detect this positive association. However, other dot probe studies conducted in a laboratory setting failed to find evidence for an association (Glauert et al., 2010; House, Stephen, et al., 2022; Moussally et al., 2016), and one study found similar results regardless of whether the study was completed online or in a laboratory setting (House, Stephen, et al., 2022). Therefore, a laboratory setting is certainly not a sufficient condition for detecting a positive association. We also excluded participants with poor dot probe accuracy, so we can assume participants were directing an acceptable level of attention to the task. It therefore appears unlikely that these inconsistent results are due to the study setting.

Another variable feature of dot probe studies is the stimulus-onset asynchrony (SOA) of the dot probe task, which refers to the interval between the onset of the stimulus pair and the onset of the probe. Dot probe studies reporting a positive association all used a 500ms SOA (Dondzilo et al., 2017; Joseph et al., 2016; Moussally et al., 2016); however, other studies using a 500ms SOA failed to find evidence for an association (Glauert et al., 2010; House, Stephen, et al., 2022). Further, Chapman et al. (2019) found that shorter SOAs (<300ms) improved the reliability of the dot probe task, possibly because participants had less time to redistribute their attention before responding to the probe. We aimed to increase the reliability of our dot probe task by using a short SOA of 100ms. However, our dot probe task still demonstrated poor internal consistency ($r \leq 0.50$). There is not a standard practice in psychological science for consistent reporting on the psychometric properties of cognitive behavioural tasks (Parsons et al., 2019). Therefore, it is difficult to compare the reliability of our dot probe task to the other previously mentioned studies that measured attentional bias to body size. However, the low reliability of our dot probe task is consistent with other studies that have analysed the reliability of the dot probe task (Chapman et al., 2019; Rodebaugh et al., 2016; Schmukle, 2005). In fact, low reliability affects many other similar cognitive tasks used for individual difference research that calculate reaction times difference scores (e.g., the Stroop task; Hedge et al., 2018). Reaction time difference scores may be unreliable as measures of individual differences in attentional bias because they have low between-participant variability (Hedge et al., 2018), do not capture the dynamic nature of attention over repeated trials (Zvielli et al., 2015), and rely on keyboard presses that are affected by variations in participant motor speed (Jiang & Vartanian, 2018).

Although dot probe studies have produced inconsistent results, eye-tracking studies consistently show that women reporting high levels of body dissatisfaction, in comparison to women with low levels of body dissatisfaction, spend more time fixating on thin women (Cho & Lee, 2013; Gao et al., 2014; Stephen, Sturman, et al., 2018; Tobin et al., 2019; Withnell et al., 2019). Fixation durations are likely to produce more reliable estimates of attention when compared to reaction time difference scores on the dot probe task, because they do not rely on motor responses or aggregated scores (Jiang & Vartanian, 2018; Zvielli et al., 2015). Further, fixation durations measure attentional bias across the total stimulus presentation period rather than at one specific time point. Indeed, eye-tracking studies using indices such as total fixation duration report much higher reliability than dot probe measures of attention (Skinner et al., 2018; Waechter et al., 2014), which might explain why eye-tracking studies produce more consistent evidence for a positive association between body dissatisfaction and attentional bias to thin bodies. Support for this comes from research showing that eye-tracking and dot probe indices are generally not correlated despite both being common measures of attentional bias (Waechter et al., 2014).

Given the poor reliability of our dot probe task, we do not think our results can be used with confidence to evaluate the association between body dissatisfaction and attentional bias to thin bodies. Eye-tracking research provides evidence for a positive association (Cho & Lee, 2013; Gao et al., 2014; Tobin et al., 2019; Withnell et al., 2019), including with a similar sample of White Australian women (Stephen, Sturman, et al., 2018); therefore, we think it is likely that the dot probe task was too unreliable to detect this association. To the best of our knowledge, no eye-tracking research has assessed body size attentional biases in Malaysian Chinese women. Therefore, we are unsure whether an association is absent in this population or whether we failed to detect an association due to the low reliability of the dot probe task. We did not find evidence for a moderating effect of participant ethnicity on the association between body dissatisfaction and attentional bias to thin bodies. However, given the poor reliability of the dot probe task we are cautious to eliminate the possibility of cross-cultural differences. Research indicates the tripartite model of body image can be applied similarly to Australian and Malaysian women (Shagar et al., 2019); however, we think eye-tracking research is needed to confirm the association between body dissatisfaction and attentional bias to thin bodies. Similarly, we did not find evidence for a moderating effect of the ethnic congruence of the body stimuli; however, more reliable measures of attentional bias may find such evidence.

3.6.1. Strengths and Limitations

Strengths of this study include the sufficiently powered sample size, relatively high number of dot probe trials, and preregistered study protocol. However, there are a number of limitations. First, we used the same body dissatisfaction questionnaire for both White Australian and Malaysian Chinese populations; however, to the best of our knowledge the questionnaire has not had its psychometric properties assessed in a Malaysian population. We chose this questionnaire to increase comparability between populations; however, we cannot be certain that body dissatisfaction can be defined and measured equally between different cultures (Swami & Barron, 2019). The questionnaire did not require translation because it was presented to an English-speaking population. Further, the questionnaire is relatively simple and was evaluated for appropriateness to local contexts by authors HKW and NWS who are Malaysian Chinese and multilingual, speaking English, Mandarin, and Malay proficiently. A variation of the questionnaire has been shown to correlate with eating disorder symptoms in a similar Malaysian population (undergraduate students from Kuala Lumpur and Selangor, Malaysia; Chin et al., 2020). Therefore, it seems likely that our questionnaire is valid in this population, although further research is required to confirm this.

Second, to assess body stimulus ethnic congruence (own-ethnicity vs. other-ethnicity) we presented participants with body stimuli depicting women identifying as White Australian or East Asian. However, the ethnic congruence of the stimuli may not have been equivalent for each participant group. Third, we did not collect data on the living circumstances of the Malaysian Chinese participants, but these participants were recruited in Selangor—a state with a high percentage urban population (Department of Statistics, Malaysia, 2022). Research in Malaysia has found women in urban areas report lower body size preferences and greater body dissatisfaction than women in rural areas (Swami et al., 2010; Swami & Tovée, 2005); therefore, the results of this study may not apply to women in more rural areas of Malaysia.

3.7. Conclusion

To the best of our knowledge, our study is the first to use a dot probe task to investigate the relationship between body dissatisfaction and attentional bias to thin bodies in both Western and non-Western women. We found no evidence of an association between body dissatisfaction and attentional bias to thin bodies. This lack of an association did not depend on the participant's ethnicity (White Australian vs. Malaysian Chinese) or the ethnic congruence between participants and body stimuli used in the dot probe task (own-ethnicity vs. other-ethnicity). Consistent with previous research (Chapman et al., 2019; Rodebaugh et al., 2016; Schmukle, 2005), our dot probe task had low reliability. Free viewing eye-tracking paradigms are a more reliable measure of attentional bias (Skinner et al., 2018; Waechter et al., 2014) and have consistently produced evidence for a positive association between body dissatisfaction and attentional bias to thin bodies (Cho & Lee, 2013; Gao et al., 2014; Stephen, Sturman, et al., 2018; Tobin et al., 2019; Withnell et al., 2019). Therefore, it appears likely that our dot probe task was not reliable enough to detect this association. Thus, great caution must be applied before ruling out the possibility of group differences and own-ethnicity effects between White Australian and Malaysian Chinese women. Future research may employ eye-tracking techniques to investigate the moderating effects of ethnicity and ethnic congruency on the relationship between body dissatisfaction and attentional bias to body size.

Chapter 4: Is Body Dissatisfaction Related to an Attentional Bias towards Low Weight Bodies in Non-clinical Samples of Women? A Systematic Review and Meta-analysis

4.1. Addendum to Chapter 4

The results of Chapter 3 did not support the thesis hypothesis (TH1). I did not find evidence for an association between body dissatisfaction and attentional bias to low weight bodies. This lack of association was not moderated by participant ethnicity or the ethnic congruence of the body stimuli. The results from this study contradicted previous literature reporting a positive association between body dissatisfaction and attentional bias to low weight bodies (Dondzilo et al., 2017; Joseph et al., 2016; Moussally et al., 2016; Rodgers & DuBois, 2016). I also found the assessment dot probe task had unacceptably low levels of internal consistency as a measure of attentional bias, which may have contributed to the inconsistent results. Based on these results, in Chapter 4 I decided to conduct a systematic review and meta-analysis of cross-sectional data to investigate the association between body dissatisfaction and attentional bias towards low weight bodies. Therefore, Chapter 4 tested TH1. In the systematic review and meta-analysis, I synthesised the pre-training data from all three experiments in Chapter 2, as well as the data from Chapter 3.

Chapter 4 includes a systematic review and meta-analysis that I conducted as part of this cotutelle PhD with Macquarie University and the University of Bristol. I published the chapter as a research article in Body Image and as a preprint on PsyArXiv. Since publication, I have made some very minor edits to the chapter to ensure it fits within the narrative and formatting of this thesis.

4.1.1. Citations

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4.1.2. Author Contributions

Thea House: Conceptualization, methodology, formal analysis, investigation, data curation, writing - original draft, writing - review & editing, and visualization.

Katrina Graham: Investigation, writing-review & editing.

Bridget Ellis: Investigation, writing - review & editing.

Helen Bould: Conceptualization, methodology, writing - review & editing, and supervision.

Angela Attwood: Conceptualization, methodology, writing - review & editing, and supervision.

Ian Stephen: Conceptualization, methodology, writing - review & editing, and supervision.

Kevin Brooks: Conceptualization, methodology, writing - review & editing, and supervision.

Ian Penton-Voak: Conceptualization, methodology, writing - review & editing, and supervision.

4.2. Abstract

Body dissatisfaction is the negative subjective evaluation of one's body and is considered a risk factor for, and symptom of, eating disorders. Some studies show women with high body dissatisfaction display an attentional bias towards low weight bodies; however, this finding is not consistent, and results are yet to be systematically synthesised. We conducted a qualitative and quantitative synthesis of cross-sectional studies investigating the relationship between body dissatisfaction and attentional bias to low weight bodies in non-clinical samples of women. We searched PubMed, Scopus, Web of Science, PsycINFO, ProQuest, and OpenGrey for studies up until September 2022. We identified 34 eligible studies involving a total of 2857 women. A meta-analysis of 26 studies (75 effects) found some evidence from gaze tracking studies for a positive association between body dissatisfaction and attentional bias to low weight bodies. We found no evidence for an association from studies measuring attention using the dot probe task, electroencephalogram (EEG) recording, or the modified spatial cueing task. The results together provide partial support for the positive association between body dissatisfaction and attentional bias to low weight bodies in women. These findings can be used to inform future attentional bias research.

4.3. Introduction

Body dissatisfaction is the negative subjective evaluation of one's body and is typically thought to be the attitudinal manifestation of body image disturbance (Cash & Deagle, 1997). Large scale studies conducted in multiple countries demonstrate that body dissatisfaction is highly prevalent in women (Al Sabbah et al., 2009; Ejike, 2015; Fiske et al., 2014; Griffiths et al., 2016; Matthiasdottir et al., 2012; Mond et al., 2013), leading some researchers to use the term "normative discontent" to describe the widespread dissatisfaction women feel towards their bodies (Rodin et al., 1984). Body dissatisfaction is associated with multiple negative health outcomes and behaviours. For example, in adolescence it is associated with later depressive episodes (Bornioli et al., 2021), as well as with risky health behaviours such as smoking, drug-use, self-harm, and high-risk alcohol consumption (Bornioli et al., 2019). Body dissatisfaction is also a risk factor for eating disorders, including anorexia nervosa, bulimia nervosa, binge eating disorder, and purging disorder (Stice et al., 2017; Stice & Shaw, 2002) and is a key symptom of anorexia nervosa (American Psychiatric Association, 2013).

Cognitive behavioural theories of eating disorders suggest that body dissatisfaction causes people to preferentially attend to disorder-relevant information, such as food or body related stimuli. This attentional bias is thought to exacerbate feelings of body dissatisfaction, resulting in a feedback loop and further body dissatisfaction (Williamson et al., 2004). Support for these theories comes from research showing that people with eating disorders, when compared to non-clinical samples, display attentional biases towards disorder-relevant stimuli, e.g., towards body-related words (Ralph-Nearman et al., 2019; Stott et al., 2021). However, attentional biases are not exclusively displayed by people with eating disorders. In a systematic review of studies on the general population, Rodgers and DuBois (2016) found evidence to suggest that people with high levels of body dissatisfaction also attend to body-related stimuli more than people with low body dissatisfaction. In particular, the authors found initial evidence from eight cross-sectional studies showing that body dissatisfaction is positively associated with attentional biases towards “thin” (hereafter referred to as low weight) stimuli (Cho & Lee, 2013; Gao, Deng, et al., 2011; Gao et al., 2012, 2013, 2014; Gao, Wang, et al., 2011; Joseph, 2014; Li et al., 2011). However, Rodgers and DuBois (2016) also identified five studies that did not find evidence for this positive association (Glauert et al., 2010; Joseph, 2014).

Rodgers and DuBois (2016) mention a number of different factors that may have contributed to these inconsistent findings. For example, studies varied in their measure of attention (e.g. eye-tracking vs. reaction times measures; for a summary of different attentional bias paradigms see Table 4.1), the presentation time of the low weight stimuli, the type of low weight stimuli (words vs pictures), and the amount of clothing presented on pictures of low weight bodies. Studies also varied in their use of control stimuli (non-body stimuli vs high weight stimuli). Some studies using non-body control stimuli found evidence for a positive association between body dissatisfaction and attentional bias to both low weight and high weight stimuli (e.g. Gao et al., 2013). Therefore, we might expect the association between body dissatisfaction and attentional bias to low weight bodies to differ based on whether non-body or high weight stimuli are used as control stimuli. Given the small number of studies, Rodgers and DuBois (2016) were unable to quantitatively synthesise this data and explore possible moderator variables in depth.

Table 4.1.

A summary of different paradigms that have been used to measure attentional bias to low weight bodies.

Attentional bias paradigm	Task description	Operationalisation
Attentional response to distal vs. proximal emotional information (ARDPEI) task	Participants are presented with an anchor probe, followed by a stimulus pair involving a target stimulus and a neutral stimulus. The anchor probe directs attention either towards or away from the target stimulus. Participants then respond to a probe located on the same or opposite side as the target stimulus. Participants complete trials where the target stimulus is either a low weight body or a control stimulus (e.g. Dondzilo et al., 2021; Grafton & MacLeod, 2014).	Faster reaction times to probes replacing low weight bodies relative to control stimuli are thought to reflect an attentional bias to low weight bodies. Trials that cue participants to attend to the target stimulus specifically measure disengagement bias, whereas trials that direct the participant's attention away from the target stimulus specifically measure engagement bias (e.g. Dondzilo et al., 2021; Grafton & MacLeod, 2014).
Body size discrimination task	Participants are presented with a body stimulus and must estimate the stimulus size in comparison to their own body size, e.g. by responding with "thinner", "equal", or "larger" (e.g. Nazareth et al., 2019).	Faster reaction times and greater discrimination accuracies for low weight bodies relative to control stimuli are thought to reflect an attentional bias to low weight body stimuli (e.g. Nazareth et al., 2019).
Dot probe task	Participants are presented with a stimulus pair involving a low weight body and a control stimulus. Participants then respond to a probe that replaces one of the stimuli (MacLeod et al., 1986).	Faster reaction times to probes replacing low weight bodies relative to control stimuli are thought to reflect an attentional bias to low weight bodies (MacLeod et al., 1986).

Attentional bias paradigm	Task description	Operationalisation
Electroencephalogram (EEG) recording	Participants are presented with a low weight body or control stimulus and are asked to view the stimuli, sometimes while completing an irrelevant task. Participants have their neural activity measured, typically using either event-related potentials (ERPs; averaged EEG waves produced in response to a stimulus; e.g. Wang et al., 2019) or steady-state visual evoked potentials (SSVEPs; periodic EEG waves elicited by flickering visual stimuli; e.g. Voges et al., 2019).	Greater ERP amplitudes and SSVEP reductions in response to low weight bodies relative to control stimuli are thought to reflect an attentional bias to low weight bodies (e.g. Voges et al., 2019; Wang et al., 2019). Typically, early attentional biases are assessed using ERP components such as the N1, N2, and P2, whereas late attentional biases are assessed using ERP components such as the P3 and LPC (e.g. Uusberg et al., 2018; Wang et al., 2019).
Gaze tracking	Participants are presented with a low weight body simultaneously alongside a control stimulus (or stimuli) and are asked to view the stimuli, sometimes while completing an irrelevant task (e.g. Gao et al., 2014).	Greater time spent gazing towards low weight bodies relative to control stimuli is thought to indicate an attentional bias to low weight bodies. Typically, early attentional biases are assessed using first fixation duration and late attentional biases are assessed using total fixation duration (e.g. Gao et al., 2014).
Frequency estimation task	Participants are presented with bodies that covary in size and colour. Participants are not told about the covariance and are asked to estimate the frequency of target colours (e.g. Seifert et al., 2008).	Greater frequency estimations for colours that covary with low weight bodies are thought to indicate an attentional bias to low weight bodies (e.g. Seifert et al., 2008).

Attentional bias paradigm	Task description	Operationalisation
Modified rapid serial visual presentation (RSVP) task	Participants are required to view a rapid stream of visual stimuli and identify a target stimulus that follows either a low weight body or control stimulus (e.g. Berrisford-Thompson et al., 2021).	Reduced accuracy for identifying the target stimulus following low weight bodies relative to control stimuli is thought to indicate greater attentional bias to low weight bodies. This is typically referred to as low weight body induced blindness (e.g. Berrisford-Thompson et al., 2021).
Modified spatial cueing task	Participants are presented with either a low weight body or control stimulus. Participants must respond to a subsequently presented probe. Trials are only analysed when the probe appears on the opposite side of the screen to the stimulus (Posner, 1980).	Faster reaction times to probes following control stimuli relative to low weight bodies are thought to indicate greater attentional bias to low weight bodies. This is typically referred to as disengagement bias for low weight bodies (Posner, 1980).
Visual search task	Participants are required to identify or detect the presence vs absence of a target stimulus within an array of distractor stimuli. For simple visual search tasks, the target stimulus is either a low weight body or control stimulus (e.g. Gaid, 2008). For compound visual search tasks, the target stimulus is paired adjacent to a low weight body or control stimulus (e.g. Cass et al., 2020).	Faster reaction times for low weight body trials relative to control stimulus trials are thought to indicate an attentional bias to low weight bodies (e.g. Cass et al., 2020). For tasks that require presence vs absence detection, signal detection theory can also be used to analyse sensitivity to low weight bodies by calculating the standardised difference between mean hit rates and mean false alarm rates (d'; Green & Swets, 1966).

Since Rodgers and DuBois (2016) conducted their literature search in 2015, there have been many cross-sectional studies on non-clinical populations investigating the relationship between body dissatisfaction and attentional bias to body size. Some studies found evidence for a relationship between body dissatisfaction and attentional bias to low weight bodies (e.g. Moussally et al., 2016); however, other studies found no such evidence (e.g. Cass et al., 2020). A recent metareview by Stott et al. (2021) identified some eye-tracking evidence indicating that people with eating disorders may attend towards low weight bodies more than non-clinical populations (Blechert et al., 2009; Pinhas et al., 2014). This pattern of results was not found when a dot probe task was used to measure attentional bias (Lee & Shafran, 2008; Shafran et al., 2007). However, the research on clinical populations involved only a small number of studies with very small sample sizes; therefore, these findings may not be robust. Indeed, low statistical power is prevalent in research on attentional biases and eating disorders (Enouy et al., 2022). Stott et al. (2021) also identified a number of limitations of existing systematic reviews and meta-analyses on this topic. For example, most systematic reviews lack a preregistered protocol, quality assessment of included studies, record of reasons for excluding studies, and assessment of small study effects. These limitations prevent strong conclusions from being drawn about the relationship between body dissatisfaction and attentional bias to low weight bodies.

There is a sociocultural theoretical framework to support the suggestion that attentional bias to low weight bodies exacerbates feelings of body dissatisfaction in women. Social comparison theory suggests people evaluate themselves by making social comparisons with other people. Upward social comparisons involve comparing oneself to “superior” others and are typically thought to result in negative emotions. In contrast, downward social comparisons involve comparing oneself to “inferior” others and are typically thought to result in positive emotions (Festinger, 1954). In the context of body image, low weight bodies are likely to be targets for upward comparisons by women, because low weight bodies have traditionally been promoted as an ideal for women by Western media (Owen & Laurel-Seller, 2000; Sypeck et al., 2004), and a drive for thinness is now common for women across cultures (Swami et al., 2010). Women have been found to be more likely to make upward comparisons and compare themselves to people who have a body size/shape that they consider ideal (Fardouly et al., 2017). Importantly, research supports the suggestion from social comparison theory that upward comparisons can cause negative emotions (Myers & Crowther, 2009). When women are exposed to images of low weight women, they report an increase in body dissatisfaction (Bould et al., 2018; Groesz et al., 2002; Moreno-Domínguez et al., 2019; Tiggemann & McGill, 2004). Therefore, an attentional bias to low weight bodies may be contributing to body dissatisfaction in women, which could make it a useful target for therapeutic intervention.

To target attentional biases, researchers have proposed that computerised attentional bias modification tasks could make a cost-effective adjunct to traditional talking therapies for treating symptoms of eating disorders, such as body dissatisfaction (Renwick et al., 2013a, 2013b). There is preliminary support for the effectiveness of attention modification at reducing eating disorder symptoms; however, only a small number of studies have been conducted, and they have a high degree of heterogeneity (Dondzilo et al., 2018; House, Stephen, et al., 2022; Matheson et al., 2019; Stephen, Hunter, et al., 2018). To inform future research aiming to modify attentional bias to low weight bodies, it would be useful to have a more in depth and up-to-date understanding of whether and how body dissatisfaction relates to an attentional bias towards low weight bodies.

We conducted a systematic review and meta-analysis to investigate the relationship between body dissatisfaction and attentional bias towards low weight female bodies in non-clinical samples of women. As far as we are aware, the only previous systematic review on this topic was conducted by Rodgers and DuBois (2016), who investigated the broad topic of attentional biases displayed by both men and women. Our review provides an update on this earlier review. However, given the number of recent publications, we aimed to solely investigate attentional biases displayed by women towards pictorial stimuli of low weight female bodies. We restricted the review to studies on women because research indicates gender differences in body ideals can affect attentional biases (Cho & Lee, 2013; Talbot & Saleme, 2022) and the majority of studies in this area have been conducted on women. We also limited the review to cross-sectional studies because this is the most commonly used research design on this topic. We further limited the review to pictorial stimuli, rather than word stimuli, because pictorial stimuli of low weight bodies are a more ecologically valid target for social comparisons and have been shown to increase body dissatisfaction (Bould et al., 2018; Groesz et al., 2002; Moreno-Domínguez et al., 2019; Tiggemann & McGill, 2004). By narrowing the scope of the review, we aimed to increase the likelihood of finding enough high quality, homogeneous studies to enable us to conduct a meta-analysis and follow up moderation analyses on the relationship between body dissatisfaction and attentional bias to low weight bodies. We also aimed to follow the recommendations made by Stott et al. (2021) and reduce bias in our review by preregistering our review protocol, conducting a quality assessment of included studies, documenting reasons for excluding studies, and assessing the impact of small study effects on our findings. We hypothesised that body dissatisfaction would be positively related to an attentional bias towards low weight female bodies, i.e., that women with high body dissatisfaction would direct more attention towards low weight female bodies than women with low body dissatisfaction.

4.4. Methods

The systematic review and meta-analysis were preregistered on the Open Science Framework (https://osf.io/5y9w8/) with deviations from the protocol outlined in Appendix 4.1. The review follows PRISMA reporting guidelines (Page et al., 2021).

4.4.1. Eligibility Criteria

Studies were eligible for our review if they met all of the following inclusion criteria: 1) used an analytical cross-sectional design i.e. all data were collected at one time point, 2) recruited female participants who were not recruited specifically on the basis of having a current or previous diagnosis of an eating disorder, 3) included at least one measure of our exposure variable—body dissatisfaction, 4) included at least one assessment of our outcome variable—attentional bias towards pictorial stimuli of low weight female bodies, and 5) explored whether body dissatisfaction was related to attentional bias, using body dissatisfaction as either a grouping or continuous variable. As we did not have resources to translate texts, we also specified that 6) the text of the paper must be written in English. Studies were screened as ineligible for our review if they met any of the following exclusion criteria: 1) review articles, 2) studies comparing people with eating disorders to non-clinical samples without reporting separate results for the non-clinical samples, 3) experimental studies (e.g., intervention studies) that did not report baseline data, and 4) studies that recruited both male and female participants without reporting separate results for the female participants.

4.4.2. Search Strategy

One author (TH) completed a database search on the 18th October 2020. TH searched the titles, abstracts, and keywords for terms in the following databases: PubMed, Scopus, Web of Science, PsycINFO, ProQuest, and OpenGrey. No restrictions were made on the publication date or publication status. Where possible, a search filter was applied to limit the search to text written in English. The search terms were the following: (Attention* OR "Dot probe" OR "Visual probe" OR "Visual search" OR "Eye tracking" OR EEG OR ERP OR Hypervigilance) AND (Thin* OR Slim* OR "Low adiposity" OR "Low fat" OR Underweight OR "Body size" OR "Body shape" OR Ideal*) AND ("Body dissatisfaction" OR "Body image" OR "Body satisfaction" OR "Body concern" OR "Body image disturbance" OR "Weight dissatisfaction" OR "Weight satisfaction" OR "Eating disorder").

To find additional studies, author TH 1) hand-searched the references of eligible papers and relevant reviews, 2) emailed the authors of eligible papers, 3) emailed personal contacts of the review authors, 4) posted requests for studies on social media and relevant mailing lists, and 5) emailed the authors of ineligible studies with potentially eligible data. For example, if a study recruited male and female participants but did not report separate results for female participants, then the results for the female participants alone were requested. If the study involved an experimental manipulation, then the baseline results were requested. If the study involved comparing non-clinical samples to people with eating disorders but did not report separate results for the non-clinical samples, then results for the non-clinical samples were requested. We stopped accepting additional content from authors on the 28th of February 2021. To ensure the review findings were up to date, TH repeated the electronic database search on 10th March 2022 and 17th September 2022 to identify eligible studies published after the original database search.

4.4.3. Selection of Studies

The total results of the original database search were imported into the reference manager Zotero to remove duplicates and then exported into the screening software Rayyan (Ouzzani et al., 2016). Two authors (TH and KG) independently screened all remaining titles and abstracts. TH then screened all remaining full texts and KG completed an additional independent screening of 10% of the full texts. TH documented the reasons for excluding papers at the full text screening stage (see Appendix 4.2). Any text or data received directly from authors or found via hand searching were checked for eligibility by author BE. Disagreements between TH, KG, and BE were resolved by a discussion between these authors and, if required, author IPV. The results of the follow-up database search were screened using the same approach, except that the screening was completed solely by TH.

4.4.4. Data Extraction

Data were extracted from each study using a standardised data extraction form. For studies identified from the original database search, TH extracted data from all eligible studies and KG independently extracted data from 10% of eligible studies. Data from remaining eligible studies were extracted by TH and checked by BE. Disagreements between authors were resolved by discussion between TH, KG, BE, and if required, IPV. The majority of studies quantified the relationship between body dissatisfaction and attentional bias using the effect size Pearson's *r*; therefore, we aimed to extract this effect size with the 95% confidence intervals from each study. If Pearson's *r* was not reported, then it was calculated from publicly available data or estimated by converting an alternatively reported or calculated effect size. Effect size calculations were conducted using the R package "esc" to convert Cohen's *d* (Lüdecke, 2019; R Core Team, 2020), the online calculator Psychometrica to convert standardised β coefficients (Lenhard & Lenhard, 2016; Peterson & Brown, 2005), and the R package "psychometric" to estimate 95% confidence intervals (Fletcher, 2022). If no information was available to extract an effect size, then we emailed the authors for this information. Effect sizes were extracted so positive effect sizes indicated women with high body dissatisfaction, when compared to women with low body dissatisfaction, had a greater attentional bias to low weight bodies.

4.4.5. Quality Assessment

The authors TH and BE each independently assessed all of the included studies for risk of bias using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Analytical Cross-Sectional Studies (see Appendix 4.3; Moola et al., 2020), which was specifically designed to assess the quality of analytical cross-sectional studies. Disagreements between authors were resolved by discussion between TH, BE, and if required, IPV. A risk of bias score was calculated for each study by summing the number of "Yes" responses on the checklist. Possible scores ranged from 0 to 7 and high scores indicated low risk of bias.

4.4.6. Data Analyses

The results were reported in a data extraction table and a narrative synthesis (see Table 4.2). Evidence for a positive (negative) association between body dissatisfaction and attentional bias was indicated by a positive (negative) effect size with 95% confidence intervals that did not overlap with zero. We interpreted there being no evidence for an association if the effect size 95% confidence intervals included zero. When authors did not respond to our requests for effect size data, we noted this in the full data extraction form (https://osf.io/vqrc3) and inferred evidence for an association based on the author's text summary of the results and, if reported, a p-value of < .05.

We identified enough similar studies to conduct one meta-analysis pooling effect sizes from studies measuring attentional bias using the dot probe task, gaze tracking, EEG recording, and the modified spatial cueing task. We excluded effect sizes from the meta-analysis if we could not extract the effect size data and authors did not respond to our data requests. We also excluded studies from the meta-analysis if they used a measure of attentional bias not used by any other study in the meta-analysis e.g. the frequency estimation task (Seifert et al., 2008). These studies were instead summarised via narrative synthesis. For the meta-analysis, we initially converted effect sizes from Pearson's r to Fisher's Z. We then conducted a three-level random effects model using the restricted maximum likelihood method and the "meta" and "metafor" packages in R (Assink & Wibbelink, 2016; Balduzzi et al., 2019; R Core Team, 2020; Viechtbauer, 2010). The three-level model accounted for variance of effects between participants (level 1), outcomes (level 2), and studies (level 3). By using a three-level model, we did not have to assume independence of effects and therefore if a single study reported multiple effects (e.g. different effects for different body dissatisfaction questionnaires) we were able to include both effects in the model. The results of the meta-analysis were reported in a forest plot. To assess statistical heterogeneity, we calculated τ^2, I^2, and Cochran's Q and visually inspected the forest plot for non-overlapping 95% confidence intervals.

We explored statistical heterogeneity by conducting moderation analyses on continuous variables and dummy coded categorical variables. Moderator variables were evaluated separately and included measure of attentional bias (categorical: dot probe vs EEG vs gaze tracking vs modified spatial cueing), measure of body dissatisfaction (categorical: BAS vs BPSS-R vs BSQ vs BSSS vs EDE vs EDI vs NPS, vs single item measure), publication status (categorical: published vs non-published), risk of bias score (continuous), method of effect size calculation (categorical: converted effect size vs non-converted effect size), mean participant age (continuous), mean participant body mass index (BMI; continuous), method of low weight body stimuli acquisition (categorical: photographs vs digitally altered photographs vs computer generated images), amount of skin exposed on the low weight body stimuli (categorical: nude vs clothed with torso exposed vs clothed with torso concealed), and the type of control stimuli (categorical: higher weight body stimuli vs non-body stimuli vs both higher weight body stimuli and non-body stimuli).

We conducted attention measure specific moderation analyses separately for dot probe and gaze tracking studies. For dot probe studies, moderators included the body stimulus layout (categorical: top-bottom vs left-right), the delivery setting (categorical: online vs laboratory), and the stimulus onset asynchrony (SOA)—the time period from the onset of the body stimulus pair to the onset of the probe (continuous). For gaze tracking studies, moderators included the gaze tracking index (categorical: gaze duration—the total sum time spent gazing at the low weight body, vs fixation frequency—the total count of fixations directed at the low weight body, vs first run dwell time—the sum time spent initially gazing at the low weight body prior to diverting gaze) and the presentation time of the body stimuli (continuous). Effect sizes were excluded from moderation analyses if we were unable to extract the relevant moderator data or, for categorical moderation analyses, if the effect size was too dissimilar from other effect sizes to form a category of >1 effect size.

Lastly, to investigate potential publication bias we plotted effect sizes on sunset (power-enhanced) funnel plots using the metaviz R package (Kossmeier et al., 2020). Funnel plots were presented separately for each measure of attentional bias and we used the moderation analysis estimates for plotting population effect sizes. We visually inspected the funnel plots for evidence of nominally statistically significant effects ($0.01 < p \leq 0.05$) from small studies which could be driving the meta-analysis results. We interpreted the funnel plots in conjunction with power-based statistics, including the median statistical power of the effects, the test of excess significance, and the replicability index.

4.5. Results

The results of the search and screening stages are presented in Figure 4.1. From the original database search, authors TH and KG independently screened 980 titles and abstracts (95% agreement; Cohen's κ = 0.67), followed by 8 full texts (88% agreement; Cohen's κ = 0.71). Remaining full texts and results identified from follow-up database searches were screened solely by author TH. For initial data extraction, TH and KG independently extracted data from two studies (91% overall agreement with 100% agreement specifically for effect size extraction). Once TH finished extracting data from the remaining studies, the full data extraction form (34 studies) was checked by author BE (98% overall agreement with 94% agreement specifically for effect size extraction). The results of the systematic review are presented in a pared-down data extraction table (Table 4.2), with additionally extracted details including demographics and effect sizes documented in a full data extraction form on the Open Science Framework (https://osf.io/vqrc3).

The search found 34 eligible studies, involving a total number of 2857 female participants. The largest number of studies were conducted in Australia (10 studies), followed by Canada (4 studies), United Kingdom (4 studies), United States (4 studies), China (3 studies), and Brazil (2 studies). Studies were also conducted in Estonia (1 study), Germany (1 study), Malaysia (1 study), South Korea (1 study), Switzerland (1 study), and in an online setting with no country restrictions (2 studies). Participants had a weighted mean age of 21.12 years and a weighted mean BMI of 22.62 kg/m^2, which is in the healthy weight range (National Health Service, 2019). Participants were typically university students recruited from undergraduate courses. The most common method of measuring attentional bias was the dot probe task (14 studies), followed by gaze tracking (9 studies), electroencephalogram (EEG) recording (3 studies), a modified spatial cueing paradigm (3 studies), and a visual search task (2 studies). Remaining studies used an attentional response to distal vs. proximal emotional information (ARDPEI) task (1 study), a body size discrimination task (1 study), a frequency estimation task (1 study), and a modified rapid serial visual presentation (RSVP) task (1 study).

Figure 4.1.

Flow diagram of search results. Some included full texts reported multiple studies, therefore we have distinguished between the number of full texts and individual studies included in the systematic review and meta-analysis.

