BODY IMAGE AND THE ACOUSTIC STARTLE REFLEX

by

KATIE BANNON TAYLOR

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And approved by

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ABSTRACT OF THE DISSERTATION

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By KATIE BANNON TAYLOR

Dissertation Director:
G. Terence Wilson, Ph.D.

The premise of this work is that body image is a phobic stimulus, and reaction to it may be measured using an acoustic startle reflex (ASR) paradigm. ASR is modulated by fear and body image may provoke a fearful, phobic-like response. This study aimed to determine differences in the modification of ASR produced by viewing self-body images in women with high shape and weight concerns (HSCW; n = 25) versus women with low shape and weight concerns (LSWC; n= 28) assessed with the Body Shape Questionnaire (BSQ). Secondly, this project aimed to determine differences in subjective ratings of body image. There were significant differences between groups in subjective ratings of self-body image. There were no between group differences in ASR to self-body images. Both groups of women exhibited attenuated ASR to self-face and body images, relative to neutral images, possibly indicating an effect of increased attention. Both groups demonstrated ASR potentiation to negative images. HSCW women also viewed self-body images significantly longer than LSCW women. The discussion focuses on whether ASR is a phobic stimulus for women with body image concerns and whether there are self-attention effects that override physiological affect measurement.
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Table of Contents

Abstract ii
Acknowledgement iii
List of Tables v
List of Illustrations vi
Introduction 1
Method 8
Results 18
Discussion 24
Tables 34
Illustration 38
Bibliography 46
Curriculum Vita 50
List of Tables

Mean Differences between Groups on EDE-Q, BSQ, BDI, and BAI  34
Self-Assessment Response Means for Image Category Valence,  35
    Arousal and Time (milliseconds, ms) Viewing Images
Aggregated Means for ASR Response across Image Categories  36
Partial Eta-Squared Effect Sizes for ASR in Repeated Measures ANOVA  37
List of Illustrations

Participant Flow Diagram 38
Self Assessment Valence Ratings across Image Categories 39
Self Assessment Arousal Ratings across Image Categories 40
Group by Category Image (Body Image Versus Self-Face) Interaction 41
Group by Image Category Time Interaction 42
ASR Mean Response to All Image Categories 43
Image by Group ASR Response across All Image Categories 44
Valence Images versus Self-Referent by Group 45
**Introduction**

Poor body image is a core feature of eating disorders (DSM-IV; American Psychiatric Association, 1994) and contributes to their onset and maintenance (Stice, 2002). It is also a key predictor of relapse (Fairburn, et al., 2003). Most experts agree that body image dissatisfaction is a multidimensional construct involving cognitive, affective, and behavioral components (Cash, 1994a, 1994b; Garner, 2002). A better understanding and measurement of the affective component of body image may aid in eating disorder treatment and body image dissatisfaction amelioration. The examination of the physiological correlates of body image is a potential method to understand this construct. Acoustic startle reflex (ASR), used predominantly in the anxiety disorders field, may be a useful tool to measure body image and its affective components, specifically the negative emotion involved in body image dissatisfaction.

Negative emotion is a core aspect of the cognitive behavioral model (CBT) and dual pathway model of Bulimia Nervosa (BN) (Cash, 2002; Fairburn, Cooper, & O’Conner, 2008; Stice, 2001). It is also considered a core feature of body image dissatisfaction (Cash, 2002; Williamson, Stewart, White, & York-Crowe, 2002). In the CBT model for body image, current schemas and attitudes are central to maintaining body image dissatisfaction, the level of investment in one’s body image, and evaluations of body image (Cash, 2002). Schemas in all the models discussed refer to the cognitive “short cuts” that individuals form to more easily navigate their environments. Negative body schemas are purported to generate negative attitudes around body image. As well, negative attitudes about body image will foment the negative schemas. Based on these evaluations and investments, particularly if evaluations are negative and investment is
high, body image schemas incorporate negative affect and become central to a women’s notion about the importance of her shape and weight and how it influences her life (Cash, 2002). People with negative body image schema likely place more importance on appearance-related information, the results of which may be negative automatic thoughts, inferences, and conclusions about one’s appearance, shape, and weight (Cash, 2002). Similarly, the information processing model (Williamson, et al., 2002) conceptualizes body image as a result of a cognitive process that biases people toward body images and influences body image experiences (Williamson, et al., 2002). This model assumes that the schemas are easily retrievable, mainly because of the effects of mood and the interrelatedness of schemas. Negative mood can induce activation of negative body image schemas and bias individuals to attend to body image stimuli. Conversely, these schemas and a bias toward body image may induce negative mood. It also posits events related to body/shape schema (e.g., trying on clothes at the mall) may activate a body image bias. Negative emotions that become associated with body image and cues in the environment may trigger body image biases and bad experiences related to body image. The capability to induce negative emotion via exposure has treatment implications such that clients may disentangle their body image biases from their emotions (Williamson, et al., 2002). The aforementioned models (CBT and Information Processing) are theoretically independent and have been formulated and tested by their respective authors. There are similarities to each of the models: both focus on the interrelatedness of schemas and emotions. Additionally, the CBT model emphasizes the role of behavior in maintaining negative body image.
One explanation of this distress response to body image may be that it acts as a phobic stimulus, or one that causes great anxiety and distress upon exposure (Tuschen-Caffier, Vogele, Bracht, & Hilbert, 2003). The premise of this model stems both from research examining the treatment of body image via exposure therapy and from the theoretical framework that body image includes negative affect. Many body image treatments currently entail exposure therapy, based upon treatments for anxiety (Hilbert & Tuschen-Caffier, 2004; Keys, et al., 2002; J.C Rosen, 1996; Tuschen-Caffier, et al., 2003). Current success with exposure therapy may also suggest the phobic-based quality of body image dissatisfaction (Delinsky & Wilson, 2006; Hilbert & Tuschen-Caffier, 2004; Keys, et al., 2002; Tuschen-Caffier, et al., 2003). However, it is important to examine body image as a phobic stimulus, outside of treatment trials and through component treatment designs. For example, in 2004, Hilbert and Tuschen-Caffier found no difference between CBT body image exposure and CBT cognitive restructuring treatments, indicating both may be effective treatments, and that there may be nothing singular about body image exposure. In terms of research outside of treatment studies, Laberg, Wilson, Eldredge, and Nordby (1991) were one of the first teams to examine physiological correlates of body image. The participants in this study (restrained eaters and those with BN) demonstrated a defensive response to images of their bodies as reflected by accelerated heart rate (HR). In another study that examined HR responses to body images among restrained versus unrestrained eaters demonstrated accelerated HR to body images, replicating the work conducted by Laberg et al (Overduin, Jansen, & Eilkes, 1997). In addition to HR, ASR may be an alternative and viable way to measure
body image dissatisfaction, particularly as it has been successful in measuring anxiety and specific phobias.

