GENDER DIFFERENCES IN PSYCHOPATHOLOGY EXAMINED UNDER AN EXPANDED TRANSACTIONAL THEORY OF STRESS FRAMEWORK

A Thesis

by

JILLIAN APRIL LEE

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

December 2007

Major Subject: Psychology

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Committee Members,	Hart Blanton
	Lou Tassinary
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ABSTRACT

Gender Differences in Psychopathology Examined Under an Expanded Transactional Theory of Stress Framework. (December 2007)

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Prevalence rates of many types of psychopathology are lower for men than they are for women, but the causes of these discrepancies are not known. This paper focuses on two such psychopathology groups – eating disorders and depressive disorders – and examines gender differences within a transactional theory of stress that takes into account levels of cognitive processing (an expanded transactional theory of stress). Both studies found that men are more physiologically reactive to disorder-relevant, stressful stimuli and stressful events. The study on depression also found that different cognitive processes may be depressogenic for men and women: deployment of attentional resources toward negative stimuli was associated with depression in men, while deployment of attentional resources away from positive stimuli was associated with depression in women. These findings have significant implications for choosing appropriate treatment options for men and women.

To my parents and brother.

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NOMENCLATURE

AN	Anorexia Nervosa
BN	Bulimia Nervosa
DEBQ	Dutch Eating Behaviour Questionnaire (Van Strien et al., 1986)
DRES	Dutch Restrained Eating Scale (subscale of DEBQ)
ED	Eating Disorders
EDI	Eating Disorder Inventory (Garner et al., 1983).
EDNOS	Eating Disorder Not Otherwise Specified
HPA	Hypothalamus-pituitary-adrenal
MDD	Major Depressive Disorder
ms	Milliseconds
TSST	Trier Social Stress Test (Stress Induction)
T1	Time 1
T2	Time 2

TABLE OF CONTENTS

Page

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

Psychopathology is one of the major causes of disability and disease burden around the world (Murray & Lopez, 1997). It takes its toll on society through lost working days, cost of treatment, and personal suffering. Some forms of psychopathology, such as depression and eating disorders, are more likely to occur in women than in men (Murray & Lopez, 1997). However, it is still not clear what biological, social, or psychological factors contribute to sex differences in prevalence and presentation of depression and eating disorders. An investigation of gender differences in the etiology and maintenance of depressive and eating disorders will not only elucidate the causes of this health disparity but will also help to refine current models of psychopathology. In this section, several models of psychopathology will be reviewed. Then, an extended model based on two existing theories will be presented. This model will provide a framework for understanding gender differences in depression and eating disorders.

Beck's (1967) cognitive theory of depression laid the groundwork for investigations into the cognitive aspects of depression. According to Beck (1967), mood-congruent information processing biases lead to negative, irrational thoughts about oneself, the world, and the future; these thoughts in turn cause depression. For example, someone with a tendency to pay undue attention to negative feedback may think unrealistically, "I'm no good at all," generating depressed feelings. Several

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This thesis follows the style of *Journal of Abnormal Psychology*.

researchers have applied Beck's cognitive theory to eating disorders (i.e., Vitrousek & Hollon, 1990). That is, paying undue attention to media messages regarding the ideal body leads to negative thoughts about one's own body. Unrealistic, negative thoughts such as "No one will like me unless I'm thin" can lead to dysphoria and unhealthy attempts to control weight, such as purging, restricted eating, or excessive exercise. Supporting the link between cognitions and psychopathology, an attentional bias has been repeatedly demonstrated in depressed persons toward negative stimuli (e.g., Bradley, Mogg, & Lee, 1997) and in eating disordered persons with food, weight, and body words (e.g., Cooper & Fairburn, 1992).

Further research in cognitive biases, specifically attentional bias, led researchers to believe that there were two levels of processing, even if they disagreed on the details of these stages (Wells & Matthews, 1994). Two separate stages of processing helped answer the question of how some stimuli are identified as requiring more attentional resources than others. The early stage of processing is almost immediate, preceding conscious awareness of the stimulus. In this first stage, stimulus attributes are analyzed to categorize the stimulus via quick, parallel processing. The later stage of processing is slower, serial processing that allows the information to be used in a decision or response. The later stage may be conscious. Depending on attentional weight or relevance, attentional resources are deployed toward the object; when this happens, however, is subject to debate (Duncan & Humphreys, 1989). In attentional bias studies, the early processing is thought to correspond to the reaction evoked by stimuli presented at very short durations (about 16 ms) where subjects are unable to report what they perceived.

Conversely, the reaction evoked by stimuli presented long enough for subjects to consciously perceive and report on what they saw (more than 300 ms) is thought to engage both early and late processing.

Williams and colleagues' (1997) conception of cognitive biases in psychopathology incorporated these different stages of processing as well as delineated different processes for depression. According to this information processing model of bias, attentional bias for threats occur only preattentively. At stimulus input, an affective decision mechanism immediately comes into play: Is threat level high or low? After threat assessment, the resource allocation mechanism diverts resources either toward or away from the location of the threat. In contrast, the affective decision mechanism and resource allocation mechanism occur only in later stages of processing for depressogenic attentional bias. In depression, after input from preattentive mechanisms, this information passes to the affective decision mechanism, which categorizes the stimulus as high or low in negativity. Transient sad mood increases the output of this decision mechanism, mimicking the effects of a highly negative stimulus. Then, the resource allocation mechanism directs resources away or toward the stimulus, facilitating or inhibiting elaboration, or further processing of the stimulus, the relationship of oneself to the stimulus, the stimulus and its context, and so on. Trait depression increases the likelihood of facilitated elaboration.

This information processing bias model of psychopathology has some shortcomings. The model draws sharp distinctions between anxiety and depression, and state and trait mood; however, such clear demarcations have not been empirically found.

