Biases in orienting and maintenance of attention among weight dissatisfied women: An eye-movement study

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A B S T R A C T

Despite evidence indicating fatness and thinness information are processed differently among weight-preoccupied and eating disordered individuals, the exact nature of these attentional biases is not clear. In this research, eye movement (EM) tracking assessed biases in specific component processes of visual attention (i.e., orientation, detection, maintenance and disengagement of gaze) in relation to body-related stimuli among 20 weight dissatisfied (WD) and 20 weight satisfied young women. Eye movements were recorded while participants completed a dot-probe task that featured fatness-neutral and thinness-neutral word pairs. Compared to controls, WD women were more likely to direct their initial gaze toward fatness words, had a shorter mean latency of first fixation on both fatness and thinness words, had longer first fixation on fatness words but shorter first fixation on thinness words, and shorter total gaze duration on thinness words. Reaction time data showed a maintenance bias towards fatness words among the WD women. In sum, results indicated WD women show initial orienting, speeded detection and initial maintenance biases towards fat body words in addition to a speeded detection—avoidance pattern of biases in relation to thin body words. In sum, results highlight the importance of the utility of EM-tracking as a means of identifying subtle attentional biases among weight dissatisfied women drawn from a non-clinical setting and the need to assess attentional biases as a dynamic process.

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Introduction

Cognitive-behavioral models have implicated biases in the processing of information related to body size, shape, and food to explain the development and maintenance of eating disorders (ED) and body image disturbances (e.g., Vitousek & Hollon, 1990; Williamson, Muller, Reas, & Thaw, 1999). In part, vulnerable individuals are hypothesized to direct their attention towards or maintain a focus on perceived flaws in their own body shape or weight while ignoring less positive features of appearance and non-physical aspects of the self (e.g., Chen & Jackson, 2005; Roefs et al., 2008; Smith & Rieger, 2009; Vitousek & Hollon, 1990). While attentional biases have a critical role in cognitive-behavioural accounts, their nature and course is not well understood due to ambiguities in results of cognitive-experimental studies of body dissatisfaction and ED.

To illustrate, reviews of evidence from modified Stroop color-naming tasks indicate that ED samples more often experience interference when naming the color of body or food words than neutral words (Dobson & Dozois, 2004; Lee & Shafran, 2004). Unfortunately, the meaning of Stroop effects is uncertain: attention, cognitive avoidance and distraction due to induced emotional arousal have all been put forth as mechanisms to explain the phenomenon (Lee & Shafran, 2004).

Other strategies have been employed in attempts to clarify the nature of attentional biases in these groups. Using an “odd-one-out” visual search paradigm, Smeets, Roefs, Furth, and Jansen (2008) found that compared to controls, ED patients were faster detecting body words in arrays of neutral words. These findings suggested that initial orienting of attention towards body information was facilitated in the ED group. However, because valences of body words were not specified, it was not clear whether the effect reflected a bias towards negative, positive, or general body information. Furthermore, the approach did not permit an evaluation of biases in the maintenance or avoidance of attention.

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Still other researchers have used dot-probe paradigms to assess attention directed towards or away from particular types of information. Rieger et al. (1998) reported ED patients were faster responding to probes in the location of previously-presented words denoting a large physique and slower responding to probes in the location of previously-presented words denoting thinness. Shafran, Lee, Cooper, Palmer, and Fairburn (2007) found an ED sample was faster responding to probes in the same location as overweight or neutral body shape pictures, a bias that was not observed for thin shape pictures. Glauert, Rhodes, Fink, and Grammer (2010) reported undergraduate women were faster to discriminate the direction of a cue that appeared in the location previously occupied by thin rather than fat body figures. This bias was found using both 150 ms and 500 ms presentation times but was weakest for women who had a higher body mass index (BMI) and elevated body dissatisfaction.

These findings suggest that ED and body dissatisfied samples preferentially process negative body information and/or resist or avoid thin body information (Vitousek & Hollon, 1990; Williamson et al., 1999). Nonetheless, visual search and dot-probe paradigms provide only a discrete snapshot of responses after the onset of stimuli and fail to elucidate how attention is deployed prior to behavioral responses (Hermans, Vanstraelen, & Eelen, 1999). While varying stimulus presentation times has been used to address the time course of attention (Glauert et al., 2010), Garner, Mogg, and Bradley (2006) have pointed out this strategy still limits the assessment to discrete points during stimulus presentation.