ASR is a non-invasive measurement of a reflexive central nervous system response to a startle probe (acoustic, cutaneous, or visual) (Blumenthal, et al., 2005). Pairing the startle probe with another stimulus can produce startle modification, either potentiating (increasing) or attenuating (decreasing) the magnitude of the startle response. ASR is purported to measure motivational systems. This is predicated upon Lang’s biphasic theory of emotion (Lang, Bradley, & Cuthbert, 1997). This theory posits that emotion is organized by two motivational systems, appetitive and defensive, and can be indexed by ASR attenuation and potentiation, respectively. Both of these responses are based on survival mechanisms via promotion and protection behaviors and presumably are connected with the same brain areas that mediate the sympathetic and parasympathetic systems (Davis & Lang, 2001). The appetitive system is relevant to promotion of survival and is activated by stimuli associated with sustenance, procreation, and nurturance. It is also related to the corresponding behaviors such as ingestion, procreation, and care-giving (Bradley, Codispoti, Cuthbert, & Lang, 2001). Food, for example, is a cue that is expected to inhibit/attenuate the startle response, although this may not be the reaction in cases of eating disorders or food deprivation (Drobes, et al., 2001; Mauler, Hamm, Weihe, & Tuschen-Caffier, 2006). The defensive system is activated by protection of threatening or fearful contexts. The behaviors in this system include withdrawal, escape, and attack (Bradley, et al., 2001). The responses of both the appetitive and defensive systems are based on hedonic valence (positive-appetitive or negative-defensive) and arousal (high or low), which is the degree of motivational
activation. The magnitude of the startle reflex purportedly is potentiated (or increased) by negative cues/stimuli and inhibited (or decreased) by positive cues/stimuli (Lang, Bradley, & Cuthbert, 1990; Vrana, Spence, & Lang, 1988) and is thought to reflect the motivational potency of a cue, whether appetitive or defensive (Mauler et al., 2006).

Current use of ASR in the field of eating and weight disorders is limited, and mainly examines reaction to food cues, often based on a paradigm of food deprivation and reinstatement. Findings support the view that increases in negative affect (via mood induction or deprivation) increase food craving, as measured by an increase in startle reflex (Drobes, et al., 2001). Mood may also interact with craving in a way that taps two different motivational systems: frustration from not eating or trying to food restrain, as opposed to frustration from being hungry and finding food appetitive (Drobes, et al., 2001). Recently a study examined the effects of deprivation, craving, and varying delays of time to consume food (Rejeski, et al., 2010). The results replicated previous findings, such that food cues elicited higher ASR when individuals were food deprived (Hawk, Baschnagl, Ashare, & Epstein, 2004). In another study, negative affect, though not ASR, was higher in individuals with a delayed food consumption (Drobes, et al., 2001).

Mauler and colleagues (2006) demonstrated that BN participants who were food deprived exhibited significantly less startle potentiation than non food deprived BN participants prior to a buffet meal and the results were reversed after meal reinstatement (with food deprived BN eating more than non food deprived BN). Findings suggest that BN participants may utilize restricted eating to dampen negative affect (Mauler, et al., 2006). Food stimuli may also be less aversive to individuals with eating disorders who are successfully restricting, as opposed to binge eating. However, even with the decreased
potentiation within the BN group, this group demonstrated significantly increased potentiation compared to the control group, suggesting that people with BN respond more negatively to food cues than controls. Overall, multiple studies examining ASR and food cues resulted in interesting findings in terms of food deprivation (a state common in eating disorders); food deprivation among healthy controls may elicit potentiated ASR. However, among individuals with eating disorders, the results are reversed such that food reinstatement, not deprivation, results in a potentiated and more negative response.

The demonstrated aversion to food (after reversal of food deprivation) has implications for treatment, specifically food exposure therapy (Mauler et al., 2006). BN participants in the study were more distressed after eating a normal meal after restricting, and the optimal time to conduct exposures may be immediately following meal consumption, when emotions are strong (Mauler, et al., 2006). Additionally, the “frustrative non-reward” that is highlighted by Drobes et al. (2001) may suggest the utility of employing such techniques as “distress tolerance” (Linehan, 1993) to help clients outlast negative feelings and appetitive cravings. These findings demonstrate how ASR may be used to investigate underlying mechanisms, both behavioral and biological, of eating disorders and inform clinical treatment research and application.

There are fewer studies which examine body image and ASR. Buck and colleagues (2004) demonstrated that women with a healthy body image have attenuated ASR to images of their own bodies, suggesting this may be a pleasurable or a self-attention effect (Buck, Hillman, Evans, & Christopher, 2004). In this study, women viewed images of their own body (in bathing suits), and a set of neutral, positive, and negative images, during the ASR paradigm. ASR to body images was inhibited compared
to both positive and negative stimuli, but comparable to neutral images. The attenuated response, per the bi-phasic theory of emotion (Lang et. al., 1997), indicated a pleasurable response. The authors surmised that the effect could be attentional-driven, such that attention to self attenuated overall startle. Overduin and colleagues (1997) did not find any significant differences in ASR to self-images compared to neutral pictures, in a sample of restrained and non-restrained eaters. Finally, Friederich and colleagues (2006) found no group differences (BN, AN, Control) in startle modification in response to images of models. One explanation may be that images of models and not of the participants themselves were used as study stimuli (Friederich, et al., 2006). The authors concluded that the images may not have been emotionally salient or evocative enough. Additionally, this study did not involve mood induction; inducing a negative mood in a portion of the sample may have amplified reactions to the images of the models (Laberg et al., 1990). Based on the extant literature, it is unclear whether or not startle response is an index for body image dissatisfaction. Overduin et al. did not utilize standardized valence images to compare body images or focus specifically on body image concerns. Buck et al. focused on a non-clinical sample and Friederich et al. did not use self-images. None of the studies controlled for self-attention. If body image is a phobic stimulus or one to which women respond defensively, it follows that ASR will be an adequate measurement. If ASR is does not capture this negative response, yet women continue to self-assess their bodies negatively, as in previous studies, new methodological techniques for examining the physiological correlates of body image need to be examined.

The current study investigated whether there are differences in the potentiation of ASR in response to self- body images between women who have high shape and weight
concerns (HSWC) and women who have low shape and weight concerns (LSWC).

Prevailing models postulate that women with body dissatisfaction harbor negative body image schemas and negative affectivity that may be automatically activated by environmental cues, such as images of their own body (Cash, 2002; Williamson, et al., 2002). Accordingly, people with negative body related schemas should react differently compared to those who do not have negative body image when they are probed by an acoustic startle, accompanied by body relevant information. The body image stimulus will likely prompt negative automatic thoughts, emotions, and arousal. It was hypothesized that HSWC women would demonstrate potentiated ASR compared to LSWC women, when viewing images of their own bodies. It was expected that HSWC women would show a greater difference in potentiation between body images and neutral images and positive images than LSWC women. In a second part of the research, in which participants provided self-report ratings of the images, it was hypothesized that HSWC women would self-assess their own bodies more negatively and with higher arousal.

Method

Design

The study included female participants who self reported high shape and weight concerns (HSWC) or low shape and weight concerns (LSWC). The study was a 2 (HSWC, LSWC) X 5 (negative, positive, neutral, control-self-face, and body images) design. The first part of the study measured ASR responses to images and the second part collected participants’ self-reported responses to the images. Outcome variables included:
response amplitude of ASR, self-assessment measurements, and time spent viewing image categories.

Participants

Participants were recruited from undergraduate student pools for course credit and from the general college population or participant lists of previous research studies, conducted in our laboratory, for monetary compensation. Originally, 470 women were screened for this research study: Of those screened, 320 were deemed ineligible (described below), 48 were not interested (from previous research studies), and 102 were eligible for participation. Based on the 102 eligible participants, 70 participants completed or began the ASR session, but because of technical difficulties or later data exclusion (see below), the final sample size was \( N = 53 \). Please see participant flow chart for more information (Figure 1).

