



Time Course of Attentional Biases Toward Body Shapes in Women Who Are Overweight or Obese

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Published online: 15 November 2018
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Abstract

Although attentional bias toward body-related stimuli has been implicated as a vulnerability factor for body image disturbances, the time course of attentional biases toward body shapes in women who are overweight or obese is not clear. Using a dot-probe task and a between-subjects design, we assessed attentional biases (including facilitated attention, delayed disengagement, and avoidance) toward fat and thin body images in women who were overweight or obese (body mass index, BMI ≥ 25 kg/m²; n = 25) and normal-weight controls (BMI < 25 kg/m²; n = 25). Three stimulus presentation times were used: 100 ms, 500 ms, and 2000 ms. Women who were overweight or obese reported a stronger relative preference for Thin over Neutral images. All participants showed attentional bias toward thin body images in the initial orientation (100 ms) and later avoidance (2000 ms) stage, whereas only the women who were overweight or obese showed a bias toward fat body-related images when displayed for 500 ms, indicating difficulty disengaging from fat body-related stimuli. Slower attentional disengagement from fat body stimuli might be a cognitive marker for body image disturbance in women who are overweight or obese.

Keywords Attentional biases · Overweight/obesity · Dot-probe task · Body-related stimuli

Introduction

According to cognitive-behavioral models, selective attention plays an important role in the development and maintenance of body image disturbances and eating disorders (Dondzilo et al. 2017; Fairburn et al. 2003; Vitousek and Hollon 1990; Williamson et al. 2004). Individuals with body image disturbances or eating pathology develop self-schemas (a set of beliefs and generalizations about themselves) that focus on weight and negative thoughts about weight and other body-related attributes (e.g., size, shape). The schemas are believed to influence an individual's thoughts, affect, and behavior (Vitousek and Hollon 1990). Attentional biases (ABs) refer to differential attentional allocation towards emotional stimuli relative to neutral stimuli (Bar-Haim et al. 2007; Cisler and Koster 2010). Consequently, stimuli in the

attentional focus are processed more efficiently (Posner and Presti 1987). Empirical data have shown an association between ABs in the processing of female body images and body dissatisfaction (Allen et al. 2018; Dondzilo et al. 2018; Forsyth et al. 2018; Gao et al. 2013, 2014; Rodgers and DuBois 2016; Tobin et al. 2018). ABs are important causal and maintenance factors in body dissatisfaction, as concluded in a recent systematic review (Rodgers and DuBois 2016). For instance, in one study investigating the role of attention in causing body (dis)satisfaction by use of an eye tracker, attentional bias for self-defined unattractive body parts leads to an exacerbated body dissatisfaction, while training attention towards their own attractive areas of body can increase body satisfaction (Smeets et al. 2011).

A negative body image is highly prevalent in overweight and obese individuals (Nissen and Holm 2015; Schwartz and Brownell 2004), especially in female samples (Ferguson 2013; Tsai et al. 2016). Additionally, it is strongly associated with cognitive-affective and behavioral elements, such as body dissatisfaction, body-related avoidance behavior (e.g., not looking in the mirror), and body-checking behavior (Warschburger et al. 2015). Laboratory research has also found support for ABs in participants with overweight/

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obesity compared to normal-weight controls. For example, Gardner et al. (1990, 1991) recorded the visual search patterns exhibited by obese and normal-weight individuals as they completed a body-size estimation task with a computer-based morphology program. Participants with obesity focused more on the waist region than did participants with normal weight (Gardner and Morrell 1991; Gardner et al. 1990). Recently, Warschburger et al. (2015) analyzed the eye movements of overweight and normal-weight individuals while they viewed their own pictures and pictures of gender and BMI-matched controls. Overweight adults exhibited an unexpected but stable pattern of selective attention, with a distinctive focus on their own attractive body regions despite higher levels of body dissatisfaction. This could be interpreted as a strategy to enhance and protect self-esteem (Warschburger et al. 2015).

