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Attention bias modification produces no changes to appearance-related bias, state or trait body dissatisfaction in nonclinical women

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Abstract

The potential of attention bias modification to reduce appearance-related attentional biases and female body dissatisfaction has not been investigated. Immediate and short-term effects were therefore examined across attentional biases, state and trait body dissatisfaction in a randomised controlled trial consisting of 62 female participants aged 18–35 years. The results show no changes to attentional bias across either the experimental or control condition and no significant changes in body dissatisfaction immediately post-training or at 1–2 weeks follow-up. Single-session attention bias modification protocols may therefore not be sufficient in modifying appearance-based biases and associated disordered body schemas within a nonclinical sample.

Keywords

attentional bias, attention bias modification, body dissatisfaction, dot-probe, females

High rates of body image disturbances are found in western cultures, with body dissatisfaction or the desire to lose weight estimated to affect 74 per cent of adult women (Hay et al., 2008). Given that body dissatisfaction is a consistent predictor of problematic eating pathology and is a diagnostic criterion for eating disorders (Coker and Abraham, 2014; Stice and Shaw, 2002), it is important to better understand factors that may exacerbate body image concerns.

A central tenant of cognitive models of eating disorders is the activation of maladaptive schemas (i.e. highly efficient knowledge structures) that bias the processing of shape-, weight-, food- and self-related information over other incoming information (Vitousek and Hollon, 1990). These cognitive biases, particularly attentional biases, have been implicated in the exacerbation of general body image concerns in nonclinical samples (Smith and Rieger, 2006; Smeets et al., 2011) and women with eating disorders (Rieger et al., 1998; Shafran et al., 2007). This biased schema-driven processing may be one mechanism through which high levels of body dissatisfaction are reinforced and maintained over time (Glauert et al., 2010; Stice and Shaw, 2002; Vitousek and Hollon, 1990).

Researchers have been investigating the role of selective attention in eating disorders for over two decades. This selective bias towards shape-, weight- and food-related information has been found in a variety of tasks including the modified Stroop task (Dobson and Dozois, 2004), the dichotic listening task (Schotte et al., 1990) and the dot-probe task (Rieger et al., 1998; Shafran et al., 2007). This attentional bias is not, however, specific only to those with clinical eating disorders (Williamson et al., 1999). It is theorised that nonclinical samples will also display attentional biases towards body-related information due to body schemas being both universal and particularistic (Perpiñá et al., 1993). That is, all women possess body-related schemas, yet only some women possess dysfunctional particularistic schemas that act to bias information selectivity. Although

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less consistent than eating disorder samples, certain subgroups within the nonclinical population who are preoccupied with dieting or body size (e.g. restrained eaters or women with high body dissatisfaction) will also exhibit appearance-related biases, particularly towards negative shape, weight and food-related stimuli (Gao et al., 2011; Glauert et al., 2010). For example, Glauert et al. (2010) found that undergraduate women demonstrated an automatic attentional bias towards thin rather than fat body figures, suggesting a general preference towards thin bodies. This bias was found regardless of how dissatisfied women were with their bodies.

Manipulating these biases directly through attentional training can improve body dissatisfaction or worsen body dissatisfaction when women are trained to focus on positive or negative appearance cues, respectively (Smeets et al., 2011; Smith and Rieger, 2006, 2009). Smith and Rieger (2006) successfully induced an attentional bias via a single-session modified dot-probe task in a female undergraduate student sample aged between 17 and 28 years ($N=70$). Those trained to attend to negative shape- and weight-related information reported greater body dissatisfaction after completing a body image stressor task compared to women in the control condition who displayed no changes in body dissatisfaction. These findings were replicated in a second study by Smith and Rieger (2009) using a sample of female undergraduate students, aged between 17 and 26 years ($N=98$). Training attention towards negative appearance-based information in a single session again exacerbated body dissatisfaction after completion of a body image stressor task compared to the control condition in which participants displayed no changes in body dissatisfaction. However, training attention towards positive shape- and weight-related information did *not* affect body dissatisfaction. It may therefore be negatively valenced information specifically, and not appearance information generally, that intensifies body dissatisfaction. These findings are important as they help to identify potential processes through which body image outcomes may be improved.