For example, according to the model, depression should only occur in later processing tasks requiring elaboration, such as memory or rumination, but depression is frequently associated with attentional bias, albeit mainly with consciously perceived stimuli (see Wells & Matthews, 1994). Also, no clear separation or interaction of trait and state mood has been demonstrated (Broadbent & Broadbent, 1988). It may be that these processes are more complex than the information processing model suggests, involving transactional or bidirectional relationships between variables. Although the information processing bias model identifies key cognitive processes at different levels of processing tied to psychopathology vulnerabilities, a transactional model that takes into account feedback from the environment may better explain causes of psychopathology.

The transactional theory of stress is one model which not only incorporates cognitive appraisals as pathogenic, but also takes into account the transactional nature of psychopathology and stress, which has been robustly implicated in the etiology of psychopathology (Post, 1992). The transactional theory of stress (Cox, 1987; Lazarus & Folkman, 1984) states that stress reactions and subsequently, psychopathology, arise out of a constant dynamic interaction between the individual and the environment. Stress is seen as "the relationship between the person and the environment which is appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being" (Lazarus & Folkman, 1984, p. 21). According to the transactional theory of stress, depression is an outcome of stress, but this relationship is mediated by a series of cognitive appraisals. As the subject perceives a stimulus, primary cognitive appraisal occurs in which the subject evaluates the personal meaning of the stimulus for his or her well-being. The stimulus may be categorized as irrelevant, good/benign, or stressful. Stressful stimuli are further broken down into harm/loss, where the subject has suffered psychological damage; threat, where psychological damage is anticipated; or challenge, where positive gains are possible through successful coping. Primary appraisal is influenced by prior beliefs or expectancies, conscious and non-conscious, which may be unrealistically negative in depressives (Lazarus & Smith, 1988; Beck, 1967). In secondary appraisal, the subject evaluates what can be done about the situation, reviewing possible coping options and their likelihood to succeed. Coping is then implemented. Passive, self- or emotion-focused coping is less likely to reduce stress than active coping and is associated with depression (Billings & Moos, 1985). As coping efforts succeed or fail, feedback is incorporated into beliefs and future appraisals in the reappraisal stage. In reappraisal, psychopathology may be maintained through a vicious cycle of failed coping efforts leading to more negative appraisals (Cox, 1987). This stress cycle produces short- and long-term physiological reactions, such as rise in cortisol, as well as normal and pathological emotion and behavioral responses (Cox, 1987).

The transactional theory of stress, however, may also be problematic because it ignores the possibility of multiple levels of cognitive processing. Each stage of cognitive appraisal in the transactional theory of stress model may in fact be a detailed process with that starts unfolding within milliseconds of stimulus presentation, long before conscious decision making occurs (Wells & Matthews, 1994). The cognitive appraisal steps within the transactional theory of stress do not distinguish between processes occurring on different levels of processing, such as preattentive categorization of the stimulus or attentional orienting toward the stimulus. Psychopathogenic cognitive bias has been demonstrated in both processes, particularly attentional bias (e.g., Mogg et al., 1993), but the transactional theory of stress does not specify cognitive processes in this detail. This limits the power of the model to generate specific testable hypotheses.

A merger of the informational processing model and the transactional theory of stress may be the best solution to fill the gaps in each model. The transactional theory of stress could benefit from more specificity in levels of processing, just as the information processing bias model would be stronger including a transactional, bidirectional element. An expanded transactional theory of stress that takes into account multiple levels of cognitive processes would be better able to explain current findings in stress and cognitive bias in psychopathology as well as provide a framework within which to make detailed hypotheses.

There are several areas where the informational processing bias model may inform the transactional theory of stress. First, the transactional theory of stress presents primary appraisal as a single step in which personal meaning is established. However, this stage may be several steps at differing levels of awareness. As stimuli is presented, it must be preattentively categorized as irrelevant or relevant and, if relevant, positive or negative (helpful or harmful). A negative categorization increases stress level. Next, attentional resources must be deployed toward or away from the relevant stimulus according to its attentional weight, or importance. At this point, too, stress may be increased by depressogenic bias. In analyses or in theory, researchers often treat attention toward negative stimuli and attention away from positive stimuli as equal and opposite processes, or different ends of the same process (e.g., Bradley et al., 1999). However, they may be separate processes. After orienting to the object, the subject may disengage; alternatively, further conscious attention may be maintained through elaboration, mentally drawing connections between the stimulus and self, stimulus and context, and so on. After orienting attention to the stimulus, the subject may also evaluate potential coping options and their likelihood to succeed, and implement them to varying degrees of success. The feedback from these attempts to cope may then be reincorporated into enduring attitudes about the self and the world, which then influence future cognitive appraisals. (A flowchart of this expanded transactional theory of stress may be found in Appendix A.)

Not only will a merger of the information processing bias model and the transactional theory of stress address weaknesses in each model, it will also provide a more solid framework for understanding gender differences in psychopathology than either the informational processing bias model or the transactional theory of stress alone. The information processing bias model cannot adequately explain gender differences as it does not include the dynamic interaction between the environment and prior beliefs and attitudes. The environmental feedback from coping efforts on cognitive biases may impact men and women differently. Passive or ineffective coping may induce feedback that reinforces enduring negative or irrational beliefs that, in turn, exacerbate pathogenic cognitive biases (Beck, 1967). As women are thought to be socialized to choose passive or ineffective coping options more frequently than men (Nolen-Hoeksema et al., 1999), any existing negative cognitive style may be strengthened by negative reactions evoked by those coping options more frequently chosen by women. Also, women experience more negative events, both independent and dependent, throughout their lifetime (Karp & Frank, 1995). It is thought that women experience more stress because of their roles in society (McGrath et al., 1990); they may be fulfilling several roles (such as mother, wife, and professional), have an ambiguous role, or experience role overload (Lazarus & Folkman, 1984). Sheer exposure to negative events can detrimentally influence beliefs about the self and the world, which may aggravate cognitive biases; it can also increase the number of dependent negative events experienced in the future, as the subject contributes through their detrimental interpersonal coping strategies to emotionally negative situations (Hankin & Abramson, 2001). As the information processing bias model does not provide for an environmental feedback loop, it cannot be sensitive to gender differences in this domain.