The dot-probe task (DPT) has been used to clarify the component processes underlying ABs that are related to body image (Cisler and Koster 2010; Mogg et al. 2004). In the DPT, a pair of stimuli (e.g., an emotional stimulus and a neutral stimulus) is briefly presented on a screen, one stimulus above or beside the other, and is immediately followed by a dot (the probe) in the location of one of the stimuli. Probes appearing at the same location as the previously presented target stimulus are considered “congruent”, whereas those presented at the location of the neutral reference stimulus are “incongruent”. Participants are required to respond to the probe as quickly as possible. The probe replaces the emotional stimulus and neutral stimulus with equal frequency (50%). Response latency indicates visual attention to the stimuli presented (Townshend and Duka 2001).

The DPT allows researchers to distinguish the three types of ABs, facilitated attention, delayed disengagement, and avoidance, either by manipulating the presentation times of stimuli (Cisler and Koster 2010; Mogg et al. 2004) or by including neutral baseline trials (Koster et al. 2004). During the task, facilitated attention, which is defined as the relative ease or speed with which attention is drawn to an emotional stimulus, leads to shorter reaction times (RTs) in congruent trials than in incongruent trials with very brief stimulus presentation times (e.g., 100 ms or less), given that, with longer durations, participants are able to voluntarily shift their attentional focus to other stimuli (e.g., Rayner, 1998). Delayed disengagement, or the degree to which an emotional stimulus captures attention and impairs switching attention away from it to another stimulus, leads to shorter RTs in congruent trials than in incongruent trials with presentation times of 500 ms or longer to avoid vigilance effects (Koster et al. 2004). Alternatively, attentional avoidance, which is the allocation of attentional focus away from the emotional stimulus, leads to longer RTs in congruent trials than in incongruent trials during longer presentation times (e.g.,

2000 ms) (Deluchi et al. 2017; Gao et al. 2013; Moussally et al. 2016; Shank et al. 2015), as the attentional avoidance is more strongly influenced by explicit motivation (Lopes et al. 2014).

Selective ABs toward body shape/weight-related stimuli have been examined using DPT in previous research (Onden-Lim et al. 2012; Rodgers and DuBois 2016). Facilitated attention toward thin bodies was observed to decrease as body dissatisfaction and BMI increased (Glauert et al. 2010). However, facilitated attention toward thin versus fat bodies was not found in other research (Moussally et al. 2016). Delayed disengagement from very thin bodies was observed in women with high body dissatisfaction when the stimulus presentation time was 500 ms (Moussally et al. 2016). Moreover, delayed disengagement from non-thin body images (i.e., images with negative emotional valence) was also observed (Dondzilo et al. 2017). Furthermore, an attentional avoidance bias in response to thin-related words was shown by weight-dissatisfied women (Gao et al. 2011, 2012). In sum, numerous studies using DPT have provided evidence of ABs associated with body dissatisfaction (Rodgers and DuBois 2016), although there have been inconsistent findings.

ABs toward body-related stimuli play an important role in the potential development and/or maintenance of body dissatisfaction (Rodgers and DuBois 2016; Tobin et al. 2018). Using the attention bias modification (ABM) task, attention bias to body-related stimuli can be reduced in women with body image problems (Allen et al. 2018). A time-course analysis of attentional bias can help us develop effective intervention protocols for women with body dissatisfaction. We are not aware of any studies to date that have investigated the time course of attentional bias in response to body-related images in women who are overweight or obese.

The present study aimed to examine the three types of selective ABs toward body-related stimuli in women who are overweight or obese compared to controls. Based on cognitive-behavioral models (Fairburn et al. 2003; Vitousek and Hollon 1990; Williamson et al. 2004) and previous studies (Deluchi et al. 2017; Moussally et al. 2016), women who were overweight or obese were expected to display attentional bias toward body-related stimuli. Facilitated attention and delayed disengagement toward both thin and fat body stimuli were expected for all of the participants based on having shorter RTs in congruent trials than in incongruent trials. Attentional avoidance from fat body stimuli was expected to show at 2000 ms based on having longer RTs in congruent trials than in incongruent trials. Additionally, these biases were expected to be demonstrated more intensely by women who were overweight or obese compared to controls.