An established attentional re-training protocol designed to manipulate patterns of attention is attention bias modification (ABM). The use of ABM to improve psychological outcomes has been extensively studied within anxiety disorders. For example, several randomised, controlled trials have demonstrated a reduction in clinical anxiety symptoms when attention is trained away from threatening stimuli (Amir et al., 2009; Bar-Haim et al., 2011). Although multiple-session ABM protocols are currently proving to be more effective in producing sustained changes to attention over time, a number of studies have found that single-session ABM can also alter attentional processing. For example, when used in the context of food biases, single ABM sessions have been used to successfully increase attention towards healthy foods (Kakoschke et al., 2014) and reduce biases towards general food stimuli in obese women (Kemps et al., 2014b), with flow on effects in reducing consumption of craved foods (Kemps et al., 2014a, 2014c) and unhealthy snack foods (Kakoschke et al., 2014). Thus, we investigated whether a single-session ABM would be effective in improving body dissatisfaction in a sample of young women from the community, based on calls for more research into this area (e.g. Renwick et al., 2013).

This study reports the outcome of a double-blind randomised, controlled trial to investigate the efficacy of a single-session ABM protocol, aimed at redirecting attention towards neutral information over appearance-related information. Immediate effects on attentional biases and state and trait body dissatisfaction were taken as well as short-term (1–2 weeks) follow-up on the state and trait measures. The effects were compared across women high and low on trait body dissatisfaction as the ABM protocol was expected to be strongest in women with pre-existing body dissatisfaction. The sample for this study was divided into high and low body dissatisfaction to determine whether trait body dissatisfaction is a prerequisite to the efficacy of ABM in a nonclinical but at-risk female population. Words related to both negative and positive appearances were included to examine the specificity of any training effects.

Three hypotheses were proposed. Women in the ABM condition, compared to women in the control condition, would show the following: (H1) a significant reduction in attentional bias towards negative appearance information, (H2) an improvement in state body dissatisfaction scores immediately after training and (H3) improved state and trait body dissatisfaction 1–2 weeks following the intervention. Across all hypotheses, the magnitude of change was expected to be greater in women with pre-existing body dissatisfaction.

Method

Participants

A total of 62 women aged between 18 and 35 years ($M=23.95$ years; $SD=3.84$ years) provided data across all three stages of the study. The mean body mass index (BMI) was 23.22 ($SD=3.74$; range 16.23–36.58). Participants were primarily recruited through the university via announcements (75% of sample) while members of the general community were recruited via research flyers on online social media/community pages. Participants were aware that the project was investigating attention and body image self-perceptions, but full details were not provided. Participants were entered into a draw for one of two $50 gift vouchers after completion of the study. Ethical approval was provided by the Human Research Ethics Committee at the home institution.

Table 1. Word lists used in the ABM protocol.

Negative appearance words		Positive appearance words		Neutral non-appearance words	
Experimental	Neutral	Experimental	Neutral	Neutral	Neutral
Fat	Box	Fit	Land	Nova	Hose
Ugly	Desk	Lean	Soil	Comet	Seeds
Plump	Futon	Slim	Clay	Galaxy	Shovel
Gross	Bench	Toned	Acreage	Rocket	Gloves
Unfit	Shelf	Petite	Cavern	Planet	Garden
Hideous	Curtain	Slender	Glacier	Nebula	Shears
Unhealthy	Fireplace	Healthy	Tunnel	Eclipse	Compost
Overweight	Tablecloth	Athletic	Volcano	Asteroid	Sunlight
Disgusting	Television	Beautiful	Country	Celestial	Flowering
Unattractive	Conservatory	Attractive	Mountain	Spaceships	Fertiliser

ABM: attention bias modification.

Materials

ABM task. ABM was achieved via a modified version (MacLeod et al., 2002) of the dot-probe task. The task was designed to induce an attentional bias towards neutral non-appearance word stimuli and away from negative appearance-related stimuli. The dot-probe task consisted of four phases: pre-assessment of attentional biases, ABM training (or placebo), post-assessment of attentional biases and booster ABM/placebo training.

