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Attention and memory biases toward body-related images among restrained eaters

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ABSTRACT

This study examined biases in attention and memory toward body-related images among restrained ($n = 31$) and unrestrained ($n = 29$) eaters. Attentional allocation to images of thin and overweight bodies during a visual search task was measured by tracking participants' eyegaze. This task was followed by a recognition test assessing participants' memory for those images. Restrained and unrestrained eaters allocated more attention to body-related images than to control images, but there was no difference in attentional allocation between the two groups. Restrained eaters showed better recognition of body-related images that they had previously seen during the visual search task. Finally, increased attention was associated with better recognition of body-related images for both restrained and unrestrained eaters, but restrained eaters had better overall recognition regardless of the level of attention. These findings suggest that restrained eaters may have more organized strategies for processing body-related information than do unrestrained eaters.

Introduction

Body dissatisfaction is a known risk factor for eating disorders and dysregulated eating behaviors. In recent years, research on body dissatisfaction has emphasized the role of cognitive processing biases in the development and maintenance of such body image concerns (see Lee & Shafran, 2004, for a review). In particular, prominent cognitive theories such as that proposed by Vitousek and Hollon (1990) have specifically emphasized the importance of selective attention toward and memory for information that is relevant to individuals' concerns about their body shape, weight, and diet. The present study further examines the nature of such biases in attention and memory.

Early evidence for an attentional bias toward body-related information came from studies that used the modified Stroop Color-Naming task. Those studies found that restrained eaters (i.e., those who have body-related concerns and a propensity to try and restrict their food intake in order to lose weight; Cooper & Fairburn, 1992; Green & Rogers, 1993; Perpiñá, Hemsley, Treasure, & de Silva, 1993) and individuals with eating disorders (Cooper, Anastasiades, & Fairburn, 1992) tended to take longer to name the color of words that are relevant to their body-related concerns (e.g., "fat" or "chubby") compared to neutral words (e.g., "chair"). This color-naming interference effect was interpreted as an indication of increased attention allocated to concern-relevant information.

Building on these initial studies, more recent research has attempted to identify the nature of these attentional biases. Specifically, studies have used more advanced methods, such as a visual search paradigm (Hollitt, Kemps, Tiggemann, Smeets, & Mills, 2010; Smeets, Roefs, van Furth, & Jansen, 2008), to investigate the processes underlying the attentional bias. Participants in these studies are presented with matrices of words, and their task is to determine whether the matrices contained words all from the same category or contained an odd-one-out target word from a different category. The odd-one-out target word was either a body-related, a food-related, or a neutral word. Smeets et al. (2008) argued that the two main processes responsible for the bias in attention are speeded detection and slowed disengagement of attention. Their results showed that attentional bias among participants with anorexia and bulimia was characterized by speeded detection of body-related words but slowed disengagement from food-related words (Smeets et al., 2008).

Research examining the nature of attentional biases provides an advancement in the understanding of the cognitive processes involved in body image concerns. One limitation, however, is that most studies in this area have relied on word stimuli, which limits the external validity of the findings. Smeets, Roefs, and Jansen (2009) did use a pictorial version of the visual search task to examine attentional bias to food-related information. Similarly, using body-related images could provide a more ecologically valid measure of attentional bias. Another limitation of studies that examine

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the processes underlying attentional bias is that researchers have generally inferred apparent attention by measuring participants' reaction times rather than measuring the actual amount of attention that they allocate to the specific body-related stimuli. One possible solution is to use eyetracking techniques. Eye movements are thought to be guided by selective attention (Kowler, 1995; Mogg, Millar, & Bradley, 2000) in that individuals usually look at stimuli that attract their attention (Jonides, 1981; Klein, Kingstone, & Pontefract, 1995). Thus, the process of tracking an individual's eyegaze patterns would provide a more directly observable, and therefore comparatively unambiguous, measure of the individual's visual attention orientation. Indeed, eyetracking techniques have been effective in studies investigating differential attentional allocation toward attractive and unattractive body regions in photographs of participants' own bodies versus bodies of others (e.g., Jansen, Nederkoorn, & Mulkens, 2005; Roefs, Jansen, Moresi, Willems, van Grootel, & van der Borgh, 2008).