Materials and Methods

Participants

The final sample included 25 undergraduate women who are overweight or obese and 25 controls with a normal weight from a large Chinese university. The participants were categorized into groups based on the criteria established by the World Health Organization (WHO) (2014); individuals with a body mass index ($BMI = kg/m^2$) equal to or greater than 25 were assigned to overweight/obese group, whereas those with a BMI lower than 25 were assigned to the control group. For all of the participants, BMI ranged from normal to obese ($M = 23.76$, $SD = 3.73$). The participants ranged in age from 18 to 25 years old ($M = 20.52$, $SD = 1.61$), were right-handed, had normal or corrected-to-normal vision, and had normal color vision as assessed by several basic color tests. All of the participants were non-smokers and had no history of current or past neurological or psychiatric illness. None of the participants were diagnosed with an eating disorder according to the Eating Disorder Diagnostic Scale (Stice et al. 2000). Demographic information for the participants is presented in Table 1.

Visual Images

The photographic stimuli consisted of 12 fat body pictures, 12 thin body pictures, and 12 neutral household pictures adapted from previous studies (Gao et al. 2012, 2013,

2014). The two sets of body shape pictures featured the whole body excluding the head to control influences of ethnicity and facial expression. Fat versus thin pictures of different body parts, such as arms, waists, thighs or stomachs, were matched by gesture. Figure 1 illustrates examples of the stimuli. There were no significant differences between the two kinds of body images based on valence or arousal (Gao et al. 2014). Each image measured 6.64 cm wide and 10 cm in length. Complexity, brightness, and color composition were matched across the three categories.



Fig. 1 Representative examples of each category of stimuli (fat body picture, thin body picture and neutral picture)

Table 1 Characteristics of overweight/obese group and control group ($M \pm SD$)

| | Overweight/ obese group (n = 25) | Control group (n = 25) | t | Cohen's d |
|--------------------------------------|--|------------------------|----------|-----------|
| Age (years) | 20.60 (1.61) | 20.44 (1.64) | 0.40 | 0.10 |
| Year in university | 2.16 (0.85) | 2.39 (0.95) | -0.78 | 0.26 |
| Body mass index | 26.92 (2.35) | 20.60 (1.49) | 11.44*** | 3.21 |
| NPSS total score | 84.08 (21.55) | 77.56 (16.05) | 1.21 | 0.34 |
| NPSS-face | 25.68 (8.35) | 24.08 (6.86) | 0.74 | 0.21 |
| NPSS-fatness | 32.16 (11.00) | 28.72 (8.84) | 1.21 | 0.34 |
| NPSS-stature | 26.24 (7.00) | 24.76 (5.99) | 0.80 | 0.23 |
| OBCS total score | 41.04 (10.98) | 35.20 (11.90) | 1.80 | 0.51 |
| OBCS-body surveillance | 25.20 (8.25) | 22.60 (7.85) | 1.14 | 0.32 |
| OBCS-body shame | 15.84 (5.65) | 12.60 (6.10) | 1.95 | 0.55 |
| Image liking rating (thin) | 6.74 (1.34) | 5.94 (1.37) | 1.99 | 0.59 |
| Image liking rating (fat) | 2.55 (1.48) | 2.56 (1.06) | -0.02 | 0.01 |
| Image liking rating (neutral) | 4.78 (1.40) | 5.19 (1.06) | -1.17 | 0.33 |
| Relative preferences for thin images | 1.96 (1.45) | 0.78 (1.07) | 2.63* | 0.93 |
| Relative preferences for fat images | -2.22 (1.60) | -2.63 (1.13) | 1.03 | 0.30 |

