SEX DIFFERENCES IN THE TIME COURSE OF EMOTION

By

Marja K. Germans Gard

Dissertation

Submitted to the Faculty of the

Graduate School of Vanderbilt University

in partial fulfillment of the requirements

for the degree of

DOCTOR OF PHILOSOPHY

in

Psychology

December, 2004

Nashville, Tennessee

Approved:

Professor Jo-Anne Bachorowski

Professor Andrew Tomarken

Professor Thomas Palmeri

Professor Craig A. Smith

ACKNOWLEDGEMENTS

During this research I was supported by National Institute of Mental Health funded National Research Service Award Individual Predoctoral Fellowship #MH12918-02 and an American Association of University Women Educational Fellowship.

I would like to acknowledge my advisor, Dr. Ann Kring, my dissertation chair, Dr. Jo-Anne Bachorowski, and all of the members of my dissertation committee for their guidance on this work.

This work would not have been possible without the love and support of my family, especially my husband, and collaborator in both work and life, David Gard.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

In popular Western culture, conventional wisdom holds that women are the more "emotional" gender.[1] Stereotypes of women as being more "in touch" with their emotions and as more emotionally responsive and sensitive are endorsed by both men and women (e.g., Belk and Snell, 1986). In the past decade, empirical research has increasingly focused on sex differences in emotion. Despite this increased attention, however, inconsistent findings of sex differences have left the precise nature of these putative differences an open question. One way in which this issue may be profitably addressed is by beginning with a definition of emotion and its component parts, and considering the extant data in this light. To further explicate the nature of sex differences, the consideration of emotion in the present study is extended beyond the discussion of momentary experiential and behavioral responses to encompass the examination of the motivational systems that underpin emotional responses and how these motivational activations vary over time.

[1] Note that the use of the term gender here is intentional. The importance of distinguishing between the terms "sex" and "gender" has been argued along several lines (e.g., Deaux, 1993, Lewine, 1994; Unger, 1979). In the present context, we adopt the perspective that sex is considered to reflect the different demographic categories of men and women, and gender to refer to socioculturally constructed roles relevant to masculinity and femininity. The term sex will be used here as a default when men and women are compared, and the term gender will be invoked when prior research provides evidence that gender roles and gender stereotypes regarding emotion play an important role in understanding the observed differences in emotional responding.

Emotion and its Component Parts

The definition of what constitutes “emotion”--as opposed to affect and mood, for example--has been widely discussed and several attempts have been made to constrain the construct (e.g., Rosenberg, 1998; Russell & Feldman Barrett, 1999). Despite the debates regarding the boundary conditions of emotion, however, there is considerable agreement that emotional responses are relatively brief, phasic events that can be decomposed into experiential, expressive, and physiological components. According to a functional view of emotion, each specific emotional state is thought to reflect the coordination of these response components to best effect an adaptive response to an environmental challenge (e.g., Levenson, 1994). In this respect, emotions can be considered as states of readiness, or “action dispositions” (e.g., Frijda, 1986; Lang, 1995), which are organized along two opposing overarching approach and avoidance motivational systems (e.g., Davidson, 1995; Dickinson & Dearing, 1979; Konsorski, 1967). Engagement of these neurobehavioral motivational systems is assumed to prime a body of motivation-relevant associations and representations and a repertoire of motivation-related behaviors (e.g., Lang, 1994). More specifically, the engagement of these approach or avoidance motivational systems is thought to facilitate goal-directed behavior towards something desirable or away from something noxious, respectively. Although contextual factors may further shape the overt manifestations of emotion, these motivational systems may be considered as neurally rooted circuits that fundamentally drive emotional behavior (e.g, Lang, 1995). It should be noted that although emotions are widely considered to be relatively brief phenomena (e.g., Ekman, 1984), there is important variability in the time course, or chronometry, of emotional responses, and this variability is becoming the focus of increasing empirical and theoretical attention (e.g., Davidson 1992, 1994, 1998). That is, emotional responses are not wholly temporally constrained by the presence of an eliciting stimulus, but instead vary in their peak and duration in ways that may hold important information about individual differences.

This brief review of emotion theory highlights the possibility that differences between men and women in “emotionality” may reflect differences in one or more of these facets of emotion: experience, expression, physiological response, motivational system sensitivity, and time course of emotional responses. Most studies to date have considered sex differences in emotional experience and expression, with a select group also considering emotion-related physiology. In this paper we will broaden the scope to additionally consider sex differences in motivational system sensitivity and the time course of emotional responses. These latter two facets have remained largely unexplored in the examination of sex differences in emotion, yet they may yield important information about the nature of sex differences. More specifically, it is as of yet unclear whether sex differences exist at the level of the fundamental motivational building blocks of emotion, or whether these differences emerge only in more contextually-driven emotional behavior. Further, examination of sex differences in the time course of emotion allows for the exploration not only of the mean response in a given channel during the presence of an eliciting stimulus, but the recovery process after the stimulus offset. To better understand the existing evidence for sex differences in emotion, the review below will consider the extant data for each emotional facet delineated above.

Sex Differences in Emotion: the Literature to Date

Emotional experience

A number of studies, utilizing various emotion elicitation paradigms, have indicated that women report more frequent or more intense emotion for both positive and negative emotions. For example, Feldman Barrett and colleagues (Feldman Barrett, Robin, Pietromonaco, & Eyssell, 1998) found that women scored higher than men on a range of global emotion-related self-report measures, including a measure of affective intensity as well as anxiety, depression, hostility and pleasantness facets from the NEO-PI. Grossman and Wood (1993) also found that women's global ratings of the frequency and intensity of their own experience of love, joy, sadness and fear exceeded that of men. Additionally, in a second study that examined emotional responding to positively and negatively valenced slides from the International Affective Picture System (IAPS; Lang, Ohman, & Vaitl, 1988), Grossman and Wood found that women reported stronger emotional experience during slides of both valences. Also, Tobin and colleagues (Tobin, Graziano, Vanman, & Tassinary, 2000) asked women and men to rate the emotional intensity of written scenarios with potential positive or negative content, and found that women rated both positively and negatively valenced scenarios as more emotionally intense. Further, in a study of emotional imagery, Vrana and Rollock (2002) found that Caucasian women reported more positive emotion during joy and neutral scenarios and more negative emotion to fear and anger scenarios, although this pattern did not hold for African-American participants.

Other research has indicated that women report experiencing more negative, but not positive, emotions than men. For example, a cross-cultural study by Fischer and colleagues (Fischer, Rodriguez Mosquera, van Vianen, & Manstead, 2004) indicated that women exceeded men in their global ratings of emotions such as fear, sadness, shame, and guilt. Further, in several studies in which participants viewed both positively and negatively valenced IAPS slides, women rated their experience of slides of both valences as more negative than did men (Bradley, Codispoti, Sabatinelli, & Lang, 2001; Hillman, Rosengren, & Smith, 2004; Tobin et al., 2000). In addition, Bradley et al. found that women reported feeling more "afraid" than men during the presentation of threatening images, while men reported feeling more "sexy" than women during the presentation of erotic images. It is worth noting, however, that this pattern of sex differences in negative emotion may not hold for all negative emotions. Indeed, men may equal or exceed women in the frequency and intensity of their experience of anger (e.g., Brody & Hall, 2000; Fischer et al., 2004; Grossman & Wood, 1993; Kring, 1999).

Taken together, these studies are generally supportive of the commonly held notion that women experience more frequent, intense or extreme emotion than men, although these findings are perhaps better replicated for the experience of negative emotions, with the possible exception of anger. Other research, however, suggests that men and women do not differ in their experience of emotion. For example, Kring and Gordon (1998) found that men and women reported comparable emotional experience in response to a range of emotion-eliciting film clips. This finding was consistent over two studies using different measures of emotional experience: a dimensional Likert scale, and a 20-item measure comprising emotion words representing the emotion circumplex. Notably, Feldman Barrett et al. (1998) also found that despite women's global reports of greater emotional intensity than men, women and men did not differ in their in-the-moment reports of emotional experience during interpersonal interactions. This discrepancy between global and momentary reports led the authors to underscore that when and how emotional experience is measured may impact whether or not sex differences are seen. Further, the authors suggest that men's and women's beliefs about gender differences in emotionality more generally may influence global ratings of emotional experience. Indeed, Grossman and Wood (1993) empirically demonstrated that global ratings of emotional experience were linked to adherence to gender roles. Specifically, the more strongly that female participants subscribed to the belief that women typically feel emotions more intensely than men, the higher they rated the intensity of their own emotional experiences. Similarly, for men, stronger ascription to gender roles was linked to lower ratings of their own emotional experience. Data from Kring and Gordon, however, suggests that adherence to gender roles does not comparably influence momentary ratings of emotional experience. In their examination of self-reported experience during emotion-eliciting films, gender role did not influence emotional experience as reported after each film clip. Taken together, the findings from Kring and Gordon, Grossman and Wood and Feldman Barrett et al. suggest that adherence to gender roles may exert a stronger influence on global ratings as compared to in-the-moment reports emotional experience. That is, respondents may be drawing on their internalizations of gender roles when reflecting on their own global tendencies towards emotional expressivity and experience. By contrast, momentary ratings may be more influenced by the immediate reaction to the recent emotion-eliciting event. Thus if momentary ratings are considered as a less adulterated reflection of true sex (rather than gender) differences in emotional experience, results from the literature reviewed thus far would suggest that if men and women differ at all, they differ in that women rate their experiences of emotional events, particularly negative emotional events, as more negative than men.