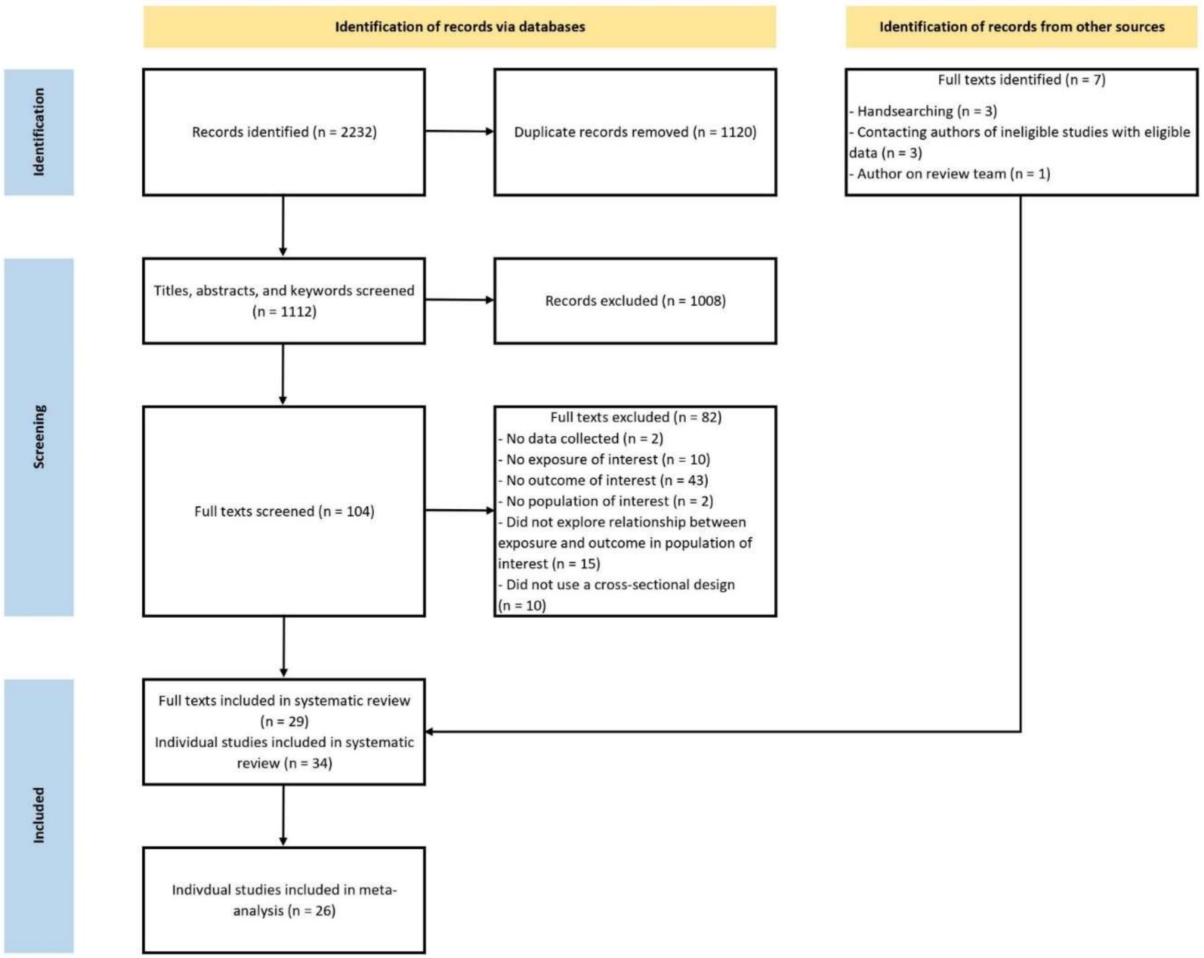


Table 4.2

Characteristics and main findings for the included studies. A full data extraction table with additionally extracted details including demographics and effect sizes is publicly available on the Open Science Framework (https://osf.io/vqrc3).

Author/Year	*N*	Paradigm	Stimuli	Body dissatisfaction assessment	Main findings
Berrisford-Thompson et al. (2021)	114	Modified RSVP task	Low weight vs scrambled bodies.	BSQ	+ Women with high (compared to low) BD demonstrated reduced accuracy for identifying target stimuli following low weight bodies (vs scrambled bodies), indicating low weight body induced blindness.
Cass et al. (2020)	71	Visual search task	Low weight vs high weight vs average weight bodies.	BSQ; Actual–ideal body discrepancy on a novel figure rating scale (NFRS); EDE-S; EDE-W	○ No associations between BD and RTs for low weight bodies (vs average weight bodies). ○ No associations between BD (BSQ; EDE-S; EDE-W) and RTs for low weight bodies (vs high weight bodies). — Women with high (compared to low) BD (NFRS) had slower RTs

Author/Year	***N***	**Paradigm**	**Stimuli**	**Body dissatisfaction assessment**	**Main findings**
					for low weight bodies (vs high weight bodies).
Cho and Lee (2013)	41	Eye-tracking during a free-viewing task	Low weight vs high weight vs muscular vs average weight bodies.	EDI-2-BD	+ Women with high (compared to low) BD gazed for longer and fixated more frequently at low weight bodies.
Dondzilo et al. (2021)	63	ARDPEI task	Low weight vs high weight bodies vs abstract art.	BSQ	○ No direct associations between BD and RTs for low weight bodies (vs high weight bodies) on engagement or disengagement bias trials. + Women with high (compared to low) BD had faster RTs for low weight bodies (vs high weight bodies) on engagement bias trials, but only via the mediators appearance comparisons and eating disorder-specific rumination.

Author/Year	*N*	Paradigm	Stimuli	Body dissatisfaction assessment	Main findings
Dondzilo et al. (2017)	70	Dot probe task	Low weight bodies vs abstract art.	BSQ	+ Women with high (compared to low) BD had faster RTs for probes replacing low weight bodies (vs abstract art).
Gaid (2008)	40	Visual search task	Low weight vs high weight vs average weight bodies.	BISS	○ No associations between BD and RTs for low, average, or high weight bodies. + Women with high (compared to low) BD had a greater difference between present vs absent trials for low weight and average weight bodies, but not high weight bodies.
Gao et al. (2014)	68	Eye-tracking during a free-viewing task	Low weight body vs body where shape/weight information was not salient vs household items vs gardening items.	NPS-F	○ No association between BD and the percentage of first fixations to low weight bodies. — Women with high (compared to low) BD were slower to fixate on low weight bodies.

Author/Year	*N*	Paradigm	Stimuli	Body dissatisfaction assessment	Main findings
					+ Women with high (compared to low) BD had longer first fixations and overall gaze durations during the 15s presentation time towards low weight bodies.
Gao et al. (2013)	204	Modified spatial cueing paradigm	Low weight bodies vs household items.	NPS-F	+ For SOA 760ms trials, women with high (compared to low) BD had slower reaction times to probes following low weight body stimuli (vs household items). ⬭ For SOA 1160ms trials, there was no association between BD and RTs to probes following low weight bodies (vs household items).
Glauert et al. (2010) study 1	49	Dot probe task	Low weight vs high weight bodies.	BSQ	⬭ No association between BD and RTs for probes replacing low weight bodies (vs high weight bodies).

Author/Year	*N*	Paradigm	Stimuli	Body dissatisfaction assessment	Main findings
Glauert et al. (2010) study 2	50	Dot probe task	Low weight vs high weight bodies.	BSQ	○ No association between BD and RTs for probes replacing low weight bodies (vs high weight bodies).
Glauert et al. (2010) study 3	50	Dot probe task	Low weight vs high weight bodies.	BSQ	— Women with high (compared to low) BD had slower RTs for probes replacing low weight bodies (vs high weight bodies). ○ This negative relationship was eliminated after controlling for BMI.
House, Stephen, et al. (2022) study 1	150	Dot probe task	Low weight vs high weight bodies.	BSSS	○ No association between BD and RTs for probes replacing low weight bodies (vs high weight bodies).
House, Stephen, et al. (2022) study 2	70	Dot probe task	Low weight vs high weight bodies.	BSSS	○ No association between BD and RTs for probes replacing low weight bodies (vs high weight bodies).

Author/Year	*N*	Paradigm	Stimuli	Body dissatisfaction assessment	Main findings
House, Stephen, et al. (2022) study 3	150	Dot probe task	Low weight vs high weight bodies.	BSSS	○ No association between BD and RTs for probes replacing low weight bodies (vs high weight bodies).
House, Wong, et al. (2022)	300	Dot probe task	Low weight vs high weight bodies.	BSSS	○ No association between BD and RTs for probes replacing low weight bodies (vs high weight bodies).
Joseph (2014) study 1	89	Dot probe task	Low weight vs high weight bodies.	BSQ	+ Women with high (compared to low) BD had faster RTs for probes replacing low weight bodies (vs high weight bodies).
Joseph (2014) study 2	25	Dot probe task	Low weight vs high weight bodies.	BSQ	○ No association between BD and RTs for probes replacing low weight bodies (vs high weight bodies).
Karlinsky et al. (2021)	87	Covert eye-tracking during a free-viewing rest period	Low weight vs average weight bodies.	BAS	○ No association between BD and likelihood of directing first fixation to low weight bodies.

Author/Year	*N*	Paradigm	Stimuli	Body dissatisfaction assessment	Main findings
					⬭ No association between BD and gaze count or gaze duration to low weight bodies.
Lee and Shafran (2008)	75	Dot probe task	Low weight bodies vs animals.	EDE-S	⬭ No association between BD and RTs for probes replacing low weight bodies (vs animals).
Misener and Libben (2020)	197	Modified spatial cueing paradigm with eye-tracking	Low weight vs high weight bodies vs control bodies where shape/weight information was not salient.	BSQ	— Women with high (compared to low) BD had faster RTs to probes following low weight bodies (vs control bodies and vs high weight bodies). ⬭ For SOA 760ms trials, there was no association between BD and first run dwell times (initial fixation durations) to low weight bodies (vs control bodies and vs high weight bodies). + For SOA 1160ms trials, women with high (compared to low) BD had longer first run dwell times

Author/Year	*N*	Paradigm	Stimuli	Body dissatisfaction assessment	Main findings
					for low weight bodies (vs control bodies). ○ For SOA 1160ms trials, there was no association between BD and first run dwell times to low weight bodies (vs high weight bodies).
Moussally et al. (2016)	163	Dot probe task	Low weight vs average weight bodies.	BSQ	+ For SOA 500ms trials, women with high (compared to low) BD had faster RTs for probes replacing low weight bodies (vs average weight bodies). ○ For SOA 100ms and 1500ms trials, there was no association between BD and RTs for probes replacing low weight bodies (vs average weight bodies).
Nazareth et al. (2019)	19	Body size discrimination task	Low weight vs high weight bodies	Brazilian BSQ; Actual–ideal body discrepancy (Brazilian FRS)	○ No associations between BD and accuracy or RTs to low weight bodies (vs high weight bodies).

Author/Year	***N***	**Paradigm**	**Stimuli**	**Body dissatisfaction assessment**	**Main findings**
Purvis et al. (2015)	77	Visual gaze tracking during a virtual reality free viewing task	Low weight vs high weight vs average weight bodies.	BPSS-R at baseline	+ In the beach environment, women with high (compared to low) BD gazed for longer at low weight bodies. ○ In the party environment, there was no association between BD and gaze duration to low weight bodies.
Scott et al. (2023)	60	Eye-tracking during a free-viewing task	Low weight vs high weight vs average weight bodies and faces	BSS	○ No association between BD and fixation duration or fixation count to low weight bodies and faces. — Women with high (compared to low) BD made less unique visits to low weight bodies and faces.
Seifert et al. (2008)	32	Frequency estimation task	Low weight vs high weight vs average weight bodies.	Actual–ideal body discrepancy (FRS)	○ No association between BD and frequency estimations for low weight bodies.

Author/Year	*N*	Paradigm	Stimuli	Body dissatisfaction assessment	Main findings
Shafran et al. (2007)	75	Dot probe task	Low weight bodies/body parts vs animals.	EDE-S	⬭ No association between BD and RTs for probes replacing low weight bodies (vs animals).
Stephen, Sturman, et al. (2018)	35	Eye-tracking during a free-viewing task	Low weight vs high weight bodies.	Single-item measure of BD rating	+ Women with high (compared to low) BD gazed for longer and fixated more frequently at low weight bodies.
Szostak (2018)	80	Dot probe task	Low weight vs average weight bodies.	BSQ; EDI-3-BD	⬭ No associations between BD and RTs for probes replacing low weight bodies (vs average weight bodies).
Tobin et al. (2019)	167	Eye-tracking during a free-viewing task	Low weight bodies vs average weight bodies where shape/weight information was not salient vs household items vs gardening items.	BSQ	+ Women with high (compared to low) BD spent more time fixating at low weight bodies.
Uusberg et al. (2018)	36	EEGs measured during a body size comparison and working memory task	Low weight vs high weight bodies.	EDI-2-BD	⬭ No associations between BD and amplitudes to low weight bodies (vs high weight bodies), as

Author/Year	*N*	Paradigm	Stimuli	Body dissatisfaction assessment	Main findings
					indexed by the P3 and LPP components. ○ For the N170 component, there were no associations between BD and amplitudes to low weight bodies (vs high weight bodies) for self-identity trials or other-identity low working memory trials. — For the N170 component, women with high (compared to low) BD demonstrated reduced amplitudes for low weight bodies (vs high weight bodies), but only for other-identity high working memory trials. ○ For the P2 component, there were no associations between BD and amplitudes to low weight bodies (vs high weight bodies)

Author/Year	*N*	Paradigm	Stimuli	Body dissatisfaction assessment	Main findings
					for other-identity trials or self-identity high working memory trials. — For the P2 component, women with high (compared to low) BD demonstrated reduced amplitudes for low weight bodies (vs high weight bodies), but only for self-identity low working memory trials.
Voges et al. (2019)	44	SSVEP measured with EEG during a dot detection task	Low weight vs high weight bodies.	Combined scores on the EDE-S and EDE-W	⬭ No associations between BD and SSVEP amplitudes to low weight bodies (vs high weight bodies).
Volkmann and de Castro (2021)	42	Modified spatial cueing paradigm	Low weight bodies vs cylinders.	Brazilian BSQ	⬭ No association between BD and RTs to probes following low weight bodies (vs cylinders) for SOA 760ms or 1160ms trials.
Wang et al. (2019)	31	EEGs measured during a body size comparison task	Low weight vs high weight bodies.	NPS-F	⬭ No associations between BD and RTs for low weight bodies.

Author/Year	*N*	Paradigm	Stimuli	Body dissatisfaction assessment	Main findings
					— Women with high (compared to low) BD showed reduced N2 amplitudes to low weight bodies (vs high weight bodies). — Women with high (compared to low) BD showed reduced LPC amplitudes during the 730–1000ms interval to low weight bodies (vs high weight bodies).
Withnell et al. (2019)	108	Eye-tracking during a free-viewing task	Low weight bodies vs average weight bodies where shape/weight information was not salient vs household items vs gardening items.	BSQ	+ Women with high (compared to low) BD fixated for longer at low weight bodies.

Note. ARDPEI = Attentional response to distal vs. proximal emotional information; BD = body dissatisfaction; EEG = electroencephalogram; RSVP = Rapid serial visual presentation; RT = reaction time; SOA = stimulus onset asynchrony; SSVEP = steady state visually evoked potentials. Body Appreciation Scale (BAS; Avalos et al., 2005); Body Image States Scale (BISS; Cash et al., 2002); Body Parts Satisfaction Scale-Revised (BPSS-R; Petrie et al., 2002); Body Satisfaction Scale (BSS; Slade et al., 1990); Body Shape Questionnaire 34 (BSQ; Cooper et al., 1987); Body Shape Satisfaction Scale (BSSS; Pingitore et al., 1997); Brazilian Body Shape Questionnaire 34 (BSQ; Di Pietro & Silveira, 2009); Brazilian Figure Rating Scale (FRS; Kakeshita et al., 2009); Eating Disorder Examination Shape Subscale (EDE-S; Fairburn & Cooper, 1993); Eating Disorder Examination Weight Subscale (EDE-W; Fairburn & Cooper, 1993); Eating

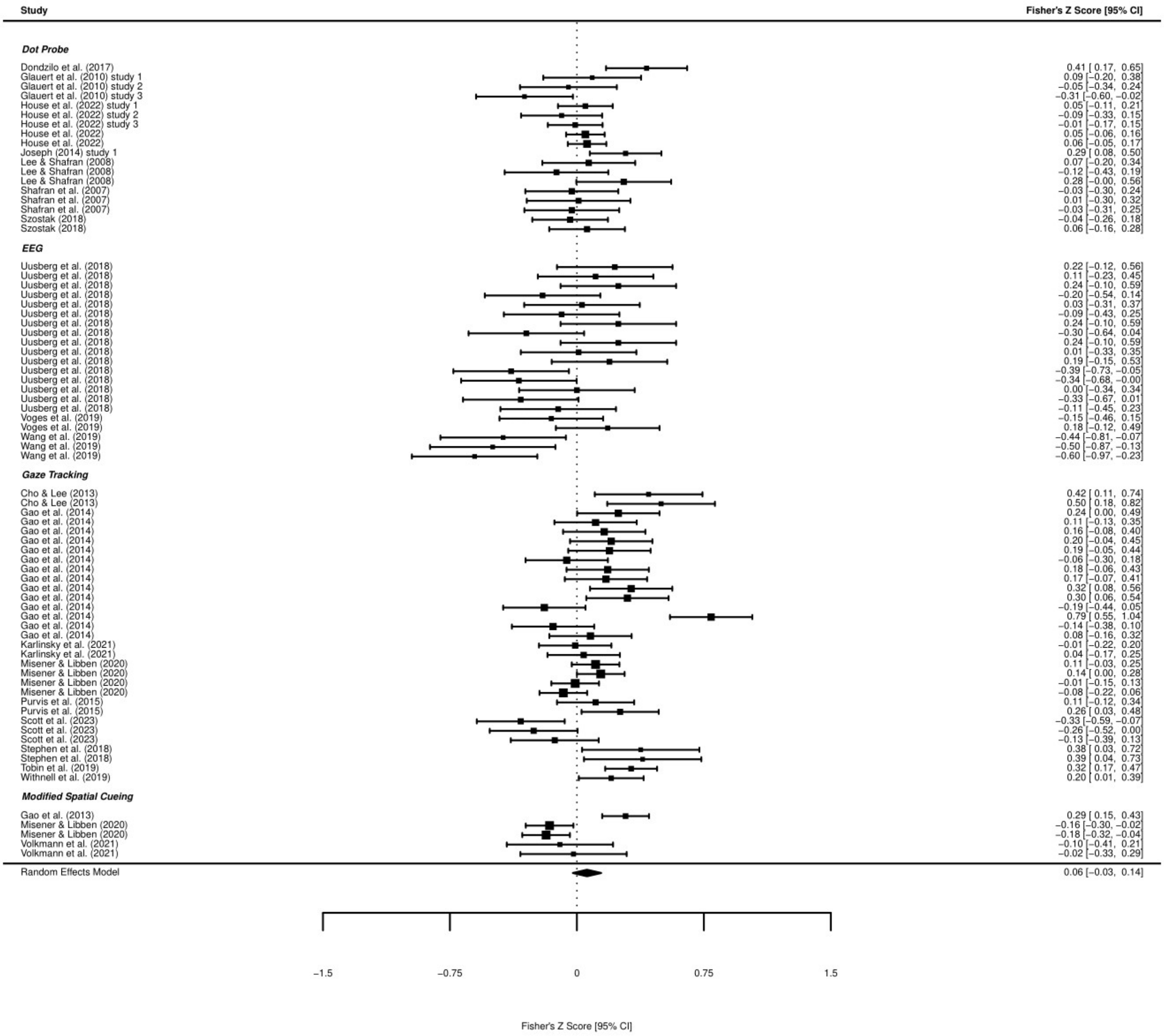
Disorder Inventory 2 Body Dissatisfaction Subscale (EDI-2-BD; Garner, 1991); Eating Disorder Inventory 3 Body Dissatisfaction Subscale (EDI-3-BD; Garner, 2004); Figure Rating Scale (FRS; Stunkard et al., 1983); Negative Physical Self Fatness Concern Subscale (NPS-F; Chen et al., 2006). In the main findings column, + indicates the finding is in our hypothesised direction, – indicates the finding is in the opposite direction, and O indicates there was no association. If a study calculated a difference score for their measure of attention (e.g. a RT difference score), we have reported the stimulus compared to the low weight body in brackets e.g. "faster RTs for probes replacing low weight bodies (vs high weight bodies)" indicates a RT difference score was calculated for low weight vs high weight bodies.

4.5.1. Meta-Analysis

The meta-analysis pooled 75 effect sizes from 26 studies (Figure 4.2). The studies measured attentional bias using either the dot probe task, gaze tracking, EEG recording, or the modified spatial cueing task. The multilevel random effects model did not provide evidence for a relationship between body dissatisfaction and attentional bias to low weight bodies, $Z(74) = 0.06$, $p = .165$, 95% confidence intervals [-0.03, 0.14], 95% prediction interval [-0.37, 0.49]. We converted the pooled Fisher's Z to Pearson's *r,* which indicated the pooled effect size was very small in size, $r = .06$ (Cohen, 1988). A visual inspection of the forest plot (Figure 4.2) revealed statistical heterogeneity, because there were multiple effects with non-overlapping 95% confidence intervals. The distribution of variance across levels indicated substantial effect size heterogeneity within and between studies, $I^2_{\text{Level 2}} =$ 27.70%, $I^2_{\text{Level 3}} =$ 48.78%; $\tau^2_{\text{Level 2}} = 0.016$, $\tau^2_{\text{Level 3}} = 0.028$, and Cochran's Q test of heterogeneity was significant, $Q(74) = 237.40$, $p < .001$.

Figure 4.2.

Forest plot of Fisher's Z for body dissatisfaction and attentional bias to low weight bodies, grouped by measure of attentional bias (k = 75). Positive effects indicate women with high body dissatisfaction, when compared to women with low body dissatisfaction, directed more attention to low weight bodies. A three-level random effects model was used for pooling effects. Study weight is indicated by square size. CI = 95% confidence interval.



4.5.1.1. Moderation Analyses. Almost all of the moderation analyses provided no evidence for moderating effects (all *p*-values > .05; see Appendix 4.4 for more details). The only exception was for measure of attentional bias, $F(3, 71) = 2.84$, $p = .044$. The pooled effects for each measure of attentional bias are reported in Table 4.3. We found evidence indicating gaze tracking effects were larger (more positive) than EEG effects ($t(71) = -2.58$, $p = .012$, but no evidence indicating gaze tracking effects differed from dot probe effects ($t(71) = -1.36$, $p = .178$) or modified spatial cueing effects ($t(71) = -1.72$, $p = .089$. There was no evidence for differences between dot probe, EEG, and modified spatial cueing effects (all *p*-values > .05; see Appendix 4.5 for more details). There was evidence indicating that gaze tracking effects were larger (more positive) than zero, whereas there was no evidence indicating that dot probe, EEG, and modified spatial cueing effects differed from zero (see Table 4.3). In summary, gaze tracking studies found evidence suggesting that women with high body dissatisfaction, when compared to women with low body dissatisfaction, had a greater attentional bias to low weight bodies. Dot probe, EEG, and modified spatial cueing studies did not provide evidence for this relationship. The moderation analyses for dot probe and gaze tracking studies found no evidence for moderating effects of body stimuli layout, delivery setting, SOA, gaze tracking index, or body stimuli presentation time (all *p*-values > .05; see Appendix 4.4 for more details).

Table 4.3.

The pooled effects reported separately for each measure of attentional bias.

Attention measure	*k*	*Z* [95% CI]	*r*	*t*	*p*
Dot Probe	18	0.05 [-0.08, 0.18]	0.05	0.71	.478
EEG	21	-0.16 [-0.38, 0.06]	-0.16	-1.43	.157
Gaze Tracking	31	0.17 [0.04, 0.29]	0.17	2.70	.009
Modified Spatial Cueing	5	0.00 [-0.19, 0.20]	0.00	0.04	.970

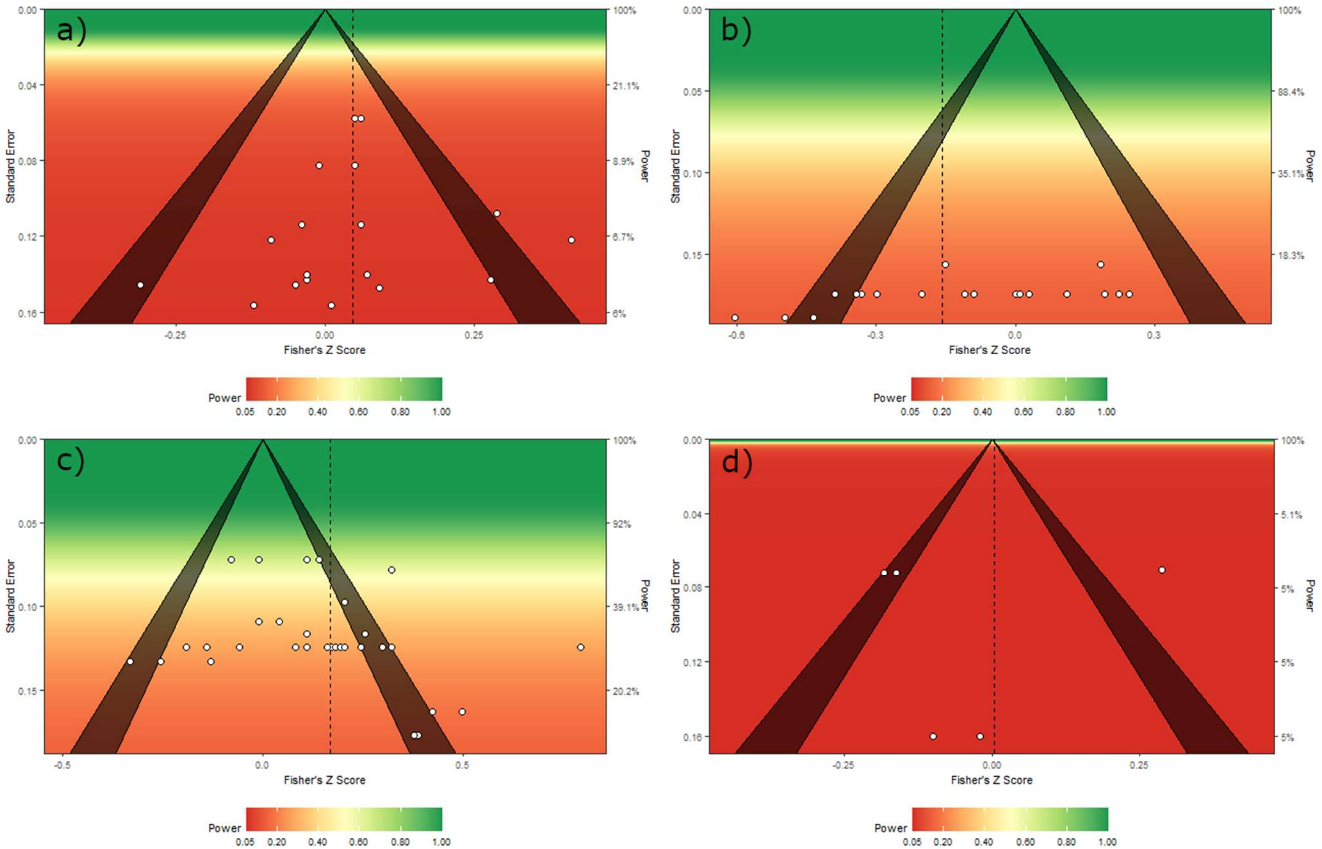
Note. CI = 95% confidence interval.

4.5.1.2. Missing Effects. We identified 11 effects from five studies that would have been eligible for the meta-analysis; however, we were unable to extract effect size data and authors were unable to provide the data. For dot probe studies, the missing effects included one positive association effect (Moussally et al., 2016) and three no-association effects (Joseph, 2014, study 2; Moussally et al., 2016). For EEG studies, the missing effects included five no-association effects for N1, P2, and early LPC components (Wang et al., 2019). For gaze tracking studies, the missing effects included one no-association effect for first gaze behaviour (Karlinsky et al., 2021). For modified spatial cueing studies, the missing effects included one no-association effect for SOA 1160ms trials (Gao et al., 2013). Given the number of no-association effects and the relatively small sample sizes for these effects, we think it is unlikely they would have influenced our interpretations of the pooled effect estimates (either overall or separated by measure of attentional bias) if effect size data had been available. However, it is possible that a marginal decrease in the pooled gaze tracking effect combined with a marginal increase in the pooled EEG effect may have reduced the evidence for a difference between these effects.

4.5.1.3. Publication Bias. The sunset (power-enhanced) funnel plots are presented separately by measure of attentional bias in Figure 4.3. For dot probe studies, we did not identify obvious asymmetry, although a small number of small study effects clustered in the significance contours (Figure 4.3.a) which could suggest publication bias. The median statistical power for dot probe tests was very low (6.5%), but a test of excess significance did not indicate we observed more statistically significant dot probe effects than expected (observed = 3.00; expected 1.32; p = .129). This does not provide clear evidence of publication bias. The expected replicability of the dot probe findings was very low (R-index = 0.0%). Similarly, for EEG studies we did not identify obvious asymmetry, although a small number of small study effects clustered in the negative significance contour (Figure 4.3.b), which could suggest publication bias. The median statistical power for EEG tests was very low (14.8%), but a test of excess significance did not indicate we observed more statistically significant EEG effects than expected (observed = 5.00; expected 3.11; p = .246). This does not provide clear evidence of publication bias. The expected replicability of the EEG findings was very low (R-index = 5.8%).

Figure 4.3.

Four sunset (power-enhanced) funnel plots presenting correlation coefficients (Fisher's Z; k = 75) for body dissatisfaction and attentional bias to low weight bodies. Plot a (top left) presents effects from dot probe studies, plot b (top right) presents effects from EEG studies, plot c (bottom left) presents effects from gaze tracking studies, and plot d (bottom right) presents effects from modified spatial cueing studies. Positive correlations indicate women with high body dissatisfaction, when compared to women with low body dissatisfaction, directed more attention to low weight bodies. Moderation analysis estimates (Table 4.3) were used for plotting population effect sizes, depicted by the dashed lines. Significance contours (0.01 < p ≤ 0.05) are depicted by the dark shaded areas. Study-level statistical power for detecting population effect sizes is colour-coded from red (underpowered) to green (appropriately powered; Kossmeier et al., 2020).



For modified spatial cueing studies, we did not identify obvious asymmetry, although the number of effects was very low (*k* = 5), making asymmetry difficult to detect. There were two effects clustered in the negative significance contour, which could suggest publication bias (Figure 4.3.d). These effects were from relatively higher powered studies; however, the median statistical power of all modified spatial cueing tests was very low (5.0%). A test of excess significance indicated we observed more statistically significant modified spatial cueing effects than expected (observed = 3.00; expected 0.25; $p < .001$), which could provide evidence for publication bias. The expected replicability of the modified spatial cueing findings was very low (R-index = 0.0%). Overall, for dot probe, EEG, and modified spatial cueing effects, we think it is possible that publication bias may have contributed to some of the nominally significant effects from studies with low statistical power. However, we do not think publication bias will have affected our overall interpretations of the dot probe, EEG, or modified spatial cueing data, given we did not interpret there being evidence for a relationship between body dissatisfaction and attentional bias based on these measures.

For gaze tracking studies, visual inspection of the funnel plot did reveal a slight asymmetry and a number of small study effects clustering in the positive significance contour (Figure 4.3.c). This could suggest the gaze tracking estimated effect was inflated due to publication bias. The median statistical power of all gaze tracking tests was higher than other measures of attentional bias, but still low (27.4%). A test of excess significance did not provide evidence indicating that we observed more statistically significant gaze tracking effects than expected (observed = 13.00; expected 10.12; $p =$ .271). The expected replicability of the findings was higher than other measures of attentional bias, but still low (R-index = 12.9%). Overall, these findings call for a cautious interpretation of the gaze tracking data. The estimated effect provided evidence for a positive relationship between body dissatisfaction and attentional bias to low weight bodies; however, this effect may be inflated due to publication bias.

4.5.2. Narrative Synthesis

4.5.2.1. Visual Search. Two studies used a visual search task to explore the relationship between body dissatisfaction and attentional bias to low weight bodies (Cass et al., 2020; Gaid, 2008). Cass et al. (2020) conducted a compound visual search task which involved young adult women searching for a horizontal or vertical target bar within an array of tilted distractor bars. Each bar was paired adjacent to a female body stimulus. For neutral trials, all body stimuli were average weight. For low and high weight body trials, body stimuli adjacent to the distractors were average weight, while the body adjacent to the target bar was either low or high weight respectively. Attentional bias was measured using the difference in mean reaction times for low weight vs high weight body trials and for low weight body trials vs neutral trials. The results did not provide evidence for associations between the measures of attentional bias and any of the body dissatisfaction measures (BSQ; Cooper et al., 1987; EDE-S; EDE-W; Fairburn & Cooper, 1993). The only exception was when body dissatisfaction was measured using actual–ideal body discrepancy on a novel figure rating scale (NFRS). There was weak evidence that women with high (compared to low) body dissatisfaction were slower to locate low weight bodies. This result was only significant relative to high weight bodies, and not to average weight bodies.

Gaid (2008) found similar results for their simple visual search task. Participants were required to detect the presence or absence of a low, average, or high weight body stimulus amongst an array of distractor body stimuli presented at various orientations. The results provided no evidence to suggest reaction times for any of the three body sizes were related to body dissatisfaction. Gaid (2008) also used signal detection theory (Green & Swets, 1966) to analyse participants' sensitivity to the target bodies. There was weak evidence demonstrating that women with high body dissatisfaction exhibited greater sensitivity to low weight and average weight bodies than to high weight bodies, unlike women with low body dissatisfaction who showed no significant variation of sensitivity across body size. For both visual search studies, a majority of the reaction time results provided no evidence for an association between body dissatisfaction and attentional bias to low weight bodies. The only exception was some weak evidence for a negative relationship when body dissatisfaction was measured using actual–ideal body discrepancy on a novel figure rating scale (NFRS; Cass et al., 2020). Therefore, low weight female bodies seem unlikely to facilitate visual search performance in women with high body dissatisfaction. However, there was some weak evidence demonstrating that body dissatisfaction is positively related with increased sensitivity to low and average weight bodies, compared to high weight bodies (Gaid, 2008). Further research is needed to confirm this finding.

4.5.2.2. Attentional Response to Distal vs. Proximal Emotional Information (ARDPEI) Task. Dondzilo et al. (2021) used the attentional response to distal vs. proximal emotional information (ARDPEI) task to measure attentional bias to low weight bodies in young adult women. The target stimulus depicted either a low weight or high weight body and the neutral stimulus depicted abstract art. Mean reaction time differences between low and high weight trials were used to calculate engagement and disengagement bias scores. The results did not provide evidence for a direct association between body dissatisfaction and engagement or disengagement bias to low weight bodies. However, engagement bias was indirectly positively related to body dissatisfaction via two mediating variables: appearance comparisons and eating disorder-specific rumination. Dondzilo et al. (2021) proposed a pathway where engagement with low weight female bodies increases feelings of body dissatisfaction via these mediators. However, it should be noted that this study only provided correlational and not causal evidence for this pathway.

4.5.2.3. Modified Rapid Serial Visual Presentation (RSVP) Task. Berrisford-Thompson et al. (2021) conducted a modified rapid serial visual presentation (RSVP) task with female undergraduate students. The target stimulus followed either a low weight body or a control version of the body in which the pixels were scrambled. Low weight body induced blindness was measured by calculating the difference in mean accuracy scores for target stimuli following low weight vs scrambled bodies. Body dissatisfaction was positively correlated with low weight body induced blindness, so women with high (compared to low) body dissatisfaction directed more attention to low weight bodies. Consistent with Dondzilo et al. (2021), this positive relationship was mediated by eating disorder-specific rumination. Berrisford-Thompson et al. (2021) proposed a similar pathway where attention to low weight bodies increases eating disorder-specific rumination, which in turn increases body dissatisfaction, although the study provided only correlational and not causal evidence for this pathway.

4.5.2.4. Body Size Discrimination. Nazareth et al. (2019) presented young adult women with body silhouettes and measured the participants' ability to discriminate between the size of the silhouette and their own body size. Compared to the other studies included in this review, this study used a very short presentation time for the body stimuli (17ms), which allowed for the measurement of attentional bias during the very initial stages of visual processing. The researchers measured discrimination accuracy and reaction time, and we calculated difference in mean accuracy scores and reaction times for the low vs high weight body trials. The results did not show evidence of an association between body dissatisfaction and discrimination accuracy or reaction time to low weight bodies, relative to high weight bodies. This would suggest any bias in attentional processing for women with high body dissatisfaction is unlikely to occur for such fast body size judgements.

