Self-reported and physiological reactions to thin and non-thin bodies: Understanding motivational processes associated with disordered eating

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Abstract

Background: The present study examined the relative roles of approach and avoidance motivation in eating pathology using a multi-method approach combining self-report and physiological measures. The potential effect of internalized ideals and fears was also investigated. **Methods:** Fifty-seven undergraduate women completed a picture-viewing task in which they viewed images of women's bodies (thin and non-thin) and affective images. Self-report ratings of valence and arousal were measured along with physiological indicators of approach (postauricular reflex) and avoidance (startle blink reflex) motivation. **Results:** Greater eating pathology was associated with more negative valence ratings of both thin and non-thin images. There was a significant interaction between valence ratings of non-thin bodies and fear of the unattractive self in relation to eating pathology, such that eating pathology was highest in those who rated non-thin images as more unpleasant and internalized fears of being/becoming unattractive. Thin-ideal internalization did not significantly interact with ratings of thin images to predict eating pathology. There were no significant findings when examining physiological data. **Conclusions:** Results from self-report measures suggest that eating pathology is associated with avoidant reactions to both thin and non-thin bodies and highlight the importance of internalized appearance-related fears.

Keywords: motivation, startle blink reflex, postauricular reflex, body images, eating pathology

Self-reported and physiological reactions to thin and non-thin bodies: Understanding motivational processes associated with disordered eating

Eating disorders (EDs) are associated with severe psychological and physical consequences (van Hoeken & Hoek, 2020). It is estimated that between 3.3% and 18.6% of women will experience an ED over the course of their lifetime (for a review, see Galmiche et al., 2018). Moreover, maladaptive weight loss behaviours (e.g., dieting, compensatory exercise) characteristic of EDs are common in non-clinical samples (Lipson & Sonneville, 2017; Slof-Op ‘t Landt et al., 2017) and are associated with poor physical and psychological outcomes (Karkainnen et al., 2017). Despite the prevalence and negative consequences of EDs and related behaviours, it remains unclear to what extent they are motivated by approach-based reward processes versus fear-based avoidance processes (Rodgers et al., 2022a). There is mounting evidence to suggest that the desire to approach thinness and the motivation to avoid fatness are independent risk and maintenance factors that demonstrate distinct patterns of association with ED symptoms and related constructs (Dalley & Buunk, 2009; Dondzilo et al., 2019; Levitt, 2003; Rodgers et al., 2018; Rodgers et al., 2022a).

Examining how people react (i.e., emotionally and physiologically) when viewing different types of body images, as well as understanding the relationship between these reactions and eating pathology, may contribute to our understanding of the motivational orientation underlying ED behaviours. Explicit affective responses (e.g., self-reported valence ratings) are thought to be prompted by the appetitive or defensive motivational system depending on the nature of the stimulus (Lang & Bradley, 2010). Indeed, perceptions of positive and negative valence have been experimentally associated with approach and avoidance responses (e.g., measured via the Manikin Task as in Krieglmeyer et al., 2010). Additionally, affective arousal

(e.g., self-reported arousal ratings) is posited as an indicator of the "intensity of motivational mobilization" (Lang & Bradley, 2010). As such, positive emotional reactions to thin bodies may indicate a desire to approach thinness, whereas negative emotional reactions to non-thin bodies may indicate a desire to avoid becoming a feared overweight body (see Dondzilo et al., 2019 for a discussion). Further, arousal ratings can help to ascertain the degree of intensity of these approach and avoidance reactions (Lang & Bradley, 2010).

Several studies have examined explicit (i.e., self-reported) motivational reactions to thin and non-thin bodies. Women with anorexia nervosa (AN) have been found to rate images of thin or underweight women as more pleasant (Clarke et al., 2016; Spring & Bulik, 2014), and images of overweight women as less pleasant (Clarke et al., 2016; Cserjesi et al., 2010; Spring & Bulik, 2014), than healthy control participants. Similarly, women with bulimia nervosa (BN) have been found to rate images of underweight women more positively than healthy control women, though no group differences in valence ratings were found for images of overweight bodies (Mai et al., 2015). In non-clinical samples, some studies have found that images of thin women are rated less positively than neutral images (Prnjak et al., 2020), while others have reported these images are being rated more positively (Dodd et al., 2017). Images of thin women have also been rated as more pleasant but equally as arousing as images of overweight women (Dodd et al., 2017; Rieger et al., 2017). Consistent with other studies, Moussally and colleagues (2017) reported that computer-generated images of thin women were rated positively. However, while images of extremely obese bodies were rated negatively, moderately obese and overweight bodies were rated as neutral by a community sample of women (Moussally et al., 2017). Overall, while findings for women with EDs suggest a positive view of thinness and negative reactions to non-thin bodies, results from non-clinical samples are mixed. Although there are many possible

reasons for mixed findings, inconsistent results may be explained by differences in the subjective rating scales administered across studies, with some asking participants to rate the images on dimensions such as pleasantness or attractiveness using study-specific Likert or visual analogue scales. Only two of the studies mentioned above (Mai et al., 2015; Rieger et al., 2017) used a standardized measure of valence and arousal often used in studies of emotion and motivation (i.e., the Self-Assessment Manikin [SAM]; Bradley & Lang, 1994).