In comparison to the research on attentional biases, fewer studies have examined memory biases in the context of body image and disordered eating. Moreover, studies in this area often yield inconsistent findings. For example, some studies have demonstrated that restrained eaters (King, Polivy, & Herman, 1991) and individuals with eating disorders (Hermans, Pieters, & Eelen, 1998; Hunt & Cooper, 2001; King et al., 1991; Sebastian, Williamson, & Blouin, 1996; Svaldi, Bender, & Tuschen-Caffier, 2010) show better recall of body-related information compared to unrestrained eaters and healthy controls. Other studies, however, have failed to find any recall and recognition biases among individuals who are preoccupied with their weight (Sebastian et al., 1996), individuals who have internalized the thin ideal (Cassin, von Ranson, & Whiteford, 2008), or individuals with clinical eating disorders (Johansson, Ghaderi, Hällgren, & Andersson, 2008). In fact, one recent study (Legenbauer, Maul, Rühl, Kleinstäuber, & Hiller, 2010) found an opposite pattern of bias in that individuals with eating disorders showed poorer recognition and free recall for body-related commercials compared to the control group. One limitation of the studies that used recognition tests is that memory bias was generally operationalized as the percentage of body-related words that participants were able to correctly recognize as "old" (i.e., words that they had seen during earlier training phases), which is referred to as the hit rate. However, memory performance is better characterized as a combination of both hits (i.e., the correct recognition of old items as old) and false alarms (i.e., the incorrect recognition of new items as old; Snodgrass & Corwin, 1988).

An important but unexplored question in the body image literature is whether there is a direct association between the amount of attention that individuals allocate to body-related information and their memory for that information. The relationship between attention and memory is a general psychological principle that has been well-established in the cognition literature. This research has shown that participants' memory for word stimuli is directly affected by their attentional allocation to the stimuli during encoding. For example, if information is processed under conditions of divided attention, participants' subsequent memory for that information is significantly reduced compared to information that is processed under conditions of full attention (Craik, Govoni, Naveh-Benjamin, & Anderson, 1996; Mulligan, 1998). Following from this research, one would also expect to see a link between attention and memory toward body-related information. That is, increased allocation of attentional resources to body-related information should also allow more opportunity for individuals to elaborate on and encode that information in memory, and should therefore lead to better subsequent recall and recognition of that information. Examining the relationship between attentional allocation and subsequent memory would help to clarify the nature of the attention and memory biases toward body-related information.

Biases in attention toward and memory for body-related information were examined among restrained and unrestrained eaters in the present study. The focus on restrained and unrestrained eaters is based on observations from previous research that restrained eaters have higher levels of body image concerns than do unrestrained eaters (Heatherton, Polivy, & Herman, 1991; van Strien, Herman, Engels, Larsen, & van Leeuwe, 2007; Vartanian, 2009; Vartanian & Hopkinson, 2010). Measures of dietary restraint have been criticized in the literature for their lack of association with actual caloric intake and restriction (Stice, Fisher, & Lowe, 2004). For the purpose of the present study, however, we are not concerned with whether dietary restriction was consistent or successful. Instead, our focus is on the heightened body image concerns that characterize restrained eaters and differentiate them from unrestrained eaters (Heatherton, Herman, Polivy, King, & McGree, 1988).

The present study extended the existing literature on attentional biases in the following ways. First, we used a visual search task in which attention was measured through the use of an eyetracking device. Second, the stimuli used in the visual search task were body-related images instead of words, thereby enhancing the external validity of the present study. We hypothesized that restrained eaters would allocate more visual attention to images of thin and overweight bodies than to control images. Moreover, we expected that restrained eaters would allocate more visual attention to the body-related images than would unrestrained eaters.

We also included a recognition test to assess participants' memory for body-related images in this study. Bias in recognition memory was evaluated using a measure of sensitivity (d') in a signal detection analysis (Snodgrass & Corwin, 1988), which combines rates of hits and false alarms to provide a more comprehensive measure of recognition performance. Although the evidence for memory biases in the body image literature is mixed, the one study that examined memory bias in a sample of restrained eaters found that those individuals showed enhanced recall of body-related information (King et al., 1991). Thus, we hypothesized that restrained eaters would show better recognition of the body-related images than control images. We also hypothesized that restrained eaters would have better recognition of the body-related images than would unrestrained eaters. Moreover, we examined the connection between attention toward and memory for body-related information. We expected that greater attentional allocation would be associated with better recognition memory of the body-related images. Finally, given that there are known cognitive processing differences in attention and memory between restrained and unrestrained eaters, we tested the possibility that the magnitude of the connection between attention and memory for body-related information may differ between restrained and unrestrained eaters. However, given the lack of previous research in this area, we did not have a specific hypothesis for the finding.