The transactional theory of stress also contains weaknesses that prevent it from powerfully explaining and predicting gender differences. This model does not provide enough detail about specific cognitive processes to test whether some processes may be more depressogenic for women than for men, or vice versa. It does not clearly identify the place of pathogenic attentional bias, nor does it provide for multiple levels of processing at which men and women may differ. Further, it does not distinguish between orienting resources to negative stimuli and away from positive stimuli as potentially separate processes. For example, a categorization bias against positive stimuli that occurs preattentively may uniquely predict psychopathology for women, but not in men. On its own, the transactional theory of stress is not sensitive enough to draw out these potential gender differences.

However, an expanded transactional theory of stress which encompasses both the information processing bias model and the transactional theory of stress may be able to provide a framework within which to understand gender differences in depressive disorders and eating disorders. The expanded transactional theory of stress may be sufficiently detailed and specific to describe several junctures at which men and women may diverge on the path to developing depression or an eating disorder. (See illustration in Appendix A). The first juncture may be in pre-existing attitudes and beliefs about the self, world, and future. Gender socialization which encourages women to be more concerned with others' social evaluations and develop a more external locus of control may predispose women to hold more dysfunctional beliefs and attitudes than men, who are socialized to be independent (Ruble et al., 1993). In depression, an interpersonal, affiliative need derived from gender socialization may place women at particular risk for interpersonal negative events (Cyranowski et al., 2000), which then reinforce negative beliefs about the self. These irrational, detrimental attitudes can, through a series of cognitive appraisals, cause stress and subsequently, depression.

Gender disparities in eating disorder prevalence may also be partly explained by differences in attitudes and beliefs. Females are more likely to have negative beliefs about their personal appearance, with 80% of adolescent girls reporting dissatisfaction with their bodies, compared to 40% of adolescent boys (Kostanski & Gullone, 1998). These cognitions are often unrealistic, as adolescent girls within normal weight ranges for their height still express dissatisfaction with their bodies (Casper & Offer, 1990). Moreover, these concerns about personal appearance are closely tied to self-worth in women (Hankin & Abramson, 2001), predisposing them to dysphoria and unhealthy weight control behaviors (Harter, 1999). This increased tendency to tie self-worth to personal appearance by females is thought to be a product of early gender socialization (Eagly & Wood, 1999). Alternatively, evolutionary theory of mate selection hypothesizes that this phenomenon occurs because males value physical attractiveness in their mates more than females do (Buss, 1994). As such, personal physical attractiveness and body satisfaction may be more motivationally significant for females, potentially leading to more detrimental attitudes about self and body. The expanded transactional theory of stress identifies one area, dysfunctional attitudes and beliefs, in which males and females may diverge, leading to different prevalence rates of depression and eating disorders.

Gender differences in dysfunctional attitudes and beliefs may also influence preattentive categorization, the next juncture within the expanded transactional theory of stress at which sex differences may predict difference in depressive and eating disorders. In preattentive categorization, the stimulus is classified as helpful or harmful within milliseconds of presentation, and this process may be both automatic and non-conscious. Biases in preattentive categorization may make women more vulnerable to depression. Women rate emotional stimuli more intensely than males do; negative stimuli are perceived as even more negative by females (Grunwald et al., 1999). Conversely, a negative stimulus may not be as “negative” for a male. This may be because categorization is heavily influenced by prior beliefs and attitudes about the self and the world, which may be more depressogenic in women. Within the expanded transactional theory of stress, an increase in the number of neutral or ambiguous stimuli categorized as negative by the subject would mimic a highly negative environment, thus increasing risk of depressive symptoms.

Just as in depressive disorders, biases in preattentive categorization may have a more significant role in women's increased prevalence of eating disorders, as predicted by the expanded transactional theory of stress. Women may be more apt to categorize incoming stimuli as negative and relevant to body image or disordered eating in early stages of processing, as these concerns are more accessible and evolutionally and socially relevant to females than to males (Eagly & Wood, 1999; Buss, 1994). This too mimics a highly negative environment, but one where women are perceiving criticism of specifically their personal appearance from external sources as well as internally. Being more likely to categorize the stimulus as relevant to the self in a detrimental way that engages salient body image issues may cause an increase in negative eating disorder related cognitions and behaviors in women. An expanded transactional theory of stress includes the early process of preattentive categorization, which may allow gender differences in prevalence or presentation of psychopathology caused at this juncture

In contrast to preattentive categorization, an early process, another major juncture where men and women may differ in their paths to psychopathology is in attentional orienting, a late process. After a stimulus is categorized, the subject either deploys attention to or away from it; if the stimulus engages attention, the subject may then maintain attention, and eventually disengage attention. If women have a greater tendency than men to preferentially orient attentional resources, through engaging, maintaining, or failing to disengage attention, to negative stimuli, it may increase their likelihood of developing depression. Alternatively, depressogenic attentional bias may be away from positive stimuli. Current models lump both attention to negative stimuli and away from positive stimuli under the category of "depressogenic," but an expanded transactional theory of stress which differentiates between the two as potentially separate processes would be more sensitive to gender differences. Attentional bias may be a key component in rumination, which has been repeatedly implicated in depression in women in particular (Nolen-Hoeksema et al., 1999). Rumination has been described as a stable, emotion-focused cognitive style that involves directing attention inwardly toward negative feelings and thoughts (Nolen-Hoeksema, 1991); however, it is not clear what attentional orienting process this involves. It may be that women are more vulnerable to depression through rumination that involves preferentially orienting attention to negative stimuli; alternatively, it may be through failing to orient attention to positive stimuli. This area is exploratory, but an expanded transactional theory of stress is detailed enough such that potential differences may be exposed.