NPSS negative physical self scale; OBCS objectified body consciousness scale

* $p < 0.05$; *** $p < 0.001$

Visual Probe Task

A modified DPT was used with a manipulation of stimulus onset asynchrony (SOA) (Deluchi et al. 2017; Moussally et al. 2016). In the task, each trial began with a fixation cross, which appeared at the center of the screen for 500 ms. Next, a pair of images (Fat vs. Neutral; Thin vs. Neutral) were presented side by side simultaneously on a computer screen before being removed and replaced by a visual probe (an arrow) that appeared on one side of the screen. The participants were asked to pay attention to the arrow and indicate its direction as quickly and accurately as possible, via a right-handed key-press on a keyboard using the up and down arrows. The probe (up or down arrow) replaced the body-related and neutral images with equal frequency (50%) and remained onscreen until a response was made or 3000 ms had passed. All images were presented four times (twice on the left side; twice on the right side) for each SOA (100, 500 and 2000 ms) in a random sequence (Deluchi et al. 2017; Tapper et al. 2010). Before the formal task, the participants performed a 10 trial training session to become familiar with the study procedures. The images used in training were not included in the main task. The formal task included 144 trials in total.

Questionnaire Measures

Negative Physical Self Scale

The Negative Physical Self Scale (NPSS) measures thoughts, feelings, projections, and behaviors related to body image, which are specific sources of appearance dissatisfaction that have been identified in adolescents and young adults in Mainland Chinese samples (Jackson et al. 2016a). The measure has subscales that assess specific concerns, i.e., facial appearance concerns (Face), fatness concerns (Fatness), and stature concerns (Stature). Each subscale has 11 items that are rated on a 5-point scale, ranging from 1 (*Not like me at all*) to 5 (*Always like me*). In this study, the internal consistencies were $\alpha = .90$ for the overall NPSS, $\alpha = .89$ for Face Appearance, $\alpha = .92$ for Fatness, and $\alpha = .82$ for Stature.

Objectified Body Consciousness Scale

The Objectified Body Consciousness Scale (OBCS) assesses perceptions of and reactions to one's body as the object of others' gaze (McKinley and Hyde 1996). A modified version of the OBCS has been found to be reliable and valid in studies of mainland Chinese young adults (Jackson and Chen 2015; Jackson et al. 2016b). The body surveillance subscale is comprised of eight items measuring tendencies to view one's body as an outside observer would (e.g., "During the day, I think about

how I look many times"). The 6-item body shame subscale assesses feelings of shame when one's appearance does not conform to cultural standards (e.g., "I feel ashamed of myself when I haven't made the effort to look my best"). All subscale items are scored on a 7-point Likert-type scale ($1 = \textit{Strongly disagree}$; $7 = \textit{Strongly agree}$). Internal consistencies in this sample were $\alpha = .78$ for the overall OBCS, $\alpha = .79$ for body surveillance, and $\alpha = .72$ for body shame.

BMI

Body weight and height were measured using the standard protocols proposed by the International Society for the Advancement of Kinanthropometry (Marfell-Jones et al. 2012) in order to calculate BMI (kg/m^2). Weight was measured to the nearest 0.1 kg on a calibrated digital scale. Height was measured with a portable height measuring device with 1 mm graduation. To obtain the most accurate weight possible, the participants were asked to wear shorts and a sleeveless T-shirt.

Procedure

The study was approved by the Human Research Ethics Committee of the associated university. Potential volunteers were recruited from the campus electronic bulletin board system and social media outlets. Upon arriving, the participants were informed of the general research focus (i.e., attention toward different kinds of images), signed the informed consent, and completed measures of weight and height. Subsequently, the participants were seated 70 cm from the computer screen and completed the visual probe task.

After the main research task, the participants rated how much they liked the fat body images, thin body images and neutral household images on a scale from $1 = \textit{Not at all}$ to $9 = \textit{Very much}$. Absolute liking ratings for each image type reflected the average of all associated ratings. In addition, the relative preferences for the Fat and Thin images were calculated by subtracting the average liking rating for the Neutral images from the average liking ratings for the Fat and Thin images, respectively, for each participant. Following the rating of the pictures, the participants completed the self-report measures described above. Debriefing occurred after the questionnaires were completed. The participants were paid 15 yuan for completing the study.