Method

Participants

Participants were 63 female undergraduate students enrolled in an introductory first-year psychology course at the University of New South Wales. They were either recruited by telephone, or via an online experiment sign-up system. Three participants were excluded from data analysis because less than 80% of their eyetracking data was recorded. Thus, the final sample consisted of 31 restrained eaters and 29 unrestrained eaters. Their mean age was 19.28 years ($SD = 2.69$; range = 17–37), and there was no difference in age between restrained and unrestrained eaters ($F = 0.48$, $p = .49$). The mean BMI (calculated from self-reported height and weight) was higher for restrained eaters (M = 22.13, SD = 3.29) than it was for unrestrained eaters (M = 19.98, SD = 2.80; F = 7.36, p = .01). Participants' BMI, however, was not correlated with any of the dependent variables (recognition d' and fixation duration for the images).

Materials

Images. Participants were exposed to three types of target images during the visual search task and the recognition test: women with a thin body shape, women with an overweight body shape, and plants (which served as control images). There were 40 images within each target image type, 20 of which were presented in the visual search task and 20 of which were used as novel images in the recognition test. The images within each target type were randomly allocated to the visual search task or to the recognition test for each participant, so that not all participants received the same set of images in the visual search task and in the recognition test. The height of all target images was 340–350 pixels. The width of images varied due to the different nature of the image content, but was no wider than 240 pixels. Participants were also exposed to images of neutral objects (e.g., stationery, furniture) which served as distracter stimuli and are therefore not included in the data analysis.

Visual search task. The visual search task required participants to search for a blue triangle onscreen and press the spacebar as quickly as possible when the blue triangle appeared. The blue triangle appeared a total of 48 times throughout the task and remained on the screen for one second. Participants' response and reaction time were recorded if the response was made within 500 ms after the triangle disappeared. The location of, and time interval between, each presentation of the blue triangle was randomized.

Throughout the task, the target (thin bodies, overweight bodies, and plants) and neutral images described above were also presented at random locations on the screen. All target and neutral images stayed onscreen for a total of three seconds before disappearing, and the time interval between the presentations of images was one second after the onset of the previous image. The images were presented in blocks with a specific order of presentation. In each block of presentation, three neutral distracter images appeared onscreen one at a time and always preceded the presentation of a target image. The neutral distracters were used in order to mask the true purpose of the study. Furthermore, each target image always appeared simultaneously with another neutral distracter image. This paired presentation provides an opportunity for, but does not restrict, participants to direct their visual attention to the target images, thereby giving them a choice of which image to orient their visual attention to. A block of presentation ended after the pair of target and neutral images (which are the last images to appear in a block) disappeared off the screen. The time interval between each block of presentation was one second (i.e., the first of the three neutral distracter images belonging to the next block appeared onscreen one second after the last image from the previous block disappeared). Thus, each block of image presentation lasted for a total of 7 seconds and participants were exposed to five different images within each block. A total of 60 target images consisting of 20 from each target image type were presented across the length of the task (i.e., there were a total of 60 blocks of presentations). The total duration of this task was approximately 7 minutes.

The visual search task was presented on a white background on a 23-inch LCD monitor, with the screen resolution set to 1920 × 1080 pixels. The task was programmed using Runtime Revolution software (Version 2.9.0). Participants' eyegaze to the three target image types (i.e., thin bodies, overweight bodies, and plants) was measured and recorded using the Tobii TX300 Eye Tracker.

Distracter task. A 3-minute distracter task was given to participants following the visual search task in order to eliminate any effects of rehearsal on the recognition test. Participants were required to list all the countries they could think of in six regions of the world: Oceania, Europe, Asia, Latin America, North America, and Africa.

Recognition test. All of the target images (thin bodies, overweight bodies, and plants) that were presented during the visual search task were shown in the recognition test. Thus, participants were presented with the 20 images from each of the three image types that they had seen during the visual search task (i.e., 60 "old" images in total). Additionally, participants were also shown 20 images from each of the target image types that they had not seen during the visual search task (i.e., 60 "new" images in total). Thus, there were a total of 120 trials in the recognition test. The order of the images shown in the recognition test was randomized for each participant. For each image, participants were asked "Do you remember seeing this picture earlier?", and they indicated their response using an onscreen scrollbar ranging from 0 (Definitely NO. It is a NEW picture) to 100 (Definitely YES. It is an OLD picture). This type of recognition rating scale was adapted from Griffiths and Mitchell (2008).