The primary inclusion criterion was shape and weight concerns. Based on the Body Shape Questionnaire (BSQ, Cooper, Taylor, Copper, & Fairburn, 1987), women who fell within one standard deviation (28.4) above (>110) or below (<53) the mean (81.5) of this questionnaire were determined to be eligible for this study. The women who scored below the mean were considered the low shape and weight concern participants (LSWC; \( n = 28 \)) and those who scored above the mean were considered the high shape and weight concern participants (HSWC; \( n = 25 \)). Additional inclusion criteria were a normal range body mass index BMI (19-25), absence of a current eating disorder, willingness to bring a bathing suit to the session, and ability to see the computer monitor.

All participants (\( N = 53 \)) were female between the ages 18 and 23 (\( M = 19.26; SD = 1.37 \)). The sample was diverse, with White 50.9% (\( n = 27 \)), Black 15.1% (\( n = 8 \)),
Asian 13.2% \( (n = 7) \), Hispanic or Latino 3.8% \( (n = 2) \), Native Hawaiian or Pacific Islander 1.9% \( (n = 1) \), Multicultural 9.4% \( (n = 5) \), and Other 3.8% \( (n = 2) \) participants. Most participants reported being born in the United States 84.2% \( (n = 45) \) and English as their primary language 98.1% \( (n = 52) \). Participants were primarily undergraduate students, having completed high school 7.5% \( (n = 4) \) or some college 88.7% \( (n = 47) \); however one participant reported not completing high school and one participant reported completing college. The average BMI was \( (M = 22.08; SD = 1.59) \), with no significant differences between the groups.

**Questionnaires**

**Eating Disorder Examination Questionnaire (EDE-Q).**

The EDE-Q is a 41-item, self-report questionnaire designed to assess eating disorder symptoms, including patterns of eating and concerns about eating, shape, and weight (Fairburn & Beglin, 1994). It is based upon the semi-structured interview the Eating Disorder Examination (Fairburn & Cooper, 1993) and has demonstrated agreement with the interview (Fairburn & Beglin, 1994). The measure demonstrated good test-retest reliability over a 2 week period on the four subscales \( (r = .81-.94) \) (Luce & Crowther, 1999), and good internal consistency \( (r = .81-.93) \). A 1-year test to examine temporal stability produced similar results for internal consistency \( (r = .93) \) and test-retest reliability for attitudinal facets of the questionnaire \( (r = .57-.79) \), but not for the behavioral indices of eating disorders \( (r = .24-.44) \) (Mond, Hay, Rodgers, Owen, & Beumont, 2004). The EDE-Q provides one Global scale and four subscales, including Restraint (R), Eating Concern (EC), Weight Concern (WC), and Shape Concern (SC). In
the current study, this questionnaire was used to assess eating disorder behavior (e.g., binge eating, vomiting, and laxative use).

**Body Shape Questionnaire (BSQ).**

The BSQ is a 34-item self-report questionnaire designed to assess concerns about body shape and weight (Cooper, et al., 1987). There are no subscales, although two individual items are predictive of body checking and avoidance behavior (Reas, Grilo, Masheb, & Wilson, 2005). The BSQ has been shown to discriminate between eating disorder patients and non-patients and demonstrates concurrent validity with other measures of body dissatisfaction and eating disorder pathology ($r = 0.35-.66$). The reported reliability coefficient for the BSQ was .88 (James C. Rosen, Jones, Ramirez, & Waxman, 1996).

**Beck Depression Inventory (BDI).**

The BDI is a 21-item self-report inventory designed to measure state depression (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961). Each item is rated on a 0-3 point scale, with 0 representing no depressed symptoms and 3 representing severe symptoms. The BDI demonstrated internal consistency and concurrent and discriminant validity (Beck, Steer, & Carbin, 1988).

**Beck Anxiety Inventory (BAI).**

The BAI is a 21-item self-report inventory designed to measure state anxiety (Beck & Steer, 1990). Each item is rated on a 0-3 point scale, with 0 representing no anxiety symptoms and 3 representing severe anxiety symptoms. The measure has been shown to discriminate between anxious and non-anxious individuals and the publisher reports reliability ratings ($r = .92$) and test-retest reliability ($r = .75$).
Demographic Questionnaire.

A demographic questionnaire was designed for the current study to assess age, race, ethnicity, place of birth, primary language, and highest level of education.

Stimulus Materials

Images for the slide show were selected from the International Affective Picture System (IAPS) (Lang, Bradley, & Cuthbert, 2005) and from body images and face images taken of the participant on the day of the experiment. There were a total of 60 images presented to each participant. The IAPS collection includes negative, positive and neutral images. The current study utilized normative results for females in selecting slides. Images were primarily selected for valence and arousal levels, selecting for the most extreme levels of each set of images (negative and positive). The scale ranged from 0-8, with 0 being the most negative and least arousing and 8 being the most positive and most arousing. Twelve negative, twelve neutral, and twelve positive images were selected for the slide show. Mean valence ratings for 12 negative images ($M = 2.10$) and 12 positive images ($M = 6.56$), indicated that negative images were relative in valence to the positive images (Lang, et al., 2005). Arousal levels indicated that negative images were slightly more arousing ($M = 7.54$) than positive images ($M = 6.41$) (Lang, et al., 2005). Erotic positive images were excluded for potential confounding with body image cues. Images of food and vomit were also excluded for similar reasons. This decreased ability to completely match the negative and positive images, for both valence and arousal. The 12 neutral images had a mean valence that fell in the middle of the scale ($M = 5.00$) and had a low arousal rating ($M = 2.88$). The IAPS numbers for the pictures included were negative: 1300, 3530, 9910, 9050, 3010, 3110, 3130, 3150, 1111, 1274, 9042, 9340;
positive: 8185, 5629, 8210, 4510, 8370, 2216, 4520, 4533, 8030, 8190, 8200, 8496; and neutral: 7002, 7010, 7020, 7050, 7090, 7100, 7130, 7140, 7150, 7170, 7175, 7211.

Body and control, self-face images, constituted the remaining stimuli. With a Kodak Easy Share C530 Digital Camera, 5 images were taken of the participant’s full figure at 45 degree angles (front, back, right silhouette, and left silhouette) and one image was taken of the participant’s face (control). Images from the body image and face categories and images from all other valence categories were presented 12 times each in the slide show. Each body image (4 angles) was repeated 3 times in the presentation and each face image (1) was repeated 12 times, to match the other valence category presentations. The camera was positioned on a Digital Concepts TR-60N camera tripod and photographs were taken from a 3 meter distance, a replicated standard (Buck, et al., 2004). Each photo was taken with a standard white backdrop (B & D Seamless Background paper), hung from a Savage Economy Background Stand.

Four presentation orders were created for the set of 60 images. Participants were randomized to view one of the four orders. There were 12 blocks in each order, each block including five images (negative, positive, neutral, body, and control). Within each order, each slide was presented for 6 seconds and did not appear twice (except for face control and body images). Of the 60 images presented, 45 were probed by the acoustic startle, 3 seconds, 4 seconds, or 5 seconds into the image presentation. For each image category, nine of the twelve images were probed. Each valence category (e.g., negative) was probed at 3 seconds, 4 seconds, and 5 seconds three times in each order. This was repeated for the other four categories. Inter-trial intervals were placed between each image presentation and were occasionally probed (six times per order). The length of the
intervals varied and was based on creating a 15 second minimum lapse of time between startle probes and thus ranged from 12-16 seconds. Within each order and block, the serial position of each probed image was averaged and compared with the other images to ensure that images were presented in a manner that would not create habituation to any one category or time effect. Across each order, each slide was probed 3 times each and at each of the probed times (3 seconds, 4 seconds, and 5 seconds).