Because saccades or eye movements (EM) are guided by attention (Kowler, 1995), eye-tracking technology is a non-invasive tool that provides a comparatively direct, continuous measure of visuospatial attention processing (Mogg, Millar, & Bradley, 2000). Within the dot-probe paradigm, orienting biases can be assessed from the direction and latency of the initial shift in gaze to stimulus choices (e.g., Garner et al., 2006). Biases in detection and orienting speed can be assessed from the first fixation latency, i.e., the interval between the onset of the stimulus pair and the onset of the first valid fixation on one stimulus (e.g., Garner et al., 2006). Maintenance biases have been operationalized as either the difference in average gaze durations of experimental versus control stimuli (e.g., Castellanos et al., 2009) or differences in the first fixation durations on experimental versus control stimuli that are terminated by the participant rather than stimulus offset (e.g., Garner et al., 2006). While individual EM studies have used one or more of these attentional indices, to date no research has assessed all of them.

By and large, EM studies have evaluated attentional biases related to anxiety (e.g., Hermans et al., 1999; Mogg et al., 2000), or substance use (e.g., Mogg, Bradley, Field, & De Houwer, 2003). However, two studies are directly relevant to body image. Jansen, Nederkoorn, and Mulkens (2005) assessed visual scanning patterns of ED symptomatic women and controls who viewed images of themselves and other women, each presented for 30 s. Symptomatic women focused less on their own “beautiful” body parts than their own “ugly” body parts and more on others’ “beautiful” body parts than others’ “ugly” body parts. Non-symptomatic controls showed the opposite pattern. Roefs et al. (2008) measured eye movements in 51 normal-weight female students with an unrestrained eating style while they were successively shown pictures of their own body and a control body for 30 s each. Attention directed towards one’s self-identified least attractive body part and the controls’ most attractive body part was associated with having a higher BMI and lower level of self-rated attractiveness. While orienting was not examined, findings supported predictions of cognitive perspectives regarding biases in the maintenance of attention on body-related stimuli (Vitousek & Hollon, 1990). Extensions that assess both initial orienting and maintenance of attention in relation to “fatness” and “thinness” stimuli can clarify more fully the extent to which biases are consonant with predictions of cognitive models.

Another issue in this literature is the assessment of cognitive biases in non-clinical samples. Williamson et al. (1999) have argued that cognitive biases are a function of distorted body schemata, rather than disordered eating, and can be observed, therefore, in weight or body dissatisfied people. This proposition is difficult to assess, in part, because of ambiguities in the status of body dissatisfaction and fatness concern as risk factors for versus diagnostic criteria of eating disorders (Jacobi, Hayward, de Zwaan, Kraemer, & Argas, 2004). Nonetheless, evaluation of cognitive biases in non-clinical samples has at least some value because possible confounds such as comorbid affective or anxiety disorders and significant functional impairment are less likely to be present and because the identification of attentional biases within a subgroup of the currently asymptomatic provides a basis for tracking future risk for eating disorder onset. And to date, meta-analyses reporting small Stroop interference effects for non-clinical samples compared to ED samples (Dobson & Dozois, 2004) suggest attentional biases apply only to clinical EDs. However, this conclusion is premature because salient experiments have been hampered by methodological concerns. For example, extreme groups required for comparisons are unlikely to result from median splits. As well, stimulus sets used have often failed to distinguish between eating, weight, and shape cues and/or negative versus positive stimuli (Lee & Shafran, 2004) which may be processed in different ways (e.g., Jansen et al., 2005; Smeets et al., 2008). On a related note, activation of relevant concerns may be necessary to observe larger effects in non-clinical samples. Finally, reaction time (RT) may not be sufficiently sensitive to detect subtle effects in non-clinical groups compared to indices such as EM registration (Jansen et al., 2005).