Restraint status. Dietary restraint was assessed using the Restraint Scale (Herman & Polivy, 1980). The Restraint Scale was chosen because it was used in the only previous study that found a memory bias in restrained eaters (King et al., 1991), thereby allowing us to draw parallels with the previous study. This 10-item scale measures the extent of an individual's dietary restrictions (e.g., "How often are you dieting?"), overeating (e.g., "Do you eat sensibly in front of others and splurge alone?"), and weight fluctuations (e.g., "In a typical week, how much does your weight fluctuate?"). Responses are scored on a scale from 0 to 3 for five of the items, and from 0 to 4 for the remaining items. The final scale score is a sum of the scores for all 10 items (range = 0–35). In order for our results to be comparable to other research in the area of cognitive biases and dietary restraint (Ahern, Field, Yokum, Bohon, & Stice, 2010; Hollitt et al., 2010; King et al., 1991; Lattimore, Thompson, & Halford, 2000), the Restraint Scale scores were used as a dichotomous variable in the present data analyses. Per Herman and Polivy's (1980) recommendations, participants were classified as restrained eaters if they scored 15 or above on the Restraint Scale (M = 20.23, SD = 4.27), and unrestrained eaters if they scored below 15 (M = 8.45, SD = 4.10). Among samples of female university students, this scale has been found to yield reliable scores over a 2-week period (r = .95; Allison, Kalinsky, & Gormon, 1992) and internally consistent scores (α = .78 to .86; Laessle, Tuschl, Kotthaus, & Pirke, 1989; Ruderman, 1983). Cronbach's alpha in this study was .87.

Procedure

Participants were told that the study examined eye movements and attentional processing in a visual search task. Upon arrival at the experimental laboratory, each participant was seated individually in front of a computer in a small room. They were asked to place their chin on a chin-rest that was mounted on the table in front of the computer and to adjust the height of the computer chair accordingly for their comfort. The experimenter then calibrated participants' eyegaze on the Tobii Eye Tracker. Once the recording of eyegaze started, participants were directed to the instructions page. The instructions provided a brief description about the reaction-timed visual search task. Participants were informed that they would be presented with a variety of images, including shapes and photographs (i.e., target and distracter images), but were not given any specific instructions regarding the nature of the photographs. Participants were also informed that their eyegaze would only be recorded for the visual search task. The participants were left alone in the room to complete the task. After completing the visual search task, the experimenter ended the recording of participants' eyegaze. Participants were then asked to complete the distracter task, followed by the recognition test and the Restraint Scale. Finally, they received either course credit or $10 for their participation. All participants were debriefed at the end of the experiment. This study was approved by the university's Human Research Ethics Advisory Panel.

Results

Fixation Duration

To index participants' attentional allocation, fixation durations (i.e., gaze length) for each image type were extracted from the eye-tracking data for each participant. The total fixation duration score is the total amount of time (in milliseconds) that each participant spent fixating on the images, averaged for each image type. A 2 × (3) analysis of variance (ANOVA) was conducted with restraint status as the between-subjects factor (restrained vs. unrestrained eaters) and image type as the within-subjects factor (thin vs. overweight vs. control). Planned contrasts were used to test our specific hypotheses. The total fixation durations for thin, overweight, and control images for restrained and unrestrained eaters are presented in Fig. 1. Overall, all participants fixated significantly longer on images of thin bodies than on control images, $F(1, 58) = 55.61$, $p < .001$, $\eta_p^2 = .49$, and also fixated longer on images of overweight bodies than on control images, $F(1, 58) = 102.69$, $p < .001$, $\eta_p^2 = .64$. However, restrained and unrestrained eaters did not differ in terms of fixation duration to images of thin bodies, $F(1, 58) = 0.20$, $p = .65$, $\eta_p^2 = .003$, or to images of overweight bodies, $F(1, 58) = 0.01$, $p = .92$, $\eta_p^2 < .001$. There was no restraint status × image type interaction.