4.5.2.5. Frequency Estimation Task. The final task used to measure attentional bias to body size was the frequency estimation task. Based on the availability heuristic (Tversky & Kahneman, 1973), Seifert et al. (2008) proposed that if women with high (compared to low) body dissatisfaction direct more attention to low and average weight bodies, then this should lead them to overestimate their frequency. They presented participants with body silhouettes that covaried in size and colour and asked them to estimate the frequency of target colours. Contrary to their hypothesis, Seifert et al. (2008) found no evidence for an association between body dissatisfaction and frequency estimations for colours that covaried with low or average weight bodes. Therefore, they concluded that women with high (compared to low) body dissatisfaction did not direct more attention to low or average weight bodies.

4.5.3. Quality Assessment

All 34 studies were independently assessed for quality by authors TH and BE (80% agreement; Cohen's κ = 0.64). Studies had a mean risk of bias score of 3.38 out of a possible 7 (*SD* = 1.37; see Appendix 4.6 for individual study scores). All 34 studies reported their participant eligibility criteria and most studies (29/34) sufficiently described participant demographics. The time period and location of recruitment was rarely reported (only by 2/34 studies); however, this is only a minor concern for assessing bias in this meta-analysis. A more major concern is that not all studies sufficiently evaluated the validity and reliability of their measures of attentional bias and body dissatisfaction. For example, only two studies reported on the reliability of their measure of attentional bias within their sample. Studies tended to justify the use of their body dissatisfaction questionnaire based on reliability or validity demonstrated by previous research; however, only 17/34 studies additionally evaluated the reliability of their body dissatisfaction questionnaire within their sample. We also found that only a small number of studies (10/34) reported their data analysis approach and results in sufficient detail, e.g. by reporting exact *p*-values and methods for dealing with statistical assumptions and confounding variables, either in the paper or supplementary materials. Overall, the quality assessment highlighted many studies included in the review were at risk of bias and therefore results should be interpreted with caution.

4.6. Discussion

We conducted a systematic review and meta-analysis to investigate the relationship between body dissatisfaction and attentional bias towards low weight female bodies in non-clinical samples of women. In a previous systematic review, Rodgers and DuBois (2016) found initial evidence for a positive relationship between body dissatisfaction and attentional bias to low weight bodies in non-clinical populations. Our meta-analysis pooled effects from dot probe, electroencephalogram (EEG) recording, gaze tracking, and modified spatial cueing tasks. We found evidence for this positive association in women, but only for studies using gaze tracking as a measure of attentional bias. Therefore, our hypothesis was partially supported. Women with high body dissatisfaction, when compared to women with low body dissatisfaction, directed their gaze more frequently and for longer durations towards low weight female body stimuli. We did not find evidence for moderating effects on this relationship; however, the statistical power of the moderation analyses may have been too low to detect such effects.

The majority of studies included in this review used either the dot probe task or gaze tracking to measure attentional bias; however, we did not find evidence from dot probe studies for an association between body dissatisfaction and attention to low weight bodies. This methodological distinction is consistent with research in clinical populations (Stott et al., 2021). Eye-tracking studies indicate women with anorexia nervosa and bulimia nervosa gaze for longer at low weight female body stimuli than women without an eating disorder diagnosis (Blechert et al., 2009; Pinhas et al., 2014). In contrast, studies have not found evidence for this difference using a dot probe task (Lee & Shafran, 2008; Shafran et al., 2007). However, the research on clinical populations involves a small number of studies with very small sample sizes; therefore, these findings may not be robust (Stott et al., 2021).

The dot probe task demonstrated heterogenous results—a common finding in anxiety research where this task is used to measure attentional bias to threatening stimuli (Dennis-Tiwary et al., 2019). Many researchers have previously critiqued the dot probe task for having poor reliability (e.g. Parsons et al., 2019; Price et al., 2015; Rodebaugh et al., 2016; Schmukle, 2005). Further, there is evidence to suggest total gaze duration is a more reliable measure of attentional bias than traditional reaction time difference scores calculated using the dot probe task (Waechter et al., 2014). Therefore, it is possible that the dot probe task is not reliable enough to detect the positive relationship between body dissatisfaction and attentional bias to low weight bodies. As our quality assessment of the 34 included studies identified only two studies that reported on the reliability of the measure of attentional bias, it is difficult to directly compare reliability between measures. Researchers have pointed out that in psychological science it is not routine practice to report on the reliability of cognitive-behavioural measures, which may have contributed to the widespread use of the dot probe task despite its poor psychometric properties (Parsons et al., 2019). Therefore, it is important for researchers in this field to adopt more consistent reporting practices for the psychometric properties of measures of attentional bias.

Although the dot probe task has poor reliability, some evidence indicates that it may not be the task itself that is unreliable, but the traditional method of calculating attentional bias scores. All dot probe studies in our meta-analysis calculated bias scores using the traditional approach of computing the difference in mean reaction times for trials with probes cued by low weight body vs control stimuli. This method assumes that attentional bias is stable and static across dot probe trials and that a person either expresses an attentional bias towards or away from the target stimulus category. On the contrary, Zvielli et al. (2015) analysed dot probe data at a trial level and found that a person's attentional bias fluctuates over the course of the task. Trial level bias scores were better predictors of psychopathological and addiction constructs than traditional bias scores, and demonstrated greater reliability. Therefore, the traditional bias scores used in our dot probe meta-analysis may not have captured the dynamic nature of attentional bias over time, which may have contributed to the heterogeneity of results.

Another possible explanation for the difference in meta-analysis results is that the dot probe studies did not recruit or group participants based on their body dissatisfaction scores, whereas at least three of the gaze tracking studies recruited participants specifically for having either high or low body dissatisfaction scores. Therefore, studies using gaze tracking may have reported larger effect sizes due to including participants with more extreme levels of body dissatisfaction. Future dot probe studies recruiting participants with more extreme body dissatisfaction scores may provide more evidence for the relationship between body dissatisfaction and attentional bias.

On the other hand, we did find some evidence to suggest the pooled gaze tracking effect may have been inflated due to publication bias, indicating that we should interpret these results with caution. Therefore, we should also consider the possibility that we only found an association between body dissatisfaction and attentional bias for gaze tracking studies due to inflated gaze tracking effects. This interpretation is supported by our additional meta-analysis findings for EEG and modified spatial cueing studies, which also produced no evidence for an association between body dissatisfaction and attentional bias to low weight bodies. Some studies excluded from the meta-analysis also support this interpretation, including studies using the visual search task (Cass et al., 2020; Gaid, 2008), body size discrimination paradigm (Nazareth et al., 2019), and frequency estimation paradigm (Seifert et al., 2008). However, other studies excluded from the meta-analysis using the ARDPEI (Dondzilo et al., 2021) and RSVP tasks (Berrisford-Thompson et al., 2021) produced results more in line with gaze tracking studies. The gaze tracking results provide the most compelling evidence for a positive relationship between body dissatisfaction and attentional bias to low weight bodies. However, we interpret this evidence as weak given the possible influence of publication bias and lack of supporting evidence from studies using other measures of attention.

4.6.1. Strengths

In this review, we posed a narrow research question focussing on a specific attentional bias in one particular population. This allowed a deeper analysis of the literature including both qualitative and quantitative synthesis. To reduce bias in our review we followed recommendations proposed by Stott et al. (2021) and preregistered our review protocol, assessed studies for risk of bias, documented reasons for excluding studies, and assessed the impact of small study effects on our findings. We also aimed to reduce publication bias by including unpublished studies in our search strategy.

4.6.2. Limitations

The narrow focus of our review limits the generalisability of our conclusions. We focussed our review specifically on attentional bias to low weight bodies, because low weight bodies are likely targets for upward social comparisons and have been shown to increase body dissatisfaction (Bould et al., 2018; Groesz et al., 2002; Moreno-Domínguez et al., 2019; Tiggemann & McGill, 2004). However, the limited evidence for an association between body dissatisfaction and attentional bias to low weight bodies may not extend to other attentional biases. For example, Rodgers and DuBois (2016) found some initial evidence for a positive association between body dissatisfaction and attentional bias to high weight stimuli. This association may be more robust than the association between body dissatisfaction attentional bias to low weight bodies. We also restricted the review to studies on women, because research indicates gender differences in body ideals can affect attentional biases (Cho & Lee, 2013) and the majority of studies in this area have been conducted on women. Despite being understudied, body image disturbance and eating disorders are common among men (Gorrell & Murray, 2019; Mitchison & Mond, 2015). A recent review suggests that our conclusions may generalise to men, as male body dissatisfaction was associated with attentional biases to lean, high muscularity male bodies in some studies (Talbot & Saleme, 2022). However, further research is required to substantiate these findings.

The generalisability of our results is also limited because the included studies were predominantly conducted on young adult undergraduate students from North America, Europe, and Australia. Body dissatisfaction is commonly reported by women across cultures (Swami et al., 2010) and across the lifespan (Quittkat et al., 2019); however, our findings may not generalise to other populations. Our decision to only review studies written in English may have contributed to the culture bias in our studies, because our search strategy may have missed non-English papers from underrepresented countries. Research suggests English language restrictions are unlikely to affect the conclusions of systematic reviews and meta-analyses (Dobrescu et al., 2021); however, future research should check the generalisability of our findings by reviewing non-English language papers.

Lastly, aside from measure of attentional bias, our moderation analyses found no evidence for an influence of moderating variables on our meta-analysis results. However, these null findings should be interpreted with caution because some of our moderation analyses involved small and imbalanced subgroups and therefore may have lacked statistical power to detect smaller moderator effects (Cuijpers et al., 2021).

4.6.3. Implications for Future Research

To improve the robustness of future research exploring the relationship between body dissatisfaction and attentional biases to low weight bodies, we have five recommendations. First, we encourage researchers to use gaze tracking measures of attention, e.g. gaze duration, because these measures currently provide the most compelling evidence for a relationship between body dissatisfaction and attentional bias to low weight bodies. Second, if researchers do not have the resources to conduct gaze tracking research, then we recommend researchers use the ARDPEI task (Dondzilo et al., 2021) or RSVP task (Berrisford-Thompson et al., 2021), because these measures have provided preliminary support for a positive relationship between body dissatisfaction and attentional bias to low weight bodies. Third, to prevent the ARDPEI and RSVP task from being susceptible to similar constraints as the dot probe task, we recommend that researchers avoid assuming attentional bias is stable and static across trials and analyse ARDPEI and RSVP data at trial level (Zvielli et al., 2015). Fourth, to help in the evaluation of different measures of attentional bias, we encourage researchers to adopt more consistent reporting standards for the psychometric properties of measures of attentional bias (Parsons et al., 2019). Fifth, to reduce the effects of publication bias on future systematic reviews and meta-analyses, we recommend authors report their unpublished findings as preprints in public repositories such as PsyArXiv (www.psyarxiv.com).

4.7. Conclusion

Our systematic review and meta-analysis provides evidence that women with high body dissatisfaction, when compared to women with low body dissatisfaction, direct more attention towards low weight female body stimuli. The most compelling evidence for this relationship comes from gaze tracking studies, with some preliminary supporting evidence from studies using the ARDPEI and RSVP tasks to measure attention. However, other measures of attention did not provide evidence for an association between body dissatisfaction and attentional bias. We make five recommendations for future research on this topic.

Chapter 5: The Effect of an Odd-One-Out Visual Search Task on Attentional Bias, Body Size Adaptation, and Body Dissatisfaction

5.1. Addendum to Chapter 5

The results of Chapter 4 partially supported the thesis hypothesis (TH1). I found evidence from gaze tracking studies for a positive association between body dissatisfaction and attentional bias to low weight bodies. Women with high body dissatisfaction, when compared to women with low body dissatisfaction, directed more gaze toward low weight female body stimuli. This result highlights attentional bias to low weight bodies as a potential target for therapeutic intervention and justifies further research to explore whether attentional bias to low weight bodies causes feelings of body dissatisfaction. However, I did not find evidence for this positive association when attentional bias was assessed using other measures of attentional bias, including the dot probe task.

While completing my systematic review and meta-analysis (Chapter 4), I conducted an online experiment (Chapter 5) to test TH2-4. Based on the largely null results of Chapter 2, I decided to use a training visual search task to alter attentional bias. The training visual search task is less often used compared the training dot probe task; however, it has shown more promise as a method of modifying attentional bias and mood (Chelliah & Robinson, 2022) and has been shown to be effective at modifying body dissatisfaction (Schmidt & Martin, 2021; Smeets et al., 2011). During my Masters of Research (MRes) at Macquarie University, I conducted an unpublished study where I used a training visual search task to alter attentional bias to high versus low weight bodies. This training was ineffective at modifying attentional bias; however, there are a couple of reasons that could explain this. First, each visual search trial displayed an even number of high and low weight body stimuli (four of each body size); therefore, the target body did not have unique features and may not have be sufficient for capturing the participant's attention (Wolfe & Horowitz, 2017). Further, to fit eight body stimuli on the display I presented each body stimulus with relatively small dimensions (10% of the display screen's width and 20% of the display screen's height). Therefore, the differences in weight between high and low weight body stimuli may have been difficult to detect, especially because the body stimuli had their torsos covered. In Chapter 5, I aimed to address these limitations by conducting an odd-one-out visual search task, where each visual search trial involved one target body, e.g. one low (high) weight body, and seven distractor bodies, e.g. seven high (low) weight bodies. I used new body stimuli that had their torsos exposed to make differences in weight more noticeable.

In Chapter 5, I tested the effects of the training visual search task on attention to high versus low weight bodies (TH2), body size adaptation (TH3), and body dissatisfaction (TH4). Chapter 5 was written to be submitted as a research article to Royal Society Open Science and as a preprint on

PsyArXiv; however, the article is still in preparation and not yet submitted to a journal at the time of thesis submission. The focus of the research article was to test TH2-4; however, for the purpose of this thesis I conducted additional exploratory analyses on the pre-training data to test the association between body dissatisfaction and attentional bias to low weight bodies (TH1). I describe these pre-training analyses and report the associated results in Appendix 5.9.

5.1.1. Author Contributions

Thea House: Conceptualization, methodology, formal analysis, investigation, data curation, writing - original draft, writing - review & editing, and visualization.

Ian Stephen: Conceptualization, methodology, writing - review & editing, and supervision.

Kevin Brooks: Conceptualization, methodology, writing - review & editing, and supervision.

Helen Bould: Conceptualization, methodology, writing - review & editing, and supervision.

Angela Attwood: Conceptualization, methodology, writing - review & editing, and supervision.

Ian Penton-Voak: Conceptualization, methodology, writing - review & editing, and supervision.

5.2. Abstract

Body image disturbance is a both a risk factor for, and a symptom of, many eating disorders and refers to the misperception of and dissatisfaction with one's own body. Women with high body dissatisfaction have been shown to direct more attention to low body mass index (BMI) bodies, which results in the overestimation of body size via body size adaptation. Therefore, attention may have a causal role in body image disturbance. We conducted a novel training visual search task with 142 young adult women who we trained to attend to either high or low BMI bodies. We assessed the effects of this training on attention to bodies of different sizes, body size adaptation, and body dissatisfaction. Women trained to attend to low BMI bodies decreased their perceptions of a "normal" body size via adaptation from pre- to post-training ($p < .001$); however, women trained to attend to high BMI bodies showed no change in how they perceived a "normal" body size. We found no lasting effects of the training on attention to body size or body dissatisfaction; however, our visual search task showed poor internal consistency as a measure of attention. These findings indicate that attention to low BMI bodies may exacerbate body image disturbance in women. However, more reliable measures of attentional are required to confirm this finding.

5.3. Introduction

The term body image disturbance refers to a person's negative subjective experiences of their own body (Cash & Deagle, 1997; Hosseini & Padhy, 2022). Body image disturbance is a complex multidimensional concept, consisting of two main constructs. The first is body size and shape misperception—a perceptual construct referring to a person's over or underestimation of their body size (Brooks et al., 2020). The second—body dissatisfaction— is an attitudinal construct referring to a person's negative evaluation of their body (Karazsia et al., 2017). Both are associated with eating pathology. For example, body dissatisfaction and the overestimation of body size are diagnostic criteria for anorexia nervosa (American Psychiatric Association, 2013) and are associated with bulimia nervosa (Cash & Deagle, 1997). Body dissatisfaction is also a risk factor for bulimia nervosa, binge eating disorder, purging disorder (Stice et al., 2017), later depressive episodes (Bornioli et al., 2021), and risky health behaviours (Bornioli et al., 2019), as well as dieting and negative affect (Stice, 2002). For these reasons, body image disturbance is considered a serious public health concern (Bornioli et al., 2019, 2021; Bucchianeri & Neumark-Sztainer, 2014).

Body image disturbance is associated with multiple cognitive biases pertaining to body-related stimuli, including attentional, memory, and judgment biases (Rodgers & DuBois, 2016). Cognitive behavioural theories of eating disorders propose that the relationship is likely bidirectional, in that body image disturbance leads to biased cognitive processing of body-related stimuli, which in turn exacerbates feelings of body dissatisfaction (Williamson et al., 2004). One particular cognitive bias that has received considerable interest is attentional bias to bodies of different sizes. Western media has traditionally promoted a low body mass index (BMI) body size as ideal for women (de Freitas et al., 2018; Malkin et al., 1999; Owen & Laurel-Seller, 2000; Spitzer et al., 1999; Sypeck et al., 2004), and people tend to rate low BMI female bodies as more attractive (Brierley et al., 2016; Crossley et al., 2012; Swami et al., 2010). This body size preference is reflected in women's attentional biases, as women reporting high levels of body dissatisfaction tend to direct more gaze to low weight female bodies (House et al., 2023).

By paying more visual attention to smaller body sizes, women with high body dissatisfaction may be worsening their body image disturbance via visual adaptation—a perceptual bias caused by exposure to extreme stimuli (Brooks et al., 2020; Challinor et al., 2017). When people observe low (high) BMI bodies they visually "adapt" to these bodies, overestimating (underestimating) the size of subsequently presented body stimuli (Bould et al., 2020; Brooks, Baldry, et al., 2019; Brooks et al., 2016, 2018; Sturman et al., 2017; Winkler & Rhodes, 2005). These "body size aftereffects" are typically measured by asking participants at pre- and post-adaptation to select the body size they perceive as "normal". Participants who adapt to low (high) BMI bodies overestimate (underestimate) the size of the post-adaptation body stimuli, and thus select smaller (larger) "normal" body sizes (Brooks et al., 2021). Correlational research shows that body size aftereffects are related to attentional bias, as people presented with high and low BMI body stimuli simultaneously visually adapt to the body size they spend more time fixating on (Stephen, Sturman, et al., 2018). Experimental research provides evidence for fixations affecting the magnitude and direction of body size aftereffects, because people presented with high and low body stimulus pairs visually adapt to the body size they are instructed to look toward (Stephen, Hunter, et al., 2018). Therefore, by directing attention to low BMI bodies in everyday life, women with high body dissatisfaction are more likely to adapt to those bodies, causing body size aftereffects.

Importantly, body size aftereffects can lead to misperceptions of one's own body size. Brooks et al. (2016) adapted participants to low (high) BMI unfamiliar body stimuli and found participants subsequently overestimated (underestimated) the size of their own body. Therefore, attentional bias to low BMI bodies may lead women to overestimate their own body size via body size adaptation (Brooks et al., 2016; Hummel et al., 2012). Given the sociocultural pressures for women to be thin (Thompson et al., 1999), the overestimation of body size may also lead to increased feelings of body dissatisfaction. Correlational research indicates the overestimation of body size is positively associated with body dissatisfaction (Hagman et al., 2015; Manjrekar & Berenbaum, 2012; Moussally et al., 2017). Further, some research shows body size aftereffects cooccur with changes in body dissatisfaction. Bould et al. (2018) found that women exposed to high BMI bodies subsequently underestimated the size of body stimuli and reported feeling more satisfied with their own body. Indeed, there is a large body of evidence indicating that exposure to low BMI bodies increases body dissatisfaction in women (Groesz et al., 2002; Moreno-Domínguez et al., 2019; Tiggemann & McGill, 2004). Therefore, women with high body dissatisfaction may be worsening their body image disturbance by directing attention and visually adapting to low BMI bodies.

Given the potential negative outcomes of attentional bias to low BMI bodies, a promising intervention for the treatment of body image disturbance is computer-based attention training (sometimes referred to as attentional bias modification; Renwick et al., 2013a, 2013b). Computer-based attention training has been found to be effective in other areas of mental health, for example, by shifting attention away from threatening stimuli and reducing symptoms of anxiety (Linetzky et al., 2015; Price, Wallace, et al., 2016), albeit producing small effect sizes (Fodor et al., 2020). The interventions are relatively low in cost and intensity and so, if effective at reducing body image disturbance, they could provide a cost-effective adjunct to traditional talking therapies (Renwick et al., 2013a, 2013b).

A number of studies have used attention training to modify body dissatisfaction (for a review see Matheson et al., 2019). Most of these studies used the training dot probe task to train attention. The training dot probe task involves briefly presenting participants with a stimulus pair consisting of a target and control stimulus, followed by a probe that participants respond to as quickly as possible. To train attention to target stimuli, the probe replaces the target stimulus consistently over repeated trials (MacLeod et al., 2002). House et al. (2022) used the training dot probe task to direct participants' attention to high versus low BMI bodies and found the training had no effect on participants' body dissatisfaction and did not induce body size aftereffects. However, in the majority of cases this paradigm also failed to modify attention, which was assessed using reaction times on an assessment version of the dot probe task. Therefore, the absence of change for the body image variables is unsurprising. Other studies using the training dot probe task to direct attention to other body-related stimuli (e.g. body-related words) have similarly found minimal effects of attention training on body dissatisfaction (Engel et al., 2019; Matheson et al., 2019). However, many of these studies did not evaluate the effects of attention training on attentional bias, and therefore it is difficult to determine whether we would expect to see changes in body dissatisfaction. Studies that did assess attentional bias typically did so using reaction times on an assessment version of the dot probe task. However, the assessment version of the dot probe task has notably poor reliability (Parsons et al., 2019; Price et al., 2015; Rodebaugh et al., 2016; Schmukle, 2005) and, unlike eye-tracking measures, does not reliably detect positive associations between body dissatisfaction and attentional bias (House et al., 2023). Therefore, the assessment dot probe task may not be an appropriate tool for evaluating the effectiveness of attention training tasks.

An alternative less commonly used method of attention training is the training visual search task, which involves participants searching for a target stimulus amongst distractor stimuli. Over repeated training visual search trials, participants gradually become quicker at detecting target stimuli, reflecting increased attentional processing of those targets (and other stimuli paired visually adjacent to them; Dandeneau & Baldwin, 2004). Training visual search tasks have been successful at modifying body dissatisfaction by increasing attention to socially accepting versus threatening faces (Schmidt & Martin, 2021) and to attractive versus unattractive body parts (Smeets et al., 2011); therefore, they may present a more effective method of attention training than training dot probe tasks. Visual search tasks also tend to produce more reliable estimates of attentional bias than dot probe tasks (Fernández-Marcos et al., 2018; Van Bockstaele et al., 2020); therefore, they could provide a more reliable assessment of whether training visual search tasks are effective at modifying attentional bias.

In the present study, we aimed to investigate whether a novel training visual search task could alter women's attention to high versus low BMI female bodies. Half of the participants were trained to attend to high BMI body stimuli and half were trained to attend to low BMI body stimuli. Participants were measured at pre- and post-training on their attentional bias to body size, body size perception, and body dissatisfaction. We hypothesised that participants trained to attend to low (high) BMI body stimuli would 1) increase attention to low (high) BMI body stimuli, 2) perceive lower (higher) BMI body stimuli as "normal" due to body size adaptation, and 3) exhibit higher (lower) body dissatisfaction. This experiment was preregistered on the Open Science Framework (https://doi.org/10.17605/OSF.IO/NF8JX) with minor deviations from the preregistration explained in Appendix 5.1.

5.4. Methods

5.4.1. Recruitment and Participants

We recruited participants via the University of Bristol's Experimental Hours Scheme and reimbursed participants with course credit. To take part in the experiment, participants had to identify as female, aged 18-35 years old, fluent in English, and as having normal or corrected-to-normal vision. The experiment was completed online and required computer keyboard responses, so we excluded participants if they used a phone or tablet device. A power analysis indicated a sample size of 142 participants would be sufficient to detect a small-medium interaction (time x attention training condition) using a 2x2 ANOVA with 80% statistical power and an alpha level of 5% (G*Power v3.1.9.2; Faul et al., 2007). Therefore, we aimed to recruit 142 participants. If a participant completed the study but failed our data screening checks (described in the 5.4.6 Data Analysis section), then we excluded the participant and recruited a replacement participant.

5.4.2. Stimuli

Body stimuli were obtained from the complete Morphed Photographic Figure Scale (MPFS; Skinner et al., 2017) set, which consists of photographs of ten women (mean age = 21.90 years, *SD* = 4.43; mean BMI = 19.64 kg/m^2, *SD* = 2.74) who consented to their photographs being used in future research. To create the original MPFS set, Skinner and colleagues altered the apparent BMI of the identities in the ten photographs using PsychoMorph (Tiddeman et al., 2001). BMI transforms were based on the shape, colour, and texture differences between templates of averaged photographs of high BMI women (mean BMI: 25.2 kg/m^2) and averaged photographs of low BMI women (mean BMI: 17.3 kg/m^2). Skinner and colleagues transformed each of the ten original photographs to produce a sequence of nine morph levels from each photograph. Each sequence of nine morph levels included the original photograph plus four morph levels with the identity gradually increasing in apparent BMI and four morph levels with the identity gradually decreasing in apparent BMI (±20%, ±40%, ±60%, and ±80% of the shape, colour, and texture differences between the low and high BMI templates).

To increase the sensitivity of the scale for the present experiment, we completed additional shape, colour, and texture transforms on the scale set using the same landmark points in

PsychoMorph as applied by Skinner et al. (2017). We added an additional four steps to each sequence, resulting in 13 morph levels for each of the ten sequences. Each new sequence of 13 morph levels involved the original photograph plus six versions with the identity gradually increasing in apparent BMI and six versions with the identity gradually decreasing in apparent BMI (±13.3%, ±26.7%, ±40.0%, ±53.3%, ±66.7%, and ±80.0% of the shape, colour, and texture differences between the averaged low and high BMI photographs). We then used the GIMP image editor platform (version 2.10.22) to add a grey background to each image and a grey layer to cover the identity's face (hexadecimal colour = #333935; Figure 5.1). The size of the body stimuli varied based on the screen size of the participant's device, but the aspect ratios were identical for all participants.

Figure 5.1.

Example body stimuli depicting the same identity at varying degrees of apparent body mass index (BMI). Figure 5.1.a depicts the low BMI version of the identity (i.e., the smallest transformed morph level), Figure 5.1.b depicts the average BMI version of the identity (i.e., the unmanipulated morph level), and Figure 5.1.c depicts the high BMI version of the identity (i.e. the largest transformed morph level).

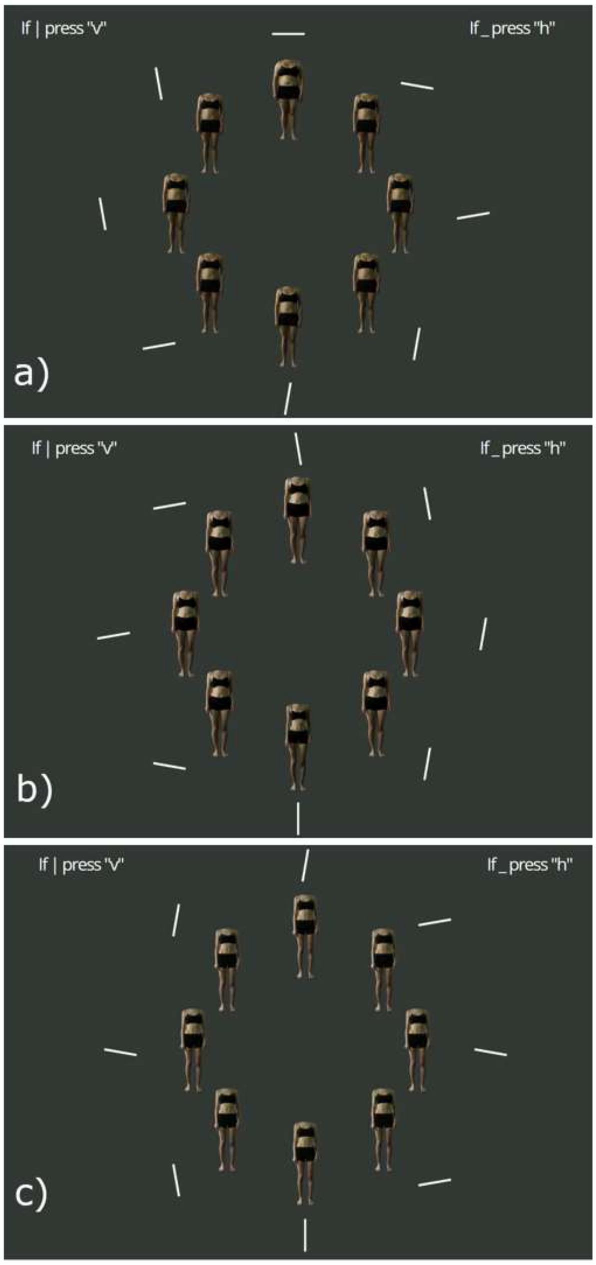
5.4.3. Training Visual Search Task

To train participants' attention, we used a novel training version of a compound visual search task (Figure 5.2; Cass et al., 2020; Talbot et al., 2019). Participants completed the task on a computer. The task involved 360 trials presented in 6 blocks (60 trials per block), including a 30 second break between blocks to reduce fatigue. Each trial started with a 1000ms fixation, followed by a display involving eight body stimuli in front of a grey background (hexadecimal colour = #333935). The bodies were positioned with their centres evenly spaced in a circular array which was centred in the middle of the screen with a radius that was 34% of the screen's height. The dimensions of each body were 22% of the screen's height and 6% of the screen's width. The eight body stimuli involved one identity selected at random from the pool of ten. For participants trained to attend to high (low) BMI bodies, each trial displayed seven average BMI body stimuli and one high (low) BMI body stimulus. The average BMI body stimuli were always the unmanipulated version of the identity, and the high (low) BMI body stimulus was always the largest (smallest) transformed version. The position of the high or low BMI body stimulus in the circular array was randomised for each trial.

Each body stimulus appeared next to a short white bar (hexadecimal colour = #FFFFFF). The centres of the bars were evenly spaced in a larger circular array centred in the middle of the screen with a radius that was 44% of the screen's height. The dimensions of each bar were 6% of the screen's height and 1% of the screen's width. One of the eight bars was a "target" bar and was oriented either horizontally or vertically (orientation randomised). The seven remaining bars were "distractor" bars and oriented at either 80°, 100°, 170°, or 190° (orientation randomised). For participants who were trained to direct attention to high (low) BMI bodies, the target bar was next to the high (low) BMI body stimulus on every training trial. The seven distractor bars were paired at random next to the seven average BMI body stimuli. We told participants to indicate, as quickly as possible, whether a horizontal or vertical bar was present by pressing the appropriate keys ("h" or "v"). For each trial, the visual search display remained on the screen until the participant responded, whereupon they automatically proceeded to the next trial.

Figure 5.2.

Example visual search trials. Figure 5.2.a depicts an example training/pre-training target visual search trial for participants trained to attend to high body mass index (BMI) body stimuli. In this example, the target bar is the horizontal bar at the top centre of the array. The target bar is located next to a high BMI body stimulus and the remaining body stimuli are average BMI. Figure 5.2.b depicts an example training/pre-training target visual search trial for participants trained to attend to low BMI body stimuli. In this example, the target bar is the vertical bar at the bottom centre of the array. The target bar is located next to a low BMI body stimulus and the remaining body stimuli are average BMI. Figure 5.2.c depicts an example pre-training neutral visual search trial. The target bar is vertical at the bottom centre of the array and all body stimuli are average BMI.



5.4.4. Measures

5.4.4.1. Attentional Bias. To check whether the attention manipulation was successful, we asked participants to complete pre- and post-training assessment versions of the visual search task that were designed to measure, rather than train, attentional bias (Figure 5.2; Cass et al., 2020; Talbot et al., 2019). We measured participants' change in attentional bias to the body size targeted in their attention training. The pre- and post-training visual search tasks each involved one block of 40 target trials and one block of 40 neutral trials presented with no break (block order randomised). Target trials were identical to the participants' training visual search trials. Neutral trials were similar to target trials; however, participants were presented with eight average BMI body stimuli with no high or low BMI body stimulus present. For these neutral trials, the target bar and seven distractor bars were paired at random with each of the eight average BMI body stimuli. For both target and neutral trials, the instructions were identical to those for the training visual search trials.

For each participant, we calculated a pre- and post-training attentional bias score. We initially screened the data at a trial level using preregistered criteria developed in similar research (Dondzilo et al., 2017). We excluded visual search trials if the participant responded incorrectly (4.31% of pre-training visual search trials; 3.89% of post-training visual search trials) or if the participant's reaction time was < 200ms (0.55% of correct pre-training visual search trials; 1.74% of correct post-training visual search trials) or > 2.5 standard deviations greater than their mean reaction time (2.62% of correct pre-training visual search trials; 2.40% of correct post-training visual search trials). After screening, pre-training attentional bias scores were calculated by subtracting mean response times for pre-training target trials from the mean response times for pre-training neutral trials. The same was done to calculate participants' post-training attentional bias scores, i.e., mean reaction times for post-training target trials were subtracted from the mean reaction times for post-training neutral trials. For participants trained to attend to high (low) BMI body stimuli, a positive attentional bias score meant that participants demonstrated an attentional bias to high (low) BMI body stimuli, relative to average BMI body stimuli.

5.4.4.2. Point of Subjective Normality (PSN). Participants' PSNs were obtained at pre- and post-training with a version of the method of adjustment task to measure body size perception, and potentially detect an adaptation aftereffect (Stephen et al., 2016). We presented participants with the ten body stimulus sequences one at a time (order randomised). Participants were initially presented with one of the 13 morph levels of a single identity at random in the centre of screen. The body dimensions were 57% of the screen's height and 15% of the screen's width. Participants could manipulate the identity's body size by keyboard pressing "p" to move up one morph level and keyboard pressing "q" to move down one morph level. The sequence of morph levels was looped, so pressing “p” on the highest morph level would lead to the lowest morph level, and vice versa. Participants were instructed to press a “Select” button to choose the morph level of the body that they thought looked the most “normal” sized. Participants were given the freedom to interpret the meaning of “normal” sized since we did not provide them with a specific definition. Pressing the “Select” button moved the participant onto the next identity. We determined a PSN score for each participant by calculating the mean body size chosen as “normal” for ten identities. Therefore, a higher (lower) PSN score indicated the participant perceived bodies higher (lower) in BMI to be “normal” in size. We interpreted a PSN increase (decrease) from pre- to post-training as evidence of body size aftereffects, because underestimating (overestimating) the size of post-training body stimuli would lead participants to select post-training bodies higher (lower) in BMI as “normal” sized.

5.4.4.3. Body Dissatisfaction. We measured body dissatisfaction at pre- and post-training with a modified version of the body shape satisfaction scale (House, Stephen, et al., 2022; Pingitore et al., 1997), which asked participants to rate their satisfaction “at this moment” with 18 body parts or features. Participants responded to each item using a slider scale and response options ranged from 0-100 (0 = “Very satisfied”; 100 = “Very dissatisfied”). We calculated body dissatisfaction scores by summing responses for all 18 items, so higher scores meant higher body dissatisfaction. For participants trained to attend to high BMI bodies, Cronbach’s alpha indicated excellent internal consistency at pre-training ($\alpha = 0.91$) and post-training ($\alpha = 0.94$). For participants training to attend to low BMI bodies, Cronbach’s alpha indicated excellent internal consistency at pre-training ($\alpha = 0.92$) and post-training ($\alpha = 0.95$).