Gender differences in attentional bias, as described by the expanded transactional theory of stress, may also explain differences in prevalence and presentation in eating disorders. While attentional bias toward stimuli has been clearly demonstrated in women (e.g., Ben-Tovim & Walker, 1991), many studies have excluded men or failed to explore gender differences in analyses of attentional bias. It may be that attentional bias toward eating disorder related stimuli is the link between attitudes or behaviors that put one at risk and actually developing an eating disorder. For example, women who restrain their eating due to weight concerns may display stronger attentional bias toward eating disorder related stimuli than male restrained eaters and thus may be more likely to develop an eating disorder. Deploying more attentional resources toward eating disorder related stimuli may increase eating disorder symptoms by augmenting the accessibility and recall of negative incidents or attitudes involving body image (Bower, 1981). The expanded transactional theory of stress, through its focus on cognitive processes as the intermediate step between stimulus input and development of psychopathology, may help to explain gender differences in eating disorders; differences in attentional bias toward eating disorder related stimuli may explain in part why women are more likely to have an eating disorder.

The current studies aim to test aspects of this expanded transactional theory of stress in two disorder groups, eating disorders (Study 1) and depression (Study 2). Study 1 tests the first link of the stress cycle, preattentive categorization. Are men or women more likely to have a stress reaction due to categorizing stimuli as ED-relevant? It also tests the second link, attentional orientation: Do men and women differentially orient to ED-relevant stimuli?

Study 2 also investigates stress and attentional bias, but in depression. As depression has been better studied in this area than eating disorders, this study will build on past research (reviewed in the Background section of Study 2) and focus on the concept of maintenance in depression with the stress cycle. Specifically, do prior depressed mood, beliefs, and expectancies make people more likely to preferentially process and respond to relevant stimuli? At what point does this occur, preattentively or consciously? If men and women are exposed to the same stressor, will there be differences in the amount of stress produced by the stress cycle? Does prior stress exacerbate depressogenic processing preattentively or consciously?

2. STUDY 1

2.1 Background: Eating Disorders

Eating disorders (ED) are characterized by abnormality in eating behavior, maladaptive efforts to control body shape or weight, and disturbances in self-perception related to body (Stice, Wonderlich, & Wade, 2006). Two major eating disorders are anorexia nervosa and bulimia nervosa. Anorexia nervosa (AN) is characterized by extreme emaciation, fear of fatness despite low weight, and amenorrhea (APA, 2000). AN affects approximately .5% of women and .05% of men (APA, 2000). Bulimia nervosa (BN), however, is characterized by a binge-purge cycle. Individuals with BN recurrently binge, or uncontrollably eat more than most would in a two hour period, and purge, or engage in compensatory behavior, such as inducing vomiting, using laxatives, or excessively exercising. While BN prevalence estimates range from 1-3% in women, prevalence rates for men are 1/10 that of women (APA, 2000). Though male incidence rates of AN and BN are relatively low, more men are diagnosed with Eating Disorder Not Otherwise Specified (EDNOS; APA, 2000). EDNOS is diagnosed when some, but not all criteria for an eating disorder are met. A cognitive component is common to AN, BN, and EDNOS; in all three cases, a disturbed self-perception of body and eating that unduly influences feelings of self-worth is central (APA, 2000).

This cognitive component of eating disorders, particularly conscious-level attentional orienting toward ED-relevant words, has been studied in clinical populations using the modified Stroop task (Stroop, 1935). The modified Stroop task is a reaction time based measure of attentional bias or interference. In the Stroop task, an ED-relevant or neutral word colored a primary color appears on the screen. The participant names the color of the word as quickly as possible. A slow reaction time indicates interference from the word as the participant directs her attention to the word.

Using combined food, body shape, and weight related words, attentional bias has been reliably found in bulimics (Cooper, Anastasiades, & Fairburn, 1992; Cooper & Fairburn, 1992; Fairburn et al., 1991) and anorexics, but specific word type has yielded different results (Cooper & Fairburn, 1992). Separately analyzing food, body shape, and weight related words have produced more mixed results (e.g., Black, Wilson, Labouvie, & Heffernan, 1997; Lovell, William, & Hill, 1997). However, the effect of food words seems to be most robust for anorexics (Ben-Tovim & Walker, 1991; Ben-Tovim, Walker, Fok, & Yap, 1989; Channon, Hemsley, & de Silva, 1988; Cooper & Todd, 1997; Green, McKenna, & de Silva, 1994; Jones-Chesters, Monsell, & Cooper, 1998; Long, Hinton, & Gillespie, 1994; Perpina, Hemsley, Treasure, & de Silva, 1993). Body shape and weight words, on the other hand, have had the greatest interference effect on bulimics (Ben-Tovim & Walker, 1991; Ben-Tovim et al., 1989; Jones-Chesters et al., 1998; Lovell et al., 1997; Perpina et al., 1993).

Unlike research with ED, attempts to link EDNOS and attentional bias using the Stroop task have had mixed results. Using the Drive for Thinness scale of the Eating Disorder Inventory (EDI; Garner, Olmstead, & Polivy, 1983) to classify a non-clinical female sample into high-DT and low-DT, Ben-Tovim and Walker (1991) did not find differences in reaction time to food or body shape words in the Stroop task. In a similar study, Tucker and Schlundt (1995) also failed to find a link between attentional bias in a sub-clinical population with varied levels of eating and body image concerns. More specific classification, separating groups based on level of restrained eating, has yielded results with the Stroop task; those with restrained eating show interference to ED-related words, particularly food words (Francis, Stewardt, & Housell, 1997; Green & Rogers, 1993, Overduin, Jansen, & Louwerse, 1995; Stewart & Samoluk, 1997). However, others have failed to replicate this relationship (e.g. Black et al., 1997). Similarly, current dieting status was a predictor of response latency in the Stroop task; current dieters were the most likely to experience interference to ED-related words (Green & Rogers, 1993; Huon & Brown, 1996). There is evidence that attentional bias plays a role in disordered eating, but failures to replicate this may be because attentional bias might occur over a smaller timeframe in subclinical than clinical populations. Green and Rogers (1993) have suggested that these mixed results may be due to relatively rapid habituation to the stimuli; in their study using a subclinical population, interference effects disappeared by the time the task had ended. It would be expected that attentional bias effects are stronger and over a longer timeframe in clinical populations as stronger, longer attentional bias effects would correspond to more severe symptoms, increasing the likelihood of meeting clinical cutoffs. The studies that did not find the expected results also did not check for habituation effects (Ben-Tovim & Walker, 1991; Tucker & Schlundt, 1997; Black et al., 1997). According to the expanded transactional theory of stress, an attentional bias toward ED-relevant stimuli may increase stress, which would then make psychopathology more likely as an outcome. Attending to ED-relevant words may trigger negative cognitions about oneself and one's body, which may then lead to disordered eating symptoms.