Emotional expression

Sex differences in the expression of emotion have been widely studied. Unlike the data for emotional experience, however, there is consistent evidence to support the conclusion that women are more expressive than men, regardless of the measure of expressivity (for a review, see Brody & Hall, 2000). For example, women report greater expressivity on global self-report measures of emotional expression (e.g., Feldman Barrett et al., 1998; Kring, Smith, & Neale, 1994; Gross & John, 1995, 1998; Grossman & Wood, 1993). Women are also more expressive than men on observer ratings of emotional expression (e.g., Barr & Kleck, 1995; Halberstadt, Hayes, & Pike, 1988; Kring & Gordon, 1998; Tobin et al., 2000), and on electromyographic measures of facial muscle activity (e.g., Bradley et al., 2001; Greenwald, Cook, & Lang, 1989; Grossman & Wood, 1993; Lang, Greenwald, Bradley, & Hamm, 1993; Schwartz, Brown, & Ahern, 1980; however see Tobin et al., 2000). There is also evidence that women are more expressive than men across negative as well as positive emotions such as sadness (e.g., Rotter & Rotter, 1988), disgust (e.g., Rotter & Rotter, 1988; Wagner, Buck, & Winterbotham, 1993), fear (Rotter & Rotter, 1988; Schwartz et al., 1980; Wagner et al., 1993), and happiness (e.g., Barr & Kleck, 1995; Halberstadt et al., 1988). However, there remains some debate as to whether women are more expressive than men for anger (e.g., Brody, 1997; Rotter & Rotter, 1988; Wagner et al., 1993).

As Brody and Hall (2000) and others (e.g., Buck, Losow, Murphy, & Costanzo, 1992) have pointed out, there are numerous factors that influence emotional expressivity.

For example, like emotional experience, emotional expression may be influenced by adherence to gender roles or stereotypes. Indeed, gender stereotypes may produce expectancies for gender differences in expressivity that elicit the expected behavior from interaction partners (e.g, Hall & Briton, 1993). Societal gender roles also contribute to *display rules*, or cultural normative prescriptions for how, when and which emotions are acceptably expressed (Ekman & Friesen, 1975). For example, in their meta-analysis of sex differences in smiling, LaFrance, Hecht, and Levy Paluck (2003) provide evidence for social norms that call for women to smile more than men. Violation of display rules can have negative social consequences that reinforce adherence to these standards. Although display rules likely apply in some social contexts more than others, learned display rules may also manifest in contexts that are not explicitly social (Ekman, 1992). Parental shaping over the course of development may contribute to the acquisition of display rules. Manstead (1992) reviews evidence from Malatesta and colleagues (e.g., Malatesta, Grigoryev, Lamb, Albin, & Culver, 1986) that suggests that mothers respond differentially to emotional expressions from male and female infants, and that this differential response is linked to future patterns of expressivity. Collectively, this line of theoretical and empirical work suggests that women's globally elevated emotional expressivity may reflect, at least in part, the influence of cultural norms for female versus male behavior.

Physiological responding

Although physiological reactions are also held to be a component of emotional responding, there has been limited research on sex differences in emotion-related physiology, and there is very little in the way of consistent sex patterning in the existing data. In his review of sex differences in emotion, Manstead (1992) concluded that the evidence suggested men tended to exhibit higher levels of psychophysiological activity than women, particularly in skin conductance and cardiac channels, which index the arousal component of emotional responding. However, subsequent research has suggested that these patterns are mitigated by the valence of the emotion, or even the specific emotion within valence.   For example, Kring and Gordon (1998) found that men manifested greater skin conductance (SC) reactivity during a fear-evoking film clip, while women showed elevated SC during sad and disgust clips. In addition, Bradley et al. (2001) found that men exceeded women in SC only during the presentation of erotica slides. Further, Bradley et al. found that women, not men, manifested greater cardiac reactivity (fear bradycardia) during negatively valenced slides, and Labouvie-Vief, Lumley, Jain, & Heinze (2003) found that women manifested higher heart rate than men during fear- and anger-related autobiographical memories. In sum, these data suggest that neither sex is globally more physiologically reactive, but rather men and women may differentially respond to positively versus negatively valenced stimuli or to specific emotional contents.

Approach and avoidance motivational systems

As noted above, emotions can be considered as organized along opponent approach and avoidance motivational systems that drive emotional behavior (e.g., Lang, 1995; Lang, Bradley, & Cuthbert, 1990). Although these motivational systems are considered by many theorists to be the fundamental underpinnings of emotion, relatively little research has examined sex differences in the sensitivity and activity of these systems. The research that has looked at sex differences in this facet of emotion has considered evidence from self-report, physiological, and behavioral channels. Carver and White (1994) developed self-report measures of sensitivity of the Behavioral Activation System (BAS) and Behavioral Inhibition System (BIS). Higher scores on the BAS scales reflect a greater responsivity to cues of reward and propensity to seek out and pursue putatively rewarding activities. Higher scores on the BIS scale reflect greater sensitivity to punishment and threat. A number of studies have found that women score higher than men on the BIS scale (Carver & White, 1994; Jorm et al., 1999; Heponiemi, Keltikangas-Jarvinen, Puttonen, & Ravaja, 2003), and on the BAS Reward Responsivity subscale (although not on BAS Drive and Fun Seeking subscales), suggesting that women are more sensitive than men to cues of both punishment and reward (Carver & White, 1994).

Engagement of approach and avoidance motivational systems has also been examined by inspecting modulation of the reflexive startle response. Lang and colleagues (e.g., Lang, 1994, 1995; Lang et al., 1990; Lang, Bradley, & Cuthbert,1997) have proposed that activation of these motivational systems exert a modulatory influence on defensive startle responses. Specifically, presentation of a negative emotion-eliciting stimulus, such as an image of an attacking animal, engages an avoidance motivational system and primes associated behaviors. Thus, a defensive startle reflex elicited (e.g., by a burst of white noise) during the engagement of this aversive motivational system will be faster and more potent than the same reflex engaged in the absence of this motivational activation. By contrast, presentation of positively valenced affective material, such as an image of an other-sex nude, engages an approach motivational state and primes appetitive behaviors. A defensive reflex such as the startle response elicited in an approach motivational context will be attenuated because of its incompatibility with the primed appetitive behaviors. Bradley et al. (2001) recently employed such an affective startle modulation paradigm to examine sex differences in approach and avoidance motivation elicited by a wide range of stimulus contents with positive and negative valences. Startle modulation findings from this study indicated that while both men and women reacted most vigorously to images depicting imminent attack, women reacted more consistently than men to all negatively valenced images, even those that were reportedly less arousing, suggesting a broader responsivity to a wide range of aversive content. By contrast, men showed startle attenuation during positive, as compared to neutral, slides, while women did not. McManis and colleagues (McManis, Bradley, Berg, Cuthbert, & Lang, 2001) found a somewhat similar pattern of sex differences in children as young as 7, in that girls responded more potently than boys to negatively valenced stimuli. Both Bradley et al. and McManis et al. conclude that aversive material, at least in the form of symbolic picture cues, activate the aversive motivational system more intensely in women than in men. It should be noted, however, that other empirical examinations of affective startle modulation have not found sex differences in responding to aversive material (e.g., Dichter, Tomarken, & Baucom, 2002; Hillman et al., 2004). The reason for this inconsistency remains unclear, but may possibly be attributable to the limited breadth of the picture content used or the relatively small sample size for each sex.

To examine sex differences in motivated behavior during the presentation of emotion-eliciting material, Hillman et al. (2004) examined postural sway in response to positive and negatively valenced IAPS slides. Postural sway reflects postural shifts towards or away from a foreground stimulus and is thought to be consistent with the activation of approach or avoidance motivational systems, respectively. Hillman et al. found that although men and women did not differ in their postural behavior during the presentation of positive slides, women showed significantly more postural sway away from the slide screen during the presentation of negatively valenced pictures, suggesting a more prominent disposition to withdraw from aversive material. Taken together, the self-report, physiological and behavioral data converge to suggest a pattern in which women may engage the aversive motivational system more intensely, and at a lower arousal threshold, than men. It remains less clear, however, whether there are sex differences in the engagement of the approach motivational system.

Time course of emotion

The time course, or chronometry, of emotional responding is an area of investigation that has recently received increased attention in both theoretical and empirical literature. Davidson (1992, 1994, 1998) in particular has called attention to response chronometry as one means of understanding interindividual variability in emotional responding and dispositional mood. According to Davidson, two key elements of the temporal dynamics of an emotional response are the time from the onset to the peak intensity of the response, and the recovery time, or the time it takes for the emotional response to resolve. In other words, individuals may differ in the rapidity with which they reach the apex of their emotional response, and in the speed of their return to a baseline state. The facet of recovery time has been a particular focus of empirical research. Recent studies have examined the recovery time of self-reported negative emotional experience (e.g., Frost & Green, 1982; Garrett & Maddock, 2001), corrugator electromyographic activity (e.g., Bradley, Cuthbert & Lang, 1996; Sirota, Schwartz, & Kristeller, 1987), pupillary dilation (e.g., Siegle, Granholm, Ingram, & Matt, 2001) and amygdalar activity (Siegle, Steinhauer, Thase, Stenger, & Carter, 2002) during processing of negative words, as well as of the affective modulation of the reflexive startle response (e.g., Bradley, Cuthbert, & Lang, 1993; Bradley et al., 1996; Dichter et al., 2002; Larson & Davidson, 2001; Larson, Sutton, & Davidson, 1998). With few exceptions (e.g., Bradley et al., 1993; Dichter et al, 2002), this research suggests that emotional responses often persist beyond the offset of the eliciting stimulus, and that individuals may differ in the duration of this persistence. Importantly, research has also suggested that this individual variability may be meaningfully related to motivational system sensitivity (e.g., Larson & Davidson, 2001; Larson et al., 1998) and vulnerability to psychopathology (e.g., depression; Rottenberg, Wilhelm, Gross, & Gotlib, 2003; Siegle et al., 2002). More specifically, Larson et al. (1998) found that higher scores on BAS subscales were related to increased reactivity to positive stimuli after stimulus offset, indicating that greater sensitivity of the approach motivational system is linked to the continued processing of positive emotional information. Larson and Davidson (2001) also found that relative right prefrontal EEG asymmetry (a physiological measure purported to reflect activity in the avoidance motivational system) was correlated with longer maintenance of a negative emotional state. In addition, recent studies have suggested that depressed individuals recover more slowly from negative emotional challenge than nondepressed individuals (e.g., Rottenberg et al., 2003; Siegle et al., 2002). Sustained processing of negatively valenced information and rumination on negative emotional material have both been implicated as risk factors for depression (e.g., MacLeod & Matthews, 1991; Nolen-Hoesksema, 2000). Thus, individual differences in the time course of emotional responses may hold information about dispositional tendencies to activate approach or avoidance motivational systems. Further, the study of individual differences in recovery time may have relevance for understanding risk factors for depression (see also Tomarken and Keener, 1998).