5.4.4.4. Attention Check. To screen for participants who were paying sufficient attention to the experiment instructions, we included two attention check questions. The pre-training attention check question asked “Based on the above text, what is 5+5?”, with the above text instructing participants to answer with the number “50”. The post-training attention check question asked, “Based on the text below, what is today’s date?”, with the below text instructing participants to answer with the word “today”. Participants were able to complete the experiment and be fully reimbursed regardless of their responses to these questions. However, we only included participants in our data analysis if they respond correctly to both questions (i.e. Q1 “50” and Q2 “today”).

5.4.5. Procedure

Participants accessed the experiment via a hyperlink to the Gorilla Experiment Builder (Anwyl-Irvine et al., 2020; https://gorilla.sc/). First, participants were asked to complete a consent form and confirm whether they met the eligibility criteria. Participants who did were then asked to complete a demographics questionnaire which asked their ethnicity, age, and if they had a current or previous eating disorder diagnosis. We then asked participants to provide their height and weight so that we could calculate their BMI (kg/m^2). Participants then completed the pre-training body shape satisfaction scale, followed by the pre-training attention check question. Participants then completed three practice PSN trials, which involved three identities selected at random, followed by the pre-training PSN task. Next, participants completed 10 practice visual search trials, which were similar to the neutral trials in the pre- and post-training visual search tasks; however, participants were presented with a tick for responding correctly and a cross for responding incorrectly. Once the participant completed the 10 practice visual search trials, they were given the opportunity to reread the task instructions and repeat the practice visual search trials. If the participant did not want to revisit the task instructions or practice visual search trials, then they completed the pre-training visual search task, followed by the training visual search task, post-training body shape satisfaction scale, post-training attention check question, post-training PSNs, and post-training visual search task.

5.4.6. Data Analysis

We initially screened data at a participant level (for screening results see Appendix 5.10). We excluded participants from analyses if 1) they did not finish the experiment, 2) they made incorrect responses on either attention check question, or 3) their response accuracy was < 80% on either the pre- or post-training visual search tasks. To minimize any effects of training decay on the post-training measures, we also excluded participants from the analysis if they took > 90 minutes to finish the experiment or took > 60 minutes and were inactive (i.e. did not make any keyboard or mouse response) for > 5 minutes during the training visual search task or post-training measures. We evaluated the internal consistency of the pre- and post-training visual search tasks as measures of attentional bias using the splithalf R package (Parsons, 2021), which estimates split half reliability statistics for cognitive tasks. We calculated the average Spearman-Brown corrected correlation coefficients for 5000 random splits of reaction time difference scores for target versus neutral visual search trials, separately by attention training condition (high vs. low BMI) and time (pre-training vs. post-training).

To test our three hypotheses, we conducted three 2x2 ANOVAs. The data satisfied ANOVA assumptions of linearity, normality, and homogeneity of variances. For each ANOVA, we included attention training condition as the between-participants independent variable (high vs. low BMI) and time as the within-participants independent variable (pre-training vs. post-training). The dependent variable for the first ANOVA was attentional bias score. The purpose of this ANOVA was to check whether the attention training worked at manipulating attention to the target body size. Hypothesis 1 would be supported if there was evidence for a main effect of time and participants in both conditions demonstrated a higher attentional bias score at post-training than pre-training. The dependent variable for the second ANOVA was PSN score. Hypothesis 2 would be supported if there was evidence for an interaction and participants in the low (high) BMI training group demonstrated a PSN score decrease (increase) from pre- to post-training. The dependent variable for the third ANOVA was body dissatisfaction score. Hypothesis 3 would be supported if there was evidence for an interaction and participants in the low (high) BMI training group demonstrated a body dissatisfaction increase (decrease) from pre- to post-training. For each ANOVA, we used a standard $p < .05$ criterion to evaluate effects and interactions, and we followed up interactions using *t*-tests.

We conducted two sensitivity analyses to assess the robustness of our main results by rerunning our main analyses but with certain participants removed from the sample. First, we reran the main analyses but excluded participants who confirmed in the demographics questionnaire that they had a current or previous eating disorder diagnosis. Second, we reran the main analyses but excluding extreme outlier participants who were more than three times the interquartile range outside the 25th and 75th percentiles for any of the dependent variables (attentional bias score, PSN score, and body dissatisfaction score).

5.5. Results

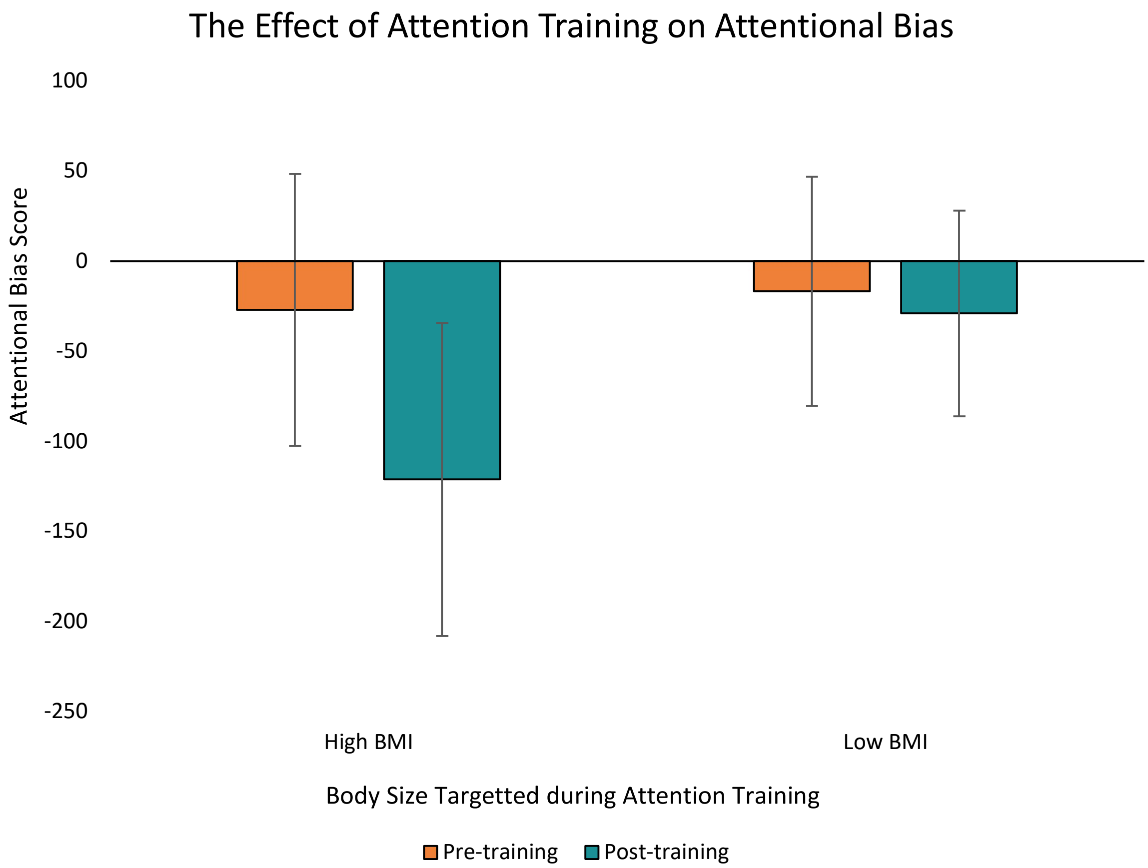
The final sample consisted of 71 participants trained to attend to high BMI bodies (mean age = 19.62 years, *SD* = 1.63; mean BMI = 22.18 kg/m^2, *SD* = 3.56) and 71 participants trained to attend to low BMI bodies (mean age = 19.39 years, *SD* = 1.70; mean BMI = 21.65 kg/m^2, *SD* = 2.74). The majority of the participants (n = 121) identified as White/White British/White European/White American), 7 identified as Asian/Asian British, 3 as Black/African/Caribbean/Black British, 3 identified as Middle Eastern, and the remaining 8 as mixed/multiple ethnic groups. Ten participants confirmed they had a history of an eating disorder. The internal consistency of the visual search task was variable. For participants trained to attend to high BMI bodies, it demonstrated poor internal consistency at pre-training (Spearman Brown coefficient = 0.46 [95% CI = 0.20, 0.64]) and moderate internal consistency at post-training (Spearman Brown coefficient = 0.71 [95% CI = 0.57, 0.82]). For participants trained to attend to low BMI bodies, internal consistency was poor at pre-training (Spearman Brown coefficient = 0.17 [95% CI = -0.15, 0.45]) and post-training (Spearman Brown coefficient = 0.49 [95% CI = 0.29, 0.65]).

Descriptive statistics for attentional bias, PSN, and body dissatisfaction scores are reported in Figures 5.3, 5.4, and 5.5. The ANOVA for attentional bias score did not provide evidence for main effects of time, $F(1, 140) = 2.25$, $p = .136$, $\eta^2_G = 0.007$, condition, $F(1, 140) = 1.86$, $p = .175$, $\eta^2_G = 0.007$, or an interaction between time and condition, $F(1, 140) = 1.33$, $p = .251$, $\eta^2_G = 0.004$. The second ANOVA had PSN score as the outcome and provided evidence for a main effect of time, *F*(1,

140) = 6.31, p = .013, η^2_G = 0.004, no evidence for an effect of condition, $F(1, 140) = 2.54$, p = .113, η^2_G = 0.016, and strong evidence for an interaction between time and condition, $F(1, 140) = 13.66$, $p < .001$, η^2_G = 0.008. Follow up paired t-tests showed there was no evidence for a difference between pre- and post-training PSN scores for the high BMI attention training condition $t(70) = -0.84$, p = .406, d = -0.099. For the low BMI training condition, there was strong evidence indicating participants decreased their PSN score from pre- to post-training, $t(70) = 4.40$, $p < .001$, d = 0.522. The third ANOVA had body dissatisfaction score as the outcome and did not provide evidence for a main effect of time, $F(1, 140) = 0.79$, p = .376, $\eta^2_G < 0.001$, condition, $F(1, 140) = 0.02$, p = .878, $\eta^2_G < 0.001$, or an interaction between time and condition, $F(1, 140) = 0.16$, p = .694, $\eta^2_G < 0.001$. The sensitivity analyses produced consistent results to our main analyses (see Appendices 5.3-5.8), indicating the results were not driven by extreme outlier participants or those with an eating disorder history.

Figure 5.3.

A bar chart depicting the effect of the attention training on the participants' attentional bias score (N = 142). For participants trained to attend to high (low) BMI body stimuli, a positive attentional bias score meant that participants demonstrated an attentional bias to high (low) BMI body stimuli, relative to average BMI body stimuli.



Note. Error bars indicate 95% confidence intervals.

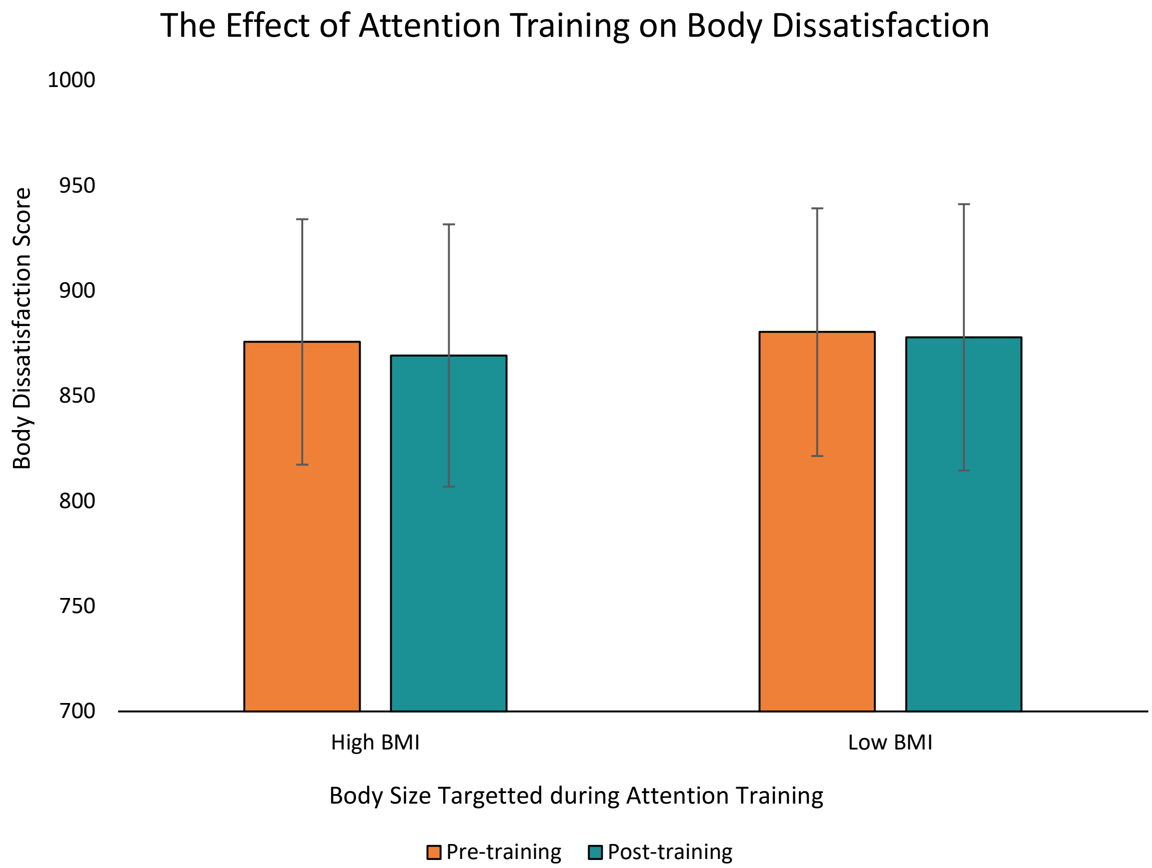
Figure 5.4.

A bar chart depicting the effect of the attention training on the participants' PSN score (N = 142). A higher (lower) PSN score indicated the participant perceived bodies higher (lower) in BMI to be "normal" in size.

Note. Error bars indicate 95% confidence intervals. *** = $p < .001$

Figure 5.5.

A bar chart depicting the effect of the attention training on the participants' body dissatisfaction score (N = 142). A higher body dissatisfaction score indicated greater body dissatisfaction.



Note. Error bars indicate 95% confidence intervals.

5.6. Discussion

We used a novel training visual search task to train the attention of young adult women to either high or low BMI female bodies. In support of our second hypothesis, participants trained to attend to low BMI bodies showed a visual aftereffect of size overestimation, as demonstrated by a decrease in the size of bodies deemed to appear “normal” from pre- to post-training. Contrary to our first and third hypothesis, there was no evidence suggesting participants trained to attend to low BMI bodies changed their attentional bias or body dissatisfaction from pre- to post-training. Contrary to all three hypotheses, there was no evidence suggesting participants trained to attend to high BMI bodies changed their attentional bias, perception of body size, or body dissatisfaction from pre- to post-training.

The participants trained to attend to low BMI bodies adapted to low BMI bodies without demonstrating a lasting measurable change in attention from pre- to post-training. Therefore, participants in this condition may have adapted to low BMI bodies simply via increased exposure to low BMI bodies during the training visual search trials. However, the low BMI training trials involved directing participants attention to low BMI bodies, by requiring participants to search for target bars located in close visual proximity to low BMI bodies. Therefore, participants are likely to have directed more attention to low BMI bodies during these training trials, even if the training did not produce a lasting change in attentional bias measurable at post-training. Further, this visual aftereffect is consistent with the results of previous research demonstrating that increased attention to low BMI bodies can lead participants to overestimate the size of subsequently presented body stimuli (Stephen, Hunter, et al., 2018; Stephen, Sturman, et al., 2018). Adaptation can transfer across identities and lead to the misperception of one’s own body size (Brooks et al., 2016; Hummel et al., 2012); therefore, these results support the suggestion that increased attentional processing of low BMI bodies could lead a person to overestimate their own body size (Brooks et al., 2020; Challinor et al., 2017). Women with high body dissatisfaction, when compared to women with low body dissatisfaction, direct more gaze to low BMI bodies (House et al., 2023). Therefore, women with high body dissatisfaction may overestimate their own body size via increased attentional processing of low BMI bodies and body size adaptation. The overestimation of body size is a core feature and symptom of anorexia nervosa (American Psychiatric Association, 2013; Mölbert et al., 2017); therefore, attentional bias induced body size adaptation may be a contributing factor in the development and/or maintenance of eating disorders.

Participants adapted to low BMI bodies; however, they did not report an increase in body dissatisfaction following the attention training. This lack of change in body dissatisfaction is inconsistent with some previous research that found body size aftereffects co-occurred with changes in body dissatisfaction (Bould et al., 2018). On the other hand, Stephen, Hunter, et al. (2018) found that increased attention to low BMI bodies led to body size aftereffects but no changes in body dissatisfaction. One possible explanation for the inconsistent findings is that Bould et al. (2018) asked participants to look in a full length mirror immediately after the adaptation period, which could have distorted the participants' stored representation of their body size (Brooks et al., 2021) and increased translation effects on body dissatisfaction. However, further research is needed to explore this explanation.

We did not find evidence that the attention training had a lasting effect on attention to high versus low BMI bodies. Although we expected faster responses to the target body size in post- compared to pre-training assessments, we did not find any such change. The low BMI attention training condition involved directing participant's attention to low BMI bodies and participants in this condition did show a body size aftereffect. Therefore, it is possible that these participants increased their attention to low BMI bodies even though we did not detect a change in reaction times. We evaluated the reliability of the visual search task as a measure of attentional bias and found the task had poor to moderate internal consistency. These results are more promising than results from dot probe tasks (e.g. House, Wong, et al., 2022); however, they are still unacceptably low. It is not yet standard practice to report on the psychometric properties of cognitive behavioural tasks (Parsons et al., 2019); therefore, it is difficult to compare the internal consistency of our version of the visual search task to previous versions (Cass et al., 2020; Talbot et al., 2019). However, the results suggest the visual search task may not have been sufficient for detecting measurable changes in attention. Given participants in the low BMI attention training condition did adapt to low BMI bodies, the training visual search task may have promise as a method of attention training (albeit to low BMI bodies which were not our target for therapeutic intervention). Future research assessing the effects of attention training on attention should consider using alternative measures of attention. For example, although more costly and resource intensive, eye-tracking measures such as total dwell time have good to excellent internal consistency results (Skinner et al., 2018; Waechter et al., 2014) and provide more evidence for a positive association between body dissatisfaction and attentional bias to low BMI bodies than reaction time measures (House et al., 2023). Similarly, event-related potentials (ERPs) produce excellent internal consistency results (Reutter et al., 2017) and are reliably modified by attention training tasks (Carlson, 2021). In addition, a control condition could be included to distinguish between aftereffects caused by exposure versus attention to low BMI bodies by training participants to attend to average sized bodies that are presented alongside low BMI bodies.

In contrast to the low BMI attention training group, participants trained to attend to high BMI bodies showed no body size aftereffects. This finding is surprising, because body size adaptation studies on non-clinical populations consistently find participants exhibit body size aftereffects to both low and high BMI bodies (Brooks, Baldry, et al., 2019; Brooks et al., 2016, 2018; Stephen, Hunter, et al., 2018; Sturman et al., 2017). While imbalanced aftereffects are uncommon in studies on non-clinical populations, a study on women with anorexia nervosa and bulimia nervosa found that participants adapted to high BMI bodies but not low BMI bodies (Mohr et al., 2016). The authors suggested that participants may have been preadapted to low BMI bodies due to a pre-existing attentional bias to low BMI bodies, so measurable body size aftereffects could not be induced in a laboratory experiment. In our study, participants trained to attend to high BMI bodies did have an average negative attentional bias score at pre-training, which could indicate a possible pre-existing attentional bias to high BMI bodies. However, we are cautious about making inferences from the attentional bias scores given that they demonstrated unacceptably poor internal consistency. As this is the first study to use this novel training visual search task and the training was successful at adapting participants to low BMI bodies, future research is justified to explore whether modifications to the task increase the likelihood of aftereffects to high BMI bodies, especially because high BMI bodies are our target for therapeutic intervention. Possible modifications could include reducing the number of breaks and increasing the number of training trials and sessions to reduce the chance of adaptation decay.

5.7. Conclusion

We used a novel attention training task and found that young adult women trained to attend to low BMI bodies showed a body size aftereffect, i.e., they overestimated the size of subsequently presented body stimuli and thus selected a lower BMI body as “normal” sized. Contrary to our expectations, the attention training did not induce adaptation to high BMI bodies and had no measurable effect on reaction times or body dissatisfaction. However, given the training was effective at inducing adaptation to low BMI bodies, modifications to the task (e.g. reducing the number of breaks and using more training trials and sessions) could make the task more effective at inducing an aftereffect following attention to high BMI bodies. The visual search task demonstrated unacceptably low internal consistency as a measure of attentional bias to body size, and therefore we recommend researchers explore other options (e.g. eye-tracking or ERPs) when assessing the effects of attention training on attention.

Chapter 6: The Relationship Between Body Dissatisfaction and Engagement and Disengagement Bias to Body Size in Malaysian Women

6.1. Addendum to Chapter 6

In Chapter 5, I found that women trained to attend to low weight bodies showed a visual aftereffect of size overestimation, as demonstrated by a decrease in the size of bodies deemed to appear “normal” from pre- to post-training. This supports TH3. However, the results for participants in this condition do not support TH2 and TH4, because these participants showed no change in their attentional bias (TH2) or body dissatisfaction (TH4) as a result of the training. Women trained using the visual search task to attend to high weight bodies did not demonstrate a change in attentional bias, body size adaptation, or body dissatisfaction as a result of the training. Therefore, the results for participants in this condition do not support TH2-4. My analysis of the pre-training data did not support TH1, because there was no evidence for an association between body dissatisfaction and attentional bias to low weight bodies (Appendix 5.9). I also found the assessment visual search task had unacceptably low to moderate levels of internal consistency as a measure of attentional bias.

Based on these results, it appears that the assessment version of the visual search task has similarly poor psychometric properties to the assessment version of the dot probe task. Therefore, as with Chapter 2, I find it difficult to determine whether the attention training had an effect on attentional bias. My conclusion from Chapter 4 still stands—gaze tracking measures of attention, e.g. gaze duration, currently provide the most compelling evidence for a positive association between body dissatisfaction and attentional bias to low weight bodies. However, a disadvantage of gaze tracking tasks is that they are resource-intensive, because they typically require more expensive equipment and training to administer when compared to reaction time tasks. Therefore, it is worthwhile to continue exploring whether there are alternative reaction time tasks that are more effective than the assessment versions of the dot probe and visual search task.

While completing Chapter 5 and my systematic review and meta-analysis (Chapter 4), I conducted one final online study (Chapter 6) to test TH1. In this study, I aimed to overcome a limitation with the dot probe task—that it cannot distinguish between biased attentional engagement and disengagement. A person could be responding faster to probes replacing low weight bodies because they are quick to initially engage with low weight body stimuli. Alternatively, people may be responding faster because they are slow to disengage from the low weight body stimuli and are therefore still attending to the correct location by the time the probe appears (Clarke et al., 2013). The Attentional Response to Distal vs. Proximal Emotional Information (ARDPEI) task (Grafton & MacLeod, 2014) was developed to overcome this limitation, by using an anchor probe to direct the participants' attention to either the left or right side of the screen prior to the presentation of the stimulus pair (see Chapter 6 for a more detailed summary). In Chapter 6, I tested whether two distinct aspects of attentional bias—engagement bias and disengagement bias—are associated with body dissatisfaction (TH1). My collaborators Dr Hoo Keat Wong, Charlotte Chiew, and Tee Huei Chua were responsible for collecting the data for this study. Charlotte Chiew, and Tee Huei Chua completed their undergraduate theses using a subset of the data; however, Chapter 6 involves new analyses on the full dataset. Chapter 6 was written to be submitted as a research article to Royal Society Open Science and as a preprint on PsyArXiv; however, the article is still in preparation and not yet submitted to a journal at the time of thesis submission.

6.1.1. Author Contributions

Thea House: Conceptualization, methodology, formal analysis, investigation, data curation, writing - original draft, and writing - review & editing.

Hoo Keat Wong: Conceptualization, methodology, investigation, and writing - review & editing.

Ian Stephen: Conceptualization, methodology, writing - review & editing, and supervision.

Kevin Brooks: Conceptualization, methodology, writing - review & editing, and supervision.

Helen Bould: Conceptualization, methodology, writing - review & editing, and supervision.

Angela Attwood: Conceptualization, methodology, writing - review & editing, and supervision.

Ian Penton-Voak: Conceptualization, methodology, writing - review & editing, and supervision.

6.2. Abstract

Body dissatisfaction—the negative subjective evaluation of one's body—is associated with negative health outcomes, including eating disorders such as anorexia nervosa. Eye-tracking studies consistently show that women with high body dissatisfaction, compared to women with low body dissatisfaction, direct more gaze toward low weight bodies. However, reaction time measures of attention produce inconsistent results and typically do not distinguish between engagement and disengagement bias. We conducted an Attentional Response to Distal Versus Proximal Emotional Information (ARDPEI) task with 200 young adult Malaysian women to measure engagement and disengagement bias to body size. Contrary to our hypotheses, we did not find evidence for a positive association between engagement or disengagement bias to body size and body dissatisfaction. We did find weak evidence for a negative association between engagement bias to low weight bodies

and body dissatisfaction. However, the ARDPEI task demonstrated poor internal consistency as a measure of attentional bias. We recommend that researchers testing the relationship between attentional bias and body dissatisfaction measure attention using eye-tracking or an ARDPEI task adapted to an individual differences framework.

6.3. Introduction

Many people report feeling discontent with their body. This negative subjective evaluation is called body dissatisfaction (Stice & Shaw, 2002) and is highly prevalent globally among adults (Swami et al., 2010) and adolescents (Al Sabbah et al., 2009). Body dissatisfaction represents the attitudinal component of body image disturbance (Cash & Deagle, 1997) and is related to various negative health outcomes, including eating disorders such as anorexia nervosa (American Psychiatric Association, 2013; Stice & Shaw, 2002). Cognitive-behavioural theories of eating disorders suggest that body dissatisfaction may lead a person to selectively attend to body-related stimuli, which may in turn exacerbate feelings of body dissatisfaction (Williamson et al., 2004). Therefore, research on body-related attentional biases may further our understanding of the development and maintenance of body dissatisfaction and the associated negative health outcomes.

High levels of body dissatisfaction are associated with an attentional bias towards low weight bodies (House et al., 2023; Rodgers & DuBois, 2016). Eye-tracking studies consistently show that, compared to women with low body dissatisfaction, women with high body dissatisfaction direct more gaze towards low weight female body stimuli (Cho & Lee, 2013; Gao et al., 2014; House et al., 2023; Stephen et al., 2018; Tobin et al., 2019; Withnell et al., 2019). However, reaction time studies using the dot probe task have generated inconsistent findings (House et al., 2023). The dot probe task involves presenting participants with a stimulus pair (e.g. one low and one high weight body stimulus), followed by a probe that the participants must react to as quickly as possible (MacLeod et al., 1986). Some research shows that women with high (compared to low) body dissatisfaction respond faster to probes replacing low weight bodies, suggesting women with high body dissatisfaction have a greater attentional bias towards low weight bodies (Dondzilo et al., 2017; Joseph et al., 2016; Moussally et al., 2016). However, other research has not replicated this association (Glauert et al., 2010; House, Wong, et al., 2022; House, Stephen, et al., 2022).

One possible reason for these inconsistent results is the reported poor reliability of the dot probe task as a measure of attentional bias (Rodebaugh et al., 2016), as demonstrated by studies using the task to measure attentional bias to emotional faces (Chapman et al., 2019; Price et al., 2015) and emotionally threatening words (Schmukle, 2005). It is not standard practice to report on the psychometric properties of cognitive behavioural tasks (Parsons et al., 2019); however, studies evaluating the internal consistency of the dot probe task as a measure of attentional bias to low weight bodies have found similarly poor levels of internal consistency (House, Wong, et al., 2022). Although eye-tracking studies typically have greater internal consistency than the dot probe task (Sears et al., 2019; Skinner et al., 2018; Waechter et al., 2014), they are more resource-intensive because they typically require more expensive equipment and training to administer.

A further limitation of the dot probe task is that it cannot distinguish between biased attentional engagement and disengagement. A person could be responding faster to probes replacing low weight bodies because they are quick to initially engage with low weight body stimuli. Alternatively, people may be responding faster because they are slow to disengage from the low weight body stimuli and are therefore still attending to the correct location by the time the probe appears (Clarke et al., 2013). To overcome this limitation, Grafton and MacLeod (2014) designed the Attentional Response to Distal vs. Proximal Emotional Information (ARDPEI) task. This reaction time task is similar to the dot probe task; however, each trial starts with an anchor probe which serves to direct the participants' attention to either the left or right side of the screen prior to the presentation of the stimulus pair. When the target stimulus is distal from the anchor probe, participants who are quick to engage with target stimuli are quicker at reacting to probes replacing target stimuli than probes replacing non-target stimuli. When the target stimulus is proximal from the anchor probe, participants who are slow to disengage from target stimuli are faster at responding to probes replacing target stimuli compared to non-target stimuli. The ARDPEI task has been used effectively by researchers to distinguish between engagement and disengagement bias to negative emotional stimuli (Dondzilo et al., 2022) and food stimuli (Jonker et al., 2020). If the ARDPEI task can reliably detect results that are consistent with eye-tracking studies (House et al., 2023), then this task could provide a less resource-intensive alternative to eye-tracking.

Dondzilo et al. (2021) used the ARDPEI task to measure engagement and disengagement bias towards low weight bodies in a sample of 63 women in Australia. Engagement bias was positively and indirectly related to body dissatisfaction, with the relationship being serially mediated via appearance comparisons followed by eating disorder-specific rumination. Eating disorder-specific rumination refers to the repeated negative thinking (reflecting and brooding) about eating, body shape, and body weight (Cowdrey & Park, 2011; Dondzilo et al., 2015), and has been shown to predict eating disorder symptoms and the onset of bulimia nervosa (Aldao et al., 2010). Further, the brooding component of eating disorder-specific rumination (critically comparing one's situation to other situations deemed more superior) has been shown to be associated with eating disorder symptoms, even while controlling for body mass index (BMI; Dondzilo et al., 2015). Several studies have now highlighted eating disorder-specific rumination as a possible mediating variable on the relationship between attentional bias to thin bodies and body dissatisfaction (Berrisford-Thompson et al., 2021; Dondzilo et al., 2017; Dondzilo et al., 2021), although evidence for this indirect relationship is correlational not causal. Dondzilo et al. (2021) found no evidence for an association (direct or indirect) between disengagement bias and body dissatisfaction. However, Dondzilo et al. (2021) may not have had enough statistical power to detect these direct or indirect relationships.

We followed the approach of Dondzilo et al. (2021) and used an ARDPEI task to test the association between body dissatisfaction and engagement and disengagement bias to low weight bodies. We recruited a sample of young adult Malaysian women. Body image concerns, thin body ideals, and eating disorder symptoms are commonly reported by Malaysian women (Chua et al., 2022; Kamaria, et al., 2016; Khor et al., 2009), and some cross-cultural body image research has highlighted similarities in body dissatisfaction and internalisation of the thin ideal between Malaysian and Australian women (House, Wong, et al., 2022; Shagar et al., 2019). However, few studies have explored body size attentional biases in this population (House et al., 2023; House, Wong, et al., 2022). In our primary models, we hypothesised that engagement bias and disengagement bias to low weight bodies would be positively and directly related to body dissatisfaction.

Our secondary models tested whether the relationships between engagement and disengagement bias to low weight bodies and body dissatisfaction were serially mediated via appearance comparisons and eating disorder-specific rumination. We hypothesised that engagement bias would be positively and indirectly related to body dissatisfaction, via a positive association between engagement bias and appearance comparisons, followed by a positive association between appearance comparisons and eating disorder-specific rumination, followed by a positive association between eating disorder-specific rumination and body dissatisfaction. We hypothesised disengagement bias would also be positively and indirectly related to body dissatisfaction, via the same serial mediation model. The study protocol was preregistered on the Open Science Framework in October 2021 and deviations from the protocol are explained in Appendix 6.1. (https://doi.org/10.17605/OSF.IO/VX8Y7).

6.4. Methods

6.4.1. Participants

Participants were required to identify as female, Malaysian, aged between 18-35 years old, fluent in English, and having normal or corrected-to-normal vision. Participants were recruited using the University of Nottingham Malaysia's study signup system and snowball sampling. Participants were reimbursed with either course credit or monetary compensation of RM5 (approximately US$1.20). We conducted a power analysis using G*Power v3.1.9.2, which indicated that we needed

191 participants to detect a small correlation coefficient (*r* = .20) between body dissatisfaction and engagement bias with 80% statistical power at an alpha level of .05 (Faul et al., 2009). Therefore, we aimed to recruit 200 participants with data eligible for analyses.

6.4.2. Stimuli

Body stimuli involved modified photographs of ten Asian women (mean body mass index (BMI) = 21.25 kg/m^2, *SD* = 3.02; mean age = 20.30 years, *SD* = 2.67) obtained from previous research (Gould-Fensom et al., 2019). All identities were photographed in a standard anatomical position wearing a grey singlet and shorts. For each identity, the Spherize tool in Photoshop was used to create one high and one low weight version of the model by horizontally expanding or contracting the body from the neck down by 50%. A black square was added to conceal each identity's face. Neutral abstract art stimuli involved ten images selected from a Google search for the term "abstract art", excluding images involving body-related content. We resized the art images to match the size of the body stimuli (450 × 900 pixels). See Figures 6.1 and 6.2 for example stimuli.

Figure 6.1.

Example abstract art stimulus.

Figure 6.2.

Example body stimuli involving a high and low weight version of the same identity.

6.4.3. Materials

All materials were presented to participants online using a display with a 4:3 aspect ratio. The material dimensions were dependent on the participant's screen size, but aspect ratios were held constant for each participant. All written materials were presented in English, which is widely spoken in Malaysia as a second language (Education First, 2022) and is used in most universities as the primary language of instruction. Questionnaires and task instructions were also evaluated for appropriateness to local contexts by author HKW who is Malaysian Chinese and multilingual, speaking English, Mandarin, and Malay proficiently.

6.4.3.1. Appearance Comparisons. Participants completed the 11-item Physical Appearance Comparison Scale-Revised (PACS-R; Schaefer & Thompson, 2014), which measures how often a person compares their physical appearance to the physical appearance of other people. Items included statements such as "When I'm at a party, I compare my body shape to the body shape of others" and "When I'm eating in a restaurant, I compare my body fat to the body fat of others." Participants rated how often they make this type of comparison on a 5-point Likert Scale (0 = Never, 1= Seldom, 2 = Sometimes, 3 = Often, 4 = Always). To calculate an appearance comparison score, responses were averaged, so possible scores could range from 0 to 4 with higher scores reflecting a greater appearance comparisons. Cronbach's alpha indicated the questionnaire had excellent internal consistency ($\alpha = 0.91$).