Preattentive processes in eating disorders have not been studied as extensively as conscious attentional orienting; however, early processes are important to study because biases at this nonconscious, automatic stage may reflect a more "hard-wired", treatment resistant form of ED. If subjects are preattentively categorizing a stimulus as ED-relevant, they may be more distracted by the stimulus, creating a response latency in an interference task, such as the Stroop task. Using the Stroop task, but presenting the stimuli at very short durations (less than 20 ms) and then masking with meaningless strings of letters, only two studies have investigated potential differences in preattentive processes. Sackville et al. (1998) did not find differences in reaction times with anorexic patients; neither did Jansen et al. (1998) using restrained eaters. However, further research is necessary to confirm these null results.

A major limitation of these studies is that the vast majority of them excluded males, precluding any investigation of gender differences in ED-relevant preattentive categorization and attentional orienting. Males may have different cultural or biological bases of eating behavior. For males, the focus is not on weight but muscularity and leanness (Drewnowski, Kurth, & Krahn, 1995). Adolescent boys are more likely to develop problem behaviors associated with the pursuit of muscularity (i.e., anabolic steroids, extreme body-building exercise) and muscle dysmorphia (Labre, 2002; Pope, Phillips, & Olivardia, 2000). Not only do males face different pressures for the ideal body, but they also have different norms for eating behavior. For example, males are more likely to eat large quantities of food which would qualify as bingeing if not for the lack of negative affect and uncontrolled feelings (Whitaker, et al., 1989). While males with disordered eating are an important, yet under-studied population, gender differences must be examined with sensitivity to biases in diagnostic criteria, as discussed above. In the current study, instead of using diagnostic labels for a clinical population, which would be biased toward females, a nonclinical population will be used, focusing on restrained eating and potential gender differences at two points in the expanded transactional model of stress: preattentive categorization of stimuli as ED-relevant, and conscious attentional orienting toward ED-relevant stimuli. Males and females may differ in their tendencies to categorize and orient toward stimuli, reflecting differences in prevalence and presentation of eating disorder symptoms. While some research has been done in these areas, studies specifically analyzing for gender differences are largely lacking; as such, this is partially exploratory. An objective of the current study is to investigate gender differences in food-related preattentive categorization and attentional bias in those with varied levels of restrained eating.

In addition to pathogenic cognitive processes like preattentive categorization and attentional bias, an expanded transactional theory of stress implicates stress as a root cause of eating disorder symptoms. Stress has a strong, measurable hormonal component; stress hormone abnormalities have been empirically linked to eating disorders as well. Cortisol, the stress hormone, has a complex role in eating disorders. Women with AN, BN, other ED, or obesity have elevated basal levels of cortisol (Bjorntorp & Rosmond, 2000; Gluck, Geliebter, & Lorence, 2004) as well as exaggerated cortisol reactivity to stressors (Bjorntorp & Rosmond, 2000; Coutinho, Moreira, Spagnol, & Appolinario, 2007). Moreover, those with binge eating problems not only exhibited elevated cortisol reactivity to a stressor, but also reported an urge to binge after exposure to the stressor (Gluck, Geliebter, Hung, & Yahav, 2004). This is consistent with Tanofsky-Kraff, Wilfley, & Spurrell's (2000) non-physiological finding that self-reported stress is a reliable predictor of overeating in restrained eaters. Cortisol is also involved directly in adiposity. Consistently elevated cortisol levels promote insulin resistance, leading to increased abdominal fat storage (Sandeep et al., 2005). Conversely, more abdominal fat increases cortisol reactivity to stress (Epel, McEwen, & Lupien, 2000). Stress and its measurable physiological components have been demonstrated to play a role in eating disorders. However, little research has been done on gender differences in this aspect of stress, as most physiological studies on eating disorders focus on women only. Men and women may display differences in stress outcome, specifically stress hormone levels, as they differentially cognitively appraise the stimulus, either preferentially categorizing stimuli as ED-relevant, or preferentially orienting attention toward ED-relevant stimuli.

Stress and cognition have been shown to play significant roles in the etiology and maintenance of eating disorders, and an expanded transactional theory of stress may be able to explain how these components fit together to explain gender differences.

2.2 Hypotheses

1. It is predicted that those with higher restrained eating levels will experience more interference by food words, and this relationship may be moderated by gender and/or presentation level.
2. It is predicted that those with higher restrained eating levels will show a greater increase in cortisol levels after being exposed to food-related words, and this relationship may be moderated by gender and/or presentation level.

2.3 Method

2.3.1 Participants

Fifty-two participants were recruited from the Texas A&M University Introduction to Psychology subject pool to participate in Study 1. Almost exactly half (51%) were female; mean age was 19.02 (SD = 1.57) years. The sample was ethnically/racially diverse: 49% Euro-American, 19.6% African-American, 19.6% Hispanic/Latino, 2% Asian, 4% mixed/other. (See Table 1 for more details.) One participant was removed from all analyses because of failure to follow instructions. All participants received class credit in exchange for participation.