Despite the increased focus on affective chronometry, however, little attention has been paid to sex differences in the time course of emotional responses. Several of the studies of response chronometry summarized above used only female participants (e.g., Garrett & Maddock, 2001; Rottenberg et al., 2003; Sirota et al., 1987), and many of those that did include participants of both sexes did not examine sex effects at all (Larson et al., 1998; Bradley et al., 1993, 1996; Siegle et al., 2002). None of the remaining studies targeted sex as a focus of hypotheses, only examining interactions with sex or using sex as a covariate in analyses of the dependent variables of interest (Dichter et al., 2002; Siegle et al., 2001). Although neither of these two studies found significant contributions for sex, the sample size for each sex was fairly small and therefore there may have been inadequate power to detect sex differences in the particular paradigms used.

Summary of Research to Date

The research summarized above provides considerable evidence that men and women do differ in both expressive and experiential emotional behavior in that women tend to report greater emotional experience as well as exhibit greater emotional expressivity. Notably, examinations of the impact of gender roles on emotion are suggestive that much of this greater “emotionality” on the part of women is related to adherence to gender roles that hold that women are more emotionally expressive and sensitive. This begs the question of whether women’s greater “emotionality” is largely a socially constructed phenomenon. Additional research reviewed above suggests not; that is, there is some evidence that sex differences are seen at the level of the motivational underpinnings of emotion, which may be less susceptible to influence by social norms or external modifications (e.g., display rules). More specifically, previous research suggests that men and women may differ in the sensitivity of approach and avoidance motivational systems such that women may engage an aversive motivational system more intensely or at a lower threshold than men. This may be reflected in their self-reported experience, motivated behavior, and pattern of modulation of the reflexive startle response, and is a pattern evident in young children as well as adults (e.g., Kagan, 1994; McManis et al., 2001). Notably, the research reviewed above does not offer a systematic examination of sex differences in the time course of emotion. The dearth of research in this area underscores the need for an examination of whether men and women differ only in their momentary responses to emotionally-evocative material or whether they also differ in the time to resolution of these responses.

The Present Study

The aims of the present study are twofold. First, we aim to replicate and extend previous investigations of sex differences in the motivational underpinnings of emotion by examining both self-reported sensitivity of approach and avoidance motivational systems as well as valence modulation of the startle response during the presentation of emotionally evocative pictures. The present study also examines self-reported experience of emotion in response to the valenced slides to replicate previous findings of sex differences in momentary ratings of emotional experience. Second, we aim to explore sex differences in the time course of approach and avoidance motivational engagement by examining valence modulation of startle after the offset of emotional stimuli to obtain an index of recovery of emotional processes. Based on the previous literature, it is expected that women in the present study will show more robust response to negative emotional material, both in terms of their momentary self-report, self-reported motivational system sensitivity, and pattern of startle modulation during picture presentation. Given the evidence that women are more responsive to negative emotional stimuli across multiple channels, and more readily and robustly engage the avoidance motivational system, it is hypothesized here that women will also take longer to disengage the avoidance motivational system. More specifically, women are expected to continue to show startle potentiation after the offset of negative stimuli, while men are not expected to do so. While there is some evidence from prior startle research suggesting that men may engage the approach motivational system more robustly than women, other research indicates that women report greater sensitivity of the approach motivational system. Therefore, it is difficult to predict with confidence whether men or women will show greater engagement of the approach motivational system. However, this underscores the importance of examining this potential sex difference using both self-report and physiological measures, both during presentation and after stimulus offset.

CHAPTER II

METHODS

Participants

Participants were 58 male and 53 female students at the University of California at Berkeley who completed the study as part of a requirement for an undergraduate psychology class. Individuals were excluded from participation if they had impaired vision (not corrected by glasses or contact lenses) or impaired hearing, or if they had participated in a similar research study. One female participant was excluded after she volunteered that she had been diagnosed with Major Depressive Disorder, resulting in *n*s of 58 and 52 for male and female participants, respectively. Male and female participant groups did not differ on age, education, or ethnic composition. Demographics of the sample are displayed in Table 1.

Materials and Design

Slide stimuli

Sixty emotionally evocative images (20 positive, 20 neutral, 20 negative[2]) were selected from the International Affective Picture System collection (Center for the Study of Emotion and Attention, 1999). Images were selected on the basis of published self-report ratings (Lang, Bradley, & Cuthbert, 1999) such that positive and negative images

[2] IAPS slide numbers: positive: 4660, 5460, 8380, 8370, 7502, 8300, 8080, 4533, 4608, 8470, 4640(f), 4652(m), 5629, 4572(f), 8260(m), 8034, 8200, 8180, 8501, 5621, 8210, 8190; neutral: 2190, 5510, 7233, 7217, 7185, 7010, 7020, 7050, 7950, 2570, 7235, 7004, 7006, 7175, 7035, 7090, 7491, 5740, 7009, 7080;

were both high on arousal but at opposite valence extremes, and neutral images were of a valence between that of negative and positive images. Similar to Bradley et al. (2001), to facilitate between-sex comparisons of responses to a given emotionally-evocative stimulus men and women viewed the same images with the exception of erotic images, which were selected separately for men and women. Positively valenced pictures included images of action/adventure scenes and other-sex erotica. Negatively valenced pictures included images of mutilations and threatening animals and humans. Neutral pictures included images of household objects.

Table 1. Sample Demographics

		Women	Men
Age (*M* (*SD*))		20.33 (2.13)	21.26 (4.16)
Education (*M* (*SD*))		13.81 (1.14)	14.09 (1.42)
Ethnicity (%)			
	Caucasian	28.8	29.3
	Asian American	40.4	58.6
	Latino/a	11.5	3.4
	African American	1.9	3.4
	Middle Eastern	3.8	1.7
	Other	11.5	3.4

Stimulus presentation

A Pentium class microcomputer determined the presentation of the digitized images by digitally pulsing a yoked computer outfitted with a 36 cm LCD display positioned approximated 0.5 meters from the participant at a visual angle subtending 15.9 degrees. Pictures were presented in a fixed order such that all valences and probe times were evenly distributed throughout the sequence of trials (pairwise comparisons of mean

negative: 9570, 3530, 9921, 6510, 3071, 3170, 3080, 3100, 1050, 9252, 6550, 3053, 6230, 3500, 3110, serial positions for trials in each Valence X Probe Time cell yield *t*s < 1). Each picture was presented for 6 seconds. Startle probes were presented either 3500 ms after image onset or 2500 ms after image offset. The earlier (3500 ms) probe occurred during picture presentation and is a lead interval commonly used in studies of this kind to measure emotional responding to the slide stimulus. The later (2500 ms post offset) probe time was intended to assess the recovery of emotional responding after the offset of the emotion-eliciting stimulus and was selected because a prior study of affective chronometry (Larson et al., 1998) had reliably elicited valence modulation of the startle response at this interval. Within sex, for each valence, slides probed during picture presentation and after offset were comparable on valence and arousal ratings from published norms (Lang, Bradley, & Cuthbert, 1999). Eight trials of each valence were probed at each probe time, and four trials of each valence were left unprobed. No more than one probe was presented per trial. No more than two pictures of the same valence and no more than three of the same probe times were presented sequentially.

Acoustic startle probes were digitally generated .WAV files of a white noise burst 50 ms in duration, with instantaneous rise and fall times. Startle probes were amplified by a Radio Shack SA-155 Integrated Stereo Mini-Amplifier to 100 dB and binaurally presented through Sennheiser HD 490 headphones. Probe stimuli were calibrated before each test session.

Self report ratings of emotional experience

Participants rated their emotional experience of each picture on the dimensions of valence and arousal using a computerized version of the Self-Assessment Manikin

---

3102, 2730, 6313, 3060, 3130

(SAM; Hodes, Cook, & Lang, 1985, Lang, 1980). The rating form displays a cartoon figure that participants can adjust, using computer keys, to reflect 1) how 'happy' or 'unhappy' and 2) how 'calm' or 'aroused' they felt during the presentation of each picture. Ratings range in value from 0 to 20. For the valence rating, lower values indicate more negative and higher values more positive, with a rating of 10 as neither negative nor positive. For the arousal rating, lower values indicate more calm and higher values more aroused or energized.

Self-report ratings of motivational system sensitivity

Participants completed the Behavioral Inhibition and Behavioral Activation Scales (BIS/BAS, Carver & White, 1994) to index self-reported sensitivity of approach and avoidance motivational systems. Based on the original Carver and White (1994) data, the BIS scale and each of the BAS subscales (BAS Reward Responsiveness, BAS Drive and BAS Fun Seeking) demonstrate good internal consistency (BIS: α= .74; BAS RR: α= .73; BAS D: α= .76; BAS FS: α= .66) and good test-retest reliability over an 8 week interval (BIS: r= .66; BAS RR: r= .59; BAS D: r= .66; BAS FS: r= .69).

Physiological response measurement

Stimulus presentation and data acquisition were controlled by VPM software (Cook, Atkinson, & Lang, 1987). The EMG signal was filtered through a 13-1000 Hz passband and amplified by a gain of 10,000 using a Coulbourn V75-04 Isolated Bioamplifier with Bandpass Filter. EMG was sampled at 1000 Hz by a Labmaster DMA A/D board for 250 ms, starting at startle probe onset. Electrode placement and skin preparation followed recommendations by Berg and Balaban (1999). Raw electromyographic (EMG) activity was collected using two Med-Associates Na-NaCL mini (4.2 mm sensor) Beckman-style reusable electrodes placed over the orbicularis oculi on the left eye, with one sensor directly under the pupil and the other lateral to this. The sensors, which were filled with Teca electrolyte gel as the conductive medium, were placed just above the orbital ridge. Interelectrode distance was approximately 15 mm. A third mini electrode was placed in the middle of the forehead as a ground. Before recording electrodes were placed, the skin was cleansed using distilled water and a light abrasion with fine sandpaper to lower impedance. Impedence was checked, and efforts were made to keep all impedances under 10 Kohms.