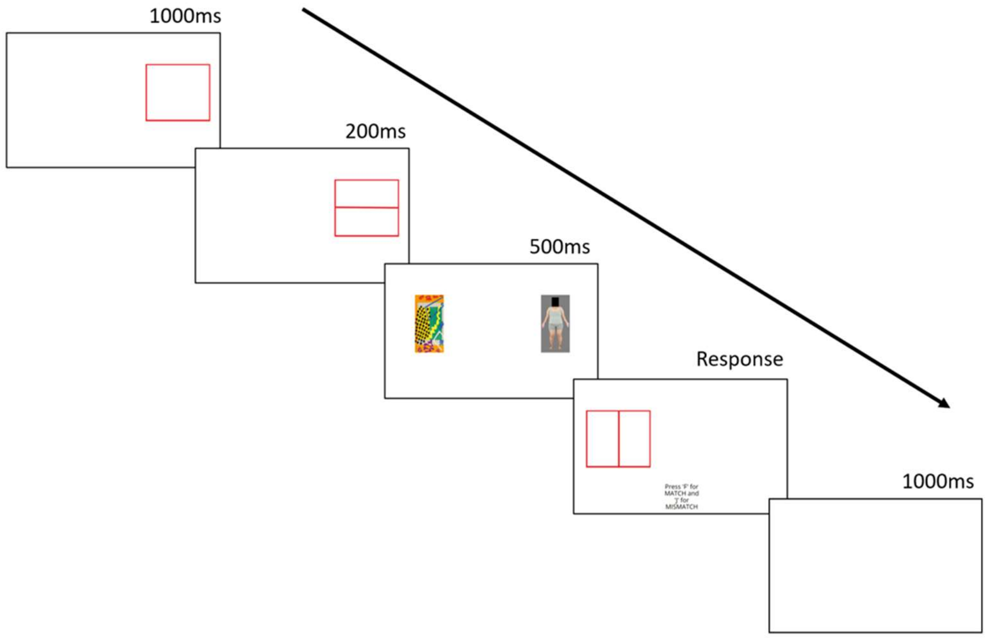
6.4.3.2. Eating Disorder-Specific Rumination. Participants completed the 9-item Ruminative Response Scale for Eating Disorders (RRS-ED; Cowdrey & Park, 2011), which asked participants how often they think or behave in specific ways when feeling concerned about controlling their eating, weight, and/or shape. Participants responded on a 4-point Likert scale (1 = "Almost never", 4 = "Almost always") to items such as "Write down what you think about your eating, weight and/or shape and analyse it". To calculate an eating disorder-specific rumination score, responses were summed, meaning scores could range from 9 to 36 with higher scores reflecting greater eating disorder-specific rumination. Cronbach's alpha indicated the questionnaire had excellent internal consistency ($\alpha = 0.87$).

6.4.3.3. Body Dissatisfaction. Participants completed a modified version of the Body Shape Satisfaction Scale (BSSS), which asked participants to rate their satisfaction with 18 body features (Pingitore et al., 1997; see Appendix 3.4). For each item, response options ranged from 1-7 and were presented on a Likert scale (1 = "Very dissatisfied", 7 = "Very satisfied"). To calculate a body dissatisfaction score, responses were reverse-coded and summed, so possible body dissatisfaction scores could range from 18 to 126 with higher scores reflecting greater body dissatisfaction. Cronbach's alpha indicated the questionnaire had excellent internal consistency (α = 0.91).

6.4.3.4. Attentional Response to Distal Versus Proximal Emotional Information (ARDPEI) Task. An example ARDPEI trial is depicted in Figure 6.3. Following Dondzilo et al. (2021), each ARDPEI trial started by presenting a rectangle on either the left or right side (side randomised) of a white display (Hex Colour Code = #FFFFFF). The rectangle was transparent with a red outline (Hex Colour Code = #F01C24) and was sized at 34% of the display's width and 40% of the display's height. After 1000ms, an anchor probe appeared. The anchor probe was a red straight line (Hex Colour Code = #F01C24) dissecting the rectangle through its centre at a horizontal or vertical angle (orientation randomised). The rectangle and anchor probe both disappeared after 200ms. Then a stimulus pair appeared involving one body stimulus (either high or low weight) and one neutral abstract art stimulus, both selected at random from the stimulus set and presented on the left and right side of the display (side randomised). The stimulus pair remained on the display for 500ms before being replaced by a second rectangle presented on either the left or right side of the display (side randomised). This second rectangle had identical colour and size properties as the first rectangle and contained a target probe. The target probe was a red straight line (Hex Colour Code = #F01C24) dissecting the rectangle through its centre at a horizontal or vertical angle (orientation randomised). The participants were instructed to identify if the target probe orientation matched the anchor probe orientation as accurately and quickly as possible by pressing the keyboard letter "f" for match and "j" for mismatch. After the participants responded, a blank display appeared for 1000ms and the next trial began.

Figure 6.3.

An example ARDPEI trial. In this example, a high weight body stimulus is proximal to the anchor probe (horizontal line) and a neutral abstract art stimulus cues the target probe (vertical line). This trial type constitutes the PHCN component of the disengagement bias formulae. A correct keyboard response for this trial would be "j" for mismatch, because the orientation of the target probe (vertical) does not match the orientation of the anchor probe (horizontal).



Participants completed 224 trials in total with a 30-second midway break. For half of the trials, the body stimulus was a low weight body; for the other half a high weight body. Trials were presented in a random order. We used mean reaction times to calculate an engagement bias score and a disengagement bias score for each participant using the following formulae (Dondzilo et al., 2021; D = distal (appears on the opposite side of the screen), P = proximal (appears on the same side of the screen), C = cue for the target probe, H = high weight body, L = low weight body, and N = neutral abstract art).

Engagement bias score = [(DLCN – DLCL) – (DHCN – DHCH)]

Disengagement bias score = [(PLCN – PLCL) – (PHCN – PHCH)]

For example, PLCN is the participant's mean reaction time when the anchor probe is proximal (P) to a low weight body (L) and the target probe is cued (C) by neutral abstract art (N). PLCN includes trials where the anchor probe is presented on the left (right) side of the screen, followed by a low weight body presented on the left (right) side of the screen and neutral abstract art presented on the right (left) side of the screen, followed by the probe presented on the right (left) side of the screen). In another example, DHCH is the mean reaction time when the anchor probe is distal (D) from a high weight body (H) and the target probe is cued (C) by the high weight body (H). DHCH includes trials where the anchor probe is presented on the left (right) side of the screen, followed by a high weight body presented on the right (left) side of the screen and neutral abstract art presented on the left (right) side of the screen, followed by the probe presented on the right (left) side of the screen). Greater engagement bias scores reflect quicker attentional engagement with low weight bodies relative to high weight bodies. Greater disengagement bias scores reflect slower attentional disengagement from low weight bodies relative to high weight bodies.

6.4.3.5. Attention Checks. We included two attention check questions to ensure we only analysed data on participants who paid attention to the study instructions. Our first question asked: "Based on the above text, what is 5+5?" with the above text instructing participants to answer with "50". Our second question asked: "Based on the text below, what is today's date?" with the below text instructing participants to answer by writing the word "today". We determined participants were sufficiently following the study instructions if they responded with "50" to question 1 and "today" to question 2.

6.4.4. Procedure

We presented the study online via the Gorilla Experiment Builder (https://gorilla.sc/), which records reaction times with good temporal precision (8.25ms) and a delay (80ms) that is relatively consistent across operating systems and devices (Anwyl-Irvine et al., 2021). Prior research has successfully replicated reaction time findings using the Gorilla Experiment Builder across different participant groups, settings, equipment, and internet connections (Anwyl-Irvine et al., 2020). Participants accessed the study via a hyperlink. The ARDPEI task required participants to respond on a computer keyboard (excluding participants using a phone or tablet device). Participants who gave informed consent and confirmed they met our eligibility criteria were able to start the study. Participants started the study by completing a demographic questionnaire, which asked them to report their height and weight (so we could calculate their BMI), as well as their age (in years) and ethnicity. Participants then completed the remaining questionnaires in the following order: BSSS, first attention check question, PACS-R, RRS-ED, and second attention check question.

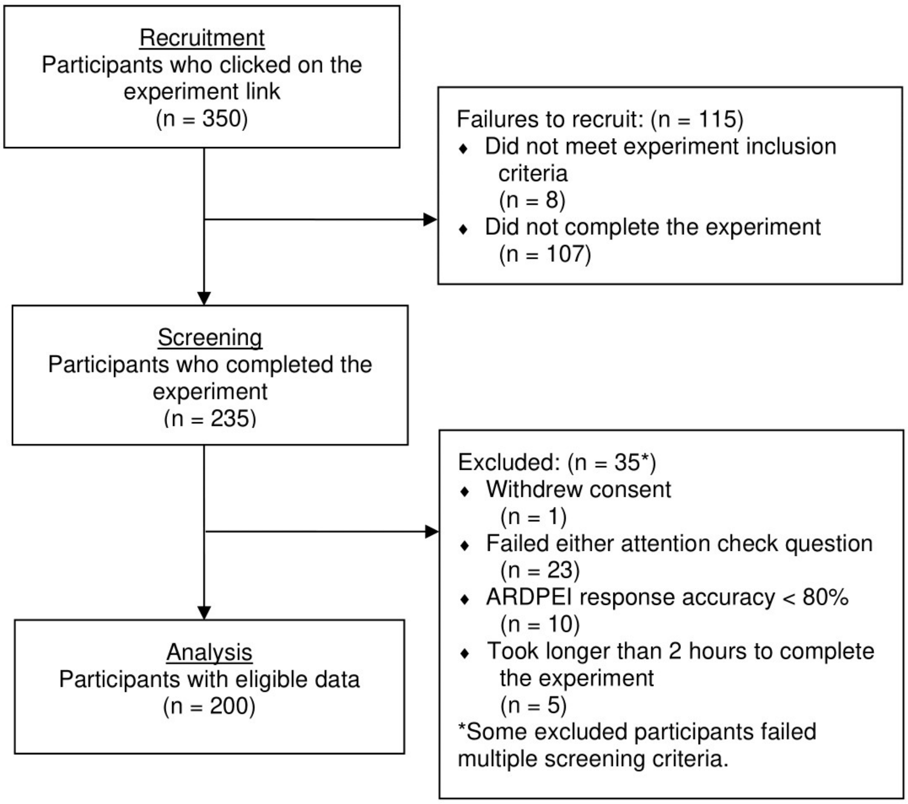
Next, participants completed 20 practice trials of the ARDPEI task. Body stimuli for the practice trials involved the veridical body stimuli, i.e., the body stimuli without the size manipulations. Participants were presented with their practice score, and participants who responded correctly on ≥ 16 trials were given the option of commencing the main ARDPEI task or rereading the task instructions and having a second attempt at the practice trials. Participants who responded correctly on < 16 trials were instructed to reread the task instructions and have a second attempt at the practice trials. Participants who completed a second attempt at the practice trials were shown their second practice score followed by the task instructions. Participants commenced the main ARDPEI task regardless of their second practice score. After participants completed the main ARDPEI task, participants completed a final consent form that asked whether they consented to submitting their data. The entire study took approximately 30 minutes to complete.

6.4.5. Data Screening

We initially screened data at a participant level (see Figure 6.4) and excluded participants if 1) they did not finish the study, 2) they took > two hours to finish the study, 3) their response accuracy was < 80% on the ARDPEI task, or 4) they made incorrect responses on either of the two attention check questions. When participants were excluded, we recruited replacement participants so we met our target sample size. Next, we screened data for the ARDPEI task at a trial level, following the approach used by Dondzilo et al. (2021). We excluded individual trials where participants responded incorrectly (4.04% of trials) or where the participant's reaction time was < 200ms or > 2.58 standard deviations away from the participant's mean reaction time (2.48% of correct trials).

Figure 6.4.

The recruitment and data screening process presented in a modified CONSORT diagram.



6.5.6. Data Analysis

For testing our primary hypotheses, we used two linear regressions with body dissatisfaction as the outcome variable. For model 1, we included engagement bias as a predictor and interpreted support for Hypothesis 1 if the regression coefficient for engagement bias was positive (p<.05). For model 2, we included disengagement bias as a predictor and interpreted support for Hypothesis 2 if the regression coefficient for disengagement bias was positive (p<.05). We then ran two sensitivity analyses which involved rerunning each linear regression and a) excluding outlier participants and b) including BMI and age as covariates. Outlier participants were defined as being more than three times the interquartile range outside the 25th and 75th percentiles for the variables included in each model.

To test our secondary hypotheses, we conducted two serial mediation models using the PROCESS tool for SPSS (Hayes, 2018). For model 3, the predictor variable was engagement bias, the first mediator variable was appearance comparisons, the second mediator variable was eating disorder-specific rumination, and the outcome variable was body dissatisfaction (see Figure 6.5). Hypothesis 3 would be supported if a) each independent component of the hypothesised indirect relationship (a_1, d_{21}, and b_2) had a positive coefficient (p<.05) and b) percentile bootstrapped 95% confidence intervals with 5000 samples for the hypothesised indirect relationship ($a_1d_{21}b_2$) did not overlap zero. For model 4, we conducted an identical serial mediation model, except that the predictor variable was disengagement bias (see Figure 6.6). Hypothesis 4 would be supported if a) each independent component of the hypothesised indirect relationship (a_1, d_{21}, and b_2) had a positive coefficient (p<.05) and b) percentile bootstrapped 95% confidence intervals with 5000 samples for the hypothesised indirect relationship ($a_1d_{21}b_2$) did not overlap zero. We ran two sensitivity analyses on models 3 and 4 using the same approach as described previously, except that outlier participants were defined as participants who were either a) more than three times the interquartile range outside the 25th and 75th percentiles for any of the variables included in the model and/or b) had a Mahalanobis distance greater than 16.27 (df = 3; p < .001). Lastly, we evaluated the internal consistency of the engagement and disengagement bias indices using the splithalf R package and 5000 random splits (Parsons, 2021).

Figure 6.5.

The statistical diagram for model 3. Solid arrows represent the hypothesised indirect relationship and dashed arrows represent alternate pathways.

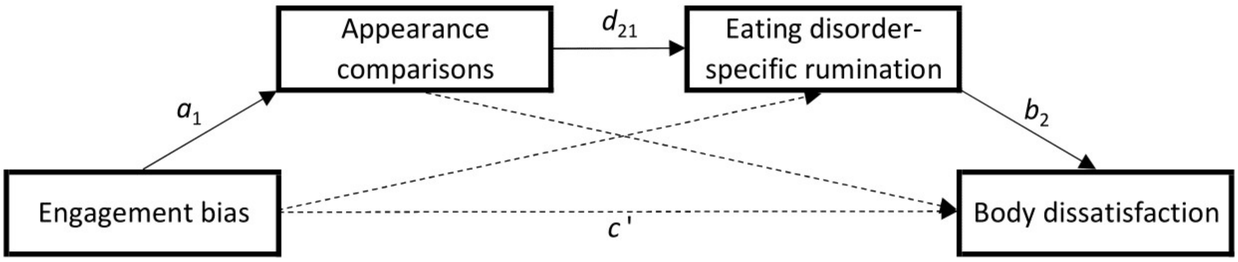
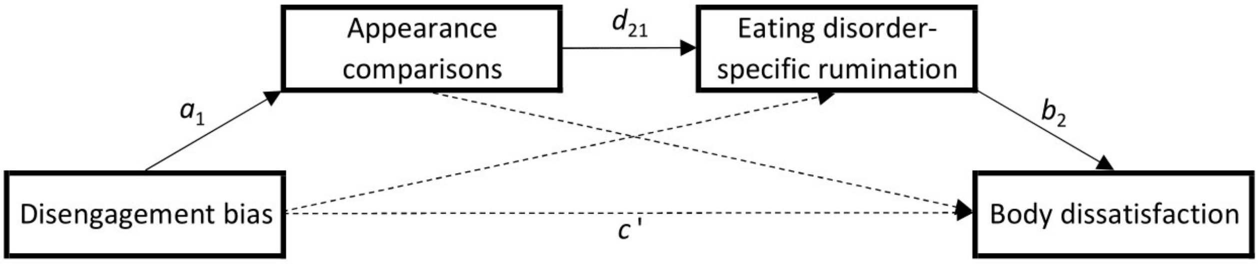


Figure 6.6.

The statistical diagram for model 4. Solid arrows represent the hypothesised indirect relationship and dashed arrows represent alternate pathways.



6.5. Results

The results of the recruitment and data screening process are presented in Figure 6.4. Descriptive statistics and correlation coefficients for the final sample (*N* = 200) are presented in Table 6.1. The majority of participants (n = 180) identified as Malaysian Chinese, 10 as mixed ethnicity, 4 as Malaysian Indian, 4 as Malaysian Malay, and 2 as Kadazan. The results of the linear regressions and sensitivity analyses testing Hypotheses 1 and 2 are presented in Table 6.2. Model 1 did not produce evidence for a relationship between engagement bias and body dissatisfaction. Consistent results were found from the sensitivity analyses that removed outlier participants. The sensitivity analysis controlling for age and BMI found some evidence for a negative relationship between engagement bias and body dissatisfaction, indicating that women who engaged slower (faster) with low (high) weight bodies had higher body dissatisfaction; however the effect size was small and evidence for the association was weak. Model 2 and the related sensitivity analyses did not find any evidence supporting the hypothesised relationship between disengagement bias and body dissatisfaction.

Table 6.1.

The descriptive statistics and correlation coefficients (Pearson's r) for the main variables (N = 200).

Variable	*M*	*SD*	1.	2.	3.	4.	5.	6.	7.
1. Age (years)	21.39	2.40	-						
2. BMI (kg/m^2)	20.33	3.12	0.32***	-					
3. Engagement bias	0.64	96.45	-0.01	0.08	-				
4. Disengagement bias	-6.66	108.82	-0.01	-0.08	-0.07	-			
5. Appearance comparisons	1.79	0.78	0.03	0.18**	0.07	0.11	-		
6. Eating disorder-specific rumination	16.74	5.63	0.12	0.28***	0.10	0.01	0.46***	-	
7. Body dissatisfaction	72.97	15.62	0.10	0.44***	-0.09	0.01	0.41***	0.45***	-

Note. BMI = body mass index; *p < .05. **p < .01. *** p < .001

Table 6.2.

The results of the linear regressions and associated sensitivity analyses with body dissatisfaction as the outcome variable. For each model, the first sensitivity analysis (a) excluded outlier participants and the second sensitivity analysis (b) included BMI and age as covariates. Outlier participants were defined as being more than three times the interquartile range outside the 25th and 75th percentiles for the variables included in each model.

Model	Predictor	*N*	*B*	95% CI for *B*		*SE B*	*p*	*β*	R^2	R^2_{adj}
				LL	UL					
Model 1	Engagement bias	200	-0.015	-0.038	0.007	0.011	.189	-0.093	0.009	0.004
Sensitivity analysis: 1a	Engagement bias	197	-0.014	-0.044	0.015	0.015	.344	-0.068	0.005	-0.001
Sensitivity analysis: 1b	Engagement bias	200	-0.021	-0.042	-0.001	0.010	.041	-0.131	0.210	0.198
	Age (years)		-0.305	-1.167	0.556	0.437	.485	-0.047	-	-
	BMI (kg/m^2)		2.315	1.652	2.978	0.336	< .001	0.463	-	-
Model 2	Disengagement bias	200	0.001	-0.019	0.021	0.010	.925	0.007	4.436×10^{-5}	-0.005
Sensitivity analysis: 2a	Disengagement bias	198	0.001	-0.025	0.027	0.013	.928	0.006	4.168×10^{-5}	-0.005
Sensitivity analysis: 2b	Disengagement bias	200	0.006	-0.012	0.024	0.009	.500	0.043	0.195	0.183
	Age (years)		-0.276	-1.145	0.593	0.441	.531	-0.042	-	-
	BMI (kg/m^2)		2.273	1.604	2.942	0.339	< .001	0.455	-	-

Note. BMI = body mass index; *B* = unstandardised regression coefficient; CI = confidence interval; LL = lower limit; UL = upper limit; *SE B* = standard error of the coefficient; *β* = standardised coefficient; R^2 = coefficient of determination; R^2_{adj} = adjusted R^2

The results of the serial mediation models and sensitivity analyses testing Hypotheses 3 and 4 are presented in Table 6.3. For both models 3 and 4, we found strong evidence for a positive association between appearance comparisons and eating disorder-specific rumination, as well as between eating disorder-specific rumination and body dissatisfaction. However, model 3 and the related sensitivity analyses did not find any evidence in support of the hypothesis that engagement bias was associated with appearance comparisons or for our hypothesised indirect relationship between engagement bias and body dissatisfaction. Consistent with model 1, model 3 and the related sensitivity analyses produced weak evidence for a negative direct association between engagement bias and body dissatisfaction, indicating that women who engaged slower (faster) with low (high) weight bodies had higher body dissatisfaction. Model 4 and the related sensitivity analyses did not produce any evidence for an association between disengagement bias and appearance comparisons or for our hypothesised indirect relationship between disengagement bias and body dissatisfaction. The internal consistency of the ARDPEI task was poor (engagement bias Spearman-Brown corrected reliability estimate: -0.10, 95% CI [-0.45, 0.24]; disengagement bias Spearman-Brown corrected reliability estimate: 0.19, 95% CI [-0.06, 0.41])[4].

[4] One participant had too few engagement bias trials for the splithalf package to run, so we excluded this participant from the evaluation of the engagement bias trials.

Table 6.3.

The results of the serial mediation models and associated sensitivity analyses with body dissatisfaction as the outcome variable, appearance comparisons as the first mediator, and eating disorder-specific rumination as the second mediator. For model 3 and the associated sensitivity analyses, the predictor variable is engagement bias. For model 4 and the associated sensitivity analyses, the predictor variable is disengagement bias. For each model, the first sensitivity analysis (a) excluded outlier participants and the second sensitivity analysis (b) included BMI and age as covariates. Outlier participants were defined as participants who were either a) more than three times the interquartile range outside the 25th and 75th percentiles for any of the variables included in the model and/or b) had a Mahalanobis distance greater than 16.27 (df = 3; p < .001).

Model	***N***	a_1		d_{21}		b_2		c'		$a_1d_{21}b_2$	c	
		***B* [95% CI]**	***p***	***B* [95% CI]**	***p***	***B* [95% CI]**	***p***	***B* [95% CI]**	***p***	***B* [Bootstrapped 95% CI]**	***B* [95% CI]**	***p***
Model 3	200	0.0006 [-0.0006, 0.0017]	.3303	3.2666 [2.3603, 4.1730]	< .0001	0.9505 [0.5758, 1.3253]	< .0001	-0.0237 [-0.0432, -0.0042]	.0177	0.0017 [-0.0017, 0.0065]	-0.0151 [-0.0377, 0.0075]	.1886
Sensitivity analysis: 3a	196	0.0008 [-0.0007, 0.0023]	.2964	3.2951 [2.3850, 4.2052]	< .0001	0.9650 [0.5815, 1.3485]	< .0001	-0.0271 [-0.0532, -0.0010]	.0417	0.0025 [-0.0022, 0.0082]	-0.0149 [-0.0452, 0.0154]	.3324
Sensitivity analysis: 3b	200	0.0004 [-0.0007, 0.0015]	.4472	3.0232 [2.1202, 3.9263]	< .0001	0.7374 [0.3799, 1.0949]	.0001	-0.0268 [-0.0449, -0.0086]	.0041	0.0010 [-0.0017, 0.0046]	-0.0213 [-0.0416, -0.0009]	.0408
Model 4	200	0.0008 [-0.0002, 0.0018]	.1185	3.3323 [2.4206, 4.2440]	< .0001	0.9118 [0.5326, 1.2910]	< .0001	-0.0038 [-0.0214, 0.0137]	.6668	0.0024 [-0.0007, 0.0053]	0.0010 [-0.0192, 0.0211]	.9254
Sensitivity analysis: 4a	197	0.0003 [-0.0010, 0.0017]	.6082	3.3489 [2.4404, 4.2575]	< .0001	0.9261 [0.5400, 1.3122]	< .0001	0.0001 [-0.0231, 0.0232]	.9940	0.0011 [-0.0033, 0.0051]	0.0013 [-0.0255, 0.0280]	.9247

Model	***N***	$\boldsymbol{a_1}$		$\boldsymbol{d_{21}}$		$\boldsymbol{b_2}$		***c'***		$\boldsymbol{a_1 d_{21} b_2}$	***c***	
		B **[95% CI]**	***p***	***B*** **[95% CI]**	***p***	***B*** **[95% CI]**	***p***	***B*** **[95% CI]**	***p***	***B*** **[Bootstrapped 95% CI]**	***B*** **[95% CI]**	***p***
Sensitivity analysis: 4b	200	0.0009 [-0.0001, 0.0019]	.0701	3.0644 [2.1534, 3.9755]	< .0001	0.7031 [0.3386, 1.0676]	.0002	0.0007 [-0.0158, 0.0172]	.9349	0.0020 [-0.0003, 0.0042]	0.0062 [-0.0120, 0.0244]	.5002

Note. *c'* = direct effect, $a_1 d_{21} b_2$ = hypothesised indirect effect, *c* = total effect; a_1, d_{21}, and b_2 = independent components of the hypothesised indirect relationship; CI = confidence interval

6.6. Discussion

We conducted an ARDPEI task to measure engagement and disengagement bias to body size and explore the psychological correlates in young adult Malaysian women. Contrary to our hypotheses, we found weak evidence for a negative direct association between engagement bias and body dissatisfaction when other relevant variables were controlled in our models (e.g. age, BMI, appearance comparisons, and eating disorder-specific rumination). Women who engaged more slowly (quickly) with low (high) weight bodies had higher body dissatisfaction. We also found no evidence for a relationship (either direct or indirect) between disengagement bias and body dissatisfaction.

Both our engagement bias and disengagement bias findings contrast with results reported by eye-tracking studies that typically show body dissatisfaction to be positively associated with attention to low weight bodies (Cho & Lee, 2013; Gao et al., 2014; Stephen, Sturman, et al., 2018; Tobin et al., 2019; Withnell et al., 2019). This discrepancy between eye-tracking and reaction times measures has previously been highlighted in a meta-analysis synthesising eye-tracking measures and other reaction times measures, such as the dot probe task (House et al., 2023). The absence of an association between disengagement bias and body dissatisfaction is perhaps not surprising, given that Dondzilo et al. (2021) also found no evidence for an association between disengagement bias to body size and body dissatisfaction in their ARDPEI study. However, they did find evidence for a positive indirect association between engagement bias and body dissatisfaction. Women who engaged faster (slower) with low (high) weight bodies had higher body dissatisfaction, with this association being mediated by appearance comparisons and eating disorder-specific rumination. Although our engagement bias findings are in the opposite direction to these observations, it should be noted that the effect size was small and evidence for the association was weak.

One possible explanation for the difference in engagement bias results is that participants completed our study online, whereas Dondzilo et al. (2021) tested participants in a laboratory setting. Our data quality may have been reduced by the variation in participant devices and browsers, or by the participants being more distracted or less motivated without the presence of an experimenter. Therefore, the online setting of our study may have led to a spurious negative association between engagement bias and body dissatisfaction. However, research generally finds online-based studies produce similar reaction time results to laboratory-based studies (Armitage & Eerola, 2020; Hilbig, 2016; Uittenhove et al., 2023). Further, we used the Gorilla Experiment Builder to host the study (https://gorilla.sc/), which produces relatively consistent reaction time results across different participant groups, settings, equipment, and internet connections (Anwyl-Irvine et al., 2021; Anwyl-Irvine et al., 2020). We also aimed to improve data quality by including practice opportunities with feedback on the ARDPEI task, and we only analysed data from participants who passed our attention check questions and responded correctly on ≥ 80% of ARDPEI trials (Sauter et al., 2020). We also recruited a sample size over three times larger than Dondzilo et al. (2021) and powered our study to detect small effect sizes. Therefore, we think it is unlikely that the online setting of our study contributed to the difference in engagement bias results.

Another possible explanation is that the contrasting results were caused by differences in populations. We recruited a sample of Malaysian women, whereas Dondzilo et al. (2021) recruited a sample of women in Australia. While recent cross-cultural body image research has highlighted similarities in body dissatisfaction between Malaysian and Australian women (Shagar et al., 2019), earlier studies indicate that the presentation of body dissatisfaction differs between Western and Asian samples (Frederick et al., 2007; Mellor et al., 2013, 2014). This may be reflected in differences in the association between body dissatisfaction and attentional bias to body size. House, Wong et al. (2022) compared Malaysian Chinese women with White Australian women on the association between body dissatisfaction and attentional bias to body size using a dot probe task. There was no evidence indicating the association was moderated by participant ethnicity; however, the authors acknowledged that the lack of moderating effects may have been caused by the poor reliability of the dot probe task as a measure of attentional bias. We are not aware of an eye-tracking study measuring attentional bias to body size in Malaysian women; however, eye-tracking studies on women in other Asian countries (e.g. China (Gao et al., 2014) and South Korea (Cho & Lee, 2013)) have produced similar results to eye-tracking studies on women in Western countries (House et al., 2023), including women in Australia (Stephen, Sturman, et al., 2018). Therefore, it seems unlikely that there are population differences in the association between body dissatisfaction and attentional bias to body size; however, further research on Malaysian women is required to confirm this. It should also be noted that although we did not collect data on the living circumstances of the participants, many participants were recruited via a university in Selangor—a state with a high percentage urban population (Department of Statistics, Malaysia, 2022). Research in Malaysia has found women in urban areas report lower body size preferences and greater body dissatisfaction than women in rural areas (Swami et al., 2010; Swami & Tovée, 2005); therefore, the results of this study may not apply to women in more rural areas of Malaysia. Research should also further evaluate the psychometric properties of the questionnaires used in this study with Malaysian populations. The questionnaires demonstrated excellent internal consistency in this sample; however, other psychometric properties like predictive validity have only been comprehensively assessed in Western populations (e.g., Neumark-Sztainer et al., 2006), which may have contributed to the difference in results (Swami & Barron, 2019).

Another plausible explanation is that the difference between the results of the current study and Dondzilo et al. (2021) is caused by the poor reliability of the ARDPEI task as a measure of attentional bias. In our study, the ARDPEI task demonstrated unacceptably low levels of internal consistency as a measure of engagement bias and disengagement bias (Spearman-Brown estimates ≤ 0.19). These are similar levels to results obtained in dot probe studies (Spearman-Brown estimates typically ≤ .50; Chapman et al., 2019; House, Wong, et al., 2022; Rodebaugh et al., 2016; Schmukle, 2005) and lower than results obtained in eye-tracking studies using fixation duration as a measure of attention (Spearman-Brown estimates typically ≥ .80; Sears et al., 2019; Waechter et al., 2014). It is not standard practice in psychology to report on the psychometric properties of cognitive-behavioural tasks (Parsons et al., 2019), and we cannot directly compare the internal consistency of our ARDPEI task to the ARDPEI task used by Dondzilo et al. (2021). We identified only two other papers reporting on the internal consistency of their ARDPEI task. One study found similarly low levels of internal consistency (Spearman-Brown estimates ≤ 0.27; Jonker et al., 2020) and another study found good-excellent internal consistency (Spearman-Brown estimates ≥ 0.78; Dondzilo et al., 2022). Although, we should note that Dondzilo et al. (2022) evaluated the internal consistency of participant reaction times separately for each trial type, rather than their engagement and disengagement bias indices, which could have inflated their internal consistency results (Parsons et al., 2019). Together, these results indicate that the ARDPEI task may have similarly poor levels of internal consistency to the dot probe task as a measure of attentional bias, and this may explain why our results contrast with other ARDPEI studies (Dondzilo et al., 2021) and eye-tracking studies (House et al., 2023).

The results of our research indicates the ARDPEI task does not reliably detect a positive association between body dissatisfaction and attentional bias to body size. Therefore, although more costly and resource intensive, the evidence suggests that, at present, eye-tracking remains the most reliable approach for testing this association. Eye-tracking may also provide a more ecologically valid assessment of attentional bias compared to reaction time tasks that do not fully capture the complexity of attentional bias (Kerr-Gaffney et al., 2018). However, this does not necessarily mean that reaction time tasks like the ARDPEI task and dot probe task should be abandoned, especially given that they are relatively faster and less costly to administer. Attentional bias indices in these tasks are typically calculated using the difference in mean reaction times for various trial types. Difference scores may be appropriate for experimental designs, because they reduce the effect of between-participant variation; however, they are less appropriate for individual difference research because they reduce the effect of individual differences—the precise difference of interest (Hedge et al., 2018). Goodhew and Edwards (2019) proposed a number of recommendations for adapting these tasks to individual differences research. For example, researchers should consider fixed trial and block orders to reduce random noise and facilitate the detection of individual variation. Researchers could also consider exploring the variability of attentional bias over time by analysing data at a trial level, rather than aggregating reaction times at a task level (Zvielli et al., 2015). Trial level analyses of dot probe data have been shown in some studies (e.g. Carlson & Fang, 2020) to produce more reliable attentional bias scores than traditional difference scores. Therefore, modifications to the ARDPEI task may make it a more appropriate measure for testing the relationship between body dissatisfaction and attentional bias to body size.

6.7. Conclusion

Contrary to our hypotheses, we did not find evidence for a positive association between engagement or disengagement bias to body size and body dissatisfaction in a sample of young adult Malaysian women. Our ARDPEI task also demonstrated poor internal consistency as a measure of attentional bias. Therefore, we recommend that researchers testing the association between attentional bias and body dissatisfaction use eye-tracking measures or an ARDPEI task adapted to an individual differences framework (Goodhew & Edwards, 2019).

Chapter 7: General Discussion

7.1. Main Findings

The main findings from this thesis are summarised in Table 7.1 and discussed in relation to my four main thesis hypotheses:

TH1: Body dissatisfaction is positively associated with an attentional bias towards low weight bodies, so women with greater body dissatisfaction will direct more attention towards low weight bodies than women with lower body dissatisfaction.

TH2: Women trained to attend to low (high) weight body stimuli will increase their attention towards low (high) weight body stimuli.

TH3: Women trained to attend to low (high) weight body stimuli will perceive body stimuli as higher (lower) in weight after the training than before. This will lead them to reduce (increase) the size of an adjustable body stimulus to make it appear 'normal'.

TH4: Women trained to attend to low (high) weight body stimuli will increase (decrease) their body dissatisfaction.

TH1 was partially supported by the evidence from gaze tracking studies for a positive association between body dissatisfaction and attentional bias to low weight bodies (Chapter 4). Women with high body dissatisfaction, when compared to women with low body dissatisfaction, directed more gaze toward low weight female body stimuli. However, this result may have been inflated due to publication bias and I did not find evidence for this positive association when attentional bias was assessed using other measures, including the dot probe task (Chapter 2 Experiment 3, and Chapters 3 and 4), the visual search task (Chapter 5), and the ARDPEI task (Chapter 6). TH2 was not supported, because I found no effects of attention training on attentional bias to low or high weight body stimuli, using either the training dot probe task (Chapter 2 Experiment 3) or the training visual search task (Chapter 5). TH3 was partially supported. Women trained to attend to low weight body stimuli using the training visual search task (Chapter 5) did show a visual aftereffect of size overestimation, as demonstrated by a decrease in the size of bodies deemed to appear "normal" from pre- to post-training. In contrast, women trained to attend to low or high weight body stimuli using the training dot probe task (Chapter 2 Experiment 3) and women trained to attend to high weight body stimuli using the training visual search task (Chapter 5) did not demonstrate body size aftereffects (no change in perceptions of a "normal" body size from pre- to post-training). TH4 was not supported, because I found no effects of attention training on body dissatisfaction, using either the training dot probe task (Chapter 2 Experiment 3) or the training visual search task (Chapter 5).

Table 7.1.

A summary of the main findings from this thesis.

Chapter	Thesis Hypotheses	Method	Main Findings
2 (Experiment 3)	TH1-4	Online training dot probe experiment	• There was no effect of the training dot probe task on attentional bias to high versus low weight bodies, body size adaptation, or body dissatisfaction. • There was no evidence for an association between body dissatisfaction and attentional bias to low weight bodies at pre-training.
3	TH1	Online dot probe cross-sectional study	• There was no evidence for an association between body dissatisfaction and attentional bias to low weight bodies. • This absence of association was not moderated by participant ethnicity or the ethnic congruence between the participant and body stimuli. • The dot probe task demonstrated low internal consistency as a measure of attentional bias.
4	TH1	Systematic review and meta-analysis of cross-sectional studies	• Studies using gaze tracking to measure attention provided evidence for a positive association between body dissatisfaction and attentional bias to low weight bodies. • Studies using the dot probe task, EEG recording, and modified spatial cueing task to measure attention did not provide evidence for this association.