Studies employing tasks assessing implicit reactions to body images (e.g., Approach Avoidance Task, Affect Misattribution Task) reveal a somewhat different pattern of results. While non-clinical participants have demonstrated approach biases toward thinness (Dondzilo et al., 2019; Woud et al., 2011), several studies have not found this effect in women with EDs (Brockmeyer et al., 2020; Cserjesi et al., 2010; Kollei et al., 2021; Leins et al., 2018; Spring & Bulik, 2014). In contrast, studies using Implicit Association Tasks (IATs) have reported positive implicit associations with thin images in women with EDs (Khan & Petroczi, 2015) and in undergraduate women scoring high on a measure of drive for thinness (Ahern et al., 2008). Studies examining reactions to non-thin images using implicit tasks have consistently reported avoidance biases away from these types of stimuli (Dondzilo et al., 2019; Spring & Bulik, 2014; Woud et al., 2011). An important limitation of these implicit tasks, however, is that approach and avoidance reactions cannot be assessed simultaneously and may therefore obscure conflicting motivational responses to stimuli (for a discussion, see Racine et al., 2021).

Physiological indicators of the defensive and appetitive motivational systems can reflect part of the approach or avoidance behavioural response (Lang & Bradley, 2010). The emotion-modulated startle paradigm allows for simultaneous measurement of uncorrelated physiological indicators of approach and avoidance motivation, addressing some of the limitations of self-

report measures and other types of implicit measures. The startle blink reflex is potentiated in response to aversive stimuli relative to neutral stimuli, whereas the postauricular reflex (PAR) is amplified in response to pleasant stimuli relative to neutral stimuli (Lang et al., 1998; Benning et al., 2004). Only a small number of studies have used the emotion-modulated startle paradigm to examine implicit reactions to body images. Studies of adults with AN and BN did not find differences in the magnitude of the startle response to thin body images versus neutral images, despite higher anxiety ratings to body images in patients versus controls (Friederich et al., 2006; Erdur et al., 2017). To our knowledge, no study has examined PAR to body images, nor has startle blink response to non-thin body images been measured. Given the limited number of studies in this area, the lack of direct comparison of reactions to different types of body images, and inconsistencies between implicit and explicit reactions, additional research is warranted.

Further, it is theorized that one's motivational orientation to stimuli may be "energized" by various factors, including self-concept and sociocultural norms (Elliot, 2006). Thin-ideal internalization refers to the degree to which a person subscribes to sociocultural ideals of thinness emphasizing the importance of 'attaining' a thin body (Thompson et al., 1999; Thompson & Stice, 2001). This sociocultural construct is a well-established risk factor for the development and maintenance of EDs (see Culbert et al., 2015 for a review) and is included in leading etiological models of ED development (Stice, 2001; Thompson et al., 1999). Regarding the body, fear of an undesired body and desire for thinness/thin-ideal internalization have been found to be distinct constructs (for discussion, see Levitt, 2003; Wilson, 2020). One way that fear can be conceptualized is in terms of a feared version of the self; specifically, fear of self is defined as the fear of possessing undesired qualities or characteristics (Markus & Nurius, 1986). Fear of the overweight self (e.g., Dalley & Buunk, 2009) and fear of the unattractive self (Wilson

et al., submitted) have been associated with greater eating pathology in non-clinical samples in cross-sectional and experimental studies (for a review, see Wilson, 2020). Though fear of self is typically conceptualized as an aspect of self-concept, fear of the overweight and unattractive selves also likely reflects internalized sociocultural norms due to pervasive weight- and appearance-based stigma (Puhl & Lessard, 2020; Wilson, 2020). Taken together, approach responses toward thinness may be associated with internalization of the thin-ideal, whereas avoidance reactions to non-thin stimuli may be related to internalized appearance-related fears. As described above, positive reactions to thin body stimuli have been associated with eating pathology (e.g., Spring & Bulik, 2014), and this relationship may be "energized" or stronger in individuals who have internalized the value of thinness. Similarly, it follows that having a strong fear of being or becoming similar to the individual depicted in the image would strengthen the relationship between negative reactions to non-thin body stimuli and eating pathology observed across previous studies (e.g., Spring & Bulik, 2014). Indeed, the pattern of mixed findings described above may be due to individual differences in eating pathology, thin-ideal internalization, and fear of fatness within non-clinical samples.

The present study employed an emotion-modulated startle paradigm that simultaneously measured self-report (Self-Assessment Manikin [SAM]) and physiological (i.e., startle blink reflex and PAR) reactions to thin and non-thin body images. This methodology allows for simultaneous assessment of implicit indicators of approach and avoidance, the comparison of implicit and explicit reactions, and an examination of the relative importance of approach and avoidance motivation in eating pathology. It was hypothesized that eating pathology would be associated with positive explicit ratings and potentiated PAR (relative to neutral images) to thin body images as well as negative explicit ratings and a stronger startle blink response (relative to

neutral images) to non-thin images. It was also hypothesized that thin-ideal internalization would moderate relationships between positive implicit and explicit reactions to thin body stimuli and eating pathology, and that fear of the unattractive self would moderate relationships between negative responses to non-thin bodies and eating pathology.