To address these limitations, this study used EM-tracking to evaluate biases in the orienting and maintenance of attention among weight dissatisfied (WD) women and non-dissatisfied controls. Based on theory (Vitousek & Hollon, 1990) and results of visual search (Smeets et al., 2008), dot probe (Glauert et al., 2010; Rieger et al., 1998; Shafran et al., 2007), and EM (Jansen et al., 2005) studies, we predicted that WD women would have initial orienting biases as reflected by 1) more frequent initial fixations of gaze and 2) shorter first fixation latencies towards fat and thin word stimuli than neutral word stimuli compared to control group women. Relative to controls, WD women were also expected to show maintenance biases reflected by longer first fixation and overall gaze durations for fat stimulus words and avoidance biases reflected by shorter first fixation and overall gaze durations for thin words. Finally, compared to controls, we hypothesized WD women would have faster and slower RTs in response to probes that followed fat and thin cues, respectively.

Method

Participants

The sample included 20 WD women and 20 control group women drawn from undergraduate classes at Southwest University (SWU) in Chongqing, China. The women ranged from 18 to 24 years of age ($M = 19.85, SD = 1.56$) and had a mean BMI ($M = 19.41, SD = 2.15$) within the average weight status range for Chinese samples (Chen, 2007). All were right-handed non-smokers, with no history of current or past neurological or psychiatric illness as well as normal or corrected-to-normal vision, and normal color vision as assessed by several basic color tests.
Materials

Body image screening measure

Negative Physical Self-Fatness Scale (NPS-F; Chen, Jackson, & Huang, 2006). The 11-item NPS-F, assesses thoughts, feelings, and behaviors related to fatness and overweight concerns, and was used to identify WD women and non-dissatisfied controls. Each item was rated between 0 = not at all like me and 4 = very much like me with total scores reflecting the average of summed responses. The NPS-F is reliable, $r = .88$, stable over three weeks, $r = .89$, and nine months, $r = .70$ (Chen, 2007; Chen & Jackson, 2007) and has satisfactory convergent and predictive validity (Chen et al., 2006; Jackson & Chen, 2008a, 2008b). In the current sample the NPS-F had an alpha of $\alpha = .87$.

Word stimuli

Thirty fat-related words, 30 thin-related words and 120 neutral household words were used to create 30 fat-neutral words pairs, 30 thin-neutral word pairs, and 30 "filler" neutral–neutral word pairs. Words were adapted from recent work (Chen, 2007; Chen & Jackson, 2005, 2006; Gao, 2007). Each pair was presented four times during the task. Word lists were equated for mean word length measured in total number of Chinese characters and frequency of occurrence in the Chinese language. The 60 body-related Chinese ideograms are listed in Appendix A with corresponding English translations.

Apparatus

Stimuli were presented on a 19 inch, 85-Hz monitor connected to a Pentium IV 3.2-GHz computer. Eye movements were recorded with an EyeLink II tracker (SR Research, Mississauga, Ontario, Canada) connected to a Pentium IV 2.8-GHz host computer. The eye-tracker sampling rate was 250-Hz and the spatial accuracy was better than $5^\circ$, with $.01^\circ$ resolution in the pupil-tracking mode. An infra-red head motion tracking system tracked head motion. A forehead and chin rest was used to keep viewing distance constant and minimize head movements. Participants sat 70 cm from the screen resulting in a 29° horizontal $\times 22^\circ$ vertical visual field. Before the task, a standardized calibration procedure for eye movements was conducted by requesting participants focus on 9 white dots randomly appearing on the black display space in a 3 $\times$ 3 array (from the top left to the bottom right of the screen). EM data were recorded during each trial, starting immediately before the onset of the fixation cross and terminating immediately after the word offset.

The dot-probe task

Each trial of the task began with a central fixation cross shown for 1,000 ms and then replaced by a word pair that appeared for 1,000 ms. Words in each pair measured $60 \times 90$ mm, with their centers 10 cm apart. Immediately after the offset of each word pair, a probe (●) was presented in the position of one of the preceding words and participants had to identify its location (left or right) by pressing one of two response keys as quickly as possible. Each probe appeared until a response was made or a 5 s maximum. Basic and color vision tests were also completed. After a one month delay to introduce a lag before the experiment, appointments were made with women randomly selected from subgroups who scored higher than 2.5 ($n = 46$) or lower than 1.5 ($n = 88$) on the NPS-F.