**Stimulus Presentation, Apparatus, and Response Measurement**

DMDX software was utilized to control presentation and timing of both the images and startle stimuli. DMDX is a Win-32 based display system that is used to measure reaction times to auditory and visual stimuli (Forster, University of Arizona). DMDX was used both in conjunction with startle acquisition and alone to collect viewing times of stimuli and subjective ratings. Physiological data were acquired with a 32 channel Neuroscan Synamps2 Amplifier (Compumedics Neuroscan, El Paso, TX) and Acquire 4.3 software (Neuroscan 2003). Eye-blink reflex was evoked using an acoustic probe, generated from a sound file and played on an RCA SA-155 integrated stereo amplifier and calibrated at 102 db, using a Radio-Shack hand held multi-meter. Sounds were delivered through one pair of Sennheiser HD 28 pro headphones. Electromyography (EMG) activity was recorded using two side by side 5 mm TDE-023 reusable electrodes that were placed on the left orbicularis oculi muscle. One 11 mm TDE-022 reusable electrode was used as the reference and was placed on the forehead. Each electrode was filled with electrogel, to enable signal conductance. All electrode placements were based on published guidelines (Blumenthal, et al., 2005). Raw EMG signals were sampled at a rate of 2500 HZ, with no notch filter.
To record subjective ratings of the images presented and to measure the amount of time participants elected to view images, a computerized version of Self Assessment Manikin (SAM) was used (Bradley & Lang, 1994). The SAM presentation included the same 60 images as presented in the startle paradigm. Images were randomly presented in a single, fixed order and participants viewed each of the 60 slides 3 times. To continue to the next slide, participants were prompted by the program to press a number on the keypad. The first time a slide was viewed, the participant was instructed to view it for as long as she wished and to press any key to continue. The second time she viewed the same slide, she was instructed to rate the image on valence on a scale of 0-10, with 0 indicating a very positive reaction and 10 a very negative reaction. The third time the participant viewed the same slide, she was instructed to rate the image on arousal on a scale of 0-10 with 0 being the most arousing and 10 being the least arousing.

**Procedures**

Prior to participation in this study, each participant was screened either online or by phone. Participant’s height and weight were measured at the start of the session to re-confirm eligibility. Participants were requested to wear no make-up and to bring a bathing suit or leotard of their choice. Make-up removal, but not a bathing suit, was provided to participants if they forgot these instructions. Participation in this experiment involved one session, lasting no more than two hours. At the experimental session, the participant first met with a female staff member, who obtained informed consent. Following consent, the participant completed a battery of questionnaires described earlier. Upon completion of questionnaires, participants were asked to change into their bathing suits for the photograph session, which was conducted in a private room.
Participants were instructed to stand on an “X” in front of a white backdrop and to maintain a neutral facial expression throughout the process. Five photographs were taken of each participant’s full figure (front, back, left silhouette, right silhouette, and face). After the photos were taken, the participants were instructed to change out of their bathing suit. The images were uploaded onto a pre-existing slide show, including the negative, positive, and neutral images described previously.

Next, the participants’ skin was cleaned with alcohol pads and abraded in the areas intended for the electrodes and the three electrodes were attached. Once impedance levels were determined, the participant was seated in front of the computer monitor where the slide show commenced, lasting approximately 20 min. Participants were randomized to view one of the four orders. Headphones were placed over the participants’ heads and they were instructed to focus attention on the computer screen. After the first slide show, the electrodes were removed and participants were asked to view each slide again. First, participants were instructed to view the slide for a self-selected length of time, next they were asked to rate the image on valence, and last on arousal. The elected viewing time for each image was recorded. After the second slide show, participants were told the purpose of the experiment and were compensated, either with course credits or with $30.00.

**Data Reduction and Analysis**

Data processing and reduction for EMG raw data were performed with Matlab (version R2007b; The MathWorks, Inc.) and EEGLAB (version 6.01b) (Delorme & Mekeig, 2004). Raw EMG signals were bypass filtered from 30 Hz (high pass), rectified, and then bypass filtered to 500 Hz (low pass). Planned offline epochs were 50 ms before to 250 ms after the startle probe. However, based upon startle latency for each
participant, an earlier epoch start was required and was adjusted to 100 ms before to 250 ms after startle probe. Matlab produced a file of individual responses, which was exported to SPSS version 17, the software utilized to conduct all statistical analyses. First, data were reviewed for base range levels, missing trials, and low startle peak amplitude. Cases were excluded if: baseranges fell over 3 SDs above or below the mean or if participants were categorized as non-responders (more than 20% no response rate, or startle peak amplitude 50% of baserange). Data for 4 cases were excluded based on these criteria. For the remaining cases, ASR data were averaged across category for each participant. Raw data were z-score transformed; however, future analysis utilized raw data, as the z-score transformation did not influence the findings.

SAM scores were recorded by DMDX and participants’ responses to the images presented in the SAM protocol (valence, arousal, and time) were averaged across each image category. Some SAM variables were not normally distributed. Based upon distributions, variables were transformed with logarithmic, reflect logarithmic, reflect inverse, or square-root transformations. Statistical analyses were conducted on both transformed and raw data. Analyses revealed no difference in findings between transformed and raw comparisons and raw data were used in final analyses. Questionnaire data were entered into a separate SPSS database and total scores for BSQ, EDE-Q, BDI, and BAI were calculated.

To test the primary ASR hypothesis, repeated measures analysis of variance (ANOVA), with a priori comparisons were utilized. A priori comparisons included examining whether HSWC women differ from LSWC women in reaction to self-images and whether HSWC women and LSWC women differ in their responses to body image
compared to neutral and positive images. It was expected that HSWC women would rate their own bodies as subjectively more negative and more arousing than LSWC women and that this rating would be more negative than that for positive images and neutral images, but not different from negative images. Repeated measures ANOVA were used for SAM data to determine whether HSWC women looked at their bodies, control image, and other images longer than LSWC women. T-tests were used to determine differences on self report questionnaires. It was expected that HSWC women would report greater body image concerns on the EDE-Q and BSQ and greater state negative affect and anxiety then would LSWC women.

A-Priori Power Analyses

Using, G-Power 3 (Buchner, Erdfelder, & Erdfelder, 1997), a-priori power analysis was conducted to determine required sample sizes. It was found that a small effect partial n² (.01) would require 120 participants. A medium effect partial n² (.06) would require 20 participants and a large effect partial n² (.14) would require 10 participants. Our study sample therefore had an adequate sample size to detect small to medium effects.

Results

Descriptive Data

T-tests were performed to test for significant differences between the HSWC and LSWC groups on self-report questionnaires. For all tests, equality of variances was not assumed and all t-statistics are reported in absolute values. There were significant differences between the groups on the BSQ, \( t(27.27) = 21.90, p < .01 \), a finding predicated on our recruitment strategy, with the HSWC showing higher body image dissatisfaction \( (M = 130.64, SD = 19.11) \) than the LSWC group \( (M = 44.14, SD = 5.28) \).
Additional measures of shape and weight concern and eating disorder pathology were significantly different between groups. The global eating disorder pathology score was significantly different between groups, $t(26.23) = 10.33$, $p < .01$, with HSWC women reporting higher pathology ($M = 2.38$, $SD = 1.03$) than LSWC women ($M = .19$, $SD = .24$). Women with HSWC also reported higher levels of restrained eating, $t(33.45) = 5.37$, $p < .05$, eating concern $t(24.05) = 5.20$, $< .01$, shape concern $t(28.85) = 11.82$, $< .01$, and weight concern ($25.02) = 11.79$, $< .01$, compared to LSWC women (see Table 1).