Recognition *d*′

Participants' recognition ratings for the thin, overweight, and control images on the recognition test were converted into a measure of sensitivity (d') using a signal detection model. The sensitivity score d' is a measure of participants' ability to distinguish in memory between the "old" images that they had previously seen in the visual search task, and the "new" images that they had not seen. A higher sensitivity score indicates more accurate and selective

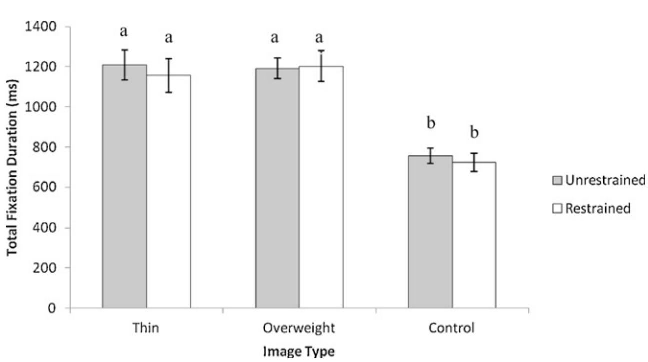

Fig. 1. Total fixation durations for each image type for restrained and unrestrained eaters. Error bars indicate the standard error of the mean. Means with different superscripts are significantly different at $p < .05$.

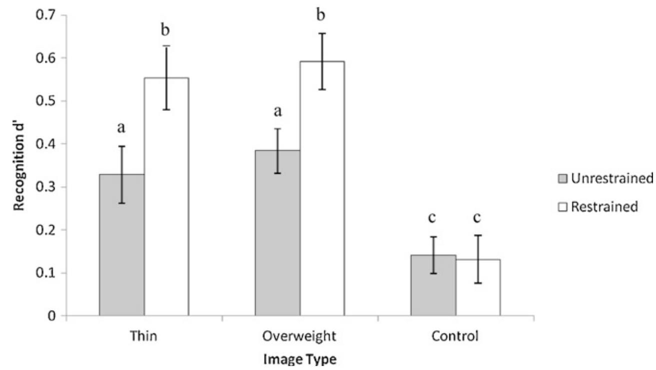

Fig. 2. Sensitivity scores (d') for each image type for restrained and unrestrained eaters. Error bars indicate the standard error of the mean. Means with different superscripts are significantly different at $p < .05$.

recognition, whereas a score of 0 indicates an inability to distinguish the "old" images from the "new" images. A 2 × (3) ANOVA was conducted with restraint status as the between-subjects factor (restrained vs. unrestrained eaters) and image type as the within-subjects factor (thin vs. overweight vs. control). Planned contrasts were used to test our specific hypotheses. The recognition sensitivity d' scores for thin, overweight, and control images are plotted separately for restrained and unrestrained eaters in Fig. 2. Participants were better able to selectively recognize images of thin bodies, $F(1, 58) = 28.07$, $p < .001$, $\eta_p^2 = .33$, and images of overweight bodies, $F(1, 58) = 48.01$, $p < .001$, $\eta_p^2 = .45$, than control images. There was, however, a significant interaction between participants' restraint status and the recognition advantage for images of thin bodies over the control images, $F(1, 58) = 4.18$, $p = .045$, $\eta_p^2 = .07$, and for images of overweight bodies over control images, $F(1, 58) = 4.59$, $p = .04$, $\eta_p^2 = .07$. Simple effects analyses indicated that restrained eaters had significantly better recognition sensitivity than unrestrained eaters for images of thin bodies ($p = .03$, $\eta_p^2 = .08$), and for images of overweight bodies ($p = .02$, $\eta_p^2 = .09$), but not for control images ($p = .89$, $\eta_p^2 < .001$).

Regression

A multiple regression analysis was conducted to examine the relationship between attention and recognition memory. Recognition d' scores were regressed on restraint status, fixation durations for the body shape images, and the interaction between restraint status and fixation duration. Restraint status and fixation duration were entered at Step 1 and their interaction was entered at Step 2 in a hierarchical regression. Participants' restraint status was dummy coded (unrestrained eaters = 0; restrained eaters = 1) and fixation duration was mean-centered prior to creating the interaction term to control for multicollinearity. Because there were no significant differences between images of thin and overweight bodies in terms of fixation duration, $F(1, 58) = 0.13$, $p = .72$, or recognition performance, $F(1, 58) = 0.93$, $p = .34$, the regression analysis was conducted using data collapsed across these two image types. The regression slopes for restrained and unrestrained eaters are plotted in Fig. 3 at 1 *SD* above and below the mean for attentional allocation. At Step 1, the overall regression model was significant, $F(3, 57) = 12.20$, $p < .001$, and explained 30% of the variance in recognition sensitivity. Restraint status was a significant predictor of participants' recognition sensitivity to the body shape images, $\beta = .35$, $t = 3.13$, $p = .003$, as was fixation duration, $\beta = .43$, $t = 3.91$, $p < .001$. At Step 2, the overall model was significant, $F(3, 56) = 8.05$, $p < .001$; however, the interaction between restraint status and attention was not a significant predictor of recognition memory performance, $\beta = -.07$, $t = -0.36$, $p = .72$, and adding the interaction