Participants were asked to consume their regular meals but to refrain from drinking caffeinated beverages for 2 h before the experiment. They were told the task focused on determining spatial locations of stimuli and would last for about 30 min. Individual testing sessions were scheduled between 9:00–11:00 am and 2:30–5:30 pm in a dimly-lit room illuminated by a variable wattage bulb to allow satisfactory eye pupil discrimination. Following their session, the women were debriefed about the research purposes and paid 10 Yuan as compensation for their time.

Data preparation

Eye-movement data

Saccades that remained stable within a $1^\circ$ visual angle for 100 ms or longer were classified as fixations to that position, the duration of which was recorded (for details, see Applied Science Group, 2000). Fixations on either word in each pair were identified when the following three conditions were satisfied: (i) Participants fixated in the central region before word onset, (ii) Saccades occurred at least 100 ms after word onset and before word offset (fixations with shorter latencies were unlikely to be contingent on the stimuli, and may have reflected express saccades or anticipatory eye movements instead [Fischer & Weber, 1993]; and (iii) participants fixated on one of the words, not the space between words, during stimulus presentations. In this study, initial fixations were made on one of the words in 85.58% of the trials. Orienting biases were reflected by 1) eye-movement direction and 2) first fixation latency bias scores. Maintenance biases were assessed via 1) first fixation duration and 2) overall gaze duration bias scores.

RT data

Trials with errors and response times of less than 200 ms or more than 3000 ms were excluded from analyses ($<2\%$ of trials). Participant error rates ranged from 0 to 2.78%; WD and control groups did not differ on number of errors made, $F(1, 38) = 1.72, p = .68$.

Design

A $2 \times 2$ mixed-design assessed effects of Group (WD vs. Control) and Word Type (Fat vs. Thin) on four EM indices (direction bias, first fixation latency bias, first fixation duration bias, and overall gaze duration bias) as well as probe RT, all of which were measured in milliseconds (ms). Simple effects analyses were conducted to evaluate significant interaction effects that emerged. For all within-subjects analyses, $p$ value was corrected for deviations according to Greenhouse and Geisser (1959). An $\alpha$-level of .05 was used to determine statistical significance.

Results

Group characteristics

Table 1 presents demographic information for each group. WD and control groups did not differ on age, $F(1, 38) = 2.48, p = .55$ or BMI, $F(1, 38) = 1.56, p = .22$.

Eye-movement data

Table 2 presented eye-movements data for WD group and control group.
effects analyses indicated WD women had more initial type interaction, $F$ main effect for Group, words compared to the control group was partially supported. The hypothesis that the WD group would display a bias in initial orienting towards both fat and thin words compared to the control group was partially supported. The main effect for Group, $F(1, 38) = 7.30, p = .010$, indicated WD women directed first fixations toward body words more often than controls did. However, this effect was qualified by a Group $\times$ Word type interaction, $F(1, 38) = 4.29, p = .045$ (Fig. 1, left panel). Simple effects analyses indicated WD women had more initial fixations on fat words than controls did, $F(1, 38) = 12.32, p = .001$, but groups did not differ in first fixations toward thin words. The main effect for Word Type was not significant, $F(1, 38) = .11, p = .744$.

**First fixation latency bias**

First fixation latency bias scores for weight-neutral word pairs were obtained by subtracting the first fixation latency of the neutral word from the first fixation latency of the fat or thin word in each trial. As indicated by the significant main effect for Group (Fig. 1, second panel from left), $F(1, 38) = 17.45, p < .001$, WD women had shorter (i.e., faster) initial fixation latencies for both fat and thin words than did control group women. Null effects were observed for Word Type, $F(1, 38) = .63, p = .433$, and Group $\times$ Word Type, $F(1, 38) = .01, p = .928$.