To begin each trial, a fixation cross (+) directed attention to the centre of the screen, with participants pressing the space bar to begin. Participants were presented with a pair of words (one appearance word and one matched neutral word) with one in the upper location of the screen and one in the lower location. After 500 ms, the word pair was replaced with a dot-probe (*) in either the upper or lower screen location. Participants were required to indicate as quickly as possible the spatial location of the dot-probe by pressing the up or down arrow key on the computer keyboard. Reaction times were recorded in milliseconds for each trial, with the trial recording a no-response after 1500 ms. Once a response was made, the fixation cross-appeared to signal the start of the next trial.

During assessment phases, 10 word pairs were presented from each of the three word categories: positive appearance, negative appearance and neutral non-appearance. The word pairs were presented for a total of four times at random, once across each possible location combination: upper location/congruent, lower location/congruent, upper location/non-congruent and lower location/non-congruent. Congruent trials refer to the dot-probe replacing the target word in either the upper or lower location of the screen, while non-congruent trials refer to the dot-probe replacing the matched neutral word in either the upper or lower location of the screen. This resulted in 120 pre-assessment trials and 120 post-assessment trials.

During the ABM phase, only negative appearance/neutral word pairs were included. During these trials, the dot-probe always appeared in the location of the neutral word, implicitly directing attention away from the negative appearance-related word. Each word pair during the ABM phase was presented eight times across the two non-congruent location combinations (upper/non-congruent; lower/non-congruent) for a total of 160 trials. The booster ABM phase included an additional 80 trials of the same type and was used to ensure participants ended the session on a training phase. The control group experienced no manipulation of attention. Instead, they completed 160 placebo trials (plus 80 placebo booster trials) that had the same contingencies as the pre-/post-assessment phases. Thus, each participant completed a total of 480 trials over the four phases plus an additional 20 practice trials at the beginning.

Word stimuli. Three categories of word stimuli were used in the ABM task: positive appearance, negative appearance and neutral (unrelated to appearance) words. Each category consisted of 10 target/neutral word pairs. Neutral words were themed to ensure that semantic relatedness was not a confounding factor (Cassin and Von Ranson, 2005). Target/neutral words were matched on word length and usage frequency (Brysbaert and New, 2009). Target appearance words were developed by the research team in line with the current body image research literature (e.g. Smith and Rieger, 2006) and included physical and affective words pertaining to weight, shape, physical health and overall appearance. Table 1 contains the full list of words.

Measures

Demographics. Participants reported on demographic information including gender (exclusion purposes), age, height, weight and whether they were from a university or general community.

State body satisfaction. The Body Image State Scale (BISS; Cash et al., 2002) is a six-item self-report measure of female evaluative and affective body image states. Participants rate how they are feeling 'at this very moment' on a 9-point Likert scale ranging from a positive to negative experience. Total BISS scores are calculated as the mean of the six items, after the three positive-to-negative items were reverse-scored. Higher scores indicate positive body image experiences at that specific point in time (Cash et al., 2002). Internal reliabilities were high across pre-training ($\alpha = .850$), post-training ($\alpha = .877$) and follow-up ($\alpha = .878$) stages of this study.

Trait body satisfaction. The Body Shape Questionnaire (BSQ; Cooper et al., 1987) is a 34-item self-report measure of general female body dissatisfaction, particularly the experience of 'feeling fat'. All BSQ items refer to body shape- and weight-related concerns experienced within the last 4 weeks, with respondents rating their experiences on a 6-point Likert scale ranging from 1 (*never*) to 6 (*always*). Scores are summed and higher scores indicate body dissatisfaction. Internal reliabilities for this study were high for pre-training ($\alpha = .962$) and follow-up ($\alpha = .972$).

Procedure

Participants completed baseline levels of state and trait body image dissatisfaction via an online survey. Approximately 1–2 weeks later, participants attended a laboratory session at the university to complete the ABM task. Upon entering the laboratory session, participants were randomly assigned to the ABM condition ($n = 37$) or control condition ($n = 25$). Allocation was double-blind and conducted by the second author who was not involved in the testing of participants. A random number generator was used to produce a string of 1s and 2s which corresponded to either the ABM or control condition. These numbers were placed in a sealed envelope with a participant number on the front which was opened upon arrival of each participant. Participants were then given brief instructions to respond as quickly and accurately as possible to the location of stimuli on the screen. The task began with the practice trials and the option to repeat the practice session again if required before completing the remaining trials. Overall, the task took approximately 15 minutes to complete and several breaks were offered throughout. Participants then completed the BISS and invited to leave their email address for a follow-up online survey. Interested participants were then contacted by email 1–2 weeks after completion of the laboratory session and invited to complete the BISS and BSQ-34 again. Those who completed all phases were entered into a prize draw.