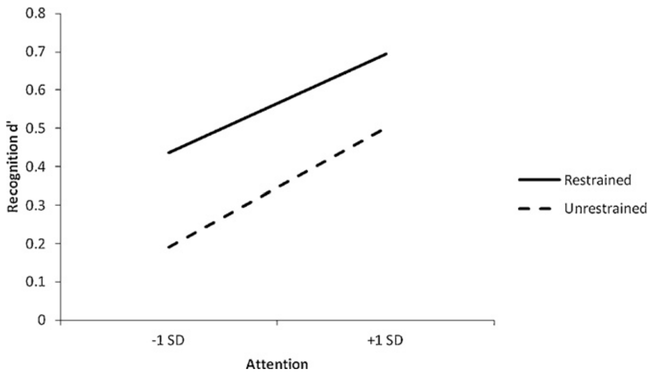

Fig. 3. Multiple regression predicting recognition d' scores from restraint status and attention for restrained and unrestrained eaters. Points on the x-axis are plotted at 1 standard deviation (*SD*) above and below the mean for attentional allocation.

to the model did not add significantly to the proportion of variance explained ($\Delta R^2 = .002$, $p = .72$). Thus, the link between fixation duration and recognition sensitivity to the body shape images did not differ between restrained and unrestrained eaters.

Discussion

The purpose of the present study was to broaden our understanding of attention and memory biases among restrained eaters. Previous research has found evidence for an attentional bias toward body-related information among individuals with body image concerns (Cooper et al., 1992; Cooper & Fairburn, 1992; Green & Rogers, 1993; Perpiñá et al., 1993; Smeets et al., 2008). In those studies, however, apparent attentional bias was inferred from participants' reaction times on various tasks and was not assessed in a directly observable way, such as by tracking their eyegaze toward the target stimuli. In the present study, allocation of visual attention to body-related images was measured by directly indexing participants' gaze length, and we found that restrained eaters did allocate more attention to the images of body shapes than to control images. However, the same pattern of attention was also found for unrestrained eaters. This discrepancy from previous findings suggests that perhaps the bias in attention toward body-related information found in previous studies may not be a result of differences in actual amount of attentional allocation. Instead, the previous findings may reflect differences in how individuals with and without body image concerns process body-related information.

The present study also extended previous literature on memory biases among weight-preoccupied individuals by using a more accurate method of indexing recognition memory, which includes a combination of both hit rates and false alarm rates (Snodgrass & Corwin, 1988). Consistent with our hypothesis, restrained eaters showed better recognition of the thin and overweight body shape images than did unrestrained eaters. Unrestrained eaters did show better recognition memory for images of body shapes than of plants, but the extent of the memory advantage for body shape images over plants was more pronounced for restrained eaters. Importantly, the fact that restrained eaters did not have better recognition of the control images (plants) than did unrestrained eaters suggests that the memory bias for body-related information was not due to general processing differences between the two groups, but rather that the memory bias is specific to body-related stimuli. Thus, the present study provides further evidence of a memory bias toward body-related information among restrained eaters. These findings are consistent with the results of the previous study that examined memory bias in a sample of restrained eaters (King et al., 1991), and supports the general postulations of the cognitive model (Vitousek & Hollon, 1990).