**First fixation duration bias**

First fixation duration bias scores for body-neutral word pairs were obtained by subtracting the first fixation duration of each neutral word from the first fixation duration of the corresponding fat or thin word in each trial. As hypothesized, WD women displayed a maintenance bias towards fat words and an avoidance bias away from thin words. The main effect for Group was not significant, $F(1, 38) = .08, p = .785$, but the effect for Word Type, $F(1, 38) = 5.81, p = .021$, was qualified by a significant Group $\times$ Word Type interaction, $F(1, 38) = 16.05, p < .001$ (Fig. 1, third panel from left). The interaction indicated WD women had longer initial fixations on fat words, $F(1, 38) = 6.02, p = .019$, and shorter initial fixations on thin words, $F(1, 38) = 7.51, p = .009$, than did controls. On average, WD women also had longer first fixation durations on fat than thin words, $F(1, 19) = 14.10, p = .001$, while controls had no such bias, $F(1, 19) = 2.36, p = .141$.

**Gaze duration bias**

Following Castellanos et al. (2009), gaze duration bias scores were calculated by computing the average time spent gazing at fat or thin words (summed across each trial) as a percentage of the total time gazing at both words in each pair. The hypothesis that WD women would show maintenance biases towards fat words and avoidance biases away from thin words was partially supported. Although the main effect for Word Type was not significant, $F(1, 38) = 2.07, p = .159$, there was a marginally significant effect for Group, $F(1, 38) = 3.96, p = .054$, and a significant Group $\times$ Word Type interaction, $F(1, 38) = 4.57, p = .039$ (Fig. 1, right panel). A simple effects analysis indicated WD women had a shorter overall gaze duration for thin words than controls did, $F(1, 38) = 10.07, p = .003$, but groups did not differ on overall gaze durations regarding fat words.

**RT data**

Attentional bias scores of RT were calculated from MacLeod and Mathews’ (1988) formula $[(B^{DR}−Br^{Dr}) + (Br^{Di}−B^{Di})]/2$, where $B$ = Body or weight words, $D$ = Dot probe, $l = Left$ and $r = Right$. Positive values were indicative of vigilance (i.e., faster RT to probes following body words than probes following neutral words), zero scores denoted no attentional bias, and negative scores reflected avoidance (i.e., slower RT to probes following body words than to those following neutral words).

A $2 \times 2$ ANOVA on RT data revealed a null effect for Group, $F(1, 38) = .25, p = .619$ and a significant effect for Word Type, $F(1, 38) = 10.27, p = .003$, that was qualified by a significant interaction, $F(1, 38) = 7.41, p = .010$. Analyses of simple effects revealed WD women were marginally more likely than controls to show a maintenance bias towards fat words as reflected by their somewhat faster RT in response to probes that followed fat words, $F(1, 38) = 3.07, p = .088$. Conversely, groups did not differ in RT for probes that followed thin words, $F(1, 38) = 1.38, p = .247$. Women within the WD group were also faster responding to probes that followed fat words than thin words, $F(1, 19) = 10.87, p = .004$. In contrast, control group women showed no RT differences to probes that followed fat or thin words, $F(1, 19) = .30, p = .589$. A one-sample $t$-test confirmed the fat word bias score was significantly greater than zero within the WD group, $t(19) = 2.25, p = .037$, but not the control group, $t(19) = 2.25, p = .037$. For thin words, RT bias scores did not differ from zero for the WD women, $t(19) = 1.70, p = .105$, or controls, $t(19) = .20, p = .846$ (see Fig. 2).
Discussion

To the best of our knowledge, this is the first experimental study to use EM measurement to examine the nature of attentional biases related to fat and thin information in a non-clinical sample of weight dissatisfied and non-dissatisfied women. Furthermore, a novel feature of the study compared to past work was the assessment of biases in not only initial orienting but also in the maintenance of attention.