Results

Analytical plan and preliminary analyses

Attentional bias indices were calculated across pre- and post-training for each word category using the following formula: (upper location/non-congruent − lower location/congruent) + (upper location/non-congruent − upper location/congruent)/2 (Smith and Rieger, 2010). Positive scores indicate a shift of attention or vigilance towards the appearance-related stimuli compared to negative scores which indicate a shift of attention away from, or attentional avoidance of the appearance-related stimuli. Attentional bias scores were used to determine the efficacy of the ABM protocol in modifying attention from pre- to post-test.

A series of *t*-tests showed that participants allocated to each condition did not differ on age, BMI, pre-test attentional bias scores or pre-test body dissatisfaction (all $ps > .05$). A median split ($Mdn = 92.11$) was used to divide the group into those with high baseline trait body dissatisfaction ($M = 121.41$, $SD = 20.19$, $n = 32$) and those with low trait body dissatisfaction ($M = 73.39$, $SD = 13.50$, $n = 30$). Our high trait group resembled the community-based normative group reported by Cooper et al. (1987) that reported some symptoms of bulimia nervosa ($M = 129.30$) or were 'body image concerned' ($M = 109$). The low trait group in our sample was a bit higher than the community-based 'unconcerned body image' group ($M = 55.90$) but similar to the group who reported no binging or purging ($M = 71.90$). Table 2 displays the key characteristics of the groups.

Main analyses

Effect of ABM on attentional bias scores. Hypothesis 1 predicted that women who received the ABM training would show a reduction in attentional bias towards the negative appearance words. This effect was expected to be greatest in women with high levels of trait body dissatisfaction. Positive appearance words were included for exploratory purposes, to determine the specificity of any training effect. Table 3 presents the attentional bias scores across ABM condition, word type and trait body dissatisfaction level. Attentional bias scores were analysed via a 2 (Time: pre- vs. post-training) × 3 (Word type: negative; positive; neutral) × 2 (Condition: ABM vs. control) × 2 (Trait body dissatisfaction: low vs. high) mixed design analysis of variance (ANOVA). Support for the hypothesis would be gained by a significant four-way interaction. However, the overall four-way interaction effect was non-significant, $F(2, 57) = 0.51$, $p = .560$, $\eta^2 = .018$. All three-way and two-way interactions were also non-significant, $ps > .05$, except for a trait body dissatisfaction by condition interaction ($F(1, 58) = 4.40$, $p = .04$, $\eta^2 = .071$). This interaction showed that for women with low trait body dissatisfaction, the control group directed their attention away from the stimuli

Table 2. Mean (standard deviation) state and trait body dissatisfaction scores across condition ($N = 62$).

	ABM				Control			
	High BD		Low BD		High BD		Low BD	
	n	*M* (*SD*)	*n*	*M* (*SD*)	*n*	*M* (*SD*)	*n*	*M* (*SD*)
Age (years)	18	23.57 (3.27)	19	24.47 (3.87)	14	23.57 (3.27)	11	24.18 (4.77)
BMI	18	24.17 (4.47)	19	22.23 (3.72)	14	23.85 (3.95)	11	22.59 (1.27)
BISS								
Pre	18	3.97 (1.58)	19	5.57 (0.95)	14	3.97 (1.10)	11	5.18 (1.19)
Post	18	4.28 (1.42)	19	5.97 (1.06)	14	4.26 (1.22)	11	5.59 (1.18)
Follow-up	17	4.09 (1.20)	19	5.28 (0.98)	14	3.70 (1.16)	10	5.38 (1.06)
BSQ-34								
Pre	18	122.70 (23.96)	19	73.30 (13.03)	14	119.74 (14.69)	11	73.54 (14.92)
Follow-up	17	122.49 (25.39)	19	65.23 (15.33)	13	117.51 (16.62)	10	78.25 (17.96)

ABM: attention bias modification; BD: pre-existing trait body dissatisfaction assessed via BSQ-34; SD: standard deviation; BMI: body mass index; BISS: Body Image States Scale; BSQ-34: Body Shape Questionnaire.