Chapter	Thesis Hypotheses	Method	Main Findings
5	TH1-4	Online training visual search experiment	• Women trained using the visual search task to attend to attend to high weight bodies showed no change in their attentional bias, perceptions of a "normal" body size, or body dissatisfaction as a result of the training. • Women trained using the visual search task to attend to low weight bodies showed a visual aftereffect of size overestimation, as demonstrated by a decrease in the size of bodies deemed to appear "normal" from pre- to post-training. However, these participants showed no change in their attentional bias or body dissatisfaction as a result of the training. • There was no evidence for an association between body dissatisfaction and attentional bias to low weight bodies at pre-training. • The visual search task demonstrated low to moderate internal consistency as a measure of attentional bias.
6	TH1	Online ARDPEI cross-sectional study	• There was no evidence for an association between body dissatisfaction and disengagement bias to low weight bodies. • There was weak evidence for a negative relationship between engagement bias to low weight bodies and body dissatisfaction. • The ARDPEI task demonstrated low internal consistency as a measure of engagement and disengagement bias.

Note. EEG = Electroencephalogram; ARDPEI = Attentional Response to Distal versus Proximal Emotional Information.

7.2. The Association Between Body Dissatisfaction and Attentional Bias to Low Weight Bodies

My systematic review and meta-analysis (Chapter 4) found gaze tracking studies demonstrated evidence for a positive association between body dissatisfaction and gaze duration to low weight bodies. This finding is consistent with preliminary evidence provided in an earlier systematic review (Rodgers & DuBois, 2016). However, my studies using the dot probe task (Chapter 2 Experiment 3 and Chapter 3) to measure attentional bias did not find evidence for an association between body dissatisfaction and attentional bias to low weight bodies. This lack of association was confirmed in my systematic review and meta-analysis synthesising dot probe studies (Chapter 4). The distinction between results from gaze tracking and dot probe studies has also been demonstrated in a recent meta-review on people with eating disorders (Stott et al., 2021). Studies using gaze tracking show women with eating disorders gaze more toward low weight bodies than healthy control participants (Blechert et al., 2009; Pinhas et al., 2014); however, dot probe studies do not find this distinction (Lee & Shafran, 2008; Shafran et al., 2007). Despite gaze tracking and dot probe tasks both commonly being used to measure attentional bias, research has demonstrated that their indices generally do not correlate (Waechter et al., 2014).

An explanation for this methodological distinction is that the dot probe task has been shown to be unreliable at measuring attentional bias. In psychology research there is no consistent standard for reporting on the psychometric properties of cognitive behavioural tasks (Parsons et al., 2019). This was demonstrated in my systematic review and meta-analysis (Chapter 4), because only 2/34 studies evaluated the internal consistency of their attentional bias measure. I evaluated the internal consistency of the dot probe task as a measure of attentional bias to low weight bodies in Chapter 3 and found the task had unacceptably low levels of internal consistency (Spearman-Brown estimates ≤ 0.50). This is in line with results obtained by other dot probe studies measuring attentional bias to non-body stimuli (Spearman-Brown estimates typically ≤ .50; Chapman et al., 2019; Rodebaugh et al., 2016; Schmukle, 2005). None of the gaze tracking studies included in my systematic review and meta-analysis (Chapter 4) evaluated the internal consistency of their gaze tracking measures; however, other studies using gaze duration to measure attentional bias to non-body stimuli have reported good levels of internal consistency (Spearman-Brown estimates typically ≥ .80; Sears et al., 2019; Waechter et al., 2014). Therefore, the dot probe task may be too unreliable to detect any positive association between body dissatisfaction and attentional bias to low weight bodies.

In Chapter 6, I measured attentional bias to low weight bodies using the ARDPEI task—a similar reaction time task to the dot probe task that uses an anchor probe to distinguish between engagement and disengagement bias. Like my dot probe studies (Chapter 2 Experiment 3 and Chapter 3), the ARDPEI study (Chapter 6) did not find evidence for a positive association between body dissatisfaction and attentional bias (either engagement or disengagement bias) to low weight bodies. The results of this study contrast with a previous ARDPEI study reporting a positive indirect association between engagement bias to low weight bodies and body dissatisfaction, via the mediators appearance comparisons and eating disorder-specific rumination (Dondzilo et al., 2021). My ARDPEI task demonstrated poor internal consistency as a measure of engagement bias and disengagement bias (Spearman-Brown estimates ≤ 0.19). These are similar levels to results obtained in my study using the dot probe task to measure attentional bias to low weight bodies (Spearman-Brown estimates ≤ 0.50; Chapter 3) and other studies using the dot probe task to measure attentional bias to non-body stimuli (Spearman-Brown estimates typically ≤ .50; Chapman et al., 2019; Rodebaugh et al., 2016; Schmukle, 2005). Dondzilo et al. (2021) did not evaluate the internal consistency of their ARDPEI task and I identified only two other papers that evaluated the internal consistency of their ARDPEI task. One study found similarly low levels of internal consistency when the ARDPEI task was used to measure of engagement and disengagement bias to food stimuli (Spearman-Brown estimates ≤ 0.27; Jonker et al., 2020). Another study found good-excellent internal consistency when the ARDPEI task was used to measure engagement and disengagement bias to negative emotional stimuli (Spearman-Brown estimates ≥ 0.78; Dondzilo et al., 2022). However, Dondzilo et al. (2022) evaluated the internal consistency of participant reaction times separately for each trial type, rather than their engagement and disengagement bias indices, which could have inflated their internal consistency results (Parsons et al., 2019). Together, these results indicate that the ARDPEI task may have similarly poor levels of internal consistency to the dot probe task as a measure of attentional bias, and this may explain why my results from Chapter 6 contrast with a previous ARDPEI study (Dondzilo et al., 2021) and previous gaze tracking studies (Chapter 4).

The dot probe and ARDPEI tasks may produce unreliable results because they only measure attention at one specific timepoint determined by the length of the stimulus onset asynchrony (SOA)—the time period between the onset of the stimulus pair and the onset of the target probe. For both of these tasks, it is assumed that a person with an attentional bias to target stimuli will respond faster to probes replacing target stimuli. However, this interpretation only holds if the person attends to the target stimulus immediately prior to the target probe presentation. The majority of dot probe studies included in my systematic review and meta-analysis (Chapter 4), as well as my ARDPEI task (Chapter 6) and the ARDPEI task employed by Dondzilo et al. (2021), used an SOA of 500ms. However, 500ms is enough time for people to make multiple shifts in attention. A participant could have attended to the target stimulus for the majority of the SOA, but shifted their attention to the control stimulus immediately prior to the target probe presentation, resulting in a slower reaction time that is incorrectly interpreted as an absence of attentional bias (Chapman et al., 2019). Therefore, a typical dot probe or ARDPEI trial may not sufficiently account for the dynamic nature of attention during the SOA. Some researchers have found short SOAs (e.g., 100ms) in the dot probe task produce more internally consistent indices of attentional bias, because participants have less time to shift their attention (Chapman et al., 2019). However, in Chapter 3 I conducted a dot probe task with a 100ms SOA and the internal consistency of the task was still unacceptably low (Spearman-Brown estimates ≤ 0.50). Further, my systematic review and meta-analysis (Chapter 4) found no evidence for a moderating effect of SOA on the results produced by dot probe studies. Therefore, dot probe and ARDPEI tasks may not capture the dynamic nature of attentional bias and reducing SOA length does not appear to be a reliable solution to this problem.

If the dot probe and ARDPEI tasks produce unreliable results because they only measure attention at one specific timepoint, then the visual search task should perform better as a measure of attentional bias. The visual search task does not involve an SOA, because the body stimuli remain on the screen until the participant makes a response. Therefore, visual search reaction times are less likely to be as affected by occasional shifts in attention when compared to the dot probe and ARDPEI tasks. In Chapter 5, I conducted a visual search task and found no evidence for an association at pre-training between body dissatisfaction and attentional bias to low weight bodies. However, the visual search task demonstrated variable internal consistency as a measure of attentional bias (Spearman-Brown estimates ranged from 0.17 to 0.71). This is better internal consistency than I found in my dot probe study (Chapter 3; Spearman-Brown estimates ranged from 0.00 to 0.50); however the results are still unacceptably low. Therefore, poor internal consistency seems to affect reaction time measures of attentional bias in general, rather than just reaction time tasks that measure attention at one specific time point.

An alternative explanation for the differences in effectiveness of these methods is that reaction time tasks typically measure early allocation of attentional bias, compared to gaze tracking studies that often measure attentional bias across longer time periods. In my systematic review and meta-analysis (Chapter 4), I found dot probe tasks used a median SOA of 500ms (range: 100-3000ms). Similarly, my ARDPEI study (Chapter 6) and the ARDPEI study conducted by Dondzilo et al. (2021) used an SOA of 500ms. Therefore, the dot probe and ARDPEI tasks measured early stages of attention. The time course of attention measured in my visual search study (Chapter 5) was paced for each participant based on their reaction times, and the median reaction time across participants was 1931ms (range: 1037-4979ms). Therefore, the visual search task may have measured a slightly later period of attention than the dot probe and ARDPEI tasks. However, the gaze tracking studies measured total gaze duration across a median time period of 9250ms (range: 300-60000ms), and so measured attention across much longer and later periods of attention compared to dot probe, ARPDEI, and visual search tasks. Therefore, it is possible that the attentional bias to low weight bodies develops over a period of a few seconds, but is absent during the first few hundred milliseconds of attention.

Support for this suggestion comes from an eye-tracking study showing that the association between body dissatisfaction and gaze duration to low weight bodies was present over the course of a 15s stimulus presentation period, but not during the first 500ms of the stimulus presentation period (Gao et al., 2014). Further, the electroencephalogram (EEG) recording studies synthesised in Chapter 4 also did not provide evidence for a positive association between body dissatisfaction and early attentional bias to low weight bodies (Uusberg et al., 2018; Voges et al., 2019; Wang et al., 2019). However, these EEG studies also found no evidence for a positive association during the later stages of attention. EEG studies measuring attentional bias to non-body stimuli have been shown to produce excellent levels of internal consistency (e.g. Reutter et al., 2017); however, none of the EEG studies synthesised in Chapter 4 evaluated internal consistency within their sample. They also recruited very small samples sizes ($N \leq 44$); therefore, further EEG research is needed to test the robustness of these findings and evaluate their internal consistency.

It is also possible that an early attentional bias to low weight bodies is present, but both reaction time and gaze tracking measures produce unreliable estimates of early attentional biases. Waechter et al. (2014) found that first fixation and fixation duration indices during a 1500ms stimulus presentation period had low internal consistency, whereas fixation duration indices over a 5000ms stimulus presentation period had excellent internal consistency. Similarly, Skinner et al. (2018) found first fixation indices had lower internal consistency and test-retest reliability than total fixation duration indices during a 4000ms presentation period. Therefore, the attentional bias to low weight bodies may be present during the early stages of attention, but both reaction time and gaze tracking measures of attention are too unreliable to detect early attentional biases. Sears et al. (2019) conducted a gaze tracking studying using an 8 second presentation period and found that total fixation duration over the 8 second period had greater internal consistency when compared to fixation duration for both and early and late 2 second intervals (i.e., 0-2s, 2-4s, 4-6s, and 6-8s). Therefore, early gaze-tracking measures of attention may simply lack sufficient data to produce an internally consistent measure of attentional bias.

Reaction time tasks like the dot probe, ARDPEI, and visual search task should not necessarily be abandoned, especially given that they are relatively faster and less costly to administer than gaze tracking. Attentional bias indices in these tasks are typically calculated using the difference in mean reaction times for various trial types. Difference scores may be appropriate for experimental designs, because they reduce the effect of between-participant variation; however, this is the precise difference of interest for individual difference research (Hedge et al., 2018). Goodhew and Edwards (2019) proposed a number of recommendations for adapting these tasks to individual differences research. For example, researchers should consider fixed trial and block orders to reduce random noise and facilitate the detection of individual variation. Researchers could also consider exploring the variability of attentional bias over time by analysing data at a trial level, rather than aggregating reaction times at a task level (Zvielli et al., 2015). Trial level analyses of dot probe data have been shown in some studies (e.g. Carlson & Fang, 2020) to produce more reliable attentional bias scores than traditional difference scores. Therefore, modifications to these reaction time tasks may make them more appropriate measures for testing the relationship between body dissatisfaction and attentional bias to body size.

7.3. Attentional Bias Modification

Women with high body dissatisfaction gaze for longer at low weight bodies; however, it is unclear whether this attentional bias causes body dissatisfaction. If robust evidence demonstrates there is a causal relationship between these variables, then further research is justified to explore the feasibility and effectiveness of a using attentional bias modification for interventions targeting body image disturbance (Renwick et al., 2013a, 2013b). In Chapter 2 (Experiment 3) and Chapter 5, I aimed to test this causal relationship. I trained women to direct attention to either high or low weight bodies and measured the effects of the training on attentional bias to high and low weight bodies, body size adaptation, and body dissatisfaction. In Chapter 2 Experiment 3, I trained participants using a training dot probe task and found the training was ineffective at causing a change in attention, body size adaptation, or body dissatisfaction. These findings were consistent with Experiment 1 and Experiment 2 from Chapter 2, with one exception being women trained in a laboratory setting increased their attention to high weight bodies (Chapter 2 Experiment 2). However, as discussed in Chapter 2, given the training dot probe was mostly ineffective at modifying attentional bias, it is possible that this result is spurious and a Type 1 error. With Chapter 2 producing mainly null findings, it is difficult to interpret whether there is a causal effect of attentional bias to bodies of different sizes on adaptation or body dissatisfaction. To the best of my knowledge, the three experiments in Chapter 2 were the first published studies to evaluate the effects of a body size training dot probe task on body size adaptation and body dissatisfaction. Two studies have previously trained women using the training dot probe task to attend/avoid low weight bodies, finding 1) women trained to attend to low weight bodies increased their attention to low weight bodies and reported an increase in negative mood (Dondzilo et al., 2018) and 2) women trained to avoid low weight bodies decreased their attention to low weight bodies and reported a reduction in state depressive rumination (Dondzilo et al., 2020). Therefore, the training dot probe task has been shown to be effective at modifying body size attentional biases and disorder-related symptoms, and the pattern of results is consistent with the idea that attentional bias to low weight bodies causes body dissatisfaction. Further research could explore modifying the training dot probe task to increase the likelihood of attention training effects, for example, by using 'top-up' adaptation stimuli to maintain adaptation, as discussed in Chapter 2.

However, the three experiments in Chapter 2 and the dot probe studies by Dondzilo et al. (2018, 2020) all relied on measuring attentional bias using the assessment version of the dot probe task which, as previously discussed (Chapter 3), has poor psychometric properties. Therefore, for these studies, we should be cautious about interpreting whether the training dot probe task had an effect on attentional bias. Studies attempting to modify attentional bias should evaluate changes in attentional bias using a measure of attention with more robust psychometric properties (e.g. gaze tracking; Sears et al., 2019; Skinner et al., 2018; Waechter et al., 2014). The inconsistent findings from studies using the training dot probe task are in line with research showing this task produces highly heterogeneous effects on attentional bias and eating disorder symptoms (Matheson et al., 2019). The training dot probe literature has also been shown to be limited by publication bias and low quality trials (Cristea et al., 2015; Fodor et al., 2020). Therefore, more high quality studies and systematic reviews including both published and unpublished studies should be conducted to establish whether the training dot probe task is appropriate for testing the causal relationship between attentional bias to bodies of different sizes and body dissatisfaction.

Following the null results from the training dot probe task (Chapter 2 Experiment 3), I attempted to train women's attention in Chapter 5 using a training visual search task. The training visual search task has not been as widely used as the training dot probe task; however, it has shown more promise as a method of modifying attentional bias and mood (Chelliah & Robinson, 2022) and has been shown to be effective at modifying body dissatisfaction (Schmidt & Martin, 2021; Smeets et al., 2011). In Chapter 5, I found that women trained using the visual search task to attend to high weight bodies did not demonstrate a change in attentional bias, body size adaptation, or body dissatisfaction as a result of the training. Women trained to attend to low weight bodies showed a visual aftereffect of size overestimation, as demonstrated by a decrease in the size of bodies deemed to appear "normal" from pre- to post-training. However, these participants showed no change in their attentional bias or body dissatisfaction as a result of the training.

The results for participants trained to attend to low weight bodies are somewhat surprising, because these participants visually adapted to low weight bodies despite not demonstrating faster reaction times to low weight bodies, indicating that there was no increase in attentional processing of low weight bodies. However, the assessment version of the visual search task demonstrated low to moderate internal consistency; therefore, the task may have been too unreliable to detect a change in attention. As discussed in Chapter 5, it seems likely that these participants did attend more to low weight bodies, because the low weight attention training condition involved directing participant's attention to low weight bodies, and participants showed a body size aftereffect in this direction. However, further research using more reliable methods of measuring attention (e.g. gaze tracking; Sears et al., 2019; Skinner et al., 2018; Waechter et al., 2014) is required to confirm this claim.

The results from this study also contradict the suggestion that adaptation induced body size misperception leads to body dissatisfaction, because participants adapted to low weight bodies without increasing their body dissatisfaction. This finding contradicts research by Bould et al. (2018) showing that body size aftereffects co-occur with changes in body dissatisfaction. However, the finding is consistent with a previous eye-tracking study that showed participants instructed to attend to low weight bodies adapted to this body size without increasing their body dissatisfaction (Stephen, Hunter, et al., 2018). Future research exploring body size attention training effects on body dissatisfaction should consider presenting participants with a full length mirror or a photograph of themselves prior to measuring body dissatisfaction. Further, given that the therapeutic aim of an intervention would be to reduce body dissatisfaction, research should also focus on improving the efficacy of the high weight training visual search task. In Chapter 5, I discussed how modifications to the task (e.g. reducing the number of breaks and using more training trials and sessions) could make the task more effective at inducing an aftereffect following attention to high weight bodies. The training visual search task is less researched than the training dot probe task (Matheson et al., 2019) and to the best of my knowledge this thesis presents one of the first attempts to test the effects of a body size training visual search task on body size adaptation and body dissatisfaction. Therefore, more research is justified to explore whether the training visual search task can be modified to effectively reduce eating disorder symptoms.

The training dot probe task (Chapter 2 Experiment 3) and visual search task (Chapter 5) presented in this thesis were both largely ineffective at producing measurable changes in attentional bias, body size adaptation, and body dissatisfaction (excepting aftereffects from the low weight training visual search task; Chapter 5). However, both tasks offer practical benefits (i.e., they are relatively cheap and easy to administer) and therefore attempts to modify and improve these tasks may be worthwhile in the development of novel treatments for eating disorder symptoms. In addition to modifying these tasks, researchers should explore alternative methods of body size attentional bias modification. Recently researchers have explored gaze tracking attentional bias modification, which involves gaze contingent training trials where participants are required to gaze at a target stimulus in order to complete each trial. Gaze tracking attentional bias modification studies have found preliminary evidence for training effects on gaze behaviour and psychological variables (Ferrari et al., 2016; Lazarov et al., 2017; Price, Greven, et al., 2016). Given my meta-analysis found evidence for a positive association between body dissatisfaction and gaze duration to low weight bodies, gaze tracking attentional bias modification could be a promising option for researchers developing novel treatments for eating disorder symptoms. Gaze tracking methods are typically expensive and resource intensive; however, web-based gaze trackers are becoming more sophisticated (Semmelmann & Weigelt, 2018) and could help make gaze tracking a more accessible option for researchers. Although, it should be noted that larger attentional bias modification effects have been found in a laboratory setting compared to an online setting, which is concerning given the ability to conduct attentional bias modification online in a home setting is typically discussed as a major practical advantage of attentional bias modification (Cristea et al., 2015; Kuckertz & Amir, 2015). Further, the time courses of body size adaptation effects are currently unknown and will determine whether attentional bias modification could be effectively translated into therapeutic intervention. Some studies show adaptation effects for high level stimuli can last up to four times as long as adaptation periods (lasting up to 6 minutes 25 seconds; Burton et al., 2016), and in some cases over 24 hours (Carbon & Ditye, 2012; Carbon et al., 2007); however, research on the time course and decay of body size adaptation effects needs to be conducted to assess if the effects are likely to persist outside of a testing environment.

7.4. Strengths and Limitations

My research has a number of strengths. First, all studies were preregistered on the Open Science Framework, which reduced the likelihood of questionable research practices, such as selective reporting or *p*-hacking (Schäfer & Schwarz, 2019). Second, the sample sizes for my online studies were all determined based on power analyses and were sufficiently statistically powered to detect small effects. For each study, I based my power analysis on either an effect reported in an unpublished pilot study or a published effect that I reduced to account for the inflation of published effect sizes (Lakens, 2013). Third, although not standard practice in psychology, I followed recommendations made by Parsons et al. (2019) and evaluated the internal consistency of my measures of attentional bias to inform future researchers who are considering using these measures. Fourth, to the best of knowledge, this thesis reports the first research on body size attentional biases in Malaysian women (Chapters 3 and 6). The body size attentional bias literature is dominated by research conducted in Western countries using body stimuli involving images of White people;

therefore, findings may not generalise to other populations and non-White body stimuli (Henrich et al., 2010). Body image concerns, thin body ideals, and eating disorder symptoms are commonly reported by Malaysian women (Chua et al., 2022; Kamaria, et al., 2016; Khor et al., 2009) and the findings from the thesis can be used to inform the development of interventions in this population.

This thesis also has a number of limitations. First, this thesis only focussed on body size attentional biases in women. In my online studies, I specifically recruited young adult women, who were generally undergraduate students. Therefore, the findings from this thesis may not generalise to other populations. Body ideals and attentional biases have been shown to depend on gender (Cho & Lee, 2013; Frederick et al., 2022; Talbot & Saleme, 2022), and it was not within the scope of this thesis to study the moderating effects of this variable. Similarly, thin ideal internalisation, body surveillance, and perceived sociocultural pressures have all been shown to be negatively correlated with age in women (Frederick et al., 2022); therefore, it seemed likely that age would moderate the association between body dissatisfaction and attentional bias in women. Age was not found to be a moderator in my meta-analysis (Chapter 4); however, the average age ranged from 18-25 years and therefore older women were not represented in this data. Eating disorders and body image concerns are being increasingly recognised as common among men (Gorrell & Murray, 2019; Mitchison & Mond, 2015) and older women (Samuels et al., 2019; Thompson & Bardone-Cone, 2019) and therefore these populations should be included in future research.

Second, my online studies all used body stimuli involving standardised images of women wearing tight fitted singlets and shorts and standing in an anatomical position with their face concealed. The stimuli were created in this way to ensure the bodies only differed in apparent fat mass, size, weight, and BMI, and not other variables like standing position, facial features, and clothing. However, the stimuli looked fairly artificial and may therefore have lacked ecological validity. Other studies have used more natural photographs sourced from the internet (e.g. Dondzilo et al., 2017, 2018, 2021), which may be more appropriate for studying body size attentional biases. In my meta-analysis (Chapter 4), I conducted moderation analyses on the association between body dissatisfaction and attentional bias to assess the effects of stimulus type, including method of stimulus acquisition and amount of skin exposed. I did not find any evidence for moderating effects; however, as discussed in Chapter 4 the moderation analyses may have been underpowered due to the small and unbalanced subgroups. Therefore, further research is needed to explore the effects of different body stimuli.

Third, due to COVID-19 restrictions on face to face data collection during my PhD I chose to conduct my research online rather than in a laboratory setting. Research generally finds online studies produce similar reaction time results to laboratory studies (Armitage & Eerola, 2020; Hilbig, 2016; Uittenhove et al., 2023). Further, I used the Gorilla Experiment Builder to host my online studies (https://gorilla.sc/), which produces relatively consistent reaction time results across different participant groups, settings, equipment, and internet connections (Anwyl-Irvine et al., 2021; Anwyl-Irvine et al., 2020). In Chapter 4 I did not finding a moderating effect of setting (online vs. laboratory) on the association between body dissatisfaction and attentional bias. Therefore, I have confidence that the online setting of my studies will not have restricted my efforts to test this association. However, it is possible that the online setting reduced the effects of the attention training tasks in Chapter 2 Experiment 3 and Chapter 5. Previous research has found attentional bias modification effects depend on delivery setting, with larger effects found in a laboratory setting compared to an online setting (Cristea et al., 2015; Kuckertz & Amir, 2015), possibly due to increased motivation and reduced distractions in a laboratory setting. In Chapter 2, I did not find evidence for an effect of experiment setting on the effects of the training dot probe task (Experiment 1 = online vs. Experiment 2 = laboratory); however, I did not conduct the training visual search task in a laboratory setting and so cannot rule out the effects of delivery setting for this task. If face to face data collection is possible, researchers should aim to initially test attentional bias modification tasks in both a laboratory and online setting so that the effects of delivery setting can be evaluated.

Fourth, this thesis found evidence for a positive association between body dissatisfaction and gaze duration to low weight bodies. However, as discussed in Chapter 4, the meta-analysis may have been affected by publication bias, because there were a number of small studies with positive effects that could have inflated the pooled effect size. Unpublished studies were eligible for my meta-analysis, and I did search thesis databases and contact authors for unpublished data. However, I did not identify any unpublished gaze tracking studies and may have missed studies by not systematically searching preprint databases such as PsyArXiv. Publication bias is likely to affect most meta-analyses and attempts to correct for publication bias are limited by relying heavily on strong assumptions (Thornton, 2000). Therefore, researchers should interpret the evidence from gaze tracking studies with caution. To reduce the effects of publication bias, researchers should post their manuscripts on preprint servers like PsyArXiv and systematic reviewers should include these databases in literature searches.

7.5. Recommendations for Future Research

Throughout this thesis I have made a number of specific recommendations for future research in this area. In summary, for researchers aiming to test the association between body dissatisfaction and attentional bias to bodies of different sizes, I suggest 1) using gaze duration as a measure of attentional bias. If gaze-tracking measures are impractical, then researchers using reaction time tasks should consider 2) adapting the task to an individual differences framework e.g. by using a fixed trial and block order (Goodhew & Edwards, 2019) or 3) analysing data at a trial level, rather than aggregating reaction times at a task level (Zvielli et al., 2015). Regardless of the chosen measure, researchers should 4) report on the psychometric properties of their measure to help others evaluate the reliability of their findings (Parsons et al., 2019).

Researchers attempting to modify attentional bias to bodies of different sizes should also follow recommendations 1-4 when measuring training effects on attentional bias. Once a reliable method of attentional bias modification has been established, researchers may choose not to include pre- and post-training measures of attentional bias if they are deemed impractical. When developing a method of attentional bias modification, researchers should consider 5) developing a gaze contingent task to modify gaze duration to bodies of different sizes. Alternatively, researchers using the training dot probe or training visual search task should consider modifying the tasks by 6) reducing the number of breaks, 7) increasing the number of training trials and sessions, and 8) using 'top-up' adaptation stimuli to reduce the likelihood of training effect decay. Researchers should also consider 9) presenting participants with a full length mirror or photograph of themselves prior to measuring body dissatisfaction at post-training, so as to increase the likelihood of body size aftereffects being internalised, and hence translating into changes in body dissatisfaction (Bould et al., 2018; Brooks et al., 2021). Researchers should also 10) aim to initially test attentional bias modification tasks in both a laboratory and online setting so that the effects of delivery setting can be evaluated.

7.6. Conclusion

In this thesis, I conducted a systematic review and meta-analysis (Chapter 4) and found evidence from gaze-tracking studies for a positive association between body dissatisfaction and attentional bias to low weight bodies. Women with high body dissatisfaction, when compared to women with low body dissatisfaction, directed more gaze toward low weight female body stimuli. However, the results may have been inflated by publication bias, and other measures of attentional bias did not find evidence for this association. Body dissatisfaction is a diagnostic criteria for anorexia nervosa (American Psychiatric Association, 2013) and a risk factor for other eating disorders, including bulimia nervosa (Stice et al., 2017). Therefore, the systematic review and meta-analysis results justify further research to explore whether gaze duration to low weight bodies causes feelings of body dissatisfaction. Reaction time tasks including the dot probe (Chapter 2 Experiment 3, Chapter 3), visual search (Chapter 5), and ARDPEI (Chapter 6) task did not find evidence for the association; however, these tasks typically produced unacceptably low levels of internal consistency. Despite the appealing properties of reaction time tasks (e.g. they are relatively cheap and simple to use), their psychometric properties need to be improved before they can be used as an alternative to gaze tracking measures of attention. My experiments (Chapter 2 Experiment 3 and Chapter 5) generally did not provide evidence for an effect of attentional bias to bodies of different sizes on body size adaptation or body dissatisfaction; however, given attention was measured using reaction times, it is difficult to determine whether attentional bias was effectively modified. For researchers attempting to measure and modify attentional bias to bodies of different sizes, I recommend using gaze tracking or amended reaction time tasks.

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Appendices

Appendix 2.1.

Results of the non-bootstrapped one-sample t-tests comparing change in attentional bias (ΔAB), change in point of subjective normality (ΔPSN), and change in body dissatisfaction (ΔBD) against a value of 0 for each experiment and condition.

			ΔAB				ΔPSN				ΔBD			
Experiment	Condition	*N*	*M* [95% CI]	*SD*	*t*	*p*	*M* [95% CI]	*SD*	*t*	*p*	*M* [95% CI]	*SD*	*t*	*p*
Experiment 1	High Fat	75	1.46 [-11.96, 14.89]	58.35	0.22	.829	-0.20 [-0.78, 0.38]	2.54	-0.68	.498	-35.84 [-92.70, 21.02]	247.13	-1.26	.213
	Low Fat	75	8.28 [-5.06, 21.63]	58.00	1.24	.220	-0.41 [-0.96, 0.14]	2.37	-1.50	.138	-9.85 [-33.66, 13.96]	103.49	-0.82	.412
Experiment 2	High Fat	35	-22.76 [-39.15, -6.37]	47.71	-2.82	.008	-0.51 [-1.37, 0.34]	2.49	-1.22	.231	0.54 [-23.18, 24.26]	69.06	0.05	.963
	Low Fat	35	6.31 [-7.69, 20.31]	40.75	0.92	.366	-0.89 [-1.82, 0.04]	2.71	-1.94	.060	2.23 [-19.78, 24.23]	64.06	0.21	.838
Experiment 3	High Fat	75	-9.24 [-25.76, 7.27]	71.78	-1.12	.268	-0.23 [-0.74, 0.27]	2.20	-0.91	.364	3.52 [-14.94, 21.98]	80.22	0.38	.705
	Low Fat	75	-18.06 [-44.59, 8.46]	115.28	-1.36	.179	-0.12 [-0.66, 0.41]	2.33	-0.46	.649	11.51 [-6.81, 29.83]	79.63	1.25	.215

Note. CI = confidence interval

Appendix 2.2.

Results of the bootstrapped one-sample t-tests comparing change in attentional bias (ΔAB), change in point of subjective normality (ΔPSN), and change in body dissatisfaction (ΔBD) against a value of 0. Outliers were removed, defined as values >3 three standard deviations above/below the mean.

			ΔAB				ΔPSN				ΔBD			
Experiment	Condition	*N*	*M* [95% CI]	*SD*	*t*	*p*	*M* [95% CI]	*SD*	*t*	*p*	*M* [95% CI]	*SD*	*t*	*p*
Experiment 1	High Fat	71	-1.93 [-12.12, 9.48]	47.28	-0.34	.777	-0.27 [-0.85, 0.32]	2.57	-0.88	.350	3.54 [-15.27, 26.34]	89.10	0.33	.709
	Low Fat	73	7.51 [-5.83, 21.62]	58.45	1.10	.257	-0.46 [-1.03, 0.06]	2.39	-1.64	.081	2.00 [-15.60, 18.24]	74.80	0.23	.821
Experiment 2	High Fat	35	-22.76 [-39.77, -8.21]	47.71	-2.82	<.001	-0.51 [-1.34, 0.28]	2.49	-1.22	.209	0.54 [-20.32, 23.54]	69.06	0.05	.997
	Low Fat	34	5.34 [-7.46, 19.52]	40.94	0.76	.445	-0.62 [-1.42, 0.04]	2.21	-1.63	.065	-1.97 [-22.21, 18.07]	59.94	-0.19	.861
Experiment 3	High Fat	70	-8.84 [-20.23, 1.94]	47.81	-1.55	.115	-0.16 [-0.64, 0.36]	2.20	-0.60	.570	1.19 [-12.45, 15.42]	61.06	0.16	.878
	Low Fat	72	-1.32 [-15.60, 13.65]	63.55	-0.18	.861	-0.04 [-0.57, 0.53]	2.33	-0.16	.882	6.38 [-8.98, 21.35]	63.83	0.85	.364

Note. CI = confidence interval

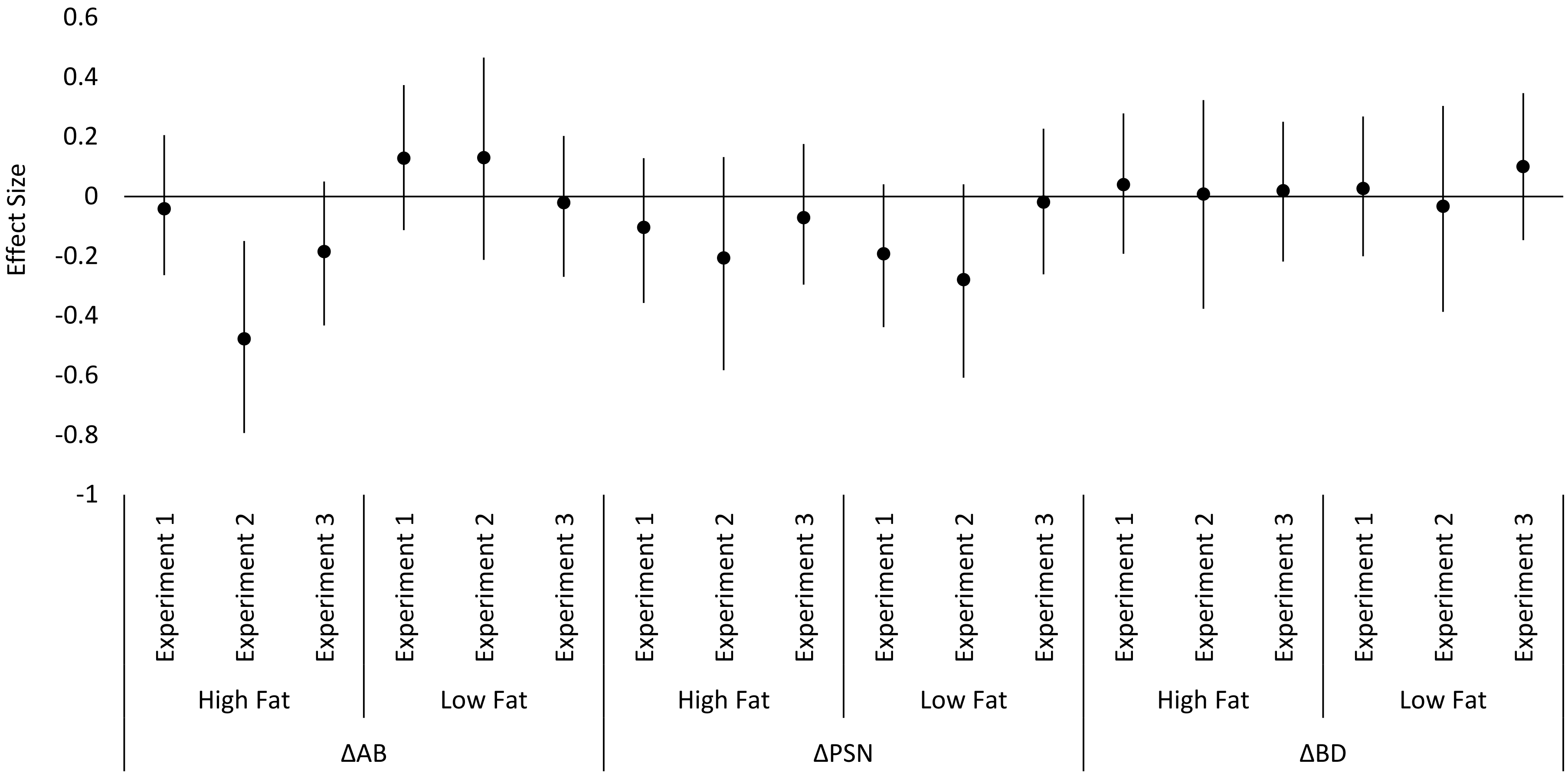
Appendix 2.3.