Overall, our results were consistent with the view that biases in information processing can be observed in non-clinical samples of women with weight concerns (Williamson et al., 1999). Compared to controls, WD women showed biases in initial orienting characterized by faster first fixations on both fat and thin body words compared to neutral words. Biases in initial orienting in speeded detection were consistent with Vitousek and Holllon’s (1990) proposal that people with elevations in weight or body dissatisfaction are more prone to show hypervigilance upon exposure to body or weight information compared to neutral information. In the only past study to report biases in speeded detection, Smeets et al. (2008) found that eating disorder patients were faster than controls in detecting body cues within a visual search paradigm. In that study, attentional biases in an ED sample were inferred from response latencies over a longer interval, i.e. three to 4 s. In the present study, we demonstrated that biases in initial orienting are far more immediate, and extend to non-clinical samples. As such, these findings are consistent with tenets of cognitive-behavioral accounts that, among vulnerable individuals, information processing related to body shape and size is presumed to occur automatically and with no conscious attention (Vitousek & Holllon, 1990; Williamson et al., 1999).

Women with extreme weight dissatisfaction also showed a direction bias in initial orienting characterized by more frequent first fixations on fat body words than neutral words. The initial direction bias may have been a function of amygdala activation in the emotional processing of comparatively threatening stimuli that reflected personal concerns with overweight and fatness (Adolphs et al., 2005; Gamer & Büchel, 2009). Other recent studies have reported amygdala activation among anorexia nervosa patients and healthy women in response to their own fat-image (Miyake et al., 2010) and significantly more right amygdala activation in ED patients than controls during the presentation of negative but not positive body words (Miyake et al., 2010; Redgrave et al., 2008).

Hypotheses regarding biases in attentional maintenance received mixed support. Following from Garner et al. (2006) who operationalized maintenance biases on the basis of differences in first fixations duration on distinct stimulus classes, WD women had longer initial fixations on fat words and shorter initial fixations on thin words than did controls. WD women also fixated longer on fat words than on thin words while controls displayed no such bias in initial fixation durations for each word type. This pattern of effects was in line with the hypothesis that women with disturbances in body image and eating focus on perceived flaws related to their preoccupations (i.e., fat stimuli) while diverting from positive aspects of physical appearance (e.g., Smith & Rieger, 2009; Vitousek & Holllon, 1990). Once attention was captured by fat stimuli in early stages of information processing, WD women may have had more difficulty, at least initially, in disengaging from them. The pattern could also indicate that more attentional resources were utilized among WD women in attending to, making appraisals of, and identifying negative body-related information (i.e., fat stimuli) during the early stage of cognitive processing, which might be a maintenance factor of body dissatisfaction and disordered eating (Williamson et al., 1999). Recently, Miyake et al. (2010) have reported that significant medial prefrontal cortex (mPFC) responses were associated with the perception of negative words concerning body image in ED patients. The mPFC plays an important role in emotional processing and is involved in cognitive aspects of emotional processing, which could account for the initial maintenance bias toward fatness-related stimuli in WD women.

While word stimuli in the current study were presented in the limits of parafoveal vision before the first fixation, semantic processing of words can occur in foveal and parafoveal vision (Liversedge & Findlay, 2000). Because thin words may be schema-based for WD women, shorter initial fixations in this group may have reflected more efficient processing upon their presentation and a rapid disengagement of overt attention from these stimuli (Garner et al., 2006). To elaborate on the latter, thin stimuli may be viewed in a generally positive light in societies that endorse a thin feminine ideal including China (Jackson &

![Fig. 1. Mean direction bias scores (left panel), mean first fixation latency bias scores (the 2nd panel from left), mean first duration bias scores (the 3rd panel from left) and mean gaze duration bias scores (right panel) in weight dissatisfied group (WD group) and control group.](image)

![Fig. 2. Mean attentional bias scores by group and word.](image)
However, among WD women, such stimuli may be processed as ego-threats that arouse negative emotion because they highlight a gap between perceptions of self and attractive-ness standards (Heinberg & Thompson, 1995; Posavac, Posavac, & Posavac, 1998). Consequently, rapid disengagement from thin words among WD women may have reflected escape tendencies away from potential threats (Heatherton & Baumeister, 1991; Waller & Meyer, 1997).