Using T-Tests, the groups also differed significantly on measures of state affect. Women in the HSWC group reported higher levels of state depression, $t(28.62) = 5.00$, $< .01$, and anxiety, $t(35.74) = 2.80$, $p < .01$, than women in the LSWC group (See Table 1).

Using a repeated measures analysis of variance (ANOVA) we tested whether there were differences between self-report and actual BMI by group. Subjective BMI was calculated using self reported height and weight and actual BMI was calculated using actual height and weight measured in the laboratory. There was a significant main effect for BMI reports, but not group, $F(1, 51) = 14.74$, $p < .01$, with all participants significantly underreporting subjective BMI ($M = 21.60$, $SD = 1.49$) verses actual BMI ($M = 22.07$, $SD = 1.59$). There was no interaction effect.

**Self-Assessment Data (SAM)**

A 2 (HSWC vs. LSWC) x 5 (image category) repeated measures ANOVA was conducted to identify self-assessment valence rating differences across image categories (Figure 2, Table 2). There was a significant image by group interaction, $F(2.90, 147.80) = 23.59$, $p < .01$. Simple contrasts were performed with body image as the referent, and
revealed significant interactions of body image group and body images versus positive images, $F(1, 51) = 49.63, p < .01$; body images versus negative images, $F(1, 51) = 34.81, p < .01$; body image versus neutral images, $F(1, 51) = 50.90, p < .01$; and body image versus self-face image, $F(1, 51) = 5.27, p < .05$. HSWC women rated their bodies with more negative valence ($M = 7.12, SD = 1.60$) compared to LSWC women ($M = 3.53, SD = 1.88$) relative to neutral images (HSWC, $M = 4.80, SD = .54$; LSWC, $M = 4.07 SD = 1.58$), positive images (HSWC, $M = 3.26, SD = 1.01$; LSWC, $M = 2.96 SD = 1.33$), and self-face images (HSWC, $M = 6.76, SD = 1.53$; LSWC, $M = 3.88 SD = 2.07$). Both groups assessed the negative images as having the highest negative valence (HSWC, $M = 7.74, SD = .97$; LSWC, $M = 7.26, SD = 1.60$).

A 2 (HSWC vs. LSWC) x 5 (image category) repeated measures ANOVA was conducted to identify differences in arousal ratings across image categories (Table 2, Figure 3). There was a significant main effect of image category, $F(2.81, 143.38) = 54.51, p < .01$. To determine main effects of the body image category, simple contrasts with body image as the referent were conducted, revealing main effects of body image versus negative images, $F(1, 55) = 51.42, p < .01$; versus neutral images $F(1, 55) = 30.64, p < .01$; and versus positive images $F(1, 55) = 27.34, p < .01$, with body image reported as less arousing than negative and positive images, but more arousing than neutral images. There was an interaction effect, $F(1, 55) = 8.10 p < .01$, with HSWC women reporting their body image as more arousing ($M = 6.65, SD = 1.90$) and their face image as less arousing ($M = 7.42, SD = .182$) whereas LSWC women self reported a smaller difference between arousal ratings of their bodies ($M = 6.96, SD = 1.79$) compared faces ($M = 7.11, SD = 1.90$; see Figure 4).
A 2 (HSWC vs. LSWC) x 5 (image category) repeated measures ANOVA was conducted to determine if there were differences in the amount of time spent looking at each image category. There was a significant image by group interaction, $F(2.11, 107.35) = 8.82, p < .01$. Simple contrasts were performed with body image as the referent. There were interactions between participant group and body image compared to negative images, $F(1, 51) = 8.91, p < .01$, compared to positive images, $F(1, 51) = 14.94, p < .01$, compared to neutral images, $F(1, 51) = 11.79, p = .001$, and compared to self images, $F(1, 51) = 13.23, p = .001$. In each instance, HSWC participants viewed their body image ($M = 5401.04, SD = 3344.39$) significantly longer than LSWC participants ($M = 2945.44, SD = 15.18.86$), and compared to all other image (Table 2, Figure 5)

**Acoustic Startle Reflex (ASR)**

**Overall Group**

First, using repeated measures ANOVA for image categories only, we examined overall group ASR responses (see Table 3 for overall and by group ASR means). There was a significant main effect of the image categories, $F(3.38, 175.85) = 8.06, p < .01$. A polynomial contrast revealed both significant linear $F(1, 52) = 9.78, p < .01$ and quadratic effects, $F(1, 52) = 19.50, p < .01$ (See Figure 6), such that participants demonstrated highest ASR to negative images, then neutral image, then positive images.

Simple contrasts with negative image category as the referent revealed that mean ASR negative images was significantly different from that for positive images, $F(1, 52) = 8.39, p < .01$; neutral images, $F(1, 52) = 11.99, p < .01$; self-face, $F(1, 52) = 18.68, p < .01$; and body images, $F(1, 52) = 18.46, p = < .01$, with negative images eliciting a
ASR potentiation compared to the other categories. When self-body image was compared to all other categories, there was an effect indicating differences between body image versus neutral images, $F(1, 52) = 3.68, p < .01$, with more potentiation to neutral images.

Also, collapsing across groups, we examined the difference between the three valence categories (negative, positive, and neutral) and a variable created combining the means of body image and self-face, a self-referent category. There was a significant main effect of image category, $F(2.30, 119.49) = 9.25, p < .01$. A simple contrast, using the new self-referent category as the contrast referent, demonstrated ASR for this category was significantly different from that for negative images, $F(1, 52) = 8.39, p < .01$, and neutral images, $F(1, 52) = 8.39, p < .01$, such that ASR was attenuated for the self-referent images. The self-referent category was not different from positive images, $F(1, 52) = 8.39, p = NS$.

**Shape and Weight Concern Groups (HSC vs. LSC)**

A 2 (HSC vs. LSC) x 5 (image category) repeated measures ANOVA was conducted to determine the differences in ASR between groups, across image categories. There was a significant main effect for image category, $F(3.50, 178.61) = 8.46, p = .001$, but no significant interaction, indicating general response differences to categories, but no significant group (HSC vs. LSC) contributions (see Figure 7). Simple contrasts were conducted, with negative image category as the referent. ASR to negative images was significantly different from: positive images, $F(1, 51) = 9.35, p < .01$; neutral images, $F(1, 51) = 13.57, p < .01$; self-face images, $F(1, 51) = 20.57, p < .01$; and body images, $F(1, 51) = 19.04, p < .01$. There was a significant interaction between weight and shape concern status and negative images and neutral images, $F(1, 51) = 4.35, p <$
.05, such that HSWC women exhibited a greater difference between the two categories compared to LSWC women. There were trend interactions between weight and shape concern status and negative images and self-face images, $F(1, 51) = 3.67, p = .06$, and negative images and positive images, $F(1, 51) = 3.67, p = .06$, such that HSWC participants had more potentiated startle to negative images compared to neutral and positive images, versus LSWC participants, who exhibit less of a difference between those valence categories. When body image was used as the referent category, body images compared to neutral images yielded a trend toward main effect, $F(1, 51) = 3.50, p = .07$, such that both groups exhibited potentiated startle to neutral images compared to body images.