Table 3. Mean (standard deviation) attentional bias index scores for each condition at pre- and post-training ($N = 62$).

	ABM		Control	
	High BD ($n = 18$)	Low BD ($n = 19$)	High BD ($n = 14$)	Low BD ($n = 11$)
Pre-assessment phase				
Negative appearance	−2.34 (40.08)	10.06 (46.17)	5.75 (26.08)	7.18 (23.61)
Positive appearance	14.18 (47.68)	−.10 (66.08)	20.89 (23.00)	−22.35 (48.91)
Neutral non-appearance	11.80 (43.70)	7.12 (66.12)	−25.17 (59.00)	−1.55 (49.65)
Post-assessment phase				
Negative appearance	−2.71 (62.83)	17.49 (49.93)	−3.73 (54.72)	−4.23 (109.28)
Positive appearance	−6.58 (66.92)	−0.12 (84.39)	−2.64 (52.11)	−50.68 (53.84)
Neutral appearance	−22.85 (51.77)	−16.46 (67.98)	−0.36 (72.27)	−36.09 (82.80)

ABM: attention bias modification; BD: pre-existing trait body dissatisfaction assessed via the Body Shape Questionnaire-34.

($M = -17.95$, standard error (SE) = 5.94) compared to women in the ABM group ($M = 3.02$, $SE = 4.52$). For women with high body dissatisfaction, there was no such difference (ABM $M = -1.42$, $SE = 4.64$; control $M = -0.87$, $SE = 5.27$). There was also a main effect for condition ($F(1, 58) = 3.97$, $p = .05$, $\eta^2 = .064$) where the control group showed a larger bias ($M = -9.41$, $SE = 3.9$) than the ABM group ($M = 0.80$, $SE = 3.34$). The remaining main effects for time and trait body satisfaction were not significant, $ps > .05$. Collectively, these results show no evidence of reduced attentional bias scores for women who received the ABM training, regardless of trait body dissatisfaction.

Effect of ABM on immediate post-test state body satisfaction. In order to establish whether the ABM intervention had a subsequent effect on state body dissatisfaction immediately after training (Hypothesis 2), participant's post-training state body dissatisfaction scores were analysed via a 2 (Condition: ABM vs. control) × 2 (trait body dissatisfaction: high vs. low) ANOVA. Support for the hypothesis would be gained by a significant two-way interaction. However, this two-way interaction between trait body dissatisfaction and condition was non-significant, $F(1, 58) = 0.33$, $p = .570$, $\eta^2 = .006$, nor was the main effect of condition, $F(1, 58) = 0.42$, $p = .516$, $\eta^2 = .007$. There was a significant main effect for trait body dissatisfaction, $F(1,58) = 22.69$, $p < .001$, $\eta^2 = .28$, where participants with low trait body dissatisfaction reported better state body satisfaction ($M = 5.78$, $SE = 0.23$) than participants with high trait body dissatisfaction ($M = 4.27$, $SE = 0.21$), regardless of the intervention condition. There were also no significant correlations between immediate post-training state body dissatisfaction and attentional bias scores for participant's in the ABM condition (r values range from .018 to .289, $ps > .05$) or control condition (r values range from −0.36 to .329, $ps > .05$). Thus, there was no evidence that ABM training was able to improve state body satisfaction.

Effect of ABM on state and trait body satisfaction at follow-up. Analyses were conducted to test whether the women who received ABM would have improved state and trait body satisfaction at the follow-up point 1–2 weeks later