Procedure

Sessions were conducted in laboratory space at the University of California at Berkeley in a testing environment that was dimly lit and free from distraction. Upon arrival at the laboratory, participants provided written consent after being given the opportunity to ask questions. Participants were then comfortably seated at a desk facing the LCD screen. Electrodes for recording startle responses were applied and impedance was checked. Participants were oriented to the computer on which the images would be presented and were instructed in how to complete the SAM rating measures. Participants were told that they would see a series of pictures presented on the computer screen and that they should look at each picture the entire time that the picture was on the screen. They were told that after each picture, they would be prompted to make a rating of how they felt while they were viewing the picture. They were also told that they would occasionally hear noises over the headphones, but that they could ignore these noises. Participants were told to relax and minimize movement during the task. To familiarize them with the procedure and to habituate them to the startle probe, participants then completed an introductory task comprising 11 pictures during which 9 startle probes were presented.

After this introductory task, participants completed 60 experimental trials. The trial complex consisted of an image presented for 6 s, followed by a 5 s delay, during which "recovery" probes were presented on select trials. After this delay, participants completed the computerized SAM rating form, which was followed by a random 2.5 to 5 s inter-trial interval before the presentation of the next slide. After the experimental trials, participants completed the BIS/BAS. Participants were then debriefed, thanked for their participation, and given credit.

CHAPTER III

RESULTS

Data Reduction and Statistical Analysis

The EMG signal was digitally refiltered offline through a 28-500 Hz passband (van Boxtel, Boelhower, & Bos, 1998) and digitally rectified and integrated using a 30 ms time constant. Integrated EMG data segments were scored by trained research assistants using the EYEBLINK subroutine in VPM, which is based on the Balaban algorithm (Balaban, Losito, Simons & Graham, 1986). Response amplitude (in A/D units) was computed by subtracting EMG activity at response onset from that at response peak. Because of extreme interindividual differences in average blink magnitude, data was standardized within each individual to produce a metric of responsivity (T scores) that was comparable across participants. Responses on the eight trials within each Valence X Probe Time cell were averaged to form a mean for each individual for each cell. The dependent variables for analyses were response magnitude, which encompasses trials on which there is a zero response, and response latency. Four participants (2 men and 2 women) did not generate sufficient startle responses to score the psychophysiological record. In addition, SAM rating data for two participants (1 man and 1 women) was lost to computer malfunction. Thus, final *n*s for statistical analysis were as follows: for startle data: 56 men, 50 women; for SAM data: 57 men, 51 women.

Distributions of all variables for analysis were examined for normality within sex. The following variables were significantly skewed and were log transformed (log (*variable* + 1)) to normalize: for women: BASRR scale, mean SAM rating for negative slides probed during slide, mean SAM rating for negative slides probed in recovery period, mean SAM ratings for all negative slides, negative startle modulation for early probes; for men: BASRR scale, mean SAM ratings for positive slides probed during slide, negative startle modulation for early probes. Repeated measures mixed-model ANOVAS were used to test for effects of sex, valence, and their interactions on modulation of reflexive startle response magnitude and latency, and on self-report ratings of emotional experience. Based on Girden (1992), in cases when sphericity is violated the Huynh-Feldt correction for degrees of freedom is used when estimates of sphericity are greater than 0.75 and Greenhouse-Geisser correction is used when estimates of sphericity are less than 0.75. Effect sizes are reported as partial η^2. Follow-up pairwise comparisons were examined using Sidak's adjustment of significance level for multiple comparisons. Startle modulation variables were computed for each valence by subtracting the mean startle magnitude during valenced slides (positive or negative) from mean startle magnitude during neutral slides. These modulation scores were calculated separately for probes presented during slide presentation and in the recovery period. Then, centered cross product regression analyses were employed to look at the independent contributions of sex, BIS/BAS scores and their interaction on startle modulation variables. The main effect of Sex (coded male=1, female=2) was entered in the first step, followed by the main effect of BIS or BAS in the second step and the Sex X BIS (or BAS) interaction in the third step.

Emotional Experience: SAM Ratings

Valence ratings

A 3 (Valence: Positive, Neutral, Negative) X 2 (Sex: Male, Female) mixed model repeated measures ANOVA of Valence ratings revealed a main effect for Valence (F (1.16, 122.84) = 459.37, $p < .001$, ES = .81), a main effect for Sex (F (1, 106) = 10.52, p = .002, ES = .09), as well as a Valence X Sex interaction (F (1.16, 122.84) = 9.12, p = .002, ES = .08).

Pairwise comparisons to examine the Valence main effect revealed that self-reported experience of slides of all valences were significantly different from one another (positive/neutral: t (107) = 15.57, $p < .001$; neutral/negative: t (107) = 22.45, $p < .001$; positive/negative: t (107) = 22.02, $p < .001$), with the positive slides experienced as most pleasant and the negative slides experienced as least pleasant. Examination of the main effect for Sex and the Valence X Sex interaction revealed that when valence ratings were averaged across all slides, women reported experiencing more negative emotion in response to the slides than men (t (106) = 3.24, p = .002), but further inspection of valence ratings revealed that women only rated their experience to negative slides as more negative than men (t (106) = 3.80, $p < .001$) and actually rated neutral slides as more positive than men (t (106) = 2.26, p = .026). Men and women did not differ on their reported experience of positive slides. Mean valence ratings for men and women are presented in Table 2.

Arousal ratings

A 3 (Valence: Positive, Neutral, Negative) X 2 (Sex: Male, Female) mixed model repeated measures ANOVA of Arousal ratings revealed a main effect for Valence (*F* (1.44, 152.97) = 259.59, *p* < .001, ES = .71), a main effect for Sex (*F* (1, 106) = 4.53, *p* = .036, ES = .04), as well as a Valence X Sex interaction (*F* (1.44, 152.97) = 5.45, *p* = .011, ES = .05).

Follow up analyses of the Valence main effect revealed that negative slides were reported to be more arousing than neutral slides (*t* (107) = 17.22, *p* < .001), positive slides were more arousing than neutral slides (*t* (107) = 16.36, *p* < .001), and negative slides were rated more arousing than positive slides (*t* (107) = 8.40, *p* < .001). Examination of the main effect for Sex and the Valence X Sex interaction revealed that when ratings were collapsed across valence, women reported experiencing the slides as more arousing than men (*t* (106) = 2.13, *p* = .036), but further inspection of the ratings for individual valences reveals that this was driven by women's greater reported arousal than men during negative slides (*t* (106) = 3.43, *p* = .001). Mean arousal ratings for men and women are presented in Table 2.

Approach and Avoidance Motivation

BIS/BAS scales

As predicted, women rated themselves as higher than men on the BIS scale (*t* (106) = 3.50, *p* = .001). They also rated themselves higher on the BAS Reward Responsivity Subscale (*t* (106) = 2.43, *p* = .017). There were no differences between men and women on the other BAS subscales or the BAS total scale. Means and standard deviations are presented in Table 2.

Table 2. Self-Report Ratings

			Women	Men
BIS/BAS Scales (*M* (*SD*))				
		BIS	22.82 (3.49)	20.64 (3.00)
		BASRR	18.32 (1.61)	17.59 (1.82)
		BASD	11.55 (2.48)	11.43 (2.45)
		BASFS	12.20 (2.14)	12.09 (1.85)
		BASTOT	41.98 (5.13)	41.11 (4.77)
SAM Ratings (*M* (*SD*))				
	Valence			
		Positive slides	12.75 (2.03)	12.62 (1.53)
		Neutral slides	10.18 (0.62)	9.90 (0.66)
		Negative slides	3.68 (2.64)	5.49 (2.30)
	Arousal			
		Positive slides	12.40 (1.64)	12.31 (1.68)
		Neutral slides	8.07 (2.27)	8.10 (2.09)
		Negative slides	14.91 (2.62)	13.33 (2.16)

Startle latency

A 3 (Valence: Positive, Netural, Negative) X 2 (Sex: Male, Female) X 2 (Probe Time: During slide, After slide) mixed model repeated measures ANOVA on startle latency revealed a main effect for Valence (F (2, 198) = 9.29, p < .001, ES = .09) and a main effect for Sex (F (1, 99) = 5.70, p = .019, ES = .05). There was no significant main effect for Probe Time and there were no significant interactions.

Further examination of the Valence main effect revealed that mean startle response latency was shortest during negative slides and longest during neutral slides, with latencies during positive slides falling in between. Only response latencies for negative and neutral valences significantly differed from one another (t (104) = 4.34, p <

.001). Inspection of the main effect for Sex revealed that women showed significantly shorter reflexive eyeblink response latencies than men to the presentation of the white noise probe across all slide valences (*t* (103) = 2.37, *p* = .02), as illustrated in Figure 1.

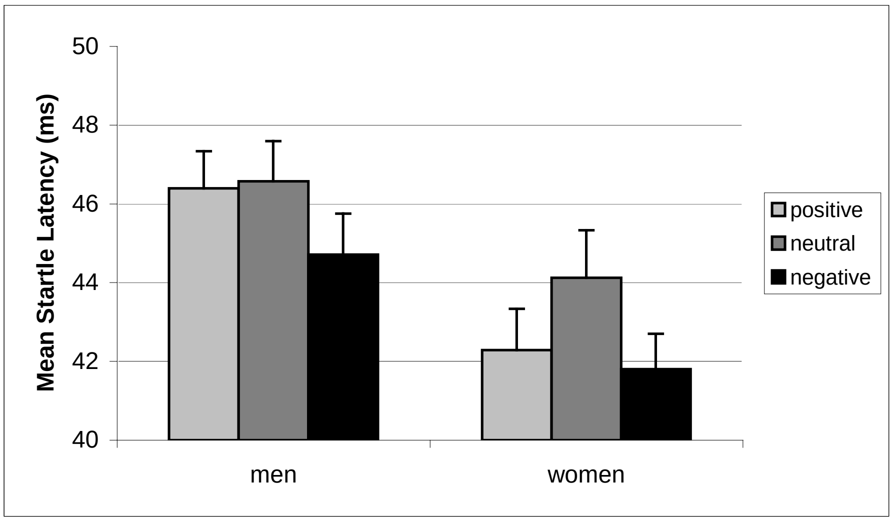

Figure 1. Sex effects on startle latency. Mean startle response latency (+ *SE*) as a function of valence for men and women.