2.3.2 Measures

Demographics Survey

Participants answered questions related to their gender, age, ethnicity, socio-economic status, height and weight, health conditions, and current school information.

Restrained Eating

Level of restrained eating was assessed using the 10-item Restrained Eating subscale of the Dutch Eating Behaviour Questionnaire (DEBQ; Van Strien, Freijters, Bergers, & Defares, 1986), hereafter referred to as the DRES (Dutch Restrained Eating Scale). In factor analysis, all items on the DRES clearly loaded on one factor, and internal consistency for this subscale is very high (Cronbach's $\alpha = .95$; Van Strien et al., 1986). In this study, Cronbach's α was also very high ($\alpha = .94$).

2.3.3 Design

This study has a between subjects variable, presentation level (2: Short presentation with mask or Long presentation without mask) and a within subjects variable, word type (2: Neutral or Food words).

2.3.4 Procedure

After obtaining written informed consent, participants filled out the demographic questionnaire, DRES, and other filler questionnaires. They then completed the modified Stoop task with neutral words, one block with 30 trials.

In the modified Stroop task, the participant sat in front of a computer equipped with a microphone. A fixation cross appeared, followed by a word colored red, green, or blue. The participant was instructed to speak the word color into the microphone as quickly as possible without making mistakes. In the long presentation without mask condition, the word appeared until response with a timeout at 2500 milliseconds. In the short presentation with mask condition, the word appeared for 16.67 ms, then was covered by a mask of the same color which remained until response with a timeout at 2500 ms. The mask, a meaningless string of letters such as “YVDFXTP”, was necessary to prevent “burning” of the image on the retina, which would have allowed perception of the word for longer than 16.67 ms. There was then an inter-trial interval of 2000 ms before the next word presentation. Neutral words and food words were matched in length and frequency, and color of word was random except with the rule that a color could not appear three or more times in a row.

The Stroop task served a dual purpose. First, it measured interference by the food words, either at the early, preattentive categorization stages or at the later, attentional orienting stage; a longer reaction time to name the color indicated more interference by the food word. Secondly, it also primed participants with lexical food stimuli, as they were presented with words at very short, masked durations and at longer, unmasked durations.

To allow cortisol levels time to rise in saliva, participants then filled out questionnaires for 20 – 30 minutes before giving a saliva sample. This saliva sample was later assayed using ELISA techniques for baseline levels of cortisol.

Next, participants completed the modified Stroop task with food words, also one block with 30 trials. Participants again filled out questionnaires to pass the time (20 – 30 minutes) until the next saliva sample, which was later assayed for change in cortisol. Participants were debriefed, thanked, and dismissed.

2.4 Results

Table 1 presents the means and standard deviations of the descriptive statistics for the sample.

Table 1. *Descriptive Statistics of Sample (Study 1)*

	All	Men	Women	Unmasked	Masked
N	51	25	26	25	26
Age	19.01 (1.55)	18.72 (1.37)	19.31 (1.72)	19.00 (1.78)	19.04 (1.37)
BMI	23.67 (4.13)	24.06 (3.66)	22.65 (3.07)	23.29 (3.01)	23.39 (3.82)
DRES	1.97 (.90)	1.71 (.62)	2.23 (1.06)	2.21 (1.04)	1.74 (.696)
Race/Ethnicity					
Asian-American	1.9%	0.0%	3.8%	0.0%	3.8%
African-American	19.2%	12.0%	26.9%	20.0%	19.2%
Euro-American	48.1%	64.0%	34.6%	52.0%	46.2%
Hispanic/Latino	21.2%	16.0%	23.1%	20.0%	19.2%
Native American	1.9%	0.0%	3.8%	4.0%	0.0%
Mixed/Other	4.0%	8.0%	7.7%	4.0%	11.5%
Baseline Cortisol	.1467962 (.11402530)	.1460766 (.11377673)	.1474881 (.11651259)	.1645845 (.09689130)	.1296920 (.12794707)
Post Cortisol	.1408126 (.12290468)	.1571667 (.14910783)	.1250876 (.09133826)	.1632794 (13078672)	.1192100 (.11313735)
RT Food Words	583.3051 (136.07686)	567.5657 (132.97993)	601.4054 (140.75353)	609.9037 (131.47767)	555.44 (138.35208)
RT Neutral Words	592.8007 (176.78562)	596.4099 (179.03099)	588.6501 (178.71505)	565.5217 (148.45387)	621.3787 (202.02736)

2.4.1 Testing Hypothesis 1

Regressed change with backward deletion was used to test whether men or women with higher restrained eating levels showed more interference to the food words, controlling for the interference by neutral words. The expanded transactional theory of stress identifies key junctures at which men and women might diverge on their path of psychopathology, such as in attentional orienting, preattentive categorization, etc. However, in most past studies, gender differences in these areas have not been studied, and previous models were not detailed enough to provide specific hypotheses. The expanded transactional theory of stress is more detailed and broad to capture these differences, but given the relative lack of previous empirical research, there is an exploratory element to this as well, as the model is in the process of being refined. In cases such as these, backward deletion of non-significant higher order predictors in a model that explains a large amount of variance provides the flexibility to identify the most parsimonious model. More rigid hypothesis testing may be more appropriate for more established theories.

In these analyses, valid trials for the Stroop task were defined as those reaction times more than 150 ms but less than 2500 ms. Each participant's reaction times for neutral and foods words were then averaged. Two outliers who had low percentages of valid trials were removed from reaction time analyses.

With average food word reaction time as the dependent variable, DRES, gender, presentation level, and the two way and three way interactions were entered into the regression equation as predictors, covarying neutral word reaction time to control for overall quickness. However, while the overall model was significant ($R^2 = .723$, $F(8,34) = 11.085$, $p < .001$), the three way interaction was not significant in Model 1, as shown in Table 2.

Table 2. *Predicting Food Word Interference (Model 1, Study 1)*

	β	***t***	**Sig.**
Neutral RT	0.752*	7.931	<.001
Female	-0.216	-0.559	0.580
Pres. Level	-0.433	-1.096	0.281
DRES	0.104	0.366	0.717
2 way interactions			
DRES x Pres. Level	0.170	0.413	0.683
DRES x Female	0.270	0.551	0.585
Female x Pres. Level	-0.159	-0.376	0.709
3 way interaction			
DRES x Female x Pres. Lvl	0.263	0.642	0.525

*** p < .001** **df = 42**

The large amount of variance explained coupled with the non-significance of the predictors suggested that the model needed to be revised. The model was then simplified, excluding presentation level, the least empirically backed component, as a variable. The model was again significant ($R^2 = .658$, $F(4,38) = 18.248$, $p < .001$), indicating that at least one of the predictors was explaining a large part of the variance, but the highest level interaction, DRES x Female, was not significant ($p = .423$), as shown in Table 3.

Table 3. *Predicting Food Word Interference (Model 2a, Study 1)*

Neutral RT	0.718*	7.562	<.001
Female	-0.187	-0.706	0.485
DRES	0.243	1.241	0.222
2 way interaction			
DRES x Female	0.286	0.809	0.423

† p < .01, * p < .001 df = 42

However, as shown in Table 4, entering just the main effects of DRES and gender without the interaction term elucidated this relationship, as DRES (p = .001), but not gender (p = .913), had a large effect on food word reaction time ($R^2 = .652$, $F(3,39) = 24.328$, $p < .001$).

Table 4. *Predicting Food Word Interference (Model 2b, Study 1)*

	β	***t***	**Sig.**
Neutral RT	0.717*	7.581	<.001
Female	0.011	0.110	0.913
DRES	0.380†	3.772	0.001

† p < .01, * p < .001 df = 42

Deleting gender from the regressed change equation, DRES is shown to be a very robust predictor of attention to food words in this population ($R^2 = .652$, $F(2,40) = 37.410$, $p < .001$; see Table 5 for more details).

Table 5. *Predicting Food Word Interference (Model 3, Study 1)*

	β	***t***	**Sig.**
Neutral RT	0.716*	7.675	<.001
DRES	0.383*	4.107	<.001

*** p < .001** **df = 42**

In Model 3, DRES predicts food word interference; as restrained eating levels increase, interference by food word also increases. Figure 1 compares the individuals with the lowest restrained eating scores (10^{th} percentile) and the highest (90^{th} percentile), showing the positive relationship between restrained eating and attentional bias to food stimuli.

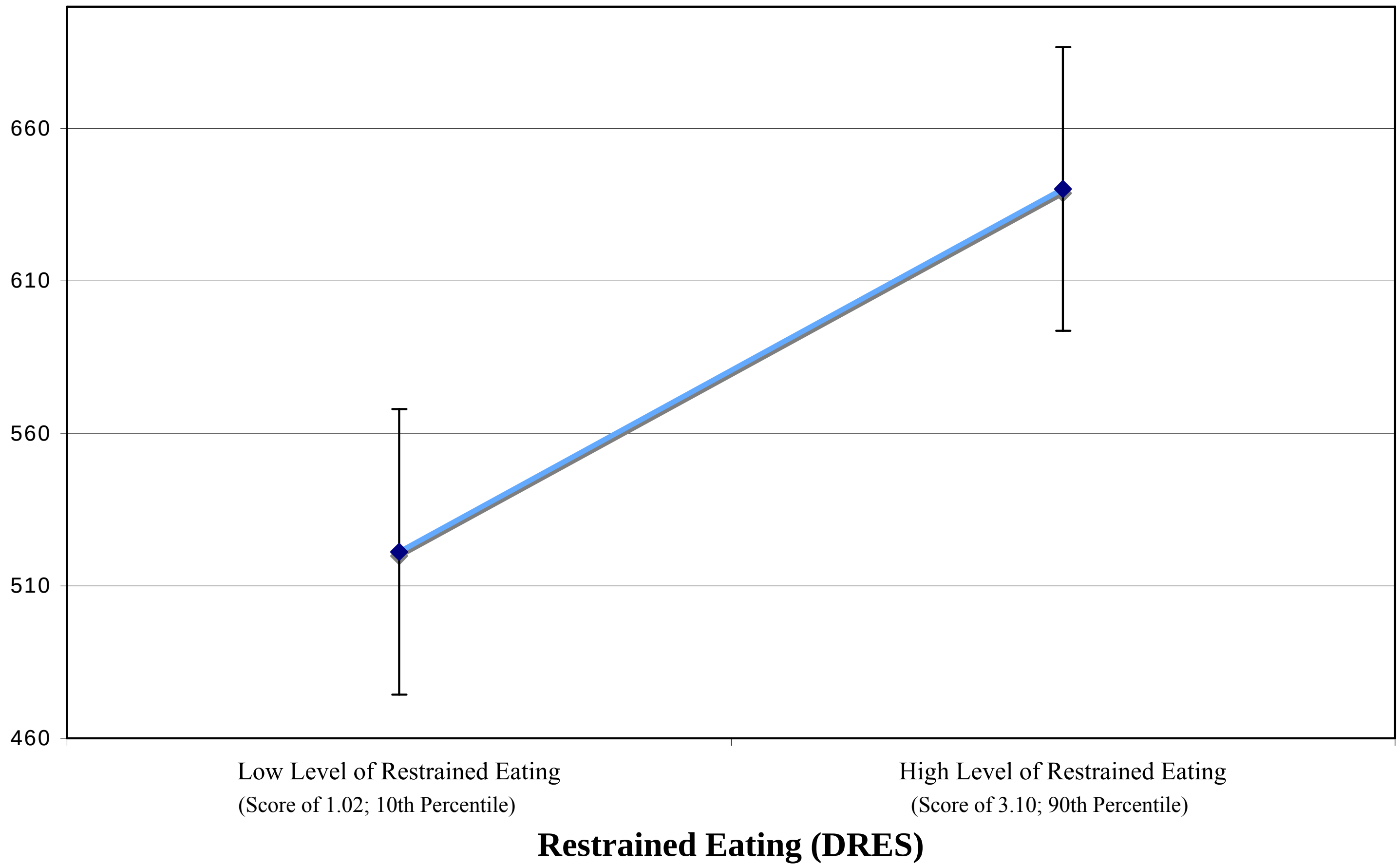

Figure 1. *Interference by Food Words Predicted by Restrained Eating Level (Study 1)*

Note: Error bars reflect standard error.

2.4.2 Testing Hypothesis 2

To test whether male and female highly restrained eaters exposed to food words presented at short, masked durations or at long, unmasked durations exhibited increases in cortisol level, regressed change was again utilized. With cortisol levels after priming by food words ("post" cortisol) as the dependent variable, gender, DRES, presentation level, the two way interactions, and the three way interaction were entered as predictors, covarying baseline cortisol ("pre" cortisol) to control for overall cortisol level. The regression equation was highly significant ($R^2 = .734$, $F(8,42) = 14.484$, $p < .001$), as was the three way interaction ($\beta = 1.069$, $t(42) = 2.703$, $p < .05$), as shown in Table 6.

Table 6. *Predicting Cortisol Level After Priming (Study 1)*

	β	***t***	**Sig.**
Baseline Cortisol	0.744*	9.054	<.001
DRES	0.856†	3.375	0.002
Female	0.739□	2.274	0.028
Presentation Level	0.672	1.916	0.062
2 way interactions			
DRES x Female	-1.425†	-3.412	0.001
Female x Pres. Level	-0.798□	-2.093	0.042
DRES x Pres. Level	-0.956□	-2.484	0.017
3 way interaction			
DRES x Female x Pres. Lvl	1.069□	2.703	0.010

p < .05,† p < .01, * p < .001 **df = 50**

As Figure 2a & 2b makes clear, restrained eating predicts rise in cortisol after food priming, but only in males and only in the unmasked condition.

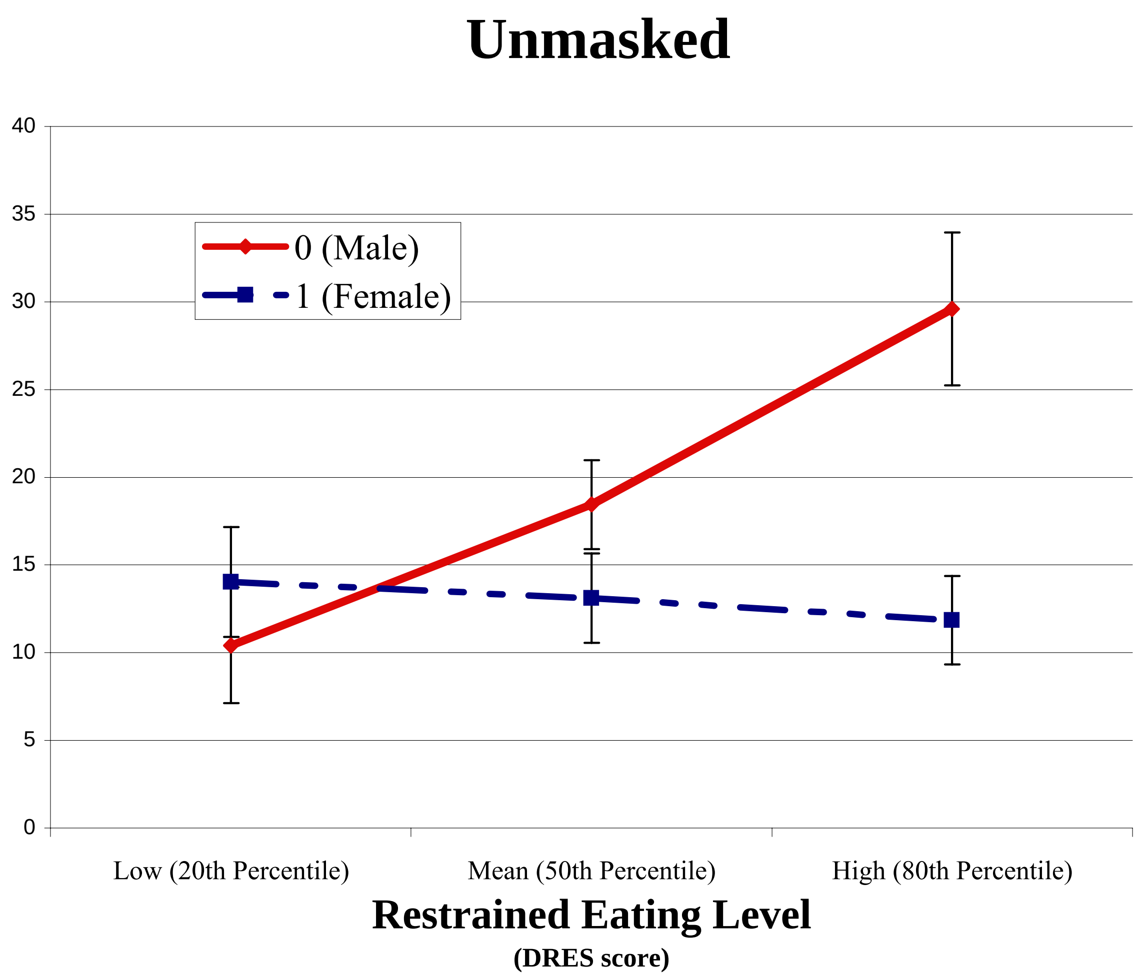

Figure 2a. *Change in Cortisol After Food Priming, Unmasked Only (Study 1)*

Note: Error bars reflect standard error.