Data Analysis

Data were analyzed with IBM SPSS Statistics 20.0. Group differences were assessed via *t*-tests for the following variables: demographics, body dissatisfaction, objectified body

consciousness, absolute liking ratings for each image type, and relative preferences for the Thin and Fat images (i.e., Thin minus Neutral image liking ratings and Fat minus Neutral image liking ratings).

Following other published research (Deluchi et al. 2017; Moussally et al. 2016), effects of the independent variable on task performance (as measured by RTs) were evaluated in a 2 (Group: overweight/obese group and control group) \times 2 (Cue Category: fat and thin body image) \times 2 (Probe Congruency: congruent and incongruent) analysis of variance (ANOVA) for each SOA. Mauchly's test of sphericity was violated in the initial ANOVA analyses; thus, Greenhouse–Geisser corrections were used to reduce the risk of Type I errors. RTs that were greater or less than three standard deviations from the mean (i.e., 0.07% of trials) were excluded from the analyses.

Results

Group Differences on Demographics and Self-Report Measures

As shown in Table 1, the groups did not differ by age, year in university, body dissatisfaction, and absolute image liking ratings for Fat or Neutral images. However, women who were overweight or obese reported a stronger relative preference for Thin over Neutral images.

Differences in ABs

100 ms Condition

The repeated measures ANOVA performed on RT data revealed a main effect of Cue Category, $F(1, 48) = 8.07$, $p = 0.01$, $\eta_p^2 = 0.14$, indicating that all of the participants responded more quickly to fat body image cues than thin body image cues ($M = 669.56$ ms vs. $M = 688.85$ ms, respectively). A main effect of Probe Congruency, $F(1, 48) = 4.97$, $p = 0.03$, $\eta_p^2 = 0.09$, indicated that the sample responded more quickly in the congruent trials than the incongruent trials ($M = 672.02$ ms vs. $M = 686.40$ ms, respectively). There was no main effect of group, $F(1, 48) = 0.02$, $p = 0.90$, $\eta_p^2 = 0.001$. Simple effects analyses of the Cue Category \times Probe Congruency interaction, $F(1, 48) = 8.37$, $p = 0.01$, $\eta_p^2 = 0.15$, indicated that the sample responded more quickly to thin body images in the congruent trials than in the incongruent trials ($p = 0.01$), but not to fat body images ($p = 0.12$). There was no interaction of group \times Cue Category \times Probe Congruency, $F(1, 48) = 0.30$, $p = 0.58$, $\eta_p^2 = 0.01$.

500 ms Condition

In the 500 ms condition, there were no main effects of Probe Congruency, $F(1, 48) = 0.07$, $p = 0.80$, $\eta_p^2 = 0.01$, or group, $F(1, 48) = 0.31$, $p = 0.58$, $\eta_p^2 = 0.01$. A main effect of Cue Category, $F(1, 48) = 7.34$, $p = 0.01$, $\eta_p^2 = 0.13$, indicated that the sample responded more quickly to thin body image cues than fat body image cues ($M = 629.10$ ms vs. $M = 650.08$ ms, respectively). Simple effects analyses of the Cue Category \times Probe Congruency interaction, $F(1, 48) = 16.22$, $p < 0.001$, $\eta_p^2 = 0.25$, indicated that the sample responded more quickly to fat body image cues than thin body image cues in the incongruent trials ($p < 0.001$), but not in the congruent trials ($p = 0.77$). There was an interaction of group \times Cue Category \times Probe Congruency, $F(1, 48) = 4.45$, $p = 0.04$, $\eta_p^2 = 0.09$. To examine the three-way interaction and our hypotheses, RT data were analyzed separately within each group to disentangle the nature of the significant effects, as suggested by previous studies (Forsyth et al. 2018; Lyu et al. 2016; Mogg et al. 2008).