Bayes factors (BF_{10}) for the one-sample t-tests comparing change in attentional bias (ΔAB), change in point of subjective normality (ΔPSN), and change in body dissatisfaction (ΔBD) against a value of 0 for each condition and experiment (Cauchy prior, r=0.707). Outliers were removed, defined as values >3 three standard deviations above/below the mean.

			ΔAB	ΔPSN	ΔBD
Experiment	Condition	*N*	BF_{10}	BF_{10}	BF_{10}
Experiment 1	High Fat	71	0.14	0.19	0.14
	Low Fat	73	0.23	0.46	0.13
Experiment 2	High Fat	35	5.22	0.36	0.18
	Low Fat	34	0.24	0.61	0.19
Experiment 3	High Fat	70	0.41	0.16	0.13
	Low Fat	72	0.13	0.13	0.18

Appendix 2.4.

Effect sizes for change in attentional bias (ΔAB), change in point of subjective normality (ΔPSN), and change in body dissatisfaction (ΔBD) for each experiment and condition. Bootstrap resampling was used to estimate 95% confidence intervals. Outliers were removed, defined as values >3 three standard deviations above/below the mean.



Appendix 2.5.

The results of the three 2x2 between-participants ANOVAs testing the effects of SOA and condition in the online experiments on change in attentional bias (ΔAB), change in point of subjective normality (ΔPSN), and change in body dissatisfaction (ΔBD). Outliers were removed, defined as values >3 three standard deviations above/below the mean.

		ΔAB			ΔPSN			ΔBD		
	df	*F*	*p*	η_p^2	*F*	*p*	η_p^2	*F*	*p*	η_p^2
SOA	1	1.48	.225	0.00	0.88	.349	0.00	0.02	.902	0.00
Condition	1	1.72	.191	0.00	0.02	.888	0.00	0.04	.835	0.00
SOA x Condition	1	0.02	.882	0.00	0.29	.591	0.00	0.15	.697	0.00

Appendix 2.6.

Bayes factors (BF_{10}) for the three 2x2 between-participants Bayesian ANOVAs testing the effects of SOA and condition in the online experiments on change in attentional bias (ΔAB), change in point of subjective normality (ΔPSN), and change in body dissatisfaction (ΔBD). Outliers were removed, defined as values >3 three standard deviations above/below the mean.

Model	ΔAB	ΔPSN	ΔBD
SOA	0.26	0.20	0.13
Condition	0.29	0.13	0.13
SOA + Condition	0.07	0.03	0.02
SOA + Condition + SOA x Condition	0.01	0.01	0.00

Appendix 3.1.

Variations from our preregistered study protocol (https://osf.io/yt5fh/).

Variation from Preregistration	Details
Hypotheses 2 and 3 from the preregistration are not in the manuscript.	After feedback from previous peer review, we removed these hypotheses to keep the focus of the manuscript was on the first hypothesis. Removing these hypotheses did not change our analyses or results in the manuscript, because we still conducted and reported the analyses and results that tested the preregistered hypotheses 2 and 3.
In the manuscript, we only report the results using body dissatisfaction scores calculated from items 1-16 of the body shape satisfaction scale. Therefore items 17 and 18 were excluded from the calculation of body dissatisfaction scores.	Items 17 and 18 have not previously been tested in population studies on Australian women; therefore, our body dissatisfaction measure is more valid without these items included. However, we have reported the results of our main analyses with body dissatisfaction scores calculated using items 1-18, as preregistered (see Appendices 3.8-3.10). Excluding these items did not change how we interpreted our results.
We analysed group differences between the Malaysian Chinese and White Australian women using independent t-tests.	After feedback from previous peer review, we included these preliminary analyses to assess the differences between both populations for our main variables.
We conducted Bayesian bivariate correlations to test the relationship between body dissatisfaction and	The results of our preregistered linear mixed effects models produced all null results, but using frequentist statistics we cannot identify whether there is evidence for the null hypotheses or whether the data are too

Variation from Preregistration	Details
attentional bias to contracted bodies separately for each participant group and ethnic congruency condition.	insensitive to interpret. Therefore, we conducted Bayesian bivariate correlations to help us evaluate the evidence for the null hypotheses.
We assessed the internal consistency of the attentional bias scores computed using the dot probe task.	The results of our preregistered linear mixed effects models produced results that contradicted some previous research using dot probe tasks. Therefore we aimed to explore the psychometric properties of the dot probe task to further our understanding of these results.
We conducted sensitivity analyses and reran our analyses without outliers.	The results of our preregistered linear mixed effects models produced results that contradicted some previous research using dot probe tasks. Therefore we aimed to explore the robustness of our findings by seeing if the results were driven by extreme values.

Appendix 3.2.

Malaysia demographics questionnaire.

This appendix includes the demographics questionnaire used to screen participants recruited in Malaysia. We only included participants in the data analysis if they responded with “Female” to question 1, if they did not respond “I am not aged between 18-35 years old” to question 2, if they responded with “Malaysian Chinese” to question 3, and if they responded with “Yes” to question 4. Participant responses to question 5-7 were not used to determine participant eligibility.

<u>Demographics Questionnaire - Malaysia</u>

1. What is your gender?

   Male
   Female
   Other (please specify)

2. You must be between 18 and 35 years old to take part in this study. Please select your age below.

   18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35
   I am not aged between 18-35 years old.

3. What is your family background with respect to ethnicity? (Please select the one that best describes you)

   Malaysian Malay
   Malaysian Indian
   Malaysian Chinese
   Mixed Race
   Other (please specify)

4. Are both your parents Malaysian Chinese?

   Yes
   No (please specify)

5. Are all your grandparents Malaysian Chinese?

Yes

No (please specify)

6. What is your height?

7. What is your weight?

Appendix 3.3.

Australia demographics questionnaire.

This appendix includes the demographics questionnaire used to screen participants recruited in Australia. We only included participants in the data analysis if they responded with “Female” to question 1, if they did not respond “I am not aged between 18-35 years old” to question 2, if they responded with “White Australian” to question 3, and if they responded with “Yes” to question 4. Participant responses to question 5-7 were not used to determine participant eligibility.

<u>Demographics Questionnaire - Australia</u>

1. What is your gender?

   Male

   Female

   Other (please specify)

2. You must be between 18 and 35 years old to take part in this study. Please select your age below.

   18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35

   I am not aged between 18-35 years old.

3. What is your family background with respect to ethnicity? (Please select the one that best describes you)

   East Asian (e.g. Chinese or Vietnamese)

   South Asian (e.g. Indian or Pakistani)

   White Australian

   Indigenous Australian

   Middle Eastern

   Mixed Race

   Other (please do not write "Australian")

4. Are both your parents White Australian?

   Yes

   No (please specify)

5. Are all your grandparents White Australian?

Yes

No (please specify)

6. What is your height?

7. What is your weight?

Appendix 3.4.

Body dissatisfaction questionnaire.

This appendix contains the items in the modified version of the body shape satisfaction scale that we presented to participants. Participants responded on a Likert scale with options ranging from 1 to 7. Our preregistered analyses involved computing body dissatisfaction scores using all 18 items (see Appendices 3.8-3.10). The analyses reported in the manuscript involved computing body dissatisfaction scores using items 1-16.

How satisfied are you with each of these parts of your body? (1 = very satisfied; 7 = very dissatisfied)

1. Height
2. Weight
3. Body shape/build
4. Waist
5. Hips
6. Thighs
7. Stomach
8. Face
9. Calves
10. Shoulders
11. Arms
12. Chest
13. Neck
14. Back
15. Muscularity
16. Amount of body fat
17. Overall, how satisfied are you with your body?
18. Overall, would you prefer to be: (1 = much heavier; 7 = much lighter)

Appendix 3.5.

The descriptive statistics for the participant characteristics. Bootstrapped independent t-tests were used to compare participants on each characteristic. Statistics were bias-corrected accelerated and used 5000 iterations. Outliers were removed, defined as values >3 three standard deviations above/below the mean within their participant ethnicity group for attentional bias to own-ethnicity body stimuli, attentional bias to other-ethnicity stimuli, body dissatisfaction, age, or BMI.

	Malaysian Chinese (*N* = 143)		White Australian (*N* = 145)			
	Mdn	*IQR*	*Mdn*	*IQR*	*t*	*p*
Age (years)	22.00	4.50	18.00	4.00	-3.04	.004
Body mass index (BMI)	19.56	3.87	22.58	6.45	6.45	<.001
Body dissatisfaction	64.00	21.00	64.00	24.00	0.76	.448
Attentional bias score to own-ethnicity body stimuli	1.44	27.60	2.27	27.75	0.67	.503
Attentional bias score to other-ethnicity body stimuli	-0.44	22.29	-0.52	27.55	-0.98	.327

Appendix 3.6.

The results of the three linear mixed effects models with the outcome variable as attentional bias score (N = 288). Outliers were removed, defined as values >3 three standard deviations above/below the mean within their participant ethnicity group for attentional bias to own-ethnicity body stimuli, attentional bias to other-ethnicity stimuli, body dissatisfaction, age, or BMI.

	Model 1			Model 2			Model 3		
Effect	*β*	95% CI	*p*	*β*	95% CI	*p*	*β*	95% CI	*p*
Body dissatisfaction	0.02	-0.07, 0.11	.603	0.05	-0.07, 0.17	.390	0.01	-0.14, 0.15	.930
Age	-0.02	-0.11, 0.06	.616	-0.02	-0.11, 0.06	.617	-0.02	-0.11, 0.06	.616
Body mass index (BMI)	0.06	-0.03, 0.15	.222	0.06	-0.03, 0.15	.210	0.06	-0.03, 0.15	.210
Participant ethnicity	-	-	-	-0.02	-0.19, 0.14	.808	-0.02	-0.19, 0.14	.807
Body dissatisfaction * participant ethnicity	-	-	-	-0.06	-0.22, 0.11	.481	-0.06	-0.22, 0.11	.480
Ethnic congruency	-	-	-	-	-	-	0.10	-0.06, 0.27	.220
Body dissatisfaction * ethnic congruency	-	-	-	-	-	-	0.09	-0.07, 0.26	.269

CI = confidence interval

Appendix 3.7.

The correlation coefficients and Bayes factors for the relationship between body dissatisfaction and attentional bias score (N = 288). Outliers were removed, defined as values >3 three standard deviations above/below the mean within their participant ethnicity group for attentional bias to own-ethnicity body stimuli, attentional bias to other-ethnicity stimuli, body dissatisfaction, age, or BMI.

Participant ethnicity	Ethnic congruency	df	r	BF_{10}
Malaysian Chinese	Own-ethnicity	141	0.19	2.46
Malaysian Chinese	Other-ethnicity	141	-0.05	0.23
White Australian	Own-ethnicity	143	0.01	0.19
White Australian	Other-ethnicity	143	0.06	0.25

Appendix 3.8.

Cronbach's alpha and bootstrapped independent t-tests (bias-corrected accelerated using 5000 iterations) assessing the difference between the 18-item body dissatisfaction scores reported by Malaysian Chinese participants and White Australian participants.

	α	*N*	*Mdn*	*IQR*	*t*	*p*
Malaysian Chinese	0.95	150	73.00	23.00	0.89	.392
White Australian	0.92	150	73.50	28.50	-	-

Appendix 3.9.

The results of the three linear mixed effects models with the outcome variable as attentional bias score and the 18-item body dissatisfaction scores included as a fixed effect (N = 300).

	Model 1			Model 2			Model 3		
Effect	*β*	95% CI	*p*	*β*	95% CI	*p*	*β*	95% CI	*p*
Body dissatisfaction	0.05	-0.03, 0.14	.215	0.08	-0.03, 0.20	.161	0.09	-0.05, 0.23	.201
Age	-0.02	-0.11, 0.06	.596	-0.02	-0.11, 0.06	.601	-0.02	-0.11, 0.06	.601
Body mass index (BMI)	0.00	-0.09, 0.09	.966	0.00	-0.09, 0.09	.938	0.00	-0.09, 0.09	.938
Participant ethnicity	-	-	-	-0.09	-0.25, 0.07	.270	-0.09	-0.25, 0.07	.271
Body dissatisfaction * participant ethnicity	-	-	-	-0.06	-0.22, 0.10	.470	-0.06	-0.22, 0.10	.471
Ethnic congruency	-	-	-	-	-	-	-0.01	-0.18, 0.15	.855
Body dissatisfaction * ethnic congruency	-	-	-	-	-	-	-0.02	-0.18, 0.14	.824

CI = confidence interval

Appendix 3.10.

The correlation coefficients and Bayes factors for the relationship between attentional bias scores and 18-item body dissatisfaction scores (N = 300).

Participant ethnicity	Ethnic congruency	df	r	BF_{10}
Malaysian Chinese	Own-ethnicity	148	0.158	1.11
Malaysian Chinese	Other-ethnicity	148	-0.024	0.20
White Australian	Own-ethnicity	148	0.002	0.19
White Australian	Other-ethnicity	148	0.074	0.28

Appendix 3.11.

Bootstrapped independent t-tests (bias-corrected accelerated using 5000 iterations) assessing the difference between the attentional bias scores calculated for the splithalf R package reported by Malaysian Chinese participants and White Australian participants.

	Malaysian Chinese (N = 150)		White Australian (N = 150)			
	Mdn	*IQR*	*Mdn*	*IQR*	*t*	*p*
Attentional bias score to own-ethnicity body stimuli	1.52	26.90	2.44	26.94	0.82	.419
Attentional bias score to other-ethnicity body stimuli	0.67	23.61	-2.10	24.73	-2.20	.006

Appendix 3.12.

The results of the three linear mixed effects models with the outcome variable as attentional bias scores calculated for the splithalf R package (N = 300).

	Model 1			Model 2			Model 3		
Effect	*β*	95% CI	*p*	*β*	95% CI	*p*	*β*	95% CI	*p*
Body dissatisfaction	0.05	-0.04, 0.13	.286	0.08	-0.04, 0.19	.187	0.09	-0.05, 0.23	.223
Age	-0.02	-0.10, 0.06	.617	-0.02	-0.10, 0.06	.617	-0.02	-0.10, 0.06	.618
Body mass index (BMI)	0.00	-0.08, 0.09	.913	0.01	-0.08, 0.10	.883	0.01	-0.08, 0.10	.883
Participant ethnicity	-	-	-	-0.10	-0.26, 0.06	.227	-0.10	-0.26, 0.06	.228
Body dissatisfaction * participant ethnicity	-	-	-	-0.07	-0.23, 0.10	.426	-0.07	-0.23, 0.10	.426
Ethnic congruency	-	-	-	-	-	-	-0.02	-0.18, 0.14	.816
Body dissatisfaction * ethnic congruency	-	-	-	-	-	-	-0.02	-0.18, 0.14	.814

CI = confidence interval

Appendix 3.13.

The correlation coefficients and Bayes factors for the relationship between body dissatisfaction and attentional bias score calculated for the splithalf R package (N = 300).

Participant ethnicity	Ethnic congruency	df	*r*	BF_{10}
Malaysian Chinese	Own-ethnicity	148	0.15	1.02
Malaysian Chinese	Other-ethnicity	148	-0.05	0.23
White Australian	Own-ethnicity	148	-0.01	0.19
White Australian	Other-ethnicity	148	0.06	0.23

Appendix 3.14.

The correlation coefficients (Pearson's r) for the preregistered attentional bias scores and the attentional bias scores calculated for the splithalf R package (N = 300).

Participant ethnicity	Ethnic congruency	df	*r*	*p*
Malaysian Chinese	Own-ethnicity	148	0.99	< .001
Malaysian Chinese	Other-ethnicity	148	0.99	< .001
White Australian	Own-ethnicity	148	0.97	< .001
White Australian	Other-ethnicity	148	0.99	< .001

Appendix 4.1.

Variations from our preregistered review protocol (https://osf.io/5y9w8/).

Variation from Preregistration	**Details**
For the meta-analysis we pooled correlation coefficients (Pearson's *r*) rather than Hedge's *g*.	Correlation coefficients were the most commonly reported effect size by included studies and we wanted to reduce converting between effect sizes.
For studies reporting multiple effect sizes, we originally specified we would use the average effect size for each study. However, instead of averaging effect sizes, we used a multilevel approach and included all available effect size data.	Calculating the average effect size would require knowing the correlations between measures of each effect size e.g., if a study reported two effect sizes with each using a different measure of body dissatisfaction, then we would need to know the correlation coefficient for the two body dissatisfaction measures in order to average the two effect sizes. However, we often did not have this data. Based on a reviewer's suggestion, we used a multilevel approach which allowed us to use all available effect sizes.
Instead of conducting separate meta-analyses for each measure of attentional bias, we conducted one more integrative meta-analysis and explored heterogeneity caused by measure of attentional bias using moderation analyses.	Based on a reviewer's suggestion, this more integrative approach allowed us to statistically test the heterogeneity caused by measure of attentional bias.
We originally specified we would only conduct a meta-analysis if we had 5 or more similar studies using the same measure of attentional bias. We also specified we would only conduct subgroup/moderation analyses if we had 10 or more	Based on a reviewer's suggestion, we used this approach to incorporate more data into our meta-analysis. We discussed the potentially limited statistical power of some of the analyses in the discussion.

Variation from Preregistration	Details
studies in a meta-analysis. However, we included EEG and modified spatial cueing effects in the meta-analysis despite the effects coming from only 3 studies each. We also conducted moderation analyses on gaze tracking effects even though there were only 9 gaze tracking studies in the meta-analysis.	
To test the robustness of our results, instead of conducting sensitivity analyses (e.g. by removing studies with converted effect sizes or high risk of bias scores) we conducted moderation analyses on these variables.	Based on a reviewer's suggestion, this approach allowed for us to statistically assess the robustness of our results without excluding effects.
Author BE completed the quality assessment and checked texts and data received directly by authors instead of author KG.	Author KG was unable to complete these tasks due to starting a new job.
Author BE completed a check on the data extraction of 100% of the included studies.	Based on a reviewer's suggestion, we included this data check to reduce the risk of data extraction errors.
We did not include OpenGrey in our follow-up database searches.	OpenGrey was discontinued in between our original database search and our follow-up database search.

Variation from Preregistration	**Details**
To assess publication bias, we plotted sunset (power-enhanced) funnel plots and used power based statistics.	Based on a reviewer's suggestion, this approach allowed for a more thorough assessment of publication bias and enabled us to visualise the statistical power of studies in the meta-analysis.

Appendix 4.2.

Reasons for excluding studies from the full text screening stage.

	Citation	Primary reason for exclusion
1	Yokokura, M., Terada, T., Bunai, T., Nakaizumi, K., Kato, Y., Yoshikawa, E., ... & Ouchi, Y. (2019). Alterations in serotonin transporter and body image-related cognition in anorexia nervosa. *NeuroImage: Clinical*, *23*, 101928.	The researchers did not explore the relationship between body dissatisfaction and attentional bias in the healthy control group.
2	Fuller-Tyszkiewicz, M., Vuong, H., Linardon, J., Krug, I., Broadbent, J., & Rodgers, R. F. (2020). Body image in and out of the lab: Correspondence between lab-based attentional bias data and body shape dissatisfaction experiences in daily life. *Body Image*, *32*, 62-69.	The study did not use a cross-sectional design.
3	Prnjak, K., Pemberton, S., Helms, E., & Phillips, J. G. (2020). Reactions to ideal body shapes. *The Journal of general psychology*, *147*(4), 361-380.	The study did not use a cross-sectional design.
4	Stephen, I. D., Hunter, K., Sturman, D., Mond, J., Stevenson, R. J., & Brooks, K. R. (2019). Experimental manipulation of visual attention affects body size adaptation but not body dissatisfaction. *International Journal of Eating Disorders*, *52*(1), 79-87.	The study did not use a cross-sectional design.
5	Rodway, V., Tatham, B., & Guo, K. (2019). Effect of model race and viewing perspective on body attractiveness and body size assessment in young Caucasian women: an eye-tracking study. *Psychological Research*, *83*(2), 347-356.	This study measured attentional bias towards body regions and not attentional bias towards low weight bodies.

	Citation	Primary reason for exclusion
6	Phillipou, A., Rossell, S. L., Gurvich, C., Castle, D. J., Troje, N. F., & Abel, L. A. (2016). Body image in anorexia nervosa: Body size estimation utilising a biological motion task and eyetracking. *European Eating Disorders Review*, *24*(2), 131-138.	This study measured attentional bias towards body regions and not attentional bias towards low weight bodies.
7	Lykins, A. D., Ferris, T., & Graham, C. A. (2014). Body region dissatisfaction predicts attention to body regions on other women. *Body Image*, *11*(4), 404-408.	This study measured attentional bias towards body regions and not attentional bias towards low weight bodies.
8	Pona, A. A., Jones, A. C., Masterson, T. L., & Ben-Porath, D. D. (2019). Biases in attention and memory for body shape images in eating disorders. *Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity*, *24*(6), 1165-1171.	The researchers did not explore the relationship between body dissatisfaction and attentional bias in the healthy control group.
9	Cobb, A., Rieger, E., & Bell, J. (2018). Inhibition of return for body images in individuals with shape/weight based self-worth. *Journal of Eating Disorders*, *6*(1), 1-10.	This study did not involve a measure of attentional bias towards pictures of low weight bodies.
10	Pinhas, L., Fok, K. H., Chen, A., Lam, E., Schachter, R., Eizenman, O., ... & Eizenman, M. (2014). Attentional biases to body shape images in adolescents with anorexia nervosa: An exploratory eye-tracking study. *Psychiatry Research*, *220*(1-2), 519-526.	The healthy control group did not complete a measure of body dissatisfaction.
11	Rieger, E., Dolan, A., Thomas, B., & Bell, J. (2017). The effect of interpersonal rejection on attentional biases regarding thin-ideal and non-thin images: The	The study did not use a cross-sectional design.

	Citation	Primary reason for exclusion
	moderating role of body weight-and shape-based self-worth. *Body Image*, *22*, 78-86.	
12	Jiang, M. Y., & Vartanian, L. R. (2016). The role of memory in the relationship between attention toward thin-ideal media and body dissatisfaction. *Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity*, *21*(1), 57-64.	The study did not use a cross-sectional design.
13	Yano, M., Kawano, N., Tanaka, S., Kohmura, K., Katayama, H., Nishioka, K., & Ozaki, N. (2016). Dysfunction of response inhibition in eating disorders. *Journal of Clinical and Experimental Neuropsychology*, *38*(6), 700-708.	This study did not involve a measure of attentional bias towards pictures of low weight bodies.
14	Slade, P. D., Newton, T., Butler, N. M., & Murphy, P. (1991). An experimental analysis of perfectionism and dissatisfaction. *British Journal of Clinical Psychology*, *30*(2), 169-176.	This study did not involve a measure of attentional bias towards pictures of low weight bodies.
15	von Wietersheim, J., Kunzl, F., Hoffmann, H., Glaub, J., Rottler, E., & Traue, H. C. (2012). Selective attention of patients with anorexia nervosa while looking at pictures of their own body and the bodies of others: an exploratory study. *Psychosomatic Medicine*, *74*(1), 107-113.	This study measured attentional bias towards body regions and not attentional bias towards low weight bodies.
16	Janelle, C. M., Hausenblas, H. A., Fallon, E. A., & Gardner, R. E. (2003). A visual search examination of attentional biases among individuals with high and low drive for thinness. *Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity*, *8*(2), 138-144.	This study measured attentional bias towards body regions and not attentional bias towards low weight bodies.

	Citation	Primary reason for exclusion
17	Mañas-Viniegra, L., Núñez-Gómez, P., & Tur-Viñes, V. (2020). Neuromarketing as a strategic tool for predicting how Instagramers have an influence on the personal identity of adolescents and young people in Spain. *Heliyon*, *6*(3), e03578.	This study did not involve a measure of body dissatisfaction.
18	Horndasch, S., Kratz, O., Holczinger, A., Heinrich, H., Hönig, F., Nöth, E., & Moll, G. H. (2012). "Looks do matter"—visual attentional biases in adolescent girls with eating disorders viewing body images. *Psychiatry Research*, *198*(2), 321-323.	This study measured attentional bias towards body regions and not attentional bias towards low weight bodies.
19	Boyce, J. A., & Kuijer, R. G. (2014). Focusing on media body ideal images triggers food intake among restrained eaters: a test of restraint theory and the elaboration likelihood model. *Eating Behaviors*, *15*(2), 262-270.	The study did not use a cross-sectional design.
20	Iceta, S., Benoit, J., Cristini, P., Lambert-Porcheron, S., Segrestin, B., Laville, M., ... & Disse, E. (2020). Attentional bias and response inhibition in severe obesity with food disinhibition: A study of P300 and N200 event-related potential. *International Journal of Obesity*, *44*(1), 204-212.	This study did not involve a measure of attentional bias towards pictures of low weight bodies.
21	Salvato, G., Romano, D., De Maio, G., & Bottini, G. (2020). Implicit mechanisms of body image alterations: The covert attention exposure effect. *Attention, Perception, & Psychophysics*, *82*(4), 1808-1817.	This study did not involve a measure of body dissatisfaction.
22	Mai, S., Gramann, K., Herbert, B. M., Friederich, H. C., Warschburger, P., & Pollatos, O. (2015). Electrophysiological evidence for an attentional bias in	The researchers did not explore the relationship between body dissatisfaction and attentional bias in the healthy control group.

	Citation	Primary reason for exclusion
	processing body stimuli in bulimia nervosa. *Biological Psychology*, *108*, 105-114.	
23	Dondzilo, L., Rieger, E., Shao, R., & Bell, J. (2020). The effectiveness of touchscreen-based attentional bias modification to thin body stimuli on state rumination. *Cognition and Emotion*, *34*(5), 1052-1058.	This study did not involve a measure of body dissatisfaction.
24	Porras-Garcia, B., Serrano-Troncoso, E., Carulla-Roig, M., Soto-Usera, P., Ferrer-Garcia, M., Figueras-Puigderrajols, N., ... & Gutiérrez-Maldonado, J. (2020). Virtual reality body exposure therapy for anorexia nervosa. A case report with follow-up results. *Frontiers in Psychology*, *11*, 956.	This study was a case study on one patient with anorexia nervosa.
25	Cho, A., Kwak, S. M., & Lee, J. H. (2013). Identifying attentional bias and emotional response after appearance-related stimuli exposure. *Cyberpsychology, Behavior, and Social Networking*, *16*(1), 50-55.	The study did not use a cross-sectional design.
26	Johansson, L. (2006). *The role of cognitive processes in eating pathology* (Thesis dissertation, Universitetsbiblioteket).	These studies did not involve a measure of attentional bias towards pictures of low weight bodies.
27	Lowry, L. S. (2011). *The effect of social comparisons on selective attention: an image based Stroop task.* (Doctoral dissertation, University of the Pacific, Thesis - Pacific Access Restricted).	The study did not use a cross-sectional design.
28	Nelson, S. J. (2006). *Body-weight and shape-attentional biases in non-clinically eating disordered women* (Doctoral dissertation, University of Bristol).	The researchers did not explore the relationship between body dissatisfaction and attentional bias.

	Citation	Primary reason for exclusion
29	Brown, A., & Dittmar, H. (2005). Think “thin” and feel bad: The role of appearance schema activation, attention level, and thin–ideal internalization for young women’s responses to ultra–thin media ideals. *Journal of Social and Clinical Psychology*, *24*(8), 1088-1113.	The study did not use a cross-sectional design.
30	Irvine, K. R. (2018). *Body Image: Representation and Constraints on Measurement in Real and Virtual Worlds*. University of Northumbria at Newcastle (United Kingdom).	These studies did not involve a measure of attentional bias towards pictures of low weight bodies.
31	Gardiner, H. M. (2018). *Identifying a Neurological Substrate for Body Image Investment Through Electroencephalography* (Doctoral dissertation, University of Windsor (Canada)).	This study did not involve a measure of attentional bias towards pictures of low weight bodies.
32	Purvis, C. K. (2016). *Virtual Reality and Body Image: An Exploration of Behavioral and Self-report Correlates of Body Satisfaction in Immersive Virtual Environments*. Palo Alto University.	Although we did not receive confirmation from the study author, we believe this study was also published by the author as a peer reviewed journal article in PLoS ONE. To avoid duplicating studies in our systematic review, we have decided to include the published version of the study and exclude the dissertation.
33	Peck, K. E. (2015). *The impact of media literacy and self-affirmation interventions on body dissatisfaction in women: an eye tracking study* (Doctoral dissertation, University of Surrey).	The study did not use a cross-sectional design.
34	Treat, T. A., Viken, R. J., Kruschke, J. K., & McFall, R. M. (2010). Role of attention, memory, and covariation-detection processes in clinically	This study did not involve a measure of attentional bias towards pictures of low weight bodies.

	Citation	Primary reason for exclusion
	significant eating-disorder symptoms. *Journal of Mathematical Psychology*, *54*(1), 184-195.	
35	Porras-Garcia, B., Ferrer-Garcia, M., Yilmaz, L., Sen, Y. O., Olszewska, A., Ghita, A., ... & Gutiérrez-Maldonado, J. (2020). Body-related attentional bias as mediator of the relationship between body mass index and body dissatisfaction. *European Eating Disorders Review*, *28*(4), 454-464.	This study measured attentional bias towards body regions and not attentional bias towards low weight bodies.
36	Moral-Agúndez, A. D., & Carrillo-Durán, M. V. (2020). Body-cult television advertisement recall among young women suffering from anorexia nervosa or bulimia nervosa. *Saúde e Sociedade*, *29*, e170418.	This study did not involve a measure of body dissatisfaction.
37	Lyu, Z., Zheng, P., & Wang, Z. (2019). Time course of Attentional biases toward body shapes in women who are overweight or obese. *Cognitive Therapy and Research*, *43*(3), 594-602.	The researchers did not explore the relationship between body dissatisfaction and attentional bias.
38	Allen, J. L., Mason, T. B., Stout, D. M., & Rokke, P. D. (2018). Emotion specific effects on attentional bias among women with shape and weight concerns. *Cognitive Therapy and Research*, *42*(5), 612-621.	This study did not involve a measure of attentional bias towards pictures of low weight bodies.
39	Forsyth, M., Rieger, E., & Bell, J. (2018). Inhibition of return regarding body images in women with shape/weight-based self-worth. *Journal of Experimental Psychopathology*, *9*(1), 2043808718778979.	The researchers did not explore the relationship between body dissatisfaction and attentional bias.
40	Glashouwer, K. A., Jonker, N. C., Thomassen, K., & de Jong, P. J. (2016). Take a look at the bright side: Effects of positive body exposure on selective visual	This study measured attentional bias towards body regions and not attentional bias towards low weight bodies.

	Citation	Primary reason for exclusion
	attention in women with high body dissatisfaction. *Behaviour Research and Therapy*, *83*, 19-25.	
41	Holland, E., & Haslam, N. (2013). Worth the weight: The objectification of overweight versus thin targets. *Psychology of Women Quarterly*, *37*(4), 462-468.	This study did not involve a measure of body dissatisfaction.
42	Purvis, C. K., Jones, M., Bailey, J., Bailenson, J., & Taylor, C.B. (2013). Designing virtual environments to measure behavioral correlates of state-level body satisfaction. *Annual Review of CyberTherapy and Telemedicine, 11,* 168 – 172.	This study did not report the results of any collected data.
43	Balcetis, E., Cole, S., Chelberg, M. B., & Alicke, M. (2013). Searching out the ideal: Awareness of ideal body standards predicts lower global self-esteem in women. *Self and Identity*, *12*(1), 99-113.	This study did not involve a measure of attentional bias towards pictures of low weight bodies.
44	Westenhoefer, J., Engel, D., Holst, C., Lorenz, J., Peacock, M., Stubbs, J., ... & Raats, M. (2013). Cognitive and weight-related correlates of flexible and rigid restrained eating behaviour. *Eating Behaviors*, *14*(1), 69-72.	This study did not involve a measure of attentional bias towards pictures of low weight bodies.
45	Jiang, M. Y., & Vartanian, L. R. (2012). Attention and memory biases toward body-related images among restrained eaters. *Body Image*, *9*(4), 503-509.	This study did not involve a measure of body dissatisfaction.
46	Smeets, E., Tiggemann, M., Kemps, E., Mills, J. S., Hollitt, S., Roefs, A., & Jansen, A. (2011). Body checking induces an attentional bias for body-related cues. *International Journal of Eating Disorders*, *44*(1), 50-57.	This study did not involve a measure of attentional bias towards pictures of low weight bodies.

	Citation	Primary reason for exclusion
47	Blechert, J., Nickert, T., Caffier, D., & Tuschen-Caffier, B. (2009). Social comparison and its relation to body dissatisfaction in bulimia nervosa: Evidence from eye movements. *Psychosomatic Medicine*, *71*(8), 907-912.	The researchers did not explore the relationship between body dissatisfaction and attentional bias in the healthy control group.
48	Fassino, S., Pieró, A., Daga, G. A., Leombruni, P., Mortara, P., & Rovera, G. G. (2002). Attentional biases and frontal functioning in anorexia nervosa. *International Journal of Eating Disorders*, *31*(3), 274-283.	This study did not involve a measure of attentional bias towards pictures of low weight bodies.
49	George, H. R., Cornelissen, P. L., Hancock, P. J., Kiviniemi, V. V., & Tovee, M. J. (2011). Differences in eye-movement patterns between anorexic and control observers when judging body size and attractiveness. *British Journal of Psychology*, *102*(3), 340-354.	This study measured attentional bias towards body regions and not attentional bias towards low weight bodies.
50	Leins, J., Waldorf, M., Kollei, I., Rinck, M., & Steins-Loeber, S. (2018). Approach and avoidance: Relations with the thin body ideal in women with disordered eating behavior. *Psychiatry Research*, *269*, 286-292.	This study did not involve a measure of attentional bias towards pictures of low weight bodies.
51	Pila, E., Jovanov, K., Welsh, T. N., & Sabiston, C. M. (2017). Body-part compatibility effects are modulated by the tendency for women to experience negative social comparative emotions and the body-type of the model. *PloS ONE*, *12*(6), e0179552.	This study did not involve a measure of attentional bias towards pictures of low weight bodies.
52	Cundall, A., & Guo, K. (2017). Women gaze behaviour in assessing female bodies: the effects of clothing, body size, own body composition and body satisfaction. *Psychological Research*, *81*(1), 1-12.	This study measured attentional bias towards body regions and not attentional bias towards low weight bodies.