Startle magnitude

A Valence X Sex X Probe Time mixed model repeated measures ANOVA on startle magnitude revealed a main effect for Valence (*F* (1.94, 197.92) = 27.17, *p* < .001, ES = .21), a Valence X Probe Time interaction (*F* (1.95, 198.77) = 3.609, *p* = .03, ES = .03), and a Valence X Probe Time X Sex interaction (*F* (1.95, 198.77) = 3.801, *p* = .025, ES = .04). There were no main effects for Probe Time or Sex.

A follow-up repeated measures ANOVA to explore the Valence main effect indicated that a linear trend fit the data (*F* (1, 104) = 45.07, *p* < .001, ES = .30) but that a quadratic trend also fit (*F* (1,104) = 5.55, *p* = .02, ES = .05). Pairwise comparisons revealed that, when collapsed across probe times, blink magnitude significantly differed between negative and neutral (*t* (104) = 5.09, $p < .001$) and negative and positive (*t* (104) = 6.71, $p < .001$) valences, but did not significantly differ between positive and neutral valences.

Follow up analyses for the Valence X Probe Time interaction revealed smaller blink magnitude for responses elicited in the offset period after positive slides compared to those elicited during the presentation of positive slides (*t* (103) = 2.82, *p* = .005). Blink magnitude for negative and neutral valences did not differ across probe time. To examine patterns of valence modulation of startle during slide presentation and after slide offset, additional repeated measures ANOVAs were conducted for each probe time. For startle responses elicited in the slide presentation period, both a linear and a quadratic trend for valence modulation fit the data (linear: *F* (1,104) = 12.0, *p* = .001, ES = .10; quadratic: *F* (1,104) = 8.83, *p* = .004, ES = .08). Subsequent pairwise comparisons indicated that startle magnitude significantly differed between neutral and negative (*t* (104) = 4.06, $p < .001$) and positive and negative (*t* (104) = 3.47, *p* = .002) valence conditions, but not between positive and neutral valence conditions. For startle responses elicited after slide offset, only the linear effect of valence was significant (*F* (1,104) = 41.59, $p < .001$, ES = .29). Pairwise comparisons revealed significant differences in startle magnitude for each pair of valence conditions (positive/neutral: *t* (104) = 3.01, *p* = .01; neutral/negative: *t* (104) = 3.43, *p* = .003; positive/negative: *t* (104) = 6.44, $p < .001$), with the smallest startle responses after the offset of positive slides and the largest startle responses after the offset of negative slides.

Further inspection of the Valence X Probe Time X Sex interaction revealed that, as predicted, women exhibited greater startle magnitude than men in the recovery period after negatively valenced slides (*t* (103)= 2.40, *p* = .019). Men and women were comparable on startle magnitude for all other Valence X Probe Time cells. To examine the patterns of valence modulation of startle for men and women, additional repeated measures ANOVAs were computed for each probe time for each sex. For startle responses elicited during slide presentation, men showed a significant linear effect of valence (F (1, 53) = 13.3, p = .001, ES = .20). Subsequent pairwise comparisons revealed that, for men, startle magnitude during both neutral (t (53) = 2.68, p = .03) and positive (t (53) = 3.65, p = .002) slides was significantly smaller than magnitude during negative slides, but magnitude for positive and neutral valence conditions did not differ. By constrast, women showed a quadratic effect of valence modulation for startle responses elicited during slide presentation (F (1, 49) = 9.57, p = .003, ES = .16). Pairwise comparisons revealed that responses during neutral slides were smaller than those during negative slides (t (49) = 3.12, p = .009), but neither positive/neutral nor positive/negative valence comparisons were significant. For startle response elicited after slide offset, men showed a linear effect of valence (F (1, 54) = 14.28, p < .001, ES = .21). Subsequent pairwise comparisons indicated that startle responses elicited after positive slides were smaller than responses after neutral (t (54) = 2.65, p = .031) and after negative (t (54) = 3.77, p = .001) slides, but neutral and negative valence conditions did not differ. Women also showed a linear effect of valence on startle responses elicited after slide offset (F (1, 49) = 28.83, p < .001, ES = .37). Pairwise comparisons revealed that, for women, startle responses elicited after negative slides were greater than those elicited after neutral (t (49) = 3.72, p = .002) or positive slides (t (49) = 5.37, p < .001) but positive and neutral valence conditions did not differ. Patterns of valence modulation of startle for each sex are illustrated in Figure 2.

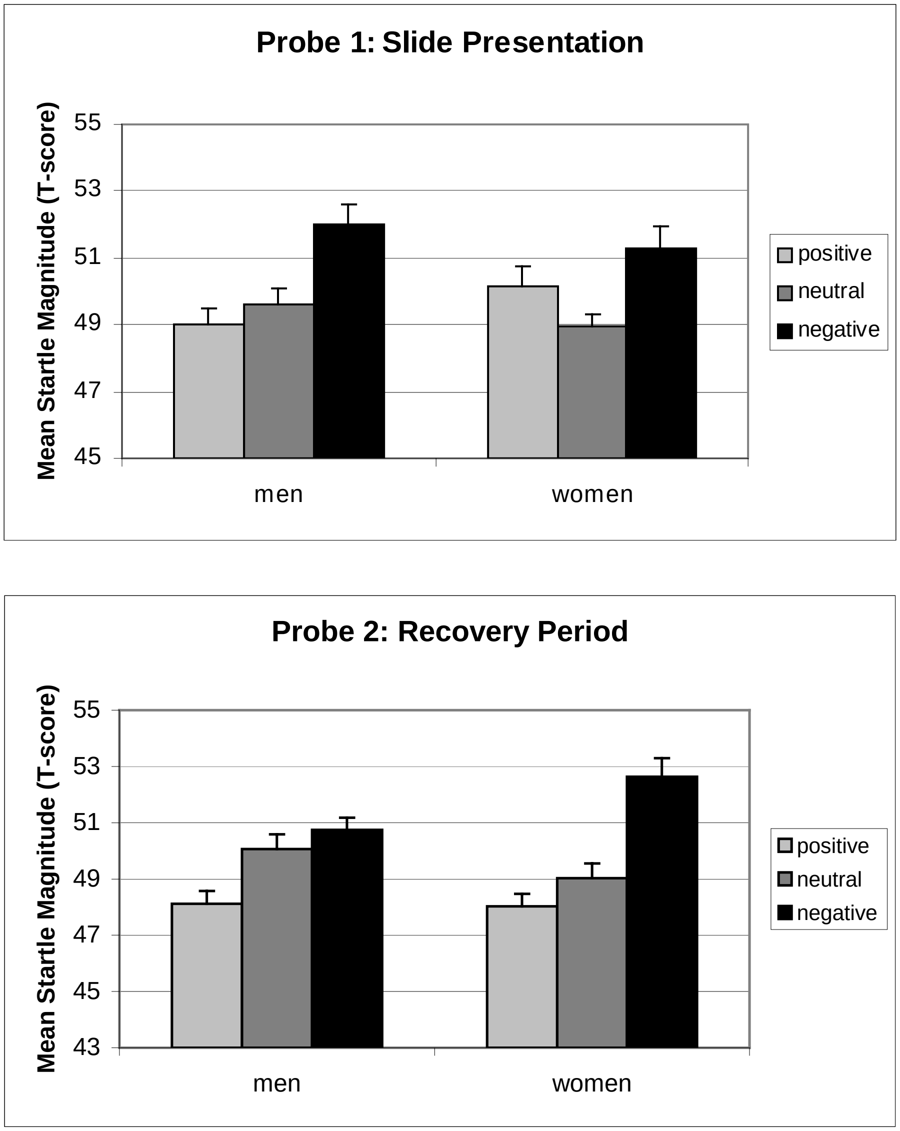

Figure 2. Sex effects on startle magnitude by probe time. Mean startle magnitude (+ *SE*) by valence for each sex at each probe time.

Effects of Sex and BIS/BAS on Startle Modulation

Centered cross products regression analyses on startle modulation variables were conducted to examine the relative proportion of variance accounted for by sex and self-report measures of motivational system sensitivity (BIS/BAS scales). Startle modulation variables reflect relative startle inhibition or potentiation in response to positive or negative slides as compared to neutral slides, respectively. These variables were computed separately for picture presentation and recovery periods and were calculated by subtracting startle magnitude for neutral slides from startle magnitude for positive or negative slides.

Sex accounted for a significant proportion of the variance in startle modulation in the recovery period after negative slides (R^2 = .056, *p* = .015). Addition of BIS and the BIS X Sex interaction term did not significantly improve the model, indicating that self-reported avoidance motivational system sensitivity does not predict startle modulation to negative slides above and beyond sex. Neither Sex nor the BIS scale accounted for a significant proportion of the variance in startle modulation in the picture presentation period for negative slides.

Sex also accounted for a significant proportion of the variance in startle modulation in the picture presentation period for positive slides (R^2 = .037, *p* = .05). Addition of BAS scales and interaction terms with Sex did not significantly improve any of the models, indicating that self-reported approach motivational system sensitivity does not predict startle modulation above and beyond sex. Neither Sex nor BAS scales accounted for a significant proportion of the variance in startle modulation in the recovery period after positive slides. Regression results are presented in Table 3.

To determine the nature of the sex effect on startle modulation, men and women were compared on startle modulation variables. Consistent with the above reported findings on startle magnitude, women showed significantly greater potentiation, relative to neutral, than men in the recovery period after the presentation of negative slides (*t* (103) = 2.48, *p* = .015). In fact, for men, blink magnitude during the recovery period for negative slides did not significantly differ from blink magnitude during the recovery period for neutral slides (*t* (54) = .97, *ns*) while this difference was significant for women

(t (49) = 3.72, p = .001). Men and women also differed in their startle modulation during the presentation of positive slides (t (102) = 1.98, p = .05). While men tended to show startle inhibition during positive slides relative to neutral slides, women tended to show startle potentiation during positive relative to neutral slides.