When maintenance biases were indexed by differences in overall gaze durations for distinct stimulus types (e.g., Castellanos et al., 2009), WD women continued to display a shorter overall gaze duration for thin words than controls did, suggesting that rapid initial disengagement from thin stimuli was followed by continued avoidance. However, WD group did not display an overall maintenance bias towards fat body words compared to controls. The failure to observe an overall maintenance bias towards fat body words was consistent with the absence of distraction findings in the Smeets et al. (2008) study, perhaps indirectly reflecting the absence of a sustained maintenance bias. On the one hand, one possible explanation for this null effect was that in order to control negative emotion and anxiety aroused by fatness-related words, participants used self-regulatory strategies in avoiding gazing at fat body words after first fixation during which they made identification and evaluation of negative body image information. The self-regulatory strategy in subsequent avoidance from fat body words might buffer the effect of group differences for overall gaze durations. Findings from a recent brain imaging study (Miyake et al., 2010) provided support for the self-regulatory explanation: compared with normal controls, anorexia nervosa patients showed activity in the left inferior frontal cortex (IFC) during the perception of negative words concerning body image. The left IFC has been implicated in self-regulation, particularly inhibitory control (Swick, Ashley, & Tuken, 2008).

Conversely, methodological issues may have also contributed to this finding. In contrast to Castellanos et al. (2009) who assessed overall maintenance biases on stimuli presented for 2000 ms, stimulus presentation was for 1000 ms in this study. In our sample, the first overt shift of initial fixation during trials of Fatness-Neutral words pairs occurred about 350 ms after stimuli onset, and the termination of initial fixations occurred approximately 740 ms after stimuli onset. Subsequent saccades and fixation(s) were based on the remaining 260 ms, an interval that may have been too short to identify overall maintenance biases in gaze. The use of longer stimulus presentation durations in future studies can more clearly elucidate the extent to which maintenance biases for fat stimuli reflect initial and overall fixations.

Findings for RT were also partially consistent with expectations (Vitousek & Hallow, 1990). WD women had marginally faster RT to probes in the location of fat words than did controls as well as significantly faster RT in probes following fat as opposed to thin words. Based on assumptions underlying the dot-probe paradigm, these findings might indicate that over a more extended interval, WD women did display a maintenance bias towards fat stimuli. An intriguing alternative explanation in light of the null effect for biases in overall gaze is that RT findings reflect biases in re-engagement rather than maintenance of attention. That is, WD women might actually disengage from fat stimuli as the course of stimulus presentation progresses but stimulus offset triggers re-engagement of attention to the location of threatening targets in anticipation of the probe onset. Although further evidence is needed, support for this latter interpretation would suggest that attentional biases towards fat stimuli among vulnerable women are dynamic rather than static and unyielding over the course of stimulus presentation.

In sum, results of EMs data and RTs data suggest that fat and thin body stimuli have differential effects on the allocation of attention among WD women. After rapid orienting to the location of general weight-related stimuli, the focus of attention among WD women may be marked by a comparatively stable tendency towards rapid disengagement from and subsequent avoidance of thin body words. In contrast, the focus of attention on fat stimuli might shift at certain points during stimulus presentation among WD women. Because past studies have relied exclusively on a single index to assess maintenance biases, potential shifts between orienting, initial and overall fixations disengagement and re-employment with salient stimuli may have been obscured. In using five different indices to track attentional biases over the course of stimulus presentations, the present investigation highlights a clear need for research on the dynamics of attentional biases related to body image and eating disturbances.

Although the assessment of both orienting and maintenance biases via EM and behavioral indices were key strength of this research, its main limitations also provide important foundations for future work. Foremost, “positive” (i.e., thin) and “negative” (i.e., fat) body words were based on sociocultural attractiveness identification and valence ratings from people who did not experience extreme concerns with fatness or overweight. However, it is possible that stimuli connoting thinness are associated with more negative affect (e.g., anxiety) among people with heightened weight or eating disturbances (e.g., Shafran et al., 2007). Therefore, in future research, valence ratings of stimuli might be made by participants themselves to ensure a match with “objectively-rated” valences. Second, the inclusion of negative and positive control words in future research may help to clarify the extent to which attentional biases reflect the content versus the emotional valences of stimuli. Third, because people gaze longer at novel or more visually complex stimuli (Eizenman et al., 2003), the use of word stimuli matched for complexity and frequency likely enhanced the internal validity of this experiment. Nonetheless, extensions that employ carefully-matched picture stimuli may contribute to the ecological validity of associated findings. Furthermore, because it was possible that the weight dissatisfied group was also more likely to engage in disordered eating behavior, the assessment of disordered eating should be included in future studies of weight dissatisfied samples drawn from non-clinical settings.