As in the overall group analysis, repeated measures ANOVA with a newly computed self-referent variable were utilized. We used a 2 (HSWC vs. LSWC) by 4 (3 valence image categories, plus new self-reference) design to determine group difference in ASR. There was a significant main effect of image category, $F(2.30, 119.49) = 9.25, p < .01$. A simple contrast, using the new self-referent category as the contrast referent, demonstrated this category as significantly different from negative images, $F(1, 51) = 23.68, p < .01$, and neutral images, $F(1, 51) = 4.44, p < .05$, but not from positive images, $F(1, 51) = .14, p = NS$ (See Figure 8). The self-referent images resulted in attenuated ASR compared to neutral and negative images.

**Post-Hoc and Sensitivity Power Analyses**

Post-hoc and sensitivity power analyses were conducted to further determine that the study was adequately powered and had the sensitivity to detect effects for ASR. The post hoc analyses for the 2 x 5 repeated measures ANOVA test, with negative images as
the referent, revealed power \((\beta - 1) = .88\), which is conventionally viewed as adequate. The sensitivity test revealed that in the study, given power \((\beta - 1) = .80\), and sample size, a small effect size \((f = .15)\) could be detected. See table 4 for obtained effect sizes for the 2 x 5 repeated measures ANOVA test, with negative images as the referent.

**Discussion**

The goal of this dissertation was to determine whether there were differences in ASR responses to images of their own bodies between women with HSWC and women with LSWC, and to determine whether body image acts as a phobic-like stimulus for women with high shape and weight concerns. The results did not support the primary hypothesis that HSWC women have a significantly potentiated ASR compared to LSWC when viewing their own body images. Additionally, there was no evidence that HSWC women have potentiated ASR to body images compared to neutral and positive images.

Analyses revealed that both groups startled significantly more to negative images versus all other image categories. This is in line with previous literature and demonstrates that proper ASR was elicited (Bradley, et al., 2001; Friederich, et al., 2006) and therefore established conditions necessary for hypotheses testing; participants exhibited potentiated ASR to negative images. Another finding revealed a trend toward all women startling more to neutral images, compared to self-face and self-body images. Previous research examining ASR and body image has demonstrated similar ASR attenuation effects to self-referent images (Buck, et al., 2004). To further examine this concept, a new variable was created, combining the average responses to self-body and self-face image categories. The ASR to the new self-referent category was significantly different from that for negative images and neutral images, but not positive images. Interestingly, self-
referent combination was significantly different from neutral images, indicating ASR attenuation. The lack of difference between this new category and positive images is also consistent with the interpretation that this reflected ASR attenuation, perhaps due to diverted attention to self.

The next set of analyses included between group comparisons, indicating the main effect for negative image we saw across all participants, and the same trend toward an interaction between self-face, body, and neutral images and shape and weight concern groups. Although the difference between the images remained, in this instance, HSWC concern women demonstrated potentiated ASR to each of the image categories, perhaps revealing a tendency to have a greater ASR reaction overall. Previous literature has shown that persons with higher state or fear specific anxiety levels may have exacerbated ASR (Grillon, Ameli, Foot, & Davis, 1993). Women in the HSWC group scored higher on levels of state anxiety compared to LSWC women, which may account, in part, for the overall potentiated ASR, across most image categories. Conversely, ASR literature has demonstrated that people who score higher on levels of depression may have attenuated ASR responses to negative images (Grusser, Wolfling, Morsen, Kathmann, & Flor, 2007). The HSWC women also had significantly higher scores on state depression than LSWC women, but this did not seem to dampen ASR reactions. In one study participants with clinical depression demonstrated potentiated responses to positive images, compared to people without depression (Allen, Trinder, & Brennan, 1999). Friederich and colleagues (2006) found that women with an eating disorder displayed abnormal (potentiated) reactions to positive stimuli, which they related to a dysfunction in the
appetitive system. Women with HSWC in this study demonstrated potentiated startle across categories compared to LSWC women.

There was a disconnection between women’s physiological response versus self-report response to their own body images. As expected, women with HSWC reported having a negative reaction to seeing images of their own bodies, both compared to women with LSWC and compared to the other image categories. These women also rated their own face very negatively, indicating a negative reaction to both self-referent images. This reaction was not seen in women with LSWC and was not reflected in the physiological data. In terms of how arousing women found the image categories, HSWC women reported their own body images as more arousing compared to LSWC women. Arousal (particularly high arousal) is considered a primary element of the biphasic theory of emotion, and a purported emotion captured by measuring ASR (Cuthbert, Bradley, & Lang, 1996). Considering the difference in subjective ratings, for both valence and arousal, it is surprising this is not reflected in the physiological counterpart.

One explanation for lack of findings for body image differences between groups, as stated earlier, is attention. It is plausible that participants attended to their own images so much so that response to ASR was inhibited. For example, women with HSWC versus women with LSWC viewed their own body images significantly longer in the part of the experiment where they were instructed to view the slides as long as they desired. Body image was the only image category for which there was a significant image by group interaction for time spent viewing images. This effect may indicate that HSWC women in this study were more interested in their own bodies, attended more to their bodies, which in turn may have attenuated ASR responses. However, LSWC also
demonstrated an attenuated response to self-face and self-body images. It may be likely that self-images are attention diverting to all groups. However, it is difficult to determine whether or not this attention effect dampened ASR for HSWC women, considering both groups demonstrated similar effects.

In the study conducted by Buck and colleagues (2004), women with no significant shape and weight concerns viewed images of their own body versus a standard set of valence image categories, undergoing EMG measurement. Participants demonstrated the smallest eye blink response to their own body images compared to all other images. The authors concluded that body image, for those without body image concerns, may be a pleasant stimulus. This indicates, according to the bi-phasic theory of emotion, that the appetitive motivation system was active (Bradley, et al., 2001). An alternate conclusion provided by the authors was self-attention, whereby the participants’ attentional resources were focused more on the image than on the acoustic startle probe.

There is conflicting evidence for the effects of self-attention in ASR. In one study when socially anxious participants were observed, ASR was attenuated (rather than the hypothesized increase due to anxiety), indicating a self-attention effect (Blumenthal, Chapman, & Muse, 1995). Correspondingly, other research has investigated the effects of redirecting cognitive attentional focus during startle tasks (Dvorak-Bertsch, Curtin, Rubinstein, & Newman, 2007). Dvorak-Bertsch and colleagues (2007) found that when attention was diverted during a startle paradigm, fear-potentiated startle was decreased. The authors concluded that affective processing may require attentional resources and that attention to threat may mediate affective reactions. Although participants in the current study were attending to the threat cue (body image), this may have been
overridden by an overall attention to self. Conversely, in a study examining persons with
social anxiety, self-focused conditions produced larger ASR responses, likely based upon
heighted arousal (Panayiotou & Vrana, 1998). In order to control for a self-attention
effect in the current study, images of participants’ faces, in addition to self-body images,
were utilized. All participants had similar ASR responses to face and to body images,
despite self-reported ratings. The current findings extend those by Buck et al. in
demonstrating a self-referent (face and body) ASR attenuation effect, across both groups.