Table 3. Predicting startle modulation: Sex and BIS/BAS. Model comparison A: Dependent variable is negative startle modulation in recovery period. Model 1 = Sex only; Model 2 = Sex + BIS; Model 3 = Sex + BIS + Sex X BIS. Model comparison B: Dependent variable is positive startle modulation in picture presentation period. Model 1 = Sex only; Model 2 = Sex + BAS Reward Responsivity; Model 3 = Sex + BAS Reward Responsivity + Sex X BAS Reward Responsivity.

A.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics R Square Change	F Change	df1	df2	Sig. F Change
1	.237	.056	.047	.9761299	.056	6.149	1	103	.015
2	.238	.057	.038	.9807657	.000	.029	1	102	.866
3	.259	.067	.039	.9802094	.010	1.116	1	101	.293

B.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics R Square Change	F Change	df1	df2	Sig. F Change
1	.193	.037	.028	.9860800	.037	3.929	1	102	.050
2	.252	.063	.045	.9773646	.026	2.827	1	101	.096
3	.260	.068	.040	.9799900	.004	.460	1	100	.499

To examine whether these sex difference in startle modulation could be best explained by differences in how men and women experienced these slides compared to others of the same valence, self-report ratings to these slides versus other slides of the same valence were compared within sex. Both men and women reported experiencing the negative slides probed in the recovery period as less aversive than other negative slides, although this difference reached traditional levels of significance only for men (women: t (50) = 1.96, p = .056; men: t (56) = 3.08, p = .003). Both men and women continued to rate these negative slides as significantly more aversive than neutral slides (women: t (50) = 16.51, $p < .001$; men: t (56) = 13.36, $p < .001$). Neither men nor women significantly differed in their reported experience of positive slides probed during slide presentation versus other positive slides. Thus although both men and women experienced the negative slides probed in the recovery period as less aversive than other negative slides, women continued to manifest a robust potentiation of the startle response, while men did not. Further, although neither men nor women reported differences in their experience of positive slides probes during the picture period compared to other positive slides, men manifested greater inhibition to these positive slides compared to women. Therefore, this pattern of sex differences in startle modulation is not well accounted for by reported experience of the slides.

Relations between emotional experience and motivational system activity

To examine the relationship between reported emotional experience and measures of approach and avoidance motivational activity, correlations between SAM ratings and startle modulation variables and between SAM ratings and BIS/BAS scales were computed separately for men and women.

Startle modulation variables

For men, self-reported experience of positive emotion during positive slides was correlated with startle modulation during the presentation of positive slides (r = -.28, p = .042), such that the more pleasant the experience of the picture, the greater the relative inhibition of the reflexive startle eyeblink when probed during picture presentation. Ratings of experienced arousal during the presentation of positive slides were also significantly correlated with startle modulation ($r = -.33$, $p = .016$), such that the more arousing the experience of the positive slides, the greater the relative inhibition of the startle when probed during picture presentation. Reported experience during positive slides was not significantly correlated with startle modulation in the recovery period after the presentation of positive slides, and reported experience of negative slides was not significantly correlated with startle modulation during either picture presentation or recovery periods for negative slides. For women, neither valence nor arousal measures of self-reported experience were significantly correlated with startle modulation for either positive or negative emotional material, either during picture presentation or in the recovery period.

BIS/BAS scales

For men, mean ratings of self-reported experience during negative slides was correlated with BIS scale score ($r = -.38$, $p = .004$), such that higher BIS was linked with more aversive experience (lower reported pleasantness) during negative slides. There were no significant correlations between BAS scales and self-reported emotional experience. Women also showed a significant correlation between BIS and self-reported experience of negative slides ($r = -.39$, $p = .006$), with higher BIS ratings again linked to more aversive experience of negative slides. For women, however, BAS Fun Seeking and Drive subscales and BAS total score were correlated with pleasantness of experience during positive slides (BAS FS: $r = .39$, $p = .006$; BAS D: $r = .38$, $p = .008$;BAS total: $r =$

.37, $p = .01$). The BAS Reward Responsivity subscale was not related to self-report ratings of experience during positive slides.

CHAPTER IV

DISCUSSION

The present study replicates and extends previous research on sex differences in emotion by examining approach and avoidance motivational underpinnings of emotion and how the engagement of these motivational systems differs over time. Results from the present study provided partial support for our hypotheses of a more robust and prolonged responsivity to negative emotional stimuli for women as compared to men. Specifically, similar to many previous studies, and consistent with our hypotheses, women were more experientially reactive to negative, but not positive, emotional material, rating their experience of negative emotionally-evocative images as more unpleasant than did men. Also consistent with previous research (e.g., Carver & White, 1994), and our hypotheses, women scored higher than men on the BIS scale, suggesting that they experience greater sensitivity of the aversive motivational system. In the present study, women were also more briskly reactive to the abrupt aversive stimulus of the white noise probe, manifesting shorter startle latencies than men regardless of the valence of the foreground stimulus. Shortening of startle latencies is often seen under conditions of fear or threat (e.g, Vrana, 1995; Waters, Lipp, & Cobham, 2000), and startle latency is lengthened by the administration of benzodiazepines (Rodriguez-Fornells, Riba, Gironell, Kulisevsky, & Barbanoj, 1999), suggesting that shorter startle latency is linked to activation of an aversive motivational state. Consistent with these previous studies, both men and women manifested shortest startle latencies in response to negative emotional material. However, women also manifested shorter startle latencies than men during the presentation of positively and neutrally valenced material, suggesting that they more readily engaged an aversive motivational system in response to the presentation of the white noise probe.

Although women were more rapidly reactive than men to the startle stimulus itself, they did not differ from men in their startle responses to negatively valenced pictures when these responses were measured during the picture presentation period. In other words, inconsistent with our predictions, men and women reacted comparably in the modulation of their reflexive startle response during the presentation of negative images. One possible explanation for this result is that the negative slide stimuli were aversive enough that they overrode any sex differences in motivational system sensitivity, engaging the aversive motivational system equally for men and women. Indeed, in the only other previous systematic study of sex differences in affective startle modulation in adults (Bradley et al., 2001), sex differences were evident in that women were more consistent in their startle potentiation to a wider variety of negative image contents, although both men and women were equally responsive to the most aversive contents. In the present study, we only used the most aversive negative contents (mutilation slides and human and animal threat), in many ways a stronger test of linkages to the aversive motivational system. However, this may have precluded our seeing any sex differences in startle modulation during negative picture presentation.

Notably, although men and women were comparably reactive to negative slides during picture presentation, women were more reactive than men during the recovery period after negative slides. More specifically, women continued to show startle potentiation after the offset of negative slides while men no longer showed startle potentiation compared to neutral. This result suggests that women may continue to respond to negative emotional material even after the offset of the eliciting stimulus, while men do not. How is this finding best understood? Although women do report higher BIS sensitivity than men, results from the present study suggest that BIS does not contribute to this startle potentiation above and beyond the influence of sex. One possible explanation for this finding is participants' experience of the particular negative slides that were probed in the recovery period. Both men and women experienced these slides as less aversive than other negative slides, but this effect was greater for men than for women. Thus, it is possible that men do not manifest potentiation during the recovery period for negative slides because they did not find these slides aversive.

Two points argue against this interpretation. First, although men did not report experiencing these slides as comparably aversive to other negative slides, they did report experiencing these slides as significantly more aversive than neutral slides, suggesting that they were responsive to them. Second, women also reported experiencing these slides as less aversive than other negative slides, but despite this women continued to manifest robust startle potentiation after the offset of these negative images.

If women, but not men, are continuing to engage the aversive motivational system after the offset of the eliciting stimulus, what might be driving this continued activation? It is possible that women's prolonged response to negative emotional material after stimulus offset reflects an effort to cope with the negative emotional experience. Indeed, there is evidence that women use different strategies than men to cope with negative emotional events (e.g., Garnefski, Teerds, Kraaij, Legersdtee, & van der Kommer, 2004; Nolen-Hoeksema, Morrow, & Fredrickson, 1993). For example, women are more prone than men to rumination, or "passively and repetitively focusing on one's symptoms of distress… and on the meanings and consequences of the distress" (Nolen-Hoeksema, Larson, & Grayson, 1999, p.1062), and this sex difference in rumination is seen both in adult and young adolescent samples (Nolen-Hoeksema & Girgus, 1994). Thus, women's prolonged responding after the offset of negative stimuli in the present study may reflect an attempt to cope with or regulate their responses to the stimuli themselves.

In addition to women's more pronounced responding to negatively valenced stimuli, there was some evidence that men manifested more robust responses to positively valenced stimuli, at least during the picture presentation period. Although there were no sex differences in absolute magnitude of startle responses during positive stimuli, men tended to show startle inhibition to positive, relative to neutral, stimuli when probed during picture presentation, while women tended to show startle potentiation during positive relative to neutral slides. This result is largely consistent with previous findings of greater startle inhibition to positive, relative to neutral, stimuli in men, but not in women (Bradley et al., 2001). Despite this pattern of startle modulation, however, in the present study men and women did not differ in their self-reported experience of positive stimuli. Further, men and women did not differ on BAS Drive and Fun Seeking subscales or BAS total score, and women actually exceeded men on the BAS Reward Responsivity subscale. One possible account for the lack of coherence between sex differences in these two measures of motivational system sensitivity (i.e. BIS/BAS scales and startle modulation variables) is that women are more sensitive to particular types of rewarding stimuli, and that we did not tap these particular stimuli in the contents of the slides we presented. Indeed, the positive slides presented in the present study consisted of erotica and action-adventure themes, which may be less inherently rewarding to women. Inclusion of a greater breadth of positive slide content (e.g., nature scenes, families) might have enabled us to detect startle modulation evidence of elevated approach motivational sensitivity in women.

It should be noted that there were few significant correlations between self-reported experience of positive and negative slides and startle modulation responses to these same stimuli. Men showed significant correlations between these two measures only for positive stimuli, and women did not show any significant relations between self-report and startle modulation variables. This is in partial contrast to Bradley et al. (2001), in which significant correlations between arousal ratings and startle magnitude were obtained for both positive and negative slides in both men and women. Notably, however, BIS/BAS scales, which reflect self-reported sensitivity of approach and avoidance motivational systems, were significantly correlated with self-reported experience of the slide stimuli. There are several possible interpretations for these findings. One possibility is that we did not fully replicate the correlations in Bradley et al. because, unlike Bradley et al., who used a wide range of slide contents at various levels of arousal, we utilized only high arousal positive and negative stimuli, thereby constraining the variance in the arousal ratings. It is also possible that we failed to find a significant correlation between SAM ratings and startle measures because different channels of emotional responding do not cohere as well as theory would suggest (e.g., Mandler, Mandler, Kremen, & Sholiton, 1961). More specifically, it is more likely to find relations between two self-report measures than between self-report and physiological measures.