Method

Participants

Sixty-four undergraduate women were recruited from universities in Montreal, Quebec, Canada. Participants recruited from the McGill University participant pool were compensated with course credit, while those recruited from outside the participant pool or from other universities (via community advertisement) received financial compensation. Exclusion criteria were as follows: male, under the age of 18 years, use of psychotropic medication (due to potential impact on startle blink reflex [Grillon & Baas, 2003]), uncorrected visual impairment, auditory impairment, history of loss of consciousness lasting longer than 10 minutes, and allergy to adhesives and/or latex gloves. Seven participants withdrew prior to study completion. The final sample consisted of 57 women (*M* age = 20.70 years, *SD* = 1.58; *M* BMI = 23.21, *SD* = 4.93). Nearly half of participants identified as White (47.4%), with an additional 19.3% identifying as Chinese, 5.3% as South Asian, 5.3% as Southeast Asian, 3.5% as Arab, 3.5% as Korean, 1.8% as Black, 1.8% as Latin American, 1.8% as ‘other’, 8.8% as multiracial, and 1.8% preferred not to indicate their ethnicity.

Stimuli

Approximately 200 images of thin and non-thin women’s bodies were sourced from the internet using a Google image search with search terms such as ‘model’, ‘thin’, ‘plus-size model’, ‘obese’. Images that were not front-facing or that depicted isolated body parts were not

included. Only images of comparable quality to the affective image set (see below) were included. Faces were cropped out of images, but images were otherwise unedited. These images were previously validated in a large community sample (Wilson et al., 2013). Each participant viewed 12 thin and 12 non-thin body images.

Affective images were selected from the International Affective Picture System (IAPS; Lang et al., 2008) based on normative ratings in females. Twelve aversive (6 threat, 6 disgust/mutilation), 12 pleasant (6 nurturant, 6 erotic), and 12 neutral (objects) images were presented to each participant. Ratings of and physiological reactions to IAPS images served as anchor points from which to compare reactions to body images and allowed us to evaluate whether the paradigm was effective in eliciting the expected pattern of responses. Participants were randomly assigned to view one of three matched image sets each comprised of 60 images. Body images were matched on the following demographic and physical characteristics: race of the model, amount of clothing worn, proportion of body visible, and presence/absence of tattoos. IAPS images were matched using normative valence and arousal ratings for women (Lang et al., 2008). Participants were randomly assigned to one of four quasi-random image run orders. Specifically, participants were never presented with two body images or two IAPS images from the same category (e.g., pleasant) consecutively.

Measures

The Eating Disorder Examination-Questionnaire (EDE-Q; Fairburn & Beglin, 1994) is a 28-item self-report measure assessing eating pathology over the past 28 days. Items are rated along a seven-point Likert scale ranging from 0 (‘no days’ / ‘not at all’) to 6 (‘everyday’ / ‘markedly’). EDE-Q scores are highly correlated with scores on the EDE interview and other measures of eating pathology (Berg et al., 2012). The EDE-Q produces a Global Score of general

eating pathology that has been previously shown to have excellent internal consistency (α = .95; Berg et al., 2012), as was the case in the present sample (α = .95).

The Sociocultural Attitudes Towards Appearance Questionnaire-4 (SATAQ-4; Schaefer et al., 2015) 'Internalization: Thin/Low Body Fat' subscale includes five items rated from 1 ('definitely disagree') to 5 ('definitely agree'). This subscale assesses internalization of the thin-ideal and has been found to have good-to-excellent internal consistency in samples of women from different countries (α's ranging from .82-.91; Schaefer et al., 2015). Internal consistency in the present sample was good (α = .85).

The Fear of Self Questionnaire, multidimensional version (FSQ-MV; Aardema et al., 2021) was created to assess different feared self-themes, including appearance-related fears. The 'malformed' subscale (FSQ-MAL) is comprised of four items rated along a six-point Likert scale from 1 ('strongly disagree') to 6 ('strongly agree') and assesses the fear of being unattractive or perceived this way by others (e.g., "I fear being unattractive"). Internal consistency of this subscale was excellent in a previous study using a large non-clinical sample (α = .90; Aardema et al., 2021) and was good in the present sample (α = .86).

The Self-Assessment Manikin (SAM; Bradley & Lang, 1994) scales are pictorial rating scales assessing valence (1 'unhappy' to 9 'happy') and arousal (1 'calm' to 9 'excited'). The SAM scales were developed for use with IAPS images and were also recently used to assess reactions to the thin and non-thin body images included in the current study (Wilson et al., 2023) as well as to other body images in previous research (Mai et al., 2015; Rieger et al., 2017). Positive emotional reactions signal the tendency to approach, whereas negative emotional reactions indicate the tendency to avoid a stimulus. As such, SAM valence ratings were used as a

measure of explicit motivational orientation. Degree of arousal can provide information regarding the intensity of these reactions (Bradley & Lang, 1994).

Procedure

Participants completed a brief online screening questionnaire to determine study eligibility. Eligible participants received a link to complete the questionnaire battery via email prior to the scheduled lab session. On average, participants completed the questionnaires 3.5 days prior to the lab session. Participants gave informed consent twice during this study: once online prior to completing the questionnaires and again in-person before beginning the emotion-modulated startle paradigm.