Another reason for lack of differences between groups on body image may be the
stimuli used. Overduin et al. (1997) also did not find differences to body images, when
comparing restrained and unrestrained eaters. The authors suggest lack of findings may
be a function of the cue reactivity, or level of reaction to the stimuli used. Unlike
Friederich et al. (2006) this study used body images of the participants. The authors
suggested that the salience of the images were not powerful enough, particularly as a
learned, conditioned effect. They suggested stimuli would be more engaging (and likely
to elicit potentiated ASR) if there was anticipation of an event. In their study, they give
the example of possible food ingestion (food was also a stimulus category in the study).
For body image, perhaps the equivalent would be going out in public in a swimsuit or
some other behaviorally or socially challenging event. This technique was demonstrated
with socially anxious individuals (Panayiotou & Vrana, 1998). In the current study and in
the study by Overduin et al., participants had to change and be photographed in revealing
clothing/swimwear. This event may have elicited arousal and served as salient cue.
However, that task was long completed once the participants viewed the slides and were
startled, and perhaps the cue saliency diminished.
A recent study examined participants’ ASR reaction to their own faces and provides an example of salient cues for body image (Spresser, Keune, Filion, & Lungren, 2010). This study compared women with a history of weight teasing versus a history without weight teasing. The stimuli in this study were self-face images that were altered to varying degrees (thinner, slightly thinner, heavy, slightly heavier, and normal) and then presented to the participants. In essence, the cues in this study were an anticipated, feared, or desired state of an altered body image. The results found that women with a history of teasing exhibited larger ASR to the extra small and extra large alterations versus neutral photographs. Interestingly, these women did not rate the images more negatively than women without a history of teasing. Although the current study did not find physiological difference in responses to face images, the alteration of the stimulus and of the self body stimulus may have resulted in a difference between groups.

Another cue for body image may be specific body parts. This has not been examined in the current body image/startle literature. In a study by Gros and colleagues (2009), socially anxious participants did not respond differently to socially relevant versus irrelevant information. However, when the authors regrouped the participants based on fear of public speaking, there was a demonstrated difference of ASR between the groups, such that those with a public speaking phobia had greater startle potentiation for socially-relevant stimuli. The authors suggest a fear specificity reaction, such that particular anxieties may elicit physiological response (Gros, Hawk Jr, & Moscovitch, 2009). In terms of body image, fear of specific body parts may be relevant stimuli and method by which to compare groups.
An alternate explanation to stimulus and cue failure is the assessment itself. Although previous studies have been successful in demonstrating differences in ASR between eating disordered and control groups, these studies have used food cues. Food, by definition, is appetitive and something to be approached, at least in terms of the biphasic theory of emotion (Lang, et al., 1997). However, this may be dysregulated with persons with eating disorders, which has been demonstrated repeatedly in the field (Drobes, et al., 2001; Friederich, et al., 2006; Mauler, et al., 2006). Food is both a highly valenced and motivational cue, especially in the field of eating and weight disorders. However, body image may not be so clear and direct a construct to measure (Friederich, et al., 2006; Overduin, et al., 1997).

There has not been success in using ASR to demonstrate between group differences in reaction to body image, for either eating disorder or non-eating disorder groups (Friederich, et al., 2006; Overduin, et al., 1997). Additionally, neuroimaging studies examining body have failed to find predicted activation in specific emotion regions in the brain (Uher, et al., 2005; Wagner, Ruf, Braus, & Schmidt, 2003). However, Uher et al. (2005) found under-activation in brain regions related to body image processing, indicating potential spatial or tactile deficits for these individuals. There were also correlations between negative ratings of body image and activation in regions such as the fusiform gyrus and the amygdala, although these findings were not strong and may have been a result of few participants with extreme body dissatisfaction. Although a small sample, an earlier study demonstrated differences in right amygdala activation in participants with anorexia nervosa, to distorted images (Seeger, Braus, Ruf, Goldberger, & Schmidt, 2002). In terms of finding neurological or physiological correlates of body
image, the field is still in early stages. We need to learn more about both what techniques to use and what stimuli to present.

ASR was intended to assess the motivational potency of a cue, based on arousal and valence, a proven measurement for anxiety and fear-based reactions. ASR has been demonstrated to measure disgust differentially from fear (Yartz & Hawk, 2002). The levator labii, the area just above the lip, is an alternate method by which to measure disgust (Stark, Walter, Schienle, & Vaitl, 2005). A current body of literature describes body image as eliciting disgust (Davey, Buckland, Tantow, & Dallos, 1998; Harvey, Troop, Treasure, & Murphy, 2002; Troop, Murphy, Bramon, & Treasure, 2000). The current literature in this area is limited to correlation and retrospective studies and it may be important to examine the physiological correlates of disgust in eating disorders. One study investigated the neurological correlates for disgust sensitivity in BN, and found no difference to a control group (Schienle, et al., 2004). However, this was specific neither to food nor body image. It is possible that the current study (and others similar) utilized the wrong physiological measurement paradigms. Previous studies examining HR have demonstrated differences between groups, indicating this may be another viable measure (Laberg, Wilson, Eldredge, & Nordby, 1991; Overduin, et al., 1997).

The current study had limitations. First, based on previous studies, only women who scored in the extreme ranges on a body image questionnaire were eligible to participate in the study. By definition this creates two anomalous groups: They provide a useful comparison, but a continuous variable of body image dissatisfaction may have revealed different results, as it would have included a more representative sample and more power. Additionally people with current eating disorders and BMIs outside of the
normal range were ineligible to participate in the study. The high shape and weight concerns self-reported by the women in this study are a clear analogue to those seen in clinical populations. However, study of a more pathological group might have rendered different results. Another issue is that there may be more effective ways to manipulate body image stimuli. For example, self-body images could have been manipulated or particular hot spot body parts (e.g. stomach or thighs) could have been used as stimuli.

There are multiple possible directions for future work. The unexpected results of the current study underscores the difficulties in determining group differences in responses to body image based on ASR. Again, attention effects, the possibility that current body image is not an emotionally salient stimulus, and the possibility that body image has other correlates that influence ASR are all factors that need to be tested and examined. Additionally, presentation of someone’s current body image versus an altered image may be more likely to elicit negative emotion and potentiated ASR. Specific body parts also may have a similar effect. The latter suggestions may increase the saliency of the cues for participants.

The current work was an extension of the study conducted by Buck et al. (2004), who examined normal women’s reactions to self-body, discovering an attenuated reaction. Based on the literature, prevailing models of body image, and treatments body image problems, the current study was well designed to test and determine differences between women HSWC and LSWC on body image stimuli. Like some previous studies examining eating disorder pathology and body image, no group differences were found. However, HSWC women generally have potentiated ASR, similar to another studying examining women with EDs (Friederich, et al., 2006). Also, across groups, a self-referent
category of self face and body triggered significantly smaller ASR compared to negative and neutral images. This finding, coupled with the contradictory negative self-ratings by the HSWC group, lead to the conclusions that the effects are likely due to self-attention. However, this does not preclude the possibility that body image may be better assessed, objectively, through other physiological correlates or with more salient body image cues. These all remain empirical questions.
Table 1: Mean Differences between Groups on EDE-Q, BSQ, BDI, and BAI

<table>
<thead>
<tr>
<th></th>
<th>HSWC (SD)</th>
<th>LSWC (SD)</th>
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<tbody>
<tr>
<td><strong>Body Shape Questionnaire</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>130.64 (19.11)</td>
<td>44.14 (5.28)</td>
</tr>
<tr>
<td><strong>Eating Disorder Examination</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Global</td>
<td>2.38 (1.03)</td>
<td>.19 (.24)</td>
</tr>
<tr>
<td>Eating Restraint</td>
<td>1.47 (1.07)</td>
<td>.21 (.51)</td>
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<tr>
<td>Eating Concern</td>
<td>1.20 (1.15)</td>
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<td>Weight Concern</td>
<td>3.15 (1.26)</td>
<td>.14 (.20)</td>
</tr>
<tr>
<td>Shape Concern</td>
<td>3.69 (1.32)</td>
<td>.40 (.45)</td>
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<tr>
<td><strong>Beck Depression Inventory</strong></td>
<td></td>
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<tr>
<td></td>
<td>8.68 (6.54)</td>
<td>1.82 (2.16)</td>
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<tr>
<td><strong>Beck Anxiety Inventory</strong></td>
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<tr>
<td></td>
<td>7.48 (7.04)</td>
<td>3.07 (3.76)</td>
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Table 2: Self-Assessment Response Means for Image Category Valence, Arousal and Time (milliseconds, ms) Viewing Images