Limitations of the Study

Although the findings reported here extend our understanding of sex differences in emotional responding in a number of different ways, there are several limitations to the study that should be mentioned. First, only one time point was used for the assessment of the recovery of emotional responses. This allows for only a snapshot of the recovery process, and does not provide a picture of the full chronometry of emotional responding in men and women. On the other hand, it is one of the first studies to examine responding both during and after stimulus presentation. Further, the present study used a limited selection of measures of emotional responding, thereby limiting the understanding of how various measures of emotion (e.g., physiological measures such as skin conductance and heart rate) might differ in their chronometry in men and women. In addition, the present study looked at a limited range of picture contents. Previous research has suggested that there are particular contents that appear to prime the approach and avoidance systems more than others (e.g., Bradley et al., 2001; Mehta Shah, Gard, Germans Gard, Kring, & Patrick, 2004), and sex differences in emotional responding may be most clearly evident for specific picture contents, such as erotica or less arousing negative themes such as contamination. Inclusion of limited picture contents in the present study may have limited the ability to detect existing sex differences in emotion. In addition, although the present study examined measures of emotion that were ostensibly less influenced by adherence to gender roles (i.e., momentary ratings, physiological measures of motivational system activity), subscription to gender stereotypes was not measured explicitly. Therefore, it is difficult to say with certainty that the present findings reflect sex, rather than gender differences in emotion. To better map out sex differences in the chronometry of emotional responses, future studies might employ multiple measures of emotion (e.g., measures of autonomic physiology, facial expressivity, continuous self-report ratings via rating dial, as well as startle modulation) and sample at multiple time points during picture presentation and after picture offset to examine both peak and recovery of emotional responses. Future studies might also include a measure of adherence to gender roles to examine whether evident differences between men and women are more consistent with sex or gender, as well as measure of rumination to better assess whether women's prolonged response to negative stimuli is indeed linked to ruminative processes.

Conclusions

In sum, the present study provides evidence across several indices of emotional responding that women are more reactive than men to negative emotional material. Women report experiencing negative stimuli as more arousing and aversive and manifest more prolonged engagement of the avoidance motivational system in response to negative emotional material. Women also report that they are more sensitive than men to the engagement of an avoidance motivational state, and this is reflected in their more rapid response to the aversive white noise startle probe. These findings shed further light on sex differences in emotion and its motivational underpinnings, and suggest that sex differences in emotion are not limited to factors more clearly associated with gender stereotypes. Further, results of the present study provide a launching pad for future investigations of sex differences in recovery from negative emotions and ways in which this may be relevant to the understanding of sex differences in psychopathology (e.g., depression; Kessler, McGonagle, Swartz, Blazer, & Nelson, 1993).

REFERENCES

Balaban, M. T., Losito, B., Simons, R. F., & Graham, F. K. (1986). Off-line latency and amplitude scoring of the human reflex eyeblink with Fortran IV. *Psychophysiology, 23*, 612.

Barr, C. L. and Kleck, R. E. (1995). Self-other perceptions of the intensity of facial expressions of emotion: Do we know what we show? *Journal of Personality and Social Psychology, 68*, 608-618.

Belk, S. S. & Snell, W. E. (1986). Beliefs about women: Components and correlates. *Personality and Social Psychology Bulletin, 12,* 403-413.

Berg, W. K., & Balaban, M. T. (1999). Startle elicitation: Stimulus parameters, recording techniques, and quantification. In M. E. Dawson, A. M. Schell, and A. H. Bohmelt (Eds.), *Startle modification: Implications for neuroscience, cognitive science, and clinical science* (pp. 21-50). New York: Cambridge University Press.

Bradley, M. M, Codispoti, M., Sabatinelli, D., & Lang, P. J. (2001). Emotion and motivation II: Sex differences in picture processing. *Emotion, 1,* 300-319.

Bradley, M. M., Cuthbert, B. N., & Lang, P. J. (1993). Pictures as prepulse: Attention and emotion in startle modification. *Psychophysiology, 30,* 541-545.

Bradley, M. M., Cuthbert, B. N., & Lang, P. J. (1996). Picture media and emotion: Effects of a sustained affective context. *Psychophysiology, 33,* 662-670.

Brody, L. R. (1997). Beyond stereotypes: Gender and emotion. *Journal of Social Issues, 53,* 369-393.

Brody, L. R. & Hall, J. A. (2000). Sex and emotion. In M. Lewis & J. M. Haviland-Jones (Eds.), *Handbook of emotions (2nd ed.)* (pp. 325-414). New York: The Guilford Press.

Buck, R., Losow, J. I., Murphy, M. M., & Costanzo, P. (1992). Social facilitation and inhibition of emotional expression and communication. *Journal of Personality and Social Psychology, 63,* 962-968.

Carver, C. S., & White, T. L. (1994). Behavioral inhibition, behavioral activation, and affective responses to impending reward and punishment: The BIS/BAS scales. *Journal of Personality and Social Psychology, 67,* 319-333.

Center for the Study of Emotion and Attention [CSEA-NIMH] (1999). *The international affective picture system: Digitized photographs.* Gainsville, FL: The Center for Research in Psychophysiology, University of Florida.

Cook, E. W., III, Atkinson, L. S., & Lang, K. G. (1987). Stimulus control and data acquisition for IBM PCs and compatibles. *Psychophysiology, 24,* 726-727.

Davidson, R. J. (1992). Emotion and affective style: Hemispheric substrates. *Psychological Science, 3*, 39-43.

Davidson, R. J. (1994). Asymmetric brain function, affective style and psychopathology: The role of early experience and plasticity. *Development and Psychopathology, 6*, 741-758.

Davidson, R. J. (1995). Cerebral asymmetry, emotion, and affective style. In R. J. Davidson & K. Hugdahl (Eds.), *Brain asymmetry*. Cambridge, MA: MIT Press.

Davidson, R. J. (1998). Affective style and affective disorders: Perspectives from affective neuroscience. *Cognition and Emotion*, *12,* 307-330.

Deaux, K. (1993). Commentary: Sorry-wrong number- A reply to Gentile's call. *Psychological Science, 4*, 125-126.

Dichter, G. S., Tomarken, A. J., Baucom, B. R. (2002). Startle modulation before, during, and after exposure to emotional stimuli. *International Journal of Psychophysiology, 43,* 191-196.

Dickinson, A., & Dearing, M. F. (1979). Appetitive-aversive interactions and inhibitory processes. In A. Dickinson & R. A. Boakes (Eds.), *Mechanisms of learning and motivation* (pp.203-231). Hillsdale, N.J.: Erlbaum.

Ekman, P. (1984). Expression and the nature of emotion. In K. Scherer & P. Ekman (Eds.), *Approaches to emotion* (pp. 319-344). Hillsdale, NJ: Erlbaum.

Ekman, P. (1992). Facial expression and emotion. *American Psychologist, 48,* 384-392.

Ekman, P., & Friesen, W. V. (1975). *Unmasking the face: A guide to recognizing emotions from facial cues*. Englewood Cliffs, NJ: Prentice-Hall.

Feldman Barrett, L., Robin, L., Pietromonaco, P. R., & Eyssell, K. M. (1998). Are women the "more emotional" sex? Evidence from emotional experiences in social context. *Cognition and Emotion, 12,* 555-578.

Fischer, A. H., Rodriguez Mosquera, P. M., van Vianen, A. E. M., & Manstead, A. S. R. (2004). Gender and culture differences in emotion. *Emotion, 4,* 87-94.

Frijda, N. H. (1986). *The emotions*. New York: Cambridge.

Frost, R. O., & Green, M. L. (1982). Velten mood induction procedure effects: Duration and postexperimental removal. *Personality and Social Psychology Bulletin, 8,* 341-347.

Garnefski, N., Teerds, J., Kraaij, V., Legerstee, J., & van den Kommer, T. (2004). Cognitive emotion regulation strategies and depressive symptoms: Differences between males and females. *Personality and Individual Differences, 36*, 267-276.

Garrett, A. S., & Maddock, R. J. (2001). Time course of the subjective emotional response to aversive pictures: Relevance to fMRI studies. *Psychiatry Research: Neuroimaging Section, 108,* 39-48.

Girden, E. R. (1992). ANOVA: Repeated measures. *Sage University papers: Vol. 84. Quantitative applications in the social sciences* (pp. 7-84). Thousand Oaks, CA: Sage Publications.

Greenwald, M. K., Cook, E. W., & Lang, P. J. (1989). Affective judgment and psychophysiological response: Dimensional covariation in the evaluation of pictorial stimuli. *Journal of Psychophysiology, 3,* 51-64.

Gross, J. J., & John, O. P. (1995). Facets of emotional expressivity: Three self-report factors and their correlates. *Personality and Individual Differences, 19,* 555-568.

Gross, J. J., & John, O. P. (1998). Mapping the domain of expressivity: Multimethod evidence for a hierarchical model. *Journal of Personality and Social Psychology, 74,* 170-191.

Grossman, M., & Wood, W. (1993). Sex differences in intensity of emotional experience: A social role interpretation. *Journal of Personality and Social Psychology, 65,* 1010-1022.

Halberstadt, A. G., Hayes, C. W., & Pike, K. M. (1988). Gender, and gender differences in smiling and communication consistency. *Sex Roles, 19,* 598-603.

Hall, J. A., & Briton, N. (1993). Gender, nonverbal behavior, and expectations. In P. D. Blanck (Ed.), *Interpersonal expectations: Theory, research, and applications* (pp.276-295). Cambridge, England: Cambridge University Press.