Startle Paradigm. Participants were asked not to use caffeine or tobacco products in the two hours before the lab session and to avoid using sleep or allergy medication in the preceding 24 hours. Participants' height and weight were measured using a wall-mounted ruler and digital scale, respectively. Participants were then asked to sit in a lounge chair facing a 24-inch computer monitor.

The emotion-modulated startle paradigm was presented using E-Prime 3.0 software (Psychology Software Tools). Images were presented for 6 s followed by a 3 s inter-trial-interval (ITI) during which a black screen was presented. Following each image, participants were asked to use SAM scales to rate valence and arousal. An auditory startle probe (white noise with near instantaneous rise and fall lasting 50 ms at a level of 95dB) occurred 3, 4, or 5 s post-picture onset for 83.33% of the images. For the remaining trials, the startle probe occurred either during the ITI or not at all. Startle probes were presented binaurally through calibrated headphones (Etymotics ER3SE). Participants were first presented with five test images to familiarize

participants with the startle probes and the image rating procedures before beginning the emotion-modulated startle paradigm.

Psychophysiology data collection and reduction. Electrode application sites were prepared by cleaning the skin with an alcohol wipe and slightly abrading the skin with NuPrep (Weaver and Company). Electrodes filled with Signagel electrode gel (Parker Laboratories Inc.) were then attached to the skin using an adhesive collar. Two electrodes were attached to the lower left orbicularis oculi muscle to record startle blink responses, and two electrodes were placed behind each ear to record PAR (Blumenthal et al., 2005; Benning et al., 2004). A ground electrode was placed in the middle of the forehead. The impedance of each connection was tested using a Checktrode (UFI MKIII Model 1089).

Using a MindWare BioNex system, the following parameters were applied when collecting all data: sampling rate of 1000 Hz and gain of 5000 (Blumenthal et al., 2005) and use of 60 Hz notch filter. A bandpass filter at 28-500 Hz was applied to startle blink responses. A rolling filter of 10 was also applied to smoothed and rectified data. Startle blink responses were scored by subtracting the average activity during the 50 ms prior to the startle probe from peak activity 30-120 ms following onset of the probe (Blumenthal et al., 2005). For PAR responses, an 8-500 Hz bandpass filter was applied to rectified data. As PAR is a microreflex, aggregate waveforms were created by averaging all waveforms from an image category (e.g., thin bodies; Benning et al., 2004). PAR was scored by subtracting the average activity during the 50 ms prior to the startle probe from peak activity 8-35 ms following onset of the probe. When data from both ears were available, PAR magnitudes from right and left ears were averaged.

All startle blink trials and PAR aggregate waveforms were examined to determine the presence or absence of a response. In cases of uncertainty, a second coder processed the data and

discrepancies were discussed with the authorship team. If the response was indistinguishable from baseline, the trial was not included in analyses. Non-responses were coded as '0' and included in analyses. Participants with a mean startle blink amplitude less than 5μV and/or with fewer than five acceptable trials for a given image type (n = 2) and participants with a mean PAR less than 2μV and/or fewer than four acceptable trials for a given image type (n = 2) were excluded from the analyses examining these variables.

Statistical approach. Analyses were conducted using SPSS version 28. All analyses were run with and without univariate and multivariate outliers. Some indicators of normality (i.e., skewness and kurtosis) were outside the acceptable range when outliers were included but were acceptable when omitted. However, as eliminating outliers did not alter the pattern of results when examining SAM and PAR data, the findings reported below reflect the full sample for these variables. Regarding startle blink data, the exclusion of an outlier did alter the pattern of results for the repeated measures ANOVA, so results with and without this participant are presented. All other statistical assumptions were met (i.e., linearity, multicollinearity, homogeneity of variance). Image set was entered as a between-subjects factor to account for potential differences across the three image sets. For correlational and moderation analyses, startle blink and PAR magnitudes in response to neutral images were subtracted from responses to thin and non-thin body images to account for individual differences in physiological reactivity.

Pearson correlation coefficients were calculated to examine the relationships between variables of interest. To examine differences in SAM ratings of valence and arousal as well as in startle blink reflex and PAR by picture type (pleasant, neutral, aversive, thin, non-thin), four within-subjects repeated-measures ANOVAs were conducted. Image set was entered as a between-subjects factor to account for potential differences across the image sets. As the

Greenhouse-Geisser epsilon values exceeded .75 (Verma, 2016), a Huynh-Feldt correction was used for valence and arousal ratings as well as startle blink response. The Greenhouse-Geisser correction was used for PAR. To account for familywise error, a Sidak correction was applied to post-hoc tests from these analyses.

Moderation analyses were conducted to examine thin-ideal internalization and fear of the unattractive self as moderators of the relationships between independent variables (i.e., explicit and implicit reactions to thin and non-thin images) and the dependent variable (i.e., eating pathology). Multiple regression analyses indicated the assumptions of the moderation analyses (i.e., normality, linearity, and absence of multicollinearity) were met. The PROCESS macro, version 4 (Hayes, 2022) was used to conduct the moderation analyses, including simple slopes analyses and Johnson Neyman tests.