For the overweight/obese group, there were no main effects of Cue Category, $F(1, 24) = 2.62$, $p = 0.12$, $\eta_p^2 = 0.10$, or Probe Congruency, $F(1, 24) = 0.23$, $p = 0.64$, $\eta_p^2 = 0.01$. However, simple effects analyses of the Cue Category \times Probe Congruency interaction, $F(1, 24) = 15.32$, $p = 0.001$, $\eta_p^2 = 0.39$, indicated that women who were overweight or obese responded more quickly to fat body image cues in the congruent trials than in the incongruent trials ($p < 0.001$), but more slowly to thin body image cues in the congruent trials than in the incongruent trials ($p = 0.02$) (see Fig. 2).

For the control group, a main effect of Cue Category, $F(1, 24) = 5.20$, $p = 0.03$, $\eta_p^2 = 0.18$, indicated that the controls responded more quickly to thin body image cues than fat body image cues ($M = 618.33$ ms vs. $M = 641.18$ ms, respectively). There was no main effect of Probe Congruency $F(1,$

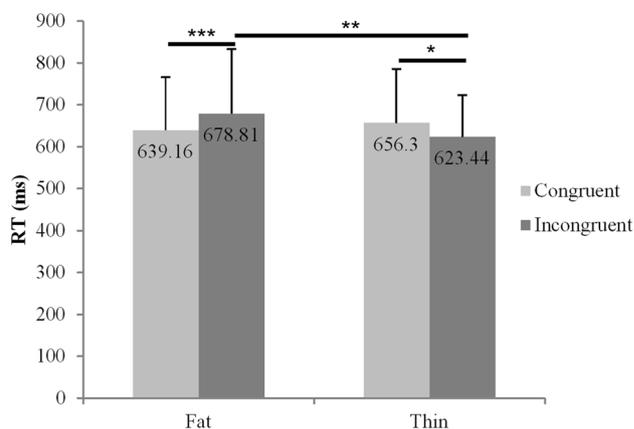


Fig. 2 Reaction time data at 500-ms presentation time of stimuli for overweight/obese group. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

24) = 0.03, $p = 0.89$, $\eta_p^2 = 0.001$, and no interaction of Cue Category \times Probe Congruency, $F(1, 24) = 2.39$, $p = 0.14$, $\eta_p^2 = 0.09$ (see Fig. 3).

2000 ms Condition

There was a main effect of Cue Category, $F(1, 48) = 7.97$, $p = 0.01$, $\eta_p^2 = 0.14$, indicating that the sample responded more quickly to fat body image cues than thin body image cues ($M = 624.05$ ms vs. $M = 641.09$ ms, respectively). A main effect of Probe Congruency, $F(1, 48) = 12.53$, $p = 0.001$, $\eta_p^2 = 0.21$, indicated that the sample responded more quickly in the incongruent trials than in the congruent trials ($M = 620.64$ ms vs. $M = 644.50$ ms, respectively). Simple effects analyses of the Cue Category \times Probe Congruency interaction, $F(1, 48) = 15.19$, $p < 0.001$, $\eta_p^2 = 0.24$, indicated that the sample responded more slowly to thin body images in the congruent trials than in the incongruent trials ($M = 668.50$ ms vs. $M = 613.67$ ms, $p < 0.001$, respectively), but not to fat body images ($M = 620.50$ ms vs. $M = 627.61$ ms, $p = 0.47$, respectively). There was no main effect of group, $F(1, 48) = 0.31$, $p = 0.58$, $\eta_p^2 = 0.01$, and no interaction of Group \times Cue Category \times Probe Congruency, $F(1, 48) = 0.82$, $p = 0.37$, $\eta_p^2 = 0.02$.

Discussion

In this study, we examined the time course of attentional bias toward fat and thin body images at different stages of attentional processing in women who were overweight or obese and normal-weight controls. We employed a visual probe task with different SOAs to monitor attentional bias during the orientation and maintenance stages of attention. Initial attentional bias toward thin body images was strong in the orienting stage of attention (100 ms) in both groups.