	Citation	Primary reason for exclusion
53	Mayer, B., Muris, P., & Wilschut, M. (2011). Fear-and disgust-related covariation bias and eating disorders symptoms in healthy young women. *Journal of Behavior Therapy and Experimental Psychiatry*, *42*(1), 19-25.	This study did not involve a measure of attentional bias towards pictures of low weight bodies.
54	Ju, H. W., & Johnson, K. K. (2010). Fashion advertisements and young women: Determining visual attention using eye tracking. *Clothing and Textiles Research Journal*, *28*(3), 159-173.	This study did not involve a measure of body dissatisfaction.
55	Viken, R. J., Treat, T. A., Nosofsky, R. M., McFall, R. M., & Palmeri, T. J. (2002). Modeling individual differences in perceptual and attentional processes related to bulimic symptoms. *Journal of Abnormal Psychology*, *111*(4), 598.	This study did not involve a measure of attentional bias towards pictures of low weight bodies.
56	Russon, J. M. (2015). *Objectification Theory and the Family: The Effect of Attachment Insecurity on Self-Objectification and Attentional Bias toward Eating Disorder Stimuli*. Drexel University.	This study did not involve a measure of attentional bias towards pictures of low weight bodies.
57	Abraham, A. C. (2004). *Cognitive processing bias in undergraduate females: Predicting color-naming delays from bulimic behavior and its covariates*. University of Arkansas.	This study did not involve a measure of attentional bias towards pictures of low weight bodies.
58	Altabe, M., & Thompson, J. K. (1995). Body image disturbance: Advances in assessment and treatment. *Innovations in clinical practice: A source book*, *14*, 89-110.	This was a review paper and not an empirical study.
59	Treat, T. A. (2000). *Role of cognitive processing of body-size and affect stimulus information in bulimia*. Indiana University.	The researchers did not explore the relationship between body dissatisfaction and attentional bias.

	Citation	Primary reason for exclusion
60	Nicolaou, M., Doak, C., van Dam, R., Hosper, K., Seidell, J., & Stronks, K. (2008). Body size preference and body weight perception among two migrant groups of non-Western origin. *Public Health Nutrition*, *11*(12), 1332-1341.	This study did not involve a measure of attentional bias towards pictures of low weight bodies.
61	Gardner, R. M., & Morrell Jr, J. A. (1991). Body-size judgments and eye movements associated with looking at body regions in obese and normal weight subjects. *Perceptual and Motor Skills*, *73*(2), 675-682.	This study measured attentional bias towards body regions and not attentional bias towards low weight bodies.
62	Porras-Garcia, B., Ghiţă, A., Moreno, M., Ferrer, M. F. G., Bertomeu Panisello, P., Serrano Troncoso, E., ... & Gutiérrez Maldonado, J. (2018). Gender differences in attentional bias after owning a virtual avatar with increased weight. *Annual Review of CyberTherapy and Telemedicine, 2018, vol. 16, p. 73-79*.	This study measured attentional bias towards body regions and not attentional bias towards low weight bodies.
63	Cornelissen, K. K., Cornelissen, P. L., Hancock, P. J., & Tovée, M. J. (2016). Fixation patterns, not clinical diagnosis, predict body size over-estimation in eating disordered women and healthy controls. *International Journal of Eating Disorders*, *49*(5), 507-518.	This study measured attentional bias towards body regions and not attentional bias towards low weight bodies.
64	Joseph, C., LoBue, V., Rivera, L. M., Irving, J., Savoy, S., & Shiffrar, M. (2016). An attentional bias for thin bodies and its relation to body dissatisfaction. *Body Image*, *19*, 216-223.	The researchers did explore the relationship between body dissatisfaction and attentional bias separately for female participants; however, this was not completed in enough detail required for data extraction. Therefore, we excluded this version

	Citation	Primary reason for exclusion
		of the manuscript and instead included the thesis version, which did report sufficient statistics required for data extraction.
65	ATAR, G. M., İSPİR, B., & ŞENER, G. Disclaimer Labels Used in Ads: An Eye-Tracking Study Exploring Body Dissatisfaction and Physical Appearance Comparison Among University Students. *Türkiye İletişim Araştırmaları Dergisi*, (38), 1-1.	This study measured attentional bias towards body regions and not attentional bias towards low weight bodies.
66	Cazzato, V., Walters, E. R., & Urgesi, C. (2021). Associations of observer's gender, Body Mass Index and internalization of societal beauty ideals to visual body processing. *Psychological Research*, *85*(8), 3026-3039.	This study did not involve a measure of attentional bias towards pictures of low weight bodies.
67	Di Gesto, C., Matera, C., Policardo, G. R., & Nerini, A. (2022). Instagram As A Digital Mirror: The Effects of Instagram Likes and Disclaimer Labels on Self-awareness, Body Dissatisfaction, and Social Physique Anxiety Among Young Italian Women. *Current Psychology*, 1-10.	This study did not involve a measure of attentional bias towards pictures of low weight bodies.
68	Dreier, M. J., Wang, S. B., Nock, M. K., & Hooley, J. M. (2021). Attentional biases towards food and body stimuli among individuals with disordered eating versus food allergies. *Journal of Behavior Therapy and Experimental Psychiatry*, *73*, 101657.	This study did not involve a measure of attentional bias towards pictures of low weight bodies.
69	Henn, A. T., Borgers, T., Vocks, S., Giabbiconi, C. M., & Hartmann, A. S. (2022). Visualizing Emotional Arousal within the Context of Body Size Evaluation: A Pilot Study of Steady-State Visual Evoked Potentials in Women with Anorexia Nervosa and Healthy Controls. *Body Image*, *40*, 78-91.	The researchers did not explore the relationship between body dissatisfaction and attentional bias in the healthy control group.

	Citation	Primary reason for exclusion
70	Kirkpatrick, C. E., & Lee, S. (2021). Effects of Instagram Body Portrayals on Attention, State Body Dissatisfaction, and Appearance Management Behavioral Intention. *Health communication*, 1-12.	The researchers did not explore the relationship between body dissatisfaction and attentional bias.
71	Lowe-Calverley, E., & Grieve, R. (2021). Do the metrics matter? An experimental investigation of Instagram influencer effects on mood and body dissatisfaction. *Body Image*, *36*, 1-4.	This study did not involve a measure of attentional bias towards pictures of low weight bodies.
72	Myre, M., Berry, T. R., Ball, G. D., & Hussey, B. (2020). Motivated, fit, and strong—Using counter-stereotypical images to reduce weight stigma internalisation in women with obesity. *Applied Psychology: Health and Well-Being*, *12*(2), 335-356.	This study did not involve a measure of attentional bias towards pictures of low weight bodies.
73	PORRAS-GARCIA, B., SERRANO-TRONCOSO, E., CARULLAROIG, M., SOTO-USERA, P., FERRER-GARCÍA, M., FERNÁNDEZ-DEL, L., ... & José, G. M. (2020). Targeting the fear of gaining weight and body-related concerns in Anorexia Nervosa. Preliminary findings from a Virtual Reality randomized clinical trial. *Annual Review Of Cybertherapy and Telemedicine 2020*, 223.	This study measured attentional bias towards body regions and not attentional bias towards low weight bodies.
74	Sidhu, N., Qualter, C., Higgs, E., & Guo, K. (2021). What colour should I wear? How clothing colour affects women's judgement of other women's body attractiveness and body size. *Acta Psychologica*, *218*, 103338.	This study did not involve a measure of body dissatisfaction.
75	Stice, E., Yokum, S., Rohde, P., Cloud, K., & Desjardins, C. D. (2021). Comparing healthy adolescent females with and without parental history of	This study did not involve a measure of body dissatisfaction.

	Citation	Primary reason for exclusion
	eating pathology on neural responsivity to food and thin models and other potential risk factors. *Journal of Abnormal Psychology*, *130*(6), 608.	
76	Stice, E., Yokum, S., Rohde, P., Gau, J., & Shaw, H. (2021). Evidence that a novel transdiagnostic eating disorder treatment reduces reward region response to the thin beauty ideal and high-calorie binge foods. *Psychological Medicine*, 1-11.	This study only recruited women who met the criteria for an eating disorder.
77	Tremblay, L., Chebbi, B., & Bouchard, S. (2022). The predictive role of body image and anti-fat attitudes on attentional bias toward body area in haptic virtual reality environment. *Virtual Reality*, *26*(1), 333-342.	This study measured attentional bias towards body regions and not attentional bias towards low weight bodies.
78	Devine, S., Germain, N., Ehrlich, S., & Eppinger, B. (2022). Changes in the Prevalence of Thin Bodies Bias Young Women's Judgments About Body Size. *Psychological Science, 33*(8), 1212-1225.	This study did not involve a measure of attentional bias towards pictures of low weight bodies.
79	Shen, J., Chen, J., Tang, X., & Bao, S. (2022). The effects of media and peers on negative body image among Chinese college students: a chained indirect influence model of appearance comparison and internalization of the thin ideal. *Journal of Eating Disorders*, *10*(1), 1-9.	This study did not involve a measure of attentional bias towards pictures of low weight bodies.

Appendix 4.3.

The Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Analytical Cross-Sectional Studies (Moola et al., 2020).

Major Components	Response options		
1. Were the criteria for inclusion in the sample clearly defined? *We responded "Yes" if the authors made reference to their eligibility criteria.*	Yes	No	Unclear
2. Were the study subjects and the setting described in detail? *We responded "Yes" if the authors included a description of the participant demographics, recruitment location, and time period of recruitment.*	Yes	No	Unclear
3. Was the exposure measured in a valid and reliable way? *We responded "Yes" if the authors included an evaluation of the validity or reliability of their body dissatisfaction questionnaire for the study sample e.g. by reporting Cronbach's alpha. We responded "Unclear" if the authors did not evaluate their measure within their sample, but the questionnaire has demonstrable reliability or validity from previous research. We responded "No" if the authors used a measure despite reporting it had poor reliability and validity.*	Yes	No	Unclear
4. Were confounding factors identified? *We responded "Yes" if 1) additional variables were analysed in relation to body dissatisfaction and attentional bias (e.g. if the authors reported on the correlation between BMI and body dissatisfaction or if they reported the BMI of high vs low body dissatisfaction groups) or 2) the authors reported using strategies to control for confounding variables.*	Yes	No	Unclear

Major Components	**Response options**		
5. Were strategies to deal with confounding factors stated? *We only responded "Yes" if the authors 1) conducted an analysis controlling for a possible confounding factor, 2) specifically recruited within a restricted range for a possible confounding variable e.g. within a restricted BMI range, or 3) justified why they did not need to deal with confounding factors.*	Yes	No	Unclear
6. Were the outcomes measured in a valid and reliable way? *We only responded "Yes" if the authors included an evaluation of the validity or reliability of their attentional bias measure for the study sample. We responded "Unclear" if the authors did not evaluate their measure within their sample. We responded "No" if the authors used a measure despite reporting it had poor reliability and validity.*	Yes	No	Unclear
7. Was appropriate statistical analysis used? *We only responded "Yes" if 1) the reporting was detailed and precise (e.g. by reporting specific p-values rather than p < .05) and 2) the authors commented on statistical assumptions. We responded "Unclear" if the authors met some but not all of these criteria. We responded "No" if the authors did not meet any of these criteria.*	Yes	No	Unclear

Note. Additional details for our assessment of each criterion are detailed in italics. We removed the following questionnaire item because it was not applicable to any study in the review: "Were objective, standard criteria used for measurement of the condition?".

Appendix 4.4.

The results of the moderation analyses for the meta-analysis.

Moderator	Categorical moderator levels	Individual estimates				Test of moderation			
		***Z* [95% CI]**	**df**	***t***	***p***	**df1**	**df2**	***F***	***p***
Attentional bias paradigm						3	71	2.84	.044
	Dot probe task	0.05 [-0.08, 0.18]	71	0.71	.478				
	EEG	-0.16 [-0.38, 0.06]	71	-1.43	.157				
	Gaze tracking	0.17 [0.04, 0.29]	71	2.70	.009				
	Modified spatial cueing	0.00 [-0.19, 0.20]	71	0.04	.970				
Body dissatisfaction questionnaire						7	67	0.54	.800
	BAS	0.02 [-0.44, 0.47]	67	0.07	.947				
	BPSS	0.18 [-0.27, 0.64]	67	0.80	.424				
	BSQ	0.10 [-0.05, 0.26]	67	1.30	.199				
	BSSS	-0.05 [-0.26, 0.16]	67	-0.47	.642				
	EDE	0.03 [-0.29, 0.34]	67	0.16	.874				
	EDI	0.11 [-0.14, 0.36]	67	0.84	.402				
	NPS	0.00 [-0.26, 0.25]	67	-0.02	.982				
	Single Item	0.38 [-0.11, 0.87]	67	1.55	.125				

Moderator	Categorical moderator levels	Individual estimates				Test of moderation			
		***Z* [95% CI]**	**df**	***t***	***p***	**df1**	**df2**	***F***	***p***
Publication Status						1	73	0.04	.850
	Published	0.06 [-0.03, 0.15]	73	1.37	.176				
	Unpublished	0.03 [-0.26, 0.32]	73	0.23	.817				
Risk of bias score		0.06 [0.00, 0.13]	73	1.90	.062	1	73	3.60	.062
Effect size computation						1	73	0.80	.375
	Non-converted *r*	0.04 [-0.06, 0.14]	73	0.82	.416				
	Converted *r*	0.13 [-0.05, 0.31]	73	1.44	.154				
Mean participant age		0.00 [-0.05, 0.05]	72	0.17	.867	1	72	0.03	.867
Mean participant BMI		-0.01 [-0.06, 0.05]	68	-0.18	.859	1	68	0.03	.859
Low weight body stimulus acquisition						2	72	0.08	.919
	Computer generated image	0.09 [-0.08, 0.26]	72	1.06	.291				
	Digitally altered photograph	0.05 [-0.12, 0.22]	72	0.59	.560				
	Photograph	0.05 [-0.09, 0.18]	72	0.73	.471				
Control stimulus/stimuli						2	72	1.81	.171
	Higher weight body	0.01 [-0.09, 0.11]	72	0.22	.823				

Moderator	Categorical moderator levels	Individual estimates				Test of moderation			
		Z [95% CI]	df	*t*	*p*	df1	df2	*F*	*p*
	Non-body	0.14 [-0.06, 0.35]	72	1.39	.170				
	Higher weight body and non-body	0.22 [-0.01, 0.45]	72	1.93	.058				
Body stimuli clothing						2	72	0.79	.457
	Nude	-0.09 [-0.39, 0.21]	72	-0.60	.548				
	Torso exposed	0.10 [-0.02, 0.21]	72	1.71	.091				
	Torso concealed	0.04 [-0.10, 0.18]	72	0.52	.606				
Dot probe SOA		0.00 [0.00, 0.00]	16	0.82	.427	1	16	0.67	.427
Dot probe body stimuli layout						1	16	1.23	.284
	Above and below	0.12 [-0.04, 0.27]	16	1.58	.133				
	Left and right	0.02 [-0.09, 0.13]	16	0.35	.735				
Dot probe delivery setting						1	16	0.05	.827
	Laboratory	0.06 [-0.07, 0.19]	16	0.93	.365				
	Online	0.03 [-0.15, 0.21]	16	0.40	.696				
Gaze tracking presentation time		0.00 [-0.01, 0.00]	26	-0.84	.411	1	26	0.70	.411

Moderator	Categorical moderator levels	Individual estimates				Test of moderation			
		***Z* [95% CI]**	**df**	***t***	***p***	**df1**	**df2**	***F***	***p***
Gaze tracking index						2	25	0.44	.647
	Gaze duration	0.20 [0.04, 0.36]	25	2.64	.014				
	Fixation frequency	0.14 [-0.11, 0.39]	25	1.17	.252				
	First run dwell time	0.04 [-0.30, 0.38]	25	0.25	.808				

Note. CI = confidence interval; EEG = Electroencephalogram recording; SOA = stimulus onset asynchrony.

Appendix 4.5.

The results of the moderation analyses comparing dot probe, EEG and modified spatial cueing effects.

Comparison	df	*t*	*p*
Dot probe vs EEG	71	-1.60	.115
Dot probe vs modified spatial cueing	71	0.37	.716
EEG vs modified spatial cueing	71	-1.10	.275

Note. EEG = Electroencephalogram recording.

Appendix 4.6.

The results of the quality assessment of included studies.

Author/Year	1. Were the criteria for inclusion in the sample clearly defined?	2. Were the study subjects and the setting described in detail?	6. Were the exposures measured in a valid and reliable way?	4. Were confounding factors identified?	5. Were strategies to deal with confounding factors stated?	3. Were the outcomes measured in a valid and reliable way?	7. Was appropriate statistical analysis used?	Score
Berrisford-Thompson et al. (2021)	Yes	No	Yes	Yes	Yes	Unclear	Yes	5
Cass et al. (2020)	Yes	No	Unclear	Yes	No	Unclear	Yes	3
Cho & Lee (2013)	Yes	No	Yes	Yes	No	Unclear	Yes	4
Dondzilo et al. (2021)	Yes	No	Yes	Yes	Yes	Unclear	Yes	5
Dondzilo et al. (2017)	Yes	No	Yes	Yes	Yes	Unclear	Yes	5
Gaid (2008)	Yes	No	Unclear	Yes	No	Unclear	No	2
Gao et al. (2014)	Yes	No	Yes	Yes	Yes	Unclear	Unclear	4
Gao et al. (2013)	Yes	No	Yes	Yes	Yes	Unclear	Yes	5
Glauert et al. (2010) study 1	Yes	No	Unclear	Yes	No	Unclear	No	2
Glauert et al. (2010) study 2	Yes	No	Unclear	Yes	No	Unclear	No	2
Glauert et al. (2010) study 3	Yes	No	Unclear	Yes	Yes	Unclear	No	3
House, Stephen, et al. (2022) study 1	Yes	No	Yes	No	No	Unclear	Unclear	2
House, Stephen, et al. (2022) study 2	Yes	No	Yes	No	No	Unclear	Unclear	2
House, Stephen, et al. (2022) study 3	Yes	No	Yes	No	No	Unclear	Unclear	2
House, Wong, et al. (2022)	Yes	No	Yes	Yes	Yes	Yes	Yes	6
Joseph (2014) study 1	Yes	No	Unclear	Yes	No	Unclear	No	2
Joseph (2014) study 2	Yes	No	Unclear	Yes	No	Unclear	No	2
Karlinsky et al. (2021)	Yes	No	Yes	Yes	Yes	Unclear	Unclear	4
Lee and Shafran (2008)	Yes	No	Unclear	Yes	No	Unclear	Unclear	2
Misener and Libben (2020)	Yes	No	Yes	Yes	Yes	Unclear	Yes	5
Moussally et al. (2016)	Yes	No	Yes	Yes	Yes	Yes	Yes	6
Nazareth et al. (2020)	Yes	No	Unclear	Yes	No	Unclear	Yes	3
Purvis et al. (2015)	Yes	Yes	Unclear	Yes	No	Unclear	Unclear	3
Scott et al. (2023)	Yes	No	Unclear	No	No	Unclear	Yes	2
Seifert et al. (2008)	Yes	No	Unclear	No	No	Unclear	Unclear	1
Shafran et al. (2007)	Yes	No	Unclear	Yes	Yes	Unclear	Unclear	3
Stephen et al. (2018)	Yes	No	Unclear	Yes	Yes	Unclear	Yes	4
Szostak (2018)	Yes	No	Unclear	Yes	Yes	Unclear	Yes	4
Tobin et al. (2019)	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	6
Uusberg et al. (2018)	Yes	No	Unclear	Yes	No	Unclear	Yes	3
Voges et al. (2019)	Yes	No	Unclear	Yes	No	Unclear	Yes	3
Volkmann et al. (2021)	Yes	No	Yes	Yes	Yes	Unclear	Unclear	4
Wang et al. (2019)	Yes	No	Yes	No	No	Unclear	Yes	3
Withnell et al. (2019)	Yes	No	Yes	Yes	No	Unclear	Unclear	3

Appendix 4.7.

The qualifications of the authors who conducted the search strategy and quality assessment.

Author	Qualifications
Thea House	BSc, MSc, and MRes in Psychology
Katrina Graham	MbCHb and MRCPsych
Bridget Ellis	BSc in Psychology and MSc in Applied Neuropsychology

Appendix 4.8.

An example of the search used for Scopus.

Database	Example search
Scopus	TITLE-ABS-KEY (Attention* OR "Dot probe" OR "Visual probe" OR "Visual search" OR "Eye tracking" OR EEG OR ERP OR Hypervigilance) AND TITLE-ABS-KEY (Thin* OR Slim* OR "Low adiposity" OR "Low fat" OR Underweight OR "Body size" OR "Body shape" OR Ideal*) AND TITLE-ABS-KEY ("Body dissatisfaction" OR "Body image" OR "Body satisfaction" OR "Body concern" OR "Body image disturbance" OR "Weight dissatisfaction" OR "Weight satisfaction" OR "Eating disorder")

Appendix 5.1.

This table explains why the experiment involved some minor deviations from the preregistered protocol (https://doi.org/10.17605/OSF.IO/NF8JX).

Variation from Preregistration	Details
In our preregistered analysis plan, we said we would run a 2x2 ANCOVA for each dependent variable (attentional bias, PSN, and body dissatisfaction), including training condition as the between-participants independent variable (high vs. low BMI), time as the within-participants independent variable (pre-training vs. post-training), and BMI included as a covariate. However, instead we ran a 2x2 ANOVA for each dependent variable, using the same independent variables but removing BMI as the covariate.	It violates an assumption of ANCOVAs to include a within-participants independent variable, and so we decided to run ANOVAs instead of ANCOVAs. This analysis change invalidates our preregistered power analyses; however, power analyses actually indicate we have more statistical power than planned due to running ANOVAs compared to ANCOVAs, and so we decided this analysis change was appropriate.
We conducted exploratory multiple linear regressions on each post-training outcome variable (attentional bias, PSN, and body dissatisfaction) while controlling for BMI and the relevant pre-training score (Appendix Table 5.2).	Due to our decision to no longer conduct ANCOVAs with BMI included as a covariate, we decided to run these multiple linear regressions to check for the influence of BMI on post-training outcome scores.

Note. BMI = body mass index; PSN = point of subjective normality

Appendix 5.2.

The results of three exploratory multiple linear regressions with outcome variables as post-training attentional bias, PSN, and body dissatisfaction. For each regression, we controlled for the relevant pre-training variable and included attention training condition as a categorical predictor (high vs. low BMI) and BMI as a continuous covariate.

Outcome	Predictors	*B*	95% CI for *B*		*SE B*	*p*	*β*	R^2	R^2_{adj}
			LL	UL					
Post-training attentional bias	Pre-training attentional bias score	0.06	-0.12	0.24	0.09	.499	0.06	0.02	< 0.01
	Attention training condition (high vs. low BMI)	92.02	-13.84	197.88	53.54	.088	0.15		
	BMI	0.91	-15.82	17.65	8.46	.914	0.01		
Post-training PSN	Pre-training PSN	0.82	0.73	0.92	0.05	< .001	0.80	0.73	0.72
	Attention training condition (high vs. low BMI)	-0.59	-0.89	-0.29	0.15	< .001	-0.17		
	BMI	0.05	> -0.01	0.10	0.02	.063	0.09		
Post-training body dissatisfaction	Pre-training body dissatisfaction	1.05	1.01	1.09	0.02	< .001	0.98	0.95	0.95
	Attention training condition (high vs. low BMI)	3.22	-16.47	22.91	9.96	.747	0.01		
	BMI	-0.94	-4.30	2.42	1.70	.581	-0.01		

Note. BMI = body mass index; PSN = point of subjective normality; *B* = unstandardised regression coefficient; CI = confidence interval; LL = lower limit; UL = upper limit; *SE B* = standard error of the coefficient; *β* = standardised coefficient; R^2 = coefficient of determination; R^2_{adj} = adjusted R^2

Appendix 5.3.

The participant demographics and pre- and post-training measures after excluding participants who confirmed in the demographics questionnaire that they had a current or previous diagnosis of an eating disorder.

						Visual search accuracy (%)				Attentional bias				PSN				Body dissatisfaction			
		Age (years)		BMI (kg/m²)		Pre-training		Post-training		Pre-training		Post-training		Pre-training		Post-training		Pre-training		Post-training	
Attention training condition	*N*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
High BMI	69	19.62	1.65	22.15	3.48	95.53	3.51	96.29	3.13	-25.49	328.68	-117.94	378.15	6.65	1.80	6.76	1.85	872.16	248.72	868.75	266.42
Low BMI	63	19.40	1.76	21.79	2.79	95.83	2.94	96.03	3.36	-19.66	277.90	-23.27	225.79	6.66	1.45	6.15	1.46	867.37	240.07	864.08	254.13

Note. BMI = body mass index; PSN = point of subjective normality

Appendix 5.4.

The results of the ANOVAs after excluding participants who confirmed in the demographics questionnaire that they had a current or previous diagnosis of an eating disorder. ANOVAs were conducted separately for each outcome variable (attentional bias, PSN, and body dissatisfaction), with attention training condition (high vs. low BMI) included as a between-participants independent variable and time (pre-training vs. post-training) included as a within-participants independent variable.

Outcome	Effects	$F(1, 130)$	p	η^2_G
Attentional bias	Condition	1.65	.202	0.01
	Time	1.66	.200	0.01
	Condition * Time	1.42	.235	0.01
PSN	Condition	1.19	.277	0.01
	Time	5.78	.018	< 0.01
	Condition * Time	14.34	< .001	0.01
Body dissatisfaction	Condition	0.01	.914	< 0.01
	Time	0.45	.502	< 0.01
	Condition * Time	0.00	.990	< 0.01

Note. PSN = point of subjective normality

Appendix 5.5.

The results of the independent and paired t-tests for point of subjective normality (PSN) after excluding participants who confirmed in the demographics questionnaire that they had a current or previous diagnosis of an eating disorder.

	t	df	*p*	*d*
Independent t-tests (high BMI vs. low BMI)				
Pre-training	-0.04	130	.969	-0.01
Post-training	2.11	130	.037	0.37
Paired t-tests (pre-training vs. post-training)				
High BMI	-1.00	68	.321	-0.12
Low BMI	4.28	62	< .001	0.54

Note. BMI = body mass index

Appendix 5.6.

The participant demographics and pre- and post-training measures after excluding outlier participants, defined as participants who were more than three times the interquartile range outside the 25th and 75th percentiles for any of the dependent variables (attentional bias score, PSN score, and body dissatisfaction score).

						Visual search accuracy (%)				Attentional bias				PSN				Body dissatisfaction			
		Age (years)		BMI (kg/m^2)		Pre-training		Post-training		Pre-training		Post-training		Pre-training		Post-training		Pre-training		Post-training	
Attention training condition	*N*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
High BMI	70	19.61	1.64	22.21	3.58	95.61	3.53	96.16	3.41	-24.46	325.82	-87.16	241.03	6.63	1.82	6.71	1.85	874.01	252.27	869.26	270.29
Low BMI	68	19.43	1.72	21.77	2.67	95.75	3.20	96.03	3.33	-25.65	270.36	-22.46	245.31	6.54	1.54	6.09	1.45	891.19	213.26	887.74	221.79

Note. BMI = body mass index; PSN = point of subjective normality

Appendix 5.7.

The results of the ANOVAs after excluding outlier participants, defined as participants who were more than three times the interquartile range outside the 25th and 75th percentiles for any of the dependent variables (attentional bias score, PSN score, and body dissatisfaction score). ANOVAs were conducted separately for each outcome variable (attentional bias, PSN, and body dissatisfaction), with attention training condition (high vs. low BMI) included as a between-participants independent variable and time (pre-training vs. post-training) included as a within-participants independent variable.

Outcome	Effects	$F(1, 136)$	p	η^2_G
Attentional bias	Condition	0.89	.347	< 0.01
	Time	0.86	.354	< 0.01
	Condition * Time	1.06	.305	< 0.01
PSN	Condition	1.65	.202	0.01
	Time	5.32	.023	< 0.01
	Condition * Time	10.59	.001	0.01
Body dissatisfaction	Condition	0.19	.662	< 0.01
	Time	0.71	.402	< 0.01
	Condition * Time	0.02	.894	< 0.01

Note. PSN = point of subjective normality

Appendix 5.8.

The results of the independent and paired t-tests for point of subjective normality (PSN) after excluding outlier participants, defined as participants who were more than three times the interquartile range outside the 25th and 75th percentiles for any of the dependent variables (attentional bias score, PSN score, and body dissatisfaction score).

	t	df	*p*	*d*
Independent t-tests (high BMI vs. low BMI)				
Pre-training	0.32	136	.750	0.05
Post-training	2.16	136	.033	0.37
Paired t-tests (pre-training vs. post-training)				
High BMI	-0.67	69	.504	-0.08
Low BMI	3.93	67	< .001	0.48

Note. BMI = body mass index

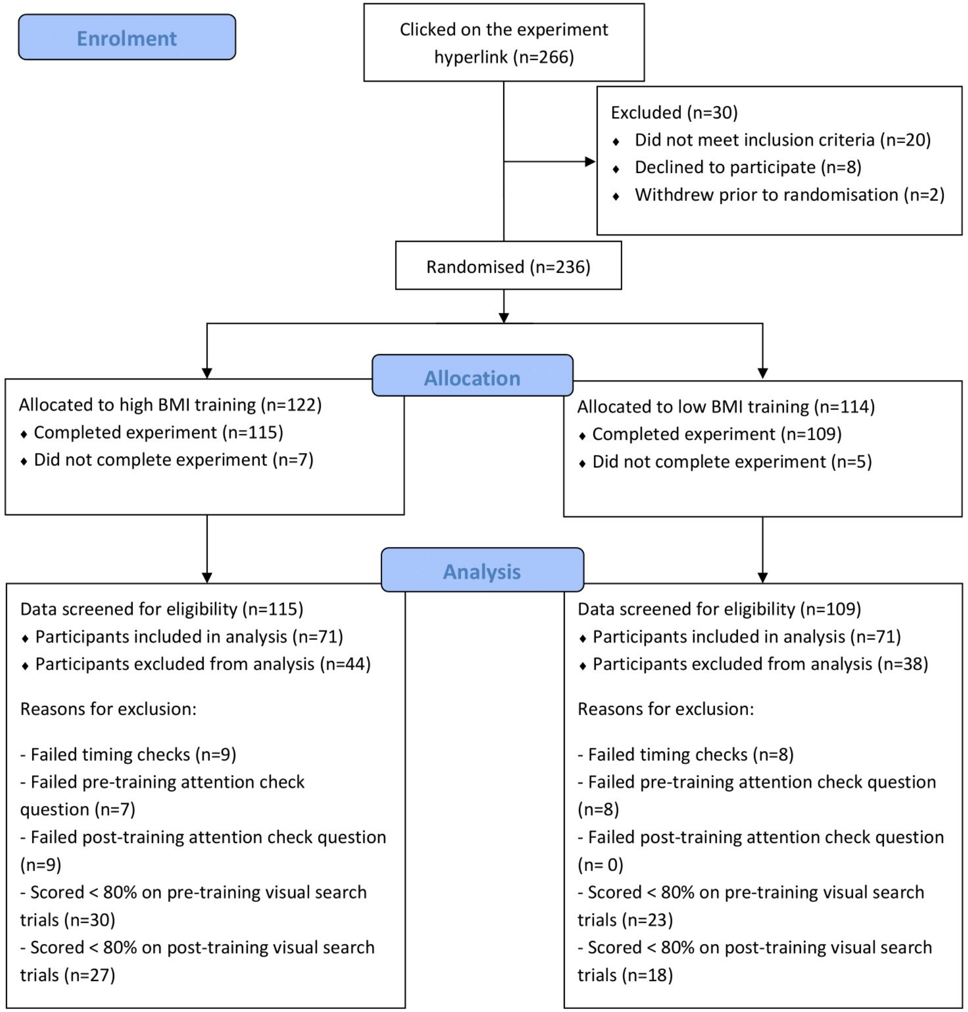
Appendix 5.9.

The correlation coefficients (Pearson's r) for the pre-training body dissatisfaction and attentional bias scores reported separately by attention training condition (high BMI vs. low BMI). We calculated Bayes factors using the correlation R package (Makowski et al., 2020) to evaluate the likelihood of the alternative hypotheses ($r \neq 0$) in relation to the null hypotheses ($r = 0$). Bayes factors > 1 provide support for the alternative hypothesis and Bayes factors < 1 provide support for the null hypothesis.

Attention training condition	*r*	*p*	BF_{10}
High BMI	0.02	.898	0.27
Low BMI	-0.19	.106	0.91

Appendix 5.10.

A CONSORT flow diagram of the recruitment, randomisation, and data screening process.



Note. Some participants excluded at the analysis stage failed multiple screening criteria.

Appendix 6.1.

Variations from the preregistration.

In our original preregistered protocol, we stated that we would stop recruitment after reaching our target sample size or by the 30th June 2022. By the 30th June 2022 we had recruited 167 participants with eligible data; however, we still had time and resources to continue data collection, so we decided to continue recruiting until reaching our target sample size with eligible data (*N* = 200). We updated our preregistration on the Open Science Framework (https://doi.org/10.17605/OSF.IO/32MZY) and in the interest of transparency reported the results of the main analyses on both sample sizes (*N* = 167 and *N* = 200). The analyses on the smaller sample size (*N* = 167) are reported in Appendices 6.2 and 6.3 and all produced results that were consistent with the analyses on the larger sample size (*N* = 200), except that with the smaller sample size we found some weak evidence for a positive association between disengagement bias and appearance comparisons. Women who disengaged slower (faster) from low (high) BMI bodies had greater appearance comparisons. We also found weak evidence for our hypothesised indirect relationship between disengagement bias and body dissatisfaction, indicating women who disengaged slower (faster) from low (high) BMI bodies had greater body dissatisfaction, via the mediators appearance comparisons and eating disorder-specific rumination. However, this evidence was very weak and was not present in the model 4 and related sensitivity analyses using the larger size. Further, all 95% confidence intervals for effects calculated using the smaller sample size overlapped considerably with 95% confidence intervals for effects calculated using the larger sample size. Finding weak evidence for an effect with a small sample size but not a large sample size is consistent with small sample sizes increasing random error, spurious results, and inflated effect sizes (Button et al., 2013; Thiese et al., 2016).

Appendix 6.2.

The results of the linear regressions. For model 1, the predictor variable is engagement bias. For model 2, the predictor variable is disengagement bias. For both models, body dissatisfaction is the outcome variable.

Model	Predictor	*N*	*B*	95% CI for *B*		*SE B*	*p*	*β*	R^2	R^2_{adj}
				LL	UL					
Model 1	Engagement bias	167	-0.013	-0.037	0.011	0.012	.274	-0.085	0.007	0.001
Model 2	Disengagement bias	167	0.005	-0.016	0.026	0.011	0.652	0.035	0.001	-0.005

Note. BMI = body mass index; *B* = unstandardised regression coefficient; CI = confidence interval; LL = lower limit; UL = upper limit; *SE B* = standard error of the coefficient; *β* = standardised coefficient; R^2 = coefficient of determination; R^2_{adj} = adjusted R^2

Appendix 6.3.

The results of the serial mediation models with appearance comparisons as the first mediator, eating disorder-specific rumination as the second mediator, and body dissatisfaction as the outcome variable. For model 3, the predictor variable is engagement bias. For model 4, the predictor variable is disengagement bias.

Model	*N*	a_1		d_{21}		b_2		c'		$a_1d_{21}b_2$	c	
		B [95% CI]	*p*	*B* [95% CI]	*p*	*B* [95% CI]	*p*	*B* [95% CI]	*p*	*B* [Bootstrapped 95% CI]	*B* [95% CI]	*p*
Model 3	167	0.0005 [-0.0007, 0.0016]	.4240	3.3319 [2.3031, 4.3606]	< .0001	1.0203 [0.6140, 1.4267]	< .0001	-0.0227 [-0.0433, -0.0021]	.0310	0.0016 [-0.0022, 0.0073]	-0.0133 [-0.0372, 0.0106]	.2737
Model 4	167	0.0011 [0.0001, 0.0021]	.0339	3.4029 [2.3567, 4.4491]	< .0001	0.9719 [0.5619, 1.3818]	< .0001	-0.0033 [-0.0215, 0.0149]	.7218	0.0036 [0.0004, 0.0071]	0.0048 [-0.0160, 0.0255]	.6517

Note. c' = direct effect, $a_1d_{21}b_2$ = hypothesised indirect effect, c = total effect; a_1, d_{21}, and b_2 = independent components of the hypothesised indirect relationship; CI = confidence interval