Results

Descriptive Statistics and Correlations

Means, standard deviations, and correlations are reported in Table 1. In the present sample, mean eating pathology (M = 1.99, SD = 1.40), fear of the unattractive self (M = 14.43, SD = 5.34), and thin-ideal internalization (M = 3.30, SD = 1.06) were all significantly greater than what has been reported previously in non-clinical samples (ts = 2.33-3.23, ps = .002-.02; Aardema et al., 2021; Fairburn, 2008; Schaefer et al., 2015). Valence ratings of thin (rs = -.36 to -.49, ps = .006 to < .001) and non-thin (rs = -.27 to -.38, ps = .04 to .004) body images were negatively correlated with eating pathology, thin-ideal internalization, and fear of the unattractive self. No significant correlations were found between arousal ratings, startle blink response, or PAR to thin and non-thin images relative to neutral images and any of the variables of interest.

Repeated-measures ANOVAs

Results for SAM valence and arousal ratings, startle blink reflex, and PAR are presented in Table 2.

SAM Ratings

The overall main effect of image type for SAM valence ratings was statistically significant (F[4, 216] = 140.07, $p < .001$; $\eta_p^2 = 0.72$), with the effect size corresponding to a large difference in valence ratings across picture types. SAM valence ratings of emotional images followed the expected pattern (pleasant > neutral > aversive). Valence ratings for thin and non-thin images did not differ from one another and were equivalent to neutral images, significantly lower than pleasant images, and significantly higher than aversive images. Similarly, the main effect of image type for SAM arousal ratings was also large and statistically significant (F[4, 216] = 91.78, $p < .001$; $\eta_p^2 = 0.63$). SAM arousal ratings of emotional images indicated greater arousal ratings for aversive images than pleasant images, with both emotional image categories rated as more arousing than neutral images. Arousal ratings for body images did not differ from one another, but body images were rated as significantly less arousing than aversive images and as significantly more arousing than neutral images. The interaction between picture type and image set was non-significant for valence (F[7.11, 192.00] = 0.78, $p = .60$, $\eta_p^2 = .03$) and arousal (F[7.67, 207.07] = 1.14, $p = .34$, $\eta_p^2 = .04$).

Startle Blink Reflex

The overall main effect of image type for SAM valence ratings was large and statistically significant (F[4, 204] = 6.60, $p < .001$; $\eta_p^2 = 0.12$). As expected, mean startle blink reflex magnitudes during aversive and neutral images were significantly greater than during pleasant images. However, though numerically greater, startle blink magnitude during aversive images did not significantly differ from magnitude during neutral images. Regarding body images,

startle blink response during thin images was significantly lower than the response during aversive images. This effect, however, became non-significant (p = .051) when the outlier was excluded from the analysis. No significant differences were found between startle blink reflex magnitude during non-thin body images and other image types, including thin images. The interaction between picture type and image set was non-significant (F[6.95, 177.10] = 1.26, p = .27, η_p^2 = .05).

PAR

PAR magnitude did not differ across image types (F[2.54, 131.81] = 0.52, p = .64, η_p^2 = .01), meaning that the expected enhanced PAR during pleasant images was not found in this sample. The interaction between picture type and image set was also non-significant (F[5.07, 131.81] = 0.57, p = .73, η_p^2 = .02). As PAR results did not follow the expected pattern (pleasant > neutral and aversive), it suggests that the paradigm was not effective in eliciting PAR potentiation. We have consequently omitted the planned moderation analyses for PAR.

Moderation Analyses with Explicit Ratings

Thin images. A moderation analysis was conducted with SAM valence ratings of thin images as the independent variable, thin-ideal internalization as the moderator, and eating pathology as the dependent variable. The overall model explained a significant proportion of variance in eating pathology (R^2 = .61, F(3, 53) = 28.01, p < .0001). However, the interaction between valence ratings of thin bodies and levels of thin-ideal internalization was not significantly associated with eating pathology (b = .096, SE = .12, t = .77, p = .44).

Non-thin images. A moderation analysis was conducted with SAM valence ratings of non-thin images as the independent variable, fear of the unattractive self as the moderator, and eating pathology as the dependent variable. The overall model explained a significant proportion

of variance in eating pathology (R^2 = .32, F(3, 52) = 8.21, p = .0001). When examined together, fear of the unattractive self was significantly associated with eating pathology (b = .45, SE = .15, 95% CI = [.15, .75], t(52) = 2.98, p = .004), but the association between valence ratings of non-thin body images and eating pathology was not significant (b = .59, SE = .43, 95% CI = [-.27, 1.45], t(52) = 1.38, p = .17). The relationship between valence ratings of non-thin body images and eating pathology was moderated by fear of the unattractive self, as indicated by a significant interaction effect (b = -.07, SE = .03, 95% CI = [-.13, -.01], t(52) = -2.45, p = .02). The relationship between valence ratings of non-thin body images and eating pathology was negative and significant at medium (b = -.47, 95% CI [-.8, -.13], p = .007) and high (b = -.88, 95% CI [-1.40, -.36], p < .001) levels of fear of the unattractive self, but not low levels (b = .03, 95% CI [-.44, .49], p = .91; see Figure 1). As indicated by the Johnson-Neyman test, the relationship between valence ratings of non-thin body images and eating pathology was negative and significant for fear of the unattractive self scores above 13.03 (95% CI [-.65, .000], possible range = 4 – 24) on this subscale. More than half of participants (60.71%) scored above this value.