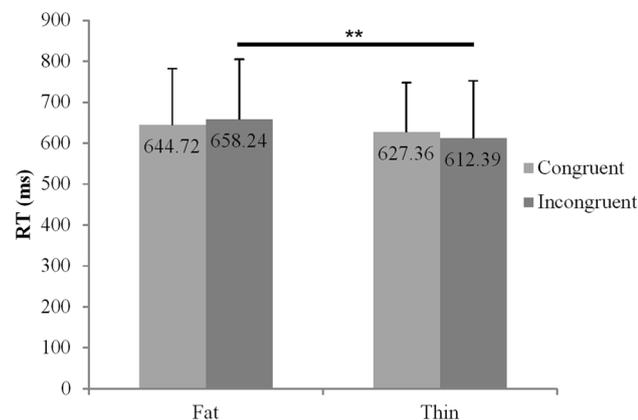


Fig. 3 Reaction time data at 500-ms presentation time of stimuli for control group. ** $p < 0.01$

In the maintenance stage (500 ms), we observed delayed disengagement from fat body images in women who were overweight or obese. The hypotheses of this study were partially confirmed by the main findings, with women who were overweight or obese having increased attentional bias toward the fat body stimuli in the maintenance stage of attention. Given that ABs are risk factors for body dissatisfaction (Dondzilo et al. 2017), the presence of ABs toward body-related stimuli may have implications for the development of body dissatisfaction in women who are overweight or obese.

In the present study, women who were overweight or obese experienced difficulty with selective disengagement difficulty after exposure to fat body images in the SOA of 500 ms. Experiencing difficulty in disengaging attention from stimuli that portray shape and weight information could lead to an individual being continuously reminded of this information, which could reduce his/her cognitive capacity to attend to other more adaptive information (Forsyth et al. 2018). These results suggest that women who were overweight or obese may have an impairment in switching their attention from fat body images to another stimulus. This pattern is in line with the results of other investigators who have observed sustained maintenance biases toward fat body images in individuals with high levels of body dissatisfaction (Gao et al. 2013, 2014) which have been proposed to intensify shape/weight concerns. Later disengagement from fat body images may help participants escape from the awareness of their perceived unattractive bodies or from the discomfort or anxiety induced by the images (Gao et al. 2013), as previous research suggests that young women engage in downward social comparison thoughts when viewing fat-related information (Gao et al. 2013; Roefs et al. 2008). Impaired disengagement may be a critical vulnerability for individuals who are at risk of being overweight or obese in light of evidence that ABs toward body-related cues contribute to the development and maintenance of body dissatisfaction and eating disorders (Rodgers and DuBois 2016).

According to cognitive-behavioral models (Vitousek and Hollon 1990), ABs toward weight-related information arise from underlying maladaptive schemata associated with shape, weight and self. Disengagement difficulty during the shorter intervals of the DPT (e.g., SOA 500 ms) by women who are high in weight dissatisfaction may be based on automatic schema-related processing (Vitousek and Hollon 1990). For women who are overweight or obese, fat-related concepts appear to be incorporated into negative weight-related schemas, and the processing of any fat-related information is affected by these schemas. The women who were overweight or obese in this study showed more difficulty disengaging from fat body images, which may be due to maladaptive schemata. Overweight/obese individuals with maladaptive schemata may enhance their attention to fat

body stimuli. Findings that suggest women who are overweight or obese have difficulty disengaging from fat images have potential implications for prevention and intervention. Manipulating these biases directly through attentional training can improve body satisfaction or lessen body dissatisfaction when women are trained to focus on positive or negative appearance cues (Allen et al. 2018; Smith and Rieger 2006, 2009). Findings from these studies provide further support for the role of cognitive biases in the development and maintenance of body dissatisfaction, and the usefulness of including cognitive biases in etiological models.

Our findings suggest that both groups showed initial positive attentional bias toward thin body images for the presentation time of 100 ms. Initial orientation of attention is a relatively fast, automatic process (Field and Cox 2008; Lopes et al. 2014) due to the preference of thin-ideal bodies influenced by mass media (Jackson, Jiang et al. 2016a; Yamamiya et al. 2005). The attentional bias toward thin bodies may reflect a general preference for thin bodies. Numerous studies have demonstrated that both men and women rate thinner bodies as more attractive than normal or overweight bodies (Swami et al. 2007). This general idealization of thin bodies may drive selective attention toward thin bodies.