<table>
<thead>
<tr>
<th></th>
<th>HSWC (SD)</th>
<th>LSWC (SD)</th>
</tr>
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<tr>
<td><strong>Valence</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative Images</td>
<td>7.74 (.97)</td>
<td>7.26 (1.60)</td>
</tr>
<tr>
<td>Positive Images</td>
<td>3.26 (1.01)</td>
<td>2.96 (1.33)</td>
</tr>
<tr>
<td>Neutral Images</td>
<td>4.80 (.54)</td>
<td>4.07 (1.58)</td>
</tr>
<tr>
<td>Body Images</td>
<td>7.11 (1.60)</td>
<td>3.53 (1.88)</td>
</tr>
<tr>
<td>Self-Face Images</td>
<td>6.76 (1.53)</td>
<td>3.88 (2.07)</td>
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<tr>
<td><strong>Arousal</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative Images</td>
<td>4.71 (1.72)</td>
<td>5.16 (1.72)</td>
</tr>
<tr>
<td>Positive Images</td>
<td>5.44 (1.76)</td>
<td>5.35 (1.85)</td>
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<tr>
<td>Neutral Images</td>
<td>8.22 (1.04)</td>
<td>8.12 (1.05)</td>
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<tr>
<td>Body Images</td>
<td>6.65 (1.90)</td>
<td>6.96 (1.79)</td>
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<tr>
<td>Self-Face Images</td>
<td>7.42 (1.82)</td>
<td>7.11 (1.90)</td>
</tr>
<tr>
<td><strong>Time (ms)</strong></td>
<td></td>
<td></td>
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<tr>
<td>Negative Images</td>
<td>2900.34 (2190.14)</td>
<td>2352.84 (1021.67)</td>
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<td>Positive Images</td>
<td>2829.21 (1289.74)</td>
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<td>2270.59 (1272.74)</td>
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<td>5401.04 (3344.39)</td>
<td>2945.44 (1518.86)</td>
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<tr>
<td>Self-Face Images</td>
<td>1984.52 (997.77)</td>
<td>1745.61 (675.39)</td>
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Table 3: Aggregated Means for ASR Response across Image Categories

<table>
<thead>
<tr>
<th></th>
<th>HSWC (SD)</th>
<th>LSWC (SD)</th>
<th>All Participants (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Acoustic Startle Reflex (ASR)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative Images</td>
<td>88.77 (67.51)</td>
<td>70.67 (69.75)</td>
<td>79.21 (68.39)</td>
</tr>
<tr>
<td>Positive Images</td>
<td>70.71 (62.03)</td>
<td>66.05 (69.49)</td>
<td>68.25 (65.49)</td>
</tr>
<tr>
<td>Neutral Images</td>
<td>73.30 (58.80)</td>
<td>66.38 (66.78)</td>
<td>69.65 (62.64)</td>
</tr>
<tr>
<td>Body Images</td>
<td>69.54 (66.26)</td>
<td>59.29 (58.96)</td>
<td>64.13 (62.12)</td>
</tr>
<tr>
<td>Self-Face Images</td>
<td>69.63 (53.67)</td>
<td>62.91 (66.21)</td>
<td>66.08 (60.14)</td>
</tr>
</tbody>
</table>
Table 4: Partial Eta-Squared Effect Sizes for ASR in Repeated Measures ANOVA

<table>
<thead>
<tr>
<th></th>
<th>Partial $\eta^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Images</td>
<td>.14</td>
</tr>
<tr>
<td>Images x Group</td>
<td>.03</td>
</tr>
</tbody>
</table>
Figure 1: Participant Flow Diagram

Total Recruitment
N= 470

Eligible n=102
- Completed Paradigm n = 70
- Excluded for technical reasons n = 13
- Excluded in Data Pass n= 4
- Completed n= 53

Screened, not interested n=48
- Excluded for ineligibility criteria at time of participation n=8
- No longer interested n = 24

Ineligible n=320
- BMI n= 80
- Eating Disorder n=23
- BSQ n=146
- Combination n=58
- Age n=4
- vision/hearing n=4
- Did not complete screen n=5

Recruitment
N= 470

Completed
Paradigm
n = 70

Excluded
for technical
reasons n = 13

Excluded in
Data Pass
n= 4

No longer
interested
n = 24

Completed
n= 53

Ineligible
n=320

Did not
complete
screen
n=5
Figure 2. Significant group by image interaction, $F(2.9, 147.80) = 23.59, p < .01$. Simple contrasts revealed body images differed significantly between groups compared to positive images, negative images, neutral images, and self-face images. Positive images differed from negative images for all participants.
Figure 3. Significant main effect of category, $F(2.81, 143.38) = 54.51, p < .01$. Simple contrasts revealed body image was significantly more arousing than neutral images and less arousing than positive and negative images. Interaction effect, $F(1, 55) = 8.10$, whereby HSWC women reported body image as more arousing and self-face as less arousing, compared to LSWC women, who reported a smaller gap between body and self-face.
Figure 4. Line bar depiction of interaction effect, $F(1, 55) = 8.10$, whereby HSWC women reported body image as more arousing and self face as less arousing, compared to LSWC women, who reported a smaller gap between body and self-face.
Figure 5: Significant group by image interaction, $F(2.11, 107.35) = 8.82, p < .01$. Simple contrasts revealed body images differed significantly between groups compared to positive images, negative images, neutral images, and self-face images. HSWC women viewed body images longer compared to all other categories and compared to LSWC women.
Figure 6. Significant main effect for image category, $F(3.38, 175.85) = 8.06, p < .01$, with participants startling more to negative images versus positive, neutral, self-face, and body images. Overall, all participants demonstrated attenuated responses to self-face and body images, compared to neutral images.
Figure 7: Significant main effect for image category, $F(3.50, 178.61) = 8.46, p = .001$. Participants startled more to negative images versus positive, neutral, self-face, and body images. When negative images were contrasted with all other images, there was an interaction between negative images and neutral images, such that there was a greater difference in startle response between the image categories for HSWC women versus LSWC women. There were two trends between negative images and positive and self-face images, such that HSWC women demonstrated greater difference between the images compared to LSWC women. When body image was contrasted to all images, there was a trend main effect where all participants demonstrated attenuated startle to body images versus neutral images.
Figure 8. Significant main effect for image category, $F(2.30, 119.49) = 9.25, p < .01$. All participants demonstrated attenuated startle to the self-referent condition compared to both negative and neutral images, but not positive images.
Reference


Curriculum Vita

Katie Bannon Taylor

Dec 2002-May 2004  Yale University, Psychology Major, B.A.
August 2006-May 2007  Rutgers University, Clinical Psychology, M.S.

Jan 2008-June 2010  Teaching Assistant, Department of Psychology, Rutgers University
Sept 2007 –Dec 2007  Graduate Assistant, Eating Disorders Clinic, Rutgers University
Sept 2006-June 2007  Graduate Fellow, Department of Psychology, Rutgers University
June 2004-May 2006  Research Assistant, New York University Child Study Center, Institute for Pediatric Neuroscience