Moderation Analyses with Implicit Reactions

Non-thin images. A moderation analysis was conducted with startle blink response during non-thin images relative to neutral images as the independent variable, fear of the unattractive self as the moderator, and eating pathology as the dependent variable. The overall model explained a significant proportion of variance in eating pathology (R^2 = .19, F(3, 50) = 3.79, p = .02). The interaction between startle blink response during non-thin body images relative to neutral images and fear of the unattractive self was not significantly associated with eating pathology (b = -.002, SE = .002, t = -0.94, p = .35).

Discussion

Using an emotion-modulated startle paradigm, the present study assessed implicit and explicit reactions to thin and non-thin body stimuli with the aim of investigating the relationship between indicators of approach and avoidance motivation with eating pathology. No differences were found between reactions to thin and non-thin bodies using subjective or physiological measures. As hypothesized, more negative subjective valence ratings of non-thin body images were associated with greater eating pathology. In contrast with hypotheses, a negative relationship between valence ratings of thin images and eating pathology was also observed. Consistent with Lang & Bradley's (2010) theory, these results suggest that both types of body images activate the defensive motivational system, resulting in a negative emotional response. No significant associations were found between disordered eating and startle blink reflex during body images. In line with the theory that motivational orientation can be "energized" by different factors (Elliot, 2006), fear of the unattractive self moderated the relationship between negative explicit valence reactions to non-thin bodies and eating pathology. Specifically, individuals who perceived non-thin bodies more negatively *and* who reported greater fears of being/becoming unattractive reported the greatest levels of eating pathology. However, no such relationship was observed when examining thin-ideal internalization, reactions to thin body images, and ED symptoms. These findings suggest the value of considering indicators of avoidance and negative emotional response in the study of motivation as it relates to eating pathology.

Similar to what has been reported in healthy controls and individuals with BN (Mai et al., 2015), but in contrast to findings from another undergraduate sample (Rieger et al., 2017), non-thin body images were rated as neutral in the present study. Discrepant findings may reflect differences in body stimuli. Rieger and colleagues (2017) presented images of body parts typically disliked by women, whereas full bodies were presented in the present study and that by

Mai and colleagues (2015). Further, the majority of the non-thin body stimuli used in the present study depicted celebrities and models in larger bodies posing confidently, wearing stylish clothing, and in desirable locations (e.g., on the red carpet). This may subvert the typical depiction of non-thin women in the media (Ata & Thompson, 2010) and contradict typical fears associated with being overweight (e.g., fear of being rejected; Levinson et al. 2019). Finally, neutral ratings of non-thin images may reflect the effects of the body positivity movement (Rodgers et al., 2022b) and changing perceptions of non-thin bodies. Rating non-thin bodies as less pleasant was associated with greater eating pathology, thin-ideal internalization, and fear of the unattractive self, with fear of the unattractive self strengthening the relationship between non-thin body image valence ratings and eating pathology. The pattern of results indicated that, for individuals with moderate and high levels of internalized appearance fears, there was a significant negative association between eating pathology and affective valence ratings when viewing non-thin bodies, but this association was not present for individuals with low internalized appearance fears. Taken together, these findings highlight the importance of integrating fear and avoidance into the conceptualization (Rodgers et al., 2022a) and treatment (Murray et al., 2016) of EDs.

Greater eating pathology was also associated with more negative valence ratings to thin body stimuli, which is at odds with the theory that the valence of a stimulus is associated with motivational orientation (Lang, 1995; Elliot, 2006). This finding, however, is consistent with some past research (e.g., Prnjak et al., 2020) and may reflect the effects of social comparison. Individuals who perceive themselves negatively in comparison to the individual depicted in the image may be more likely to feel negatively in response to that image, despite having a desire to approach/attain this body type. Indeed, it has been found that appearance comparison is

associated with body dissatisfaction and low mood following exposure to thin body stimuli (Brown & Tiggeman, 2016). Regarding non-significant findings when examining thin-ideal internalization as a potential moderator in the relationship between valence ratings of thin images and eating pathology, this result may relate to changing body ideals at a societal level. In addition to the thin ideal, recent research has highlighted the emergence of the 'fit-ideal' as well as the 'slim-thick-ideal' (McComb & Mills, 2022). Differences in what is considered the ideal body type may have obscured findings relating to the relationship between ratings of thin body images and eating pathology.