The status of attentional biases as a risk factor for later increases in weight or eating disturbances in vulnerable groups such as early adolescent girls should be evaluated within prospective research designs. Treatment studies might assess how changes in attentional processing influence the maintenance of improvements and susceptibility to relapse. Finally, replications that track eye movements during other tasks such as those that involve visual searches (Smeets et al., 2008) or spatial cueing tasks (Koster, Crombez, Verschueren, & De Houwer, 2004, 2006; Verkuil, Brosschot, Putman, & Thayer, 2009) may clarify the nature, specificity, and generalizability of attentional biases associated with weight and eating disturbances.

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### References


### Appendix A. Stimulus words.

<table>
<thead>
<tr>
<th>Fatness related words</th>
<th>Thinness related words</th>
</tr>
</thead>
<tbody>
<tr>
<td>脂</td>
<td>水蛇腰 [Curved waist]</td>
</tr>
<tr>
<td>[Elephant's legs]</td>
<td>[Lean]</td>
</tr>
<tr>
<td>肥</td>
<td>[Lean body]</td>
</tr>
<tr>
<td>[Stout]</td>
<td>[Light]</td>
</tr>
<tr>
<td>肥大</td>
<td>[Light and graceful]</td>
</tr>
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<td>肥大</td>
<td>[Nice and slim figure]</td>
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<tr>
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<td>[Light and graceful stature]</td>
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<tr>
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<tr>
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<td>[Step soft]</td>
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<tr>
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<td>[Thin and tall]</td>
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<tr>
<td>肥大</td>
<td>[Thin girl]</td>
</tr>
<tr>
<td>肥</td>
<td>[Step soft]</td>
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<tr>
<td>肥</td>
<td>[Wafer-thin]</td>
</tr>
<tr>
<td>肥</td>
<td>[Move as a plant]</td>
</tr>
<tr>
<td>肥</td>
<td>[Willy swaying in the wind]</td>
</tr>
</tbody>
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<thead>
<tr>
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<th>Thinness related words</th>
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<tr>
<td>[Big and corpulent]</td>
<td>[Curvy]</td>
</tr>
<tr>
<td>[Elephant's legs]</td>
<td>[Curved]</td>
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<tr>
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<td>[Curved waist]</td>
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<tr>
<td>肥</td>
<td>[Lean and slender]</td>
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<tr>
<td>肥胖</td>
<td>[Lean body]</td>
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<tr>
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### Fatness related words

- 脂
- [Elephant's legs]
- 肥
- [Stout]
- 肥大
- [Fat and big]
- 肥胖
- [Fat and bulky]
- 肥胖
- [Fat ball]
- 肥胖
- [Fat meat]
- 肥胖
- [Fat girl]
- 肥胖
- [Flabby meat]
- 肥胖
- [Fatty]
- 大腹便便 [Large belly]
- 大腹便便 [Large and meaty]
- 肥胖
- [Obese]
- 肥胖
- [Overweight]
- 肥胖
- [Plump]
- 肥胖
- [Stout]
- 肥胖
- [Tubby]
- 肥胖
- [Tubby waist]

### Thinness related words

- 脂
- [Elephant's legs]
- 脂
- [Excess fat]
- 脂
- [Fat (adj.)]
- 脂
- [Fat and large]
- 脂
- [Fat and bulky]
- 脂
- [Fat ball]
- 脂
- [Fat meat]
- 脂
- [Fat girl]
- 脂
- [Flabby meat]
- 脂
- [Fatty]
- 肥胖
- [Obese]
- 肥胖
- [Overweight]
- 肥胖
- [Plump]
- 肥胖
- [Stout]
- 肥胖
- [Tubby]
- 肥胖
- [Tubby waist]