Our third aim was to examine the connection between attention and memory biases toward body-related information. The cognition literature makes a clear prediction about the direct effect that attentional allocation has on memory, and our findings were consistent with this prediction: The greater the level of attention that participants allocated to images of body shapes, the more accurate was their recognition memory of those images. Although the magnitude of the association between attention and memory biases was similar for restrained and unrestrained eaters, it is important to note that restrained eaters had better recognition memory for body shape images than did unrestrained eaters, regardless of the level of attentional allocation. A potential explanation for these findings is that restrained eaters may be more efficient at processing body-related information than are unrestrained eaters. This explanation is in line with the postulations of Vitousek and Hollon's (1990) cognitive theory, in which it was proposed that individuals with eating pathology have organized cognitive structures of thoughts and beliefs (or schemas) surrounding body-related issues such as weight. Thus, restrained eaters may have more efficient and organized strategies for processing body-related information than unrestrained eaters who do not have these same schemas. This idea reinforces our earlier suggestion that the attentional bias implicated in previous studies may reflect differences in how restrained and unrestrained eaters process body-related information rather than differences in the actual allocation of attention, which is perhaps why an attentional bias was not found in our study when using an eyetracker. Given that the extent of a memory bias toward body-related information may be determined by the amount of attentional allocation, future studies should consider including directly observable measures of attention, such as tracking eyegaze, to better understand the biases in memory for body-related information.

The present study did not examine a clinical sample of individuals diagnosed with eating disorders. There are, however, noted similarities between restrained eaters and individuals with clinical eating disorders with respect to their concerns about body shape, weight, and diet, as well as how they process this concern-relevant information (e.g., Herman & Polivy, 1988; Laessle, Tuschl, Waadt, & Pirke, 1989; Polivy & Herman, 1987; Wilson, 1989). Thus, focusing on restrained eaters in the present study represents a useful starting point for examining these processes and for making predictions about clinical populations. Given that restrained eaters were found to have better recognition memory for body-related information, we speculate that the same effects would also be observed, perhaps even to a greater extent, in a clinical population. Furthermore, the use of subclinical analogue samples enables the findings to be applicable to the larger proportion of the general population who do not meet criteria for eating disorders but otherwise exhibit eating-related pathology and concerns. However, further research focusing on individuals with eating disorders will be necessary to ascertain whether the present findings regarding attention and memory are generalizable beyond restrained eaters.

A limitation of the present study is that we did not include a measure of participants' body dissatisfaction. Therefore, we are unable to make inferences about the connection between these cognitive biases and body dissatisfaction. Future research on attention and memory to body-related information should include measures of body dissatisfaction in order to advance our understanding of the impact that cognitive biases have on body image concerns. Such studies would have implications for deriving more effective interventions to address the key maintaining factors underlying body dissatisfaction and eating disorders. Furthermore, due to the correlational nature of this study, we cannot draw any causal conclusions about the relationship between attention and memory toward body-related information. Further experimental studies are needed in which the level of attention toward body-related information is manipulated in order to establish any causal relations between attention and memory. A final limitation of the present study is that we did not collect sociocultural information (e.g., ethnicity) from the present sample of participants. Thus, we could not account for cultural differences in body image concerns that may have been present. The lack of information on population characteristics also restricts our ability to generalize predictions for future studies.

The findings of the present study provided novel insight into the attentional and memory processes that take place when an individual with concerns about body shape, weight, and diet encounters body-related information. Our findings suggest that how individuals process the information might be more important than how much attention they pay to that information. An implication of the present findings is that existing interventions that are designed to reduce attentional bias on its own may not have the expected effects on targeted symptoms, as individuals may still exhibit memory bias for body-related information, even without an initial elevated level of attention. In a similar vein, it has been noted in anxiety and depression research that interventions that target a single cognitive bias (e.g., attention or memory biases) do not always have an effect on symptoms of anxiety and depression (Hallion & Ruscio, 2011; Hirsch, Clark, & Mathews, 2006). Given that an association between biases in attention and memory toward body-related information was found in the present study, these biases need to be considered in an integrated manner in the development of interventions for body image issues. However, we have only a limited understanding of the strategies that restrained eaters employ that enables them to effectively remember the body-related images without having to pay more attention to those images. Future studies could explore the possibility that when individuals with body image concerns encounter an image of a female body, they may be focusing on a specific aspect of the image (that may be particularly salient to them), which may then assist them in differentiating the image from others in the subsequent recognition test. It may also be the case that interventions need to target at the schema level, because how information is attended to, interpreted and remembered is largely guided by schemas (Bar-Haim, 2010; Vitousek & Hollon, 1990). These schemas may be biased toward body-related concerns in individuals with body image issues, just as they are biased toward threat in individuals with anxiety disorders (Bar-Haim, 2010). Thus, further research is needed to examine the connection between schema activation and these biases in attention and memory toward body-related information, and the processes that may take place between attention and memory biases, in order to derive more targeted interventions to improve body image and the problems that surround body image issues.

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