(Hypothesis 3). To assess changes in state levels at 1–2 weeks follow-up, a 2 (time: Baseline vs. follow-up) × 2 (trait body dissatisfaction: high vs. low) × 2 (condition: ABM vs. Control) mixed design ANOVA analysis was conducted. Support for the hypothesis would be gained via a significant three-way interaction. The three-way interaction was significant, $F(1, 56) = 5.13$, $p = .027$, $\eta^2 = .084$. This interaction was followed up by considering the changes over time in each condition, separately for each of the high and low trait body dissatisfaction groups. For the women who were high on trait body dissatisfaction, there was no significant effect of time ($F(1, 29) = 0.001$, $p > .05$), nor a time by condition interaction ($F(1, 29) = 1.66$, $p > .05$). For the women who were low on trait body dissatisfaction, there was no main effect of time ($F(1, 27) = 0.11$, $p > .05$), but a significant time by condition interaction ($F(1, 27) = 4.72$, $p = .039$). The pattern of means for this interaction showed that women in the ABM condition reported a slight decrease in state body satisfaction ($M_{pre} = 5.57$, $SE = 0.23$, $M_{post} = 5.29$, $SE = 0.23$) whereas the women in the control condition reported an increase in state body satisfaction ($M_{pre} = 4.99$, $SE = 0.31$, $M_{post} = 5.38$, $SE = 0.32$). However, formal analyses of these differences via paired-samples *t*-tests showed the differences from pre-to-post-state body satisfaction to be non-significant.

To assess changes in trait body dissatisfaction, a mixed design ANOVA was used which compared the interaction between condition (ABM vs. control) and time (pre to follow-up) on trait levels of body dissatisfaction. There was no significant interaction ($F(1, 57) = 1.72$, $p > .05$, $\eta^2 = .029$), no main effect of time ($F(1, 57) = 1.42$, $p > .05$, $\eta^2 = .024$) and no main effect of condition ($F(1, 57) = 0.52$, $p > .05$, $\eta^2 = .009$). Thus, there was no evidence that ABM training had any effect on trait body satisfaction at the follow-up point.

Discussion

The aim of the present investigation was to explore the effectiveness of an ABM protocol in reducing appearance-related attentional biases and improving immediate and follow-up state and trait body satisfaction. We found no evidence of such effects. Our sample showed no changes to their attentional bias scores, for either positive or negative appearance words, after undergoing a single-session ABM protocol which aimed to direct attention *away* from negative appearance–related words. Therefore, Hypothesis 1 was not supported. Furthermore, we found no evidence of changes to immediate state body satisfaction (Hypothesis 2) or follow-up state and trait body satisfaction 1–2 weeks after training (Hypothesis 3). The effectiveness of ABM in modifying appearance-related attentional biases is therefore questioned, at least within a nonclinical but body image–concerned group.

There are a number of possible reasons for these non-significant effects. First, it may be that pre-existing appearance-related biases are too potent to be modified within a single ABM session. Images and messages conveying cultural norms for beauty and appearance are highly pervasive and salient to women (Strahan et al., 2006) and play a large role in women's chronic dissatisfaction with their bodies (Thompson et al., 1999). Thus, multiple training sessions that provide systematic practice in redirecting attention away from negative appearance-related information might be required to compete with elaborate schemas for appearance-related information that have been acquired over years. Although the most effective ABM results within anxiety literature have been demonstrated with regular ABM sessions ranging from online daily sessions (e.g. See et al., 2009) to twice-weekly sessions over 4 weeks (e.g. Amir et al., 2009), Smith and Rieger (2006, 2009) were still able to successfully manipulate appearance-based attentional processing within a single training session. Both studies were successful in inducing attentional biases towards emotionally salient appearance stimuli and neutral stimuli. However, the premise of ABM as introduced by MacLeod et al. (2002) is to redirect attention *towards* a neutral item and *away* from an emotionally salient item, and successful training has occurred within a single session when redirecting attention away from food stimuli in obese women (Kemps et al., 2014b) and undergraduate women (Kemps et al., 2014c). ABM may therefore be more effective in competing with appearance-based schemas when attention is re-directed *towards* positive appearance words rather than *towards* neutral words in the presence of negative appearance information. The lack of ABM research within the body image field means that 'best practice' protocols are not available but remain an important direction for future research.

The second reason for the non-significant findings may be that attentional biases were not sufficiently evident at pre-test to allow for any modification. Most of the bias values were close to zero with the one exception of a small bias ($M = 17.11$) towards positive appearance information found in the high body dissatisfaction group. The role of pre-existing biases in modifying the outcomes of ABM has also not been fully explored (Mogoaşe et al., 2014). However, Bar-Haim (2010) has argued that pre-existing biases are not required for ABM to work, although this may only apply to samples with anxiety. It is crucial for future research to clarify the ABM mechanism of change as empirical data to date, although limited, do not provide as much support as expected for the assumption that ABM works by counteracting the dysfunctional attentional bias (Mogoaşe et al., 2014). It may be that the measurement of attentional bias itself (i.e. dot-probe task paradigm) needs to be further investigated in order to clarify the mechanism of change in ABM procedures. Again, further research is needed to examine these factors within the context of appearance-based biases and body dissatisfaction.