Heponiemi, T., Keltikangas-Jarvinen, L., Puttonen, S., & Ravaja, N. (2003). BIS/BAS sensitivity and self-rated affects during experimentally induced stress. *Personality and Individual Differences, 34,* 943-957.

Hillman, C. H., Rosengren, K. S., & Smith, D. P. (2004). Emotion and motivated behavior: Postural adjustments to affective picture viewing. *Biological Psychology, 66,* 51- 62.

Hodes, R. L., Cook, E. W., III, & Lang, P. J. (1985). Individual differences in autonomic response: Conditioned association or conditioned fear? *Psychophysiology, 22,* 545-560.

Jorm, A. F., Christensen, H., Henderson, A. S., Jacomb, P. A., Korten, A. E., & Rodgers, B. (1999). Using the BIS/BAS scales to measure behavioral inhibition and behavioral activation: Factor structure, validity and norms in a large community sample. *Personality and Individual Differences, 26,* 49-58.

Kagan, J. (1994). *Galen's prophecy: Temperament in human nature.* New York: Westview Press.

Kessler, R. C., McGonagle, K. A., Swartz, M., Blazer, D. G., & Nelson, C. B. (1993). Sex and depression in the National Comorbidity Study I: Lifetime prevalence, chronicity, and recurrence. *Journal of Affective Disorders, 29,* 85-96.

Konorski, J. (1967). *Integrative activity of the brain: An interdisciplinary approach.* Chicago: University of Chicago Press.

Kring, A. M. (1999). Gender and anger. In A. H. Fischer (Ed.), *Gender and emotion: Social psychological perspectives* (pp. 211-231). Cambridge University Press.

Kring, A. M., & Gordon, A. H. (1998). Sex differences in emotion: Expression, experience and physiology. *Journal of Personality and Social Psychology, 74,* 686-703.

Kring, A. M., Smith, D. A., & Neale, J. M. (1994). Individual differences in dispositional expressiveness: The development and validation of the Emotional Expressivity Scale. *Journal of Personality and Social Psychology, 66,* 934-949.

Labouvie-Vief, G., Lumley, M. A., Jain, E., & Heinze, H. (2003). Age and gender differences in cardiac reactivity and subjective emotional responses to emotional autobiographic memories. *Emotion, 3,* 115-126.

LaFrance, M., Hecht, M. A., & Levy Paluck, E. (2003). The contingent smile: A meta-analysis of sex differences in smiling. *Psychological Bulletin, 129,* 305-334.

Lang, P. J. (1980). Behavioral treatment and bio-behavioral assessment: Computer applications. In J. B. Sidowski, J. H. Johnson, & T. A. Williams (Eds.), *Technology in mental health care delivery systems* (pp. 119-137). Norwood, NJ: Ablex.

Lang, P. J. (1994). The motivational organization of emotion: Affect-reflex connections. In S. H. M. van Goozen, N. E. van de Poll, & J. A. Seargeant (Eds.), *Emotions: Essays on emotion theory* (pp. 61-93). Hillsdale, NJ: LEA.

Lang, P. J. (1995). The emotion probe. *American Psychologist, 50,* 372-385.

Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (1990). Emotion, attention, and the startle reflex. *Psychological Review, 97,* 377-395.

Lang, P. J., Bradley, M. M., & Cuthbert (1997). Motivated attention: Affect, activation, and action. In P. J. Lang, R. F. Simons, & M. Balaban (Eds.), *Attention and* *orienting: Sensory and motivational processes* (pp.97-135). Hillsdale, NJ: Erlbaum.

Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (1999). *International affective picture system (IAPS): Technical manual and Affective Ratings.* Gainsville, FL: The Center for Research in Psychophysiology, University of Florida.

Lang, P. J., Greenwald, M. K., Bradley, M. M., & Hamm, A. O. (1993). Looking at pictures: Affective, facial, visceral, and behavioral reactions. *Psychophysiology, 30,* 261-273.

Lang, P. J., Ohman, A., & Vaitl, D. (1988). The international affective picture system (photographic slides). Gainsville, FL: Center for Research in Psychophysiology, University of Florida.

Larson, C. L., & Davidson, R. J. (2001). Prolonged startle blink potentiation following negative stimuli among individuals with relative right frontal EEG asymmetry. *Psychophysiology, 38,* S9.

Larson, C. L., Sutton, S. K., & Davidson, R. J. (1998). Affective style, frontal EEG asymmetry, and the time course of the emotion-modulated startle response. *Psychophysiology, 35,* S52.

Levenson, R. W. (1994). Human emotion: A functional view. In P. Ekman & R. J. Davidson (Eds.) *The nature of emotion: Fundamental questions* (pp. 124-130). New York: Oxford University Press.

Lewine, R. R. J. (1994). Sex: An imperfect marker of gender. *Schizophrenia Bulletin, 20,* 777-779.

MacLeod, C., & Matthews, A. M. (1991). Cognitive-experimental approaches to the emotional disorders. In: P. R. Martin (Ed.): *Handbook of behavior therapy and psychological science: An integrative approach* (pp.116-150). New York: Pergamon.

Mandler, G., Mandler, J. M., Kremen, I., Sholiton, R. D. (1961). The response to threat: Relations among verbal and physiological indices. *Psychological Monographs, 75,* 22.

Malatesta, C. Z., Grigoryev, P., Lamb, C., Albin, M., & Culver, C. (1986). Emotion socialization and expressive development in preterm and full-term infants. *Child Development*, *57,* 964-980.

Manstead, A. S. R. (1992). Gender differences in emotion. In A. Gale & M. W. Eysenck (Eds.), *Handbook of individual differences: Biological persepctives* (pp.356-387). Chichester: John Wiley and Sons.

McManis, M. H., Bradley, M. M., Berg, W. K., Cuthbert, B. N., & Lang, P. J. (2001).

Emotional reactions in children: Verbal, physiological, and behavioral responses to affective pictures. *Psychophysiology, 38,* 222-231.

Mehta Shah, N., Gard, D. E., Germans Gard, M., Kring, A. M., & Patrick, C. (2004). Emotion and motivation in early picture processing. Poster accepted for the annual meeting of the Society for Psychophysiological Research, October 2004.

Nolen-Hoeksema, S. (2000). The role of rumination in depressive disorders and mixed anxiety/depressive symptoms. *Journal of Abnormal Psychology, 109,* 504-511.

Nolen-Hoeksema, S., & Girgus, J. S. (1994). The emergence of gender differences in depression during adolescence. *Psychological Bulletin, 115,* 424-443.

Nolen-Hoeksema, S., Larson, J., & Grayson, C. (1999). Explaining the gender difference in depressive symptoms. *Journal of Personality and Social Psychology, 77,* 1061-1072.

Nolen-Hoeksema, S., Morrow, J., & Fredrickson, B. L. (1993). Response styles and the duration of episodes of depressed mood. *Journal of Abnormal Psychology, 102,* 20-28.

Rodriguez-Fornells, A., Riba, J., Gironell, A., Kulisevsky, J., & Barbanoj, M. (1999). Effects of alprazolam on the acoustic startle response in humans. *Psychopharmacology, 143*, 280-285.

Rosenberg, E. L. (1998). Levels of analysis and the organization of affect. *Review of General Psychology, 2,* 247-270.

Rottenberg, J., Wilhelm, F. H., Gross, J. J., & Gotlib, I. H. (2003). Vagal rebound during resolution of tearful crying among depressed and nondepressed individuals. *Psychophysiology, 40,* 1-6.

Rotter, N. G., & Rotter, G. S., (1988). Sex differences in the encoding and decoding of negative facial emotions. *Journal of Nonverbal Behavior, 12,* 139-148.

Russell, J. A., & Feldman Barrett, L. (1999). Core affect, prototypical emotion episodes, and other things called emotion: Dissecting the elephant. *Journal of Personality and Social Psychology, 76,* 805-819.

Schwartz, G. E., Brown, S. L., & Ahern, G. L. (1980). Facial muscle patterning and subjective experience during affective imagery. *Psychophysiology, 17,* 75-82.

Siegle, G. J., Granholm, E., Ingram, R. E., & Matt, G. E. (2001). Pupillary and reaction time measures of sustained processing of negative information in depression. *Biological Psychiatry, 49,* 624-636.

Siegle, G. J., Steinhauer, S. R., Thase, M. E., Stenger, V. A., & Carter, C. S. (2002). Can't shake that feeling: Event-related fMRI assessment of sustained amygdala activity in response to emotional information in depressed individuals. *Biological Psychiatry, 51,* 693-707.

Sirota, A. D., Schwartz, G. E., & Kristeller, J. L., (1987). Facial muscle activity during induced mood states: Differential growth and carry-over of elated versus depressed patterns. *Psychophysiology, 24,* 691-699.

Tobin, R. M., Graziano, W. G., Vanman, E. J., & Tassinary, L. G. (2000). Personality, emotional experience, and efforts to control emotions. *Journal of Personality and Social Psychology, 79,* 656-669.

Tomarken, A. J., & Keener, A. D. (1998). Frontal brain asymmetry and depression: A self-regulatory perspective. *Cognition and Emotion, 12,* 387-420.

Unger, R. K. (1979). Toward a redefinition of sex and gender. *American Psychologist, 34,* 1085-1094.

van Boxtel, A., Boelhouwer, A. J. W., & Bos, A. R. (1998). Optimal EMG signal bandwidth and interelectrode distance for the recording of acoustic, electrocutaneous, and photic blink reflexes. *Psychophysiology, 35,* 690-697.

Vrana, S. J. (1995). Emotional modulation of skin conductance and eyeblink responses to a startle probe. *Psychophysiology, 32,* 351-357.

Vrana, S. R., & Rollock, D. (2002). The role of ethnicity, gender, emotional content, and contextual differences in physiological, expressive, and self-reported emotional responses to imagery. *Cognition and Emotion, 16,* 165-192.

Wagner, H. L., Buck, R., & Winterbotham, M. (1993). Communication of specific emotions: Gender differences in sending accuracy and communication measures. *Journal of Nonverbal Behavior, 17,* 29-52.

Waters, A. M., Lipp, O. V., & Cobham, V. E. (2000). Investigation of threat-related attentional bias in anxious children using the startle eyeblink modification paradigm. *Journal of Psychophysiology, 14,* 142-150.