In the DPT, there was no significant difference between the overweight/obese group and the control group in attentional avoidance for the presentation time of 2000 ms in this task. Previous research has found that body-dissatisfied women show an increased detection-avoidance pattern of biases in relation to thin body words (Gao et al. 2011). Body avoidances are associated with overvaluation of shape and weight (Latner 2008) and are significant predictors of extreme strategies of body change and of the psychological symptoms associated with body image disorders (Bamford et al. 2014; Reas and Grilo 2004). Future research examining how personality characteristics and teasing relate to ABs in people with overweight/obesity may be enlightening.

In the current study, the self-reported body dissatisfaction of individuals who are overweight or obese did not differ from that of individuals with normal weight, which is inconsistent with previous findings (Warschburger et al. 2015). Although body dissatisfaction increases with BMI, the relationship between BMI and body dissatisfaction cannot be considered linear (Cortese et al. 2010). Some research have found that the degree of being overweight is not associated with the degree of body dissatisfaction (Rosen et al. 1996), and BMI has no effect on body dissatisfaction (Canpolat et al. 2005). Moreover, it has been reported that 57.2% of the overweight and obese girls were at least somewhat satisfied with their bodies (Sonneville et al. 2012). Individuals who are overweight or obese displayed attention biases toward body-related pictures compared to controls, while they did not differ on self-reported body dissatisfaction. According to the cognitive-behavioral

model (Vitousek and Hollon 1990), ABs stem from dysfunctional schema about shape and weight information, yet the self-reported measures of NPSS and OBCS cannot be used to measure the body-related schema directly. Future studies should consider the use of a direct schema measure of body dissatisfaction, such as appearance-related word stem completion task (Hargreaves and Tiggemann 2002).

Despite the possible implications of these findings in regards to obesity, some limitations should be mentioned. First, reaction time is a relatively crude index of ABs that fails to elucidate the complexity of visual attention during stimulus presentation. To measure attention with more precision, the use of a dot probe paradigm combined with eye-tracking technology could be adopted in future research (Gao et al. 2012, 2014). Second, overweight/obesity may result from large amounts of lean muscle mass, which may have led us to underestimate the ABs of the participants as they were categorized based on BMI alone. Future studies should use more appropriate indices, such as waist-to-hip ratio (WHR) and the skinfold test, to determine whether an individual is overweight or not (Sellaro and Colzato 2017). The WHR has been shown to be more reflective of visceral fat and central adiposity than BMI (Qiao and Nyamdorj 2009). As the estimates of WHR are derived from predominantly Caucasian populations (WHO 2000), it should be cautious to estimate the ABs in overweight or obese population based on WHR for Asian. Third, the sample of the young women we tested was from a university. Replication studies among clinical samples (e.g., obese patients with an eating disorder or body dysmorphic disorder) are therefore necessary to examine whether obese patients present similar attentional mechanisms to body-related stimuli.

In sum, this study found evidence for ABs toward body-related images in women who were overweight or obese compared to normal-weight controls. Although the women who were overweight or obese did not report greater body dissatisfaction based on questionnaire data, their task performance provided evidence for delayed attentional disengagement from fat body-related stimuli.

Acknowledgements This study was supported by Chinese National Natural Science Foundation (Grant No: 31800925) and the Nanhu Scholars Program of XYNU and the Humanities and Social Sciences Project for the Education Department of Henan Province (Grant No: 2018-ZDJH-282). The authors would like to thank Ming Xu, Li Ma and Yao Ge for their enthusiasm and invaluable assistance in recruiting and testing the participants of this study. We thank three anonymous reviewers for their thoughtful comments, which helped us to improve this article.

Compliance with Ethical Standards

Conflict of Interest Zhenyong Lyu, Panpan Zheng and Zhan Wang declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (national and institutional). Informed consent was obtained from all individual participants included in the study.

Animal Rights No animal studies were carried out by the authors for this article.

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