There were no associations between physiological indicators of approach and avoidance in response to body stimuli (relative to neutral stimuli) and eating pathology. A similar startle blink reflex to body images and to neutral images is consistent with some previous research assessing startle blink response in patients with EDs (Erdur et al., 2017; Friederich et al., 2006). However, this finding is inconsistent with the results of studies measuring other types of physiological responses. For example, Dodd and colleagues (2017) found that exposure to images of overweight bodies elicited activation of the facial muscles associated with disgust (i.e., corrugator supercilii and levator labii) similarly to disgust-relevant stimuli and more so than images of thin bodies. It is possible that facial reflexes consistent with disgust may be more relevant physiological indicators of avoidance and negative emotion than the startle blink reflex, which is primarily indicative of fear (Lang et al., 1998). This is also consistent with mounting research identifying disgust as a relevant risk and maintenance factor for EDs (for a review, see Anderson et al., 2021). Further research comparing physiological measures of fear and disgust may be warranted to understand the distinct relationships between different emotions and eating pathology. As mentioned above, the PAR results are difficult to interpret as we did not find the

expected pattern of results for emotional images (pleasant > neutral = aversive). Taken together, these findings may suggest that relationships between reactions to body stimuli, internalized fears and ideals, and eating pathology are experienced at the conscious level rather than at a more basic motivational level. However, it is also possible that the physiological measures used in the present study were not reliable measures of approach and avoidance responses to body stimuli. In particular, PAR was potentially not appropriate for the measure of reactions to body stimuli as this reflex has been shown to potentiate in response to appetitive stimuli (e.g., food; Sandt et al., 2009) as opposed to pleasant stimuli more broadly. Future studies are needed to replicate the present findings and also to determine whether the presence of clinically-significant eating pathology may elicit a different pattern of results.

The present study is strengthened by use of a multi-method approach allowing for the simultaneous measurement of self-report and physiological indicators of approach and avoidance. Interpretation and generalizability of the results is limited by a small, non-clinical sample of mostly young undergraduate women as well as by the use of cross-sectional data. As such, our results cannot be generalized to men, other age ranges, or clinical populations. Further, body images were sourced from the internet rather than using images of participants' own bodies or computer-generated body stimuli. Computer-generated images allow for greater standardization, and some research has suggested that the use of self-images may produce a stronger effect than when using images of others (Brockmeyer et al., 2020; Legenbauer et al., 2020). That said, the use of images found online may be more ecologically valid as they reflect the types of stimuli women are exposed to through the media. Though previously piloted in a large community sample (Wilson et al., 2023), the use of three separate image sets may also have introduced an additional source of variability and may have reduced statistical power in the

present study. Additionally, the use of a measure of the fear of the unattractive self rather than of a more well-established measure of fear of fat/weight gain is also a limitation of the present study. This measure was selected in light of emerging research suggesting the potential relevance of fear of self to EDs (Wilson, 2020). Further, there is a strong link between perceived attractiveness and weight status (Lydecker et al., 2016; Watson et al., 2010; for a discussion, see Smith, 2012). That said, future research is needed to further our understanding of the relationship between fear of the unattractive self and eating pathology and to validate the FSQ in ED samples.

Improving understanding of the motivational orientation associated with eating pathology has important conceptual and clinical implications. Negative associations between reactions to all types of body stimuli and eating pathology underscore the importance of both social comparison and weight stigma (Brown & Tiggeman, 2016; Puhl & Lessard, 2020). Further, sociocultural risk models of EDs have traditionally omitted appearance-related fears and avoidance motivation. However, the results of the present study highlight associations between internalized fears, negative reactions to body stimuli, and eating pathology in a non-clinical sample, adding to the growing body of literature finding support for the role of fear in eating pathology (e.g., Rodgers et al., 2022a). Finally, the null findings from physiological measures suggest that further research is needed in this area to both replicate the present findings as well as compare physiological measures assessing different emotions (e.g., fear vs. disgust).

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Table 1

Correlations between eating pathology, fear of the unattractive self, and thin-ideal internalization, as well as self-reported and physiological responses to thin and non-thin body images

Measure	1	2	3	4	5	6	7	8	9	10	11
1. EDE-Q	-										
2. FSQ-MAL	.41**	-									
3. SATAQ	.76***	.43***	-								
Thin											
4. Valence[a]	-.46***	-.49***	-.36**	-							
5. Arousal[a]	.18	.24	.26	-.35**	-						
6. SBR[b]	-.05	-.11	-.07	-.14	.16	-					
7. PAR[b]	.07	-.11	.01	-.05	-.10	.05	-				
Non-thin											
8. Valence[a]	-.38**	-.28*	-.27*	.45***	-.21	.10	.06	-			
9. Arousal[a]	.20	.17	.20	-.40**	.72***	.02	-.04	-.41***	-		
10. SBR[b]	-.08	-.06	-.04	-.12	-.04	.61***	.07	.24	-.04	-	
11. PAR[b]	.10	.07	.02	-.07	-.13	-.05	.87***	.07	.003	.04	-
M (SD)	1.99	14.43	3.30	4.80	4.67	-6.64	-1.08	5.04	4.32	-4.32	-1.41
	(1.40)	(5.34)	(1.06)	(1.24)	(1.22)	(16.21)	(10.19)	(1.04)	(1.22)	(13.69)	(8.90)

Note. EDE-Q = Eating Disorder Examination-Questionnaire; FSQ-MAL = Fear of Self Questionnaire – 'Malformed' subscale; SATAQ = Sociocultural Attitudes Towards Appearance Scale, version 4, 'Internalization: Thin/Low Body Fat' subscale; SBR = startle blink reflex; PAR = postauricular reflex.

* $p < .05$; ** $p < .01$; *** $p < .001$.

[a]Measured by Self-Assessment Manikin scales.

[b]Relative to neutral images.

Table 2

Results of within-subjects repeated-measures ANOVAs for SAM valence and arousal ratings, startle blink response, and PAR

	Pleasant	Aversive	Neutral	Thin	Non-thin	*F* (*df*)	η_p^2
SAM Valence						140.07 (4, 216)***	0.72
M (SD)	6.54 (0.99)[a]	2.77 (0.70)[b]	5.02 (0.60)[c]	4.78 (1.25)[c]	5.03 (1.05)[c]		
SAM Arousal						91.78 (4, 216)***	0.63
M (SD)	5.12 (1.06)[a]	6.30 (1.12)[b]	3.22 (1.36)[c]	4.68 (1.25)[a,d]	4.33 (1.21)[d]		
Startle Blink						6.60 (4, 204)***	0.12
M (SD)	60.62 (64.45)[a]	70.24 (69.02)[b]	67.47 (67.17)[b,c]	60.94 (63.54)[a,c†]	62.40 (65.23)[a,b,c]		
PAR						0.52 (4, 208)	0.01
M (SD)	22.63 (28.53)	22.23 (24.87)	22.99 (27.59)	21.87 (26.70)	21.55 (24.39)		

Note. SAM = Self-Assessment Manikin; PAR = postauricular reflex; η_p^2 = partial eta squared.

SAM valence and arousal scales are rated from 1 (least) to 9 (greatest).

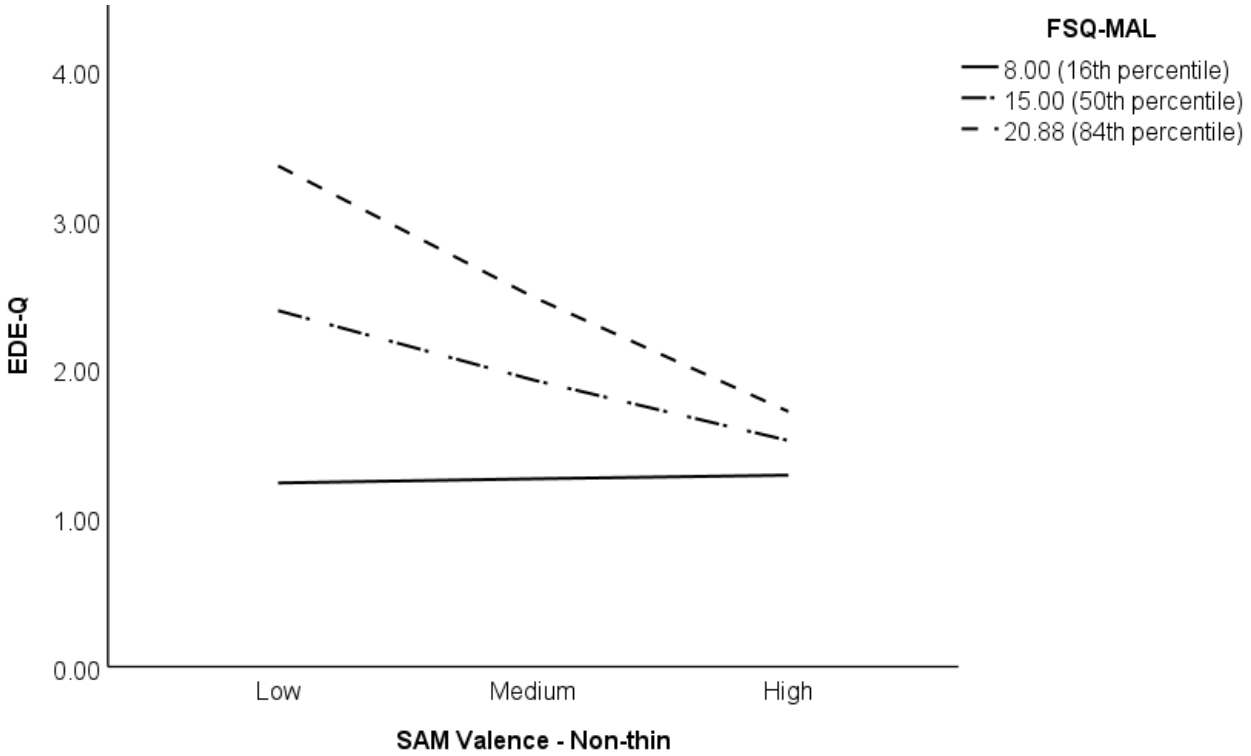
Differing alphabetic superscripts represent significant ($p < .05$) pairwise differences between image types.

*** $p < 0.001$

[†]The difference between startle blink response to aversive images and thin images becomes non-significant when a participant identified as a univariate outlier was removed.

Figure 1

Fear of the unattractive self moderates the relationship between valence ratings of non-thin body images and eating pathology



Note. The relationship between eating pathology and valence ratings of non-thin body images is significant at high and medium (but not low) levels of fear of the unattractive self.

EDE-Q = Eating Disorder Examination Questionnaire; SAM Valence – Non-thin = Self-Assessment Manikin valence ratings of non-thin body images; FSQ-MAL = Fear of Self Questionnaire – malformed subscale