Although this study failed to find evidence for the effectiveness of ABM, it does add to the limited body of ABM research outside of the anxiety disorders. Within anxiety literature itself, a number of studies that have

delivered attentional bias modification tasks have failed to successfully modify biased attentional patterns or impact clinical symptomology (Bunnell et al., 2013; Schoorl et al., 2013). As in this study, without a change in attention, it is likely that no subsequent changes in outcomes are to be expected. Unsuccessful ABM trials therefore represent an absence of evidence for the effectiveness of ABM, but not so far as to provide evidence that ABM is ineffective (Clarke et al., 2014).

Certain limitations must be taken into account when considering directions for future research. Limitations of this study include the use of a university sample with varying levels of body dissatisfaction which may limit generality to at-risk subgroups within the general population. It was also difficult to eliminate demand effects, especially with three testing points where participants became more familiar with the tone of the study. The body image questionnaires focused solely on dissatisfaction with body size and weight rather than global appearance satisfaction and importance of appearance which should also be explored. Furthermore, the reliability of the dot-probe procedure to assess differential changes in appearance-specific attentional processes may also have limited our findings.

Despite these limitations, a number of methodological strengths were present. First, we employed a gold-standard measure of training effects through a double-blind, randomised controlled trial design. Pre-training and post-training measures of attentional bias allowed for the direct examination of attentional change, ensuring any statistically significant changes were due to the experimental manipulation and not pre-existing differences. The pre-test measure of state and trait body dissatisfaction also allowed for experimental ABM outcomes to be further distinguished according to pre-existing high or low body dissatisfaction, which is an important factor in determining the practical benefit of ABM as a preventative therapy for at-risk populations. In addition, we addressed the methodological disruption of learning suggested to occur between training and assessment trials (Bar-Haim, 2010), by including an additional booster phase of ABM trials so that participants ended the session on training trials rather than assessment trials.

Further research is needed into the ideal protocols for ABM within body dissatisfaction. In particular, an examination is needed of multiple versus single sessions of ABM as well as consideration of the usefulness of directing attention towards or away from appearance-related information. Although attentional biases have been shown to be successfully modified within single-session protocols across ABM research (e.g. Kemps et al., 2014a), multiple training sessions are required for sustained changes in non-clinical samples that extend beyond the re-training protocol (Fadardi and Cox, 2009). This study's findings suggest that a single-session ABM treatment is insufficient to deliver therapeutic benefits for appearance-related concerns, but the question remains whether multiple-session ABM could be effective.

Other methodological considerations include identifying optimal ABM stimulus type (e.g. word or pictorial) and presentation times, and optimal training paradigms (e.g. eye-tracking). Finally, exploration is needed into task performance-based factors such as variations in verbal instructions, participant task compliance (e.g. fatigue), engagement with stimuli and increasing task awareness and attentional control (Mogoaşe et al., 2014). Research targeting multiple cognitive processing biases such as interpretation and memory may also prove effective in exploring potential cognitive interventions for body image dysfunction. Modifying these biases simultaneously may produce an interactive or additive effect on symptom improvement (Hirsch et al., 2006).

In terms of therapeutic implications, future work is needed into the potential applicability of ABM as an additional treatment method for reducing the role attentional mechanisms play in body image disorders. This may be particularly useful in adults with more persistent symptoms where conventional psychological therapies targeting 'top–down' cognitive processes have limited treatment success (Renwick et al., 2013). This will first require larger-scale, randomised controlled trials in order to increase our knowledge of the ability to modify attentional mechanisms maintaining such appearance-based psychopathology.

In summary, we found no evidence for the potential therapeutic value of single-session ABM in reducing body dissatisfaction. Continued research is needed to improve our understanding of ABM's mechanism of change and determine the conditions under which ABM may serve as an effective treatment for reducing appearance-based attentional biases and pathological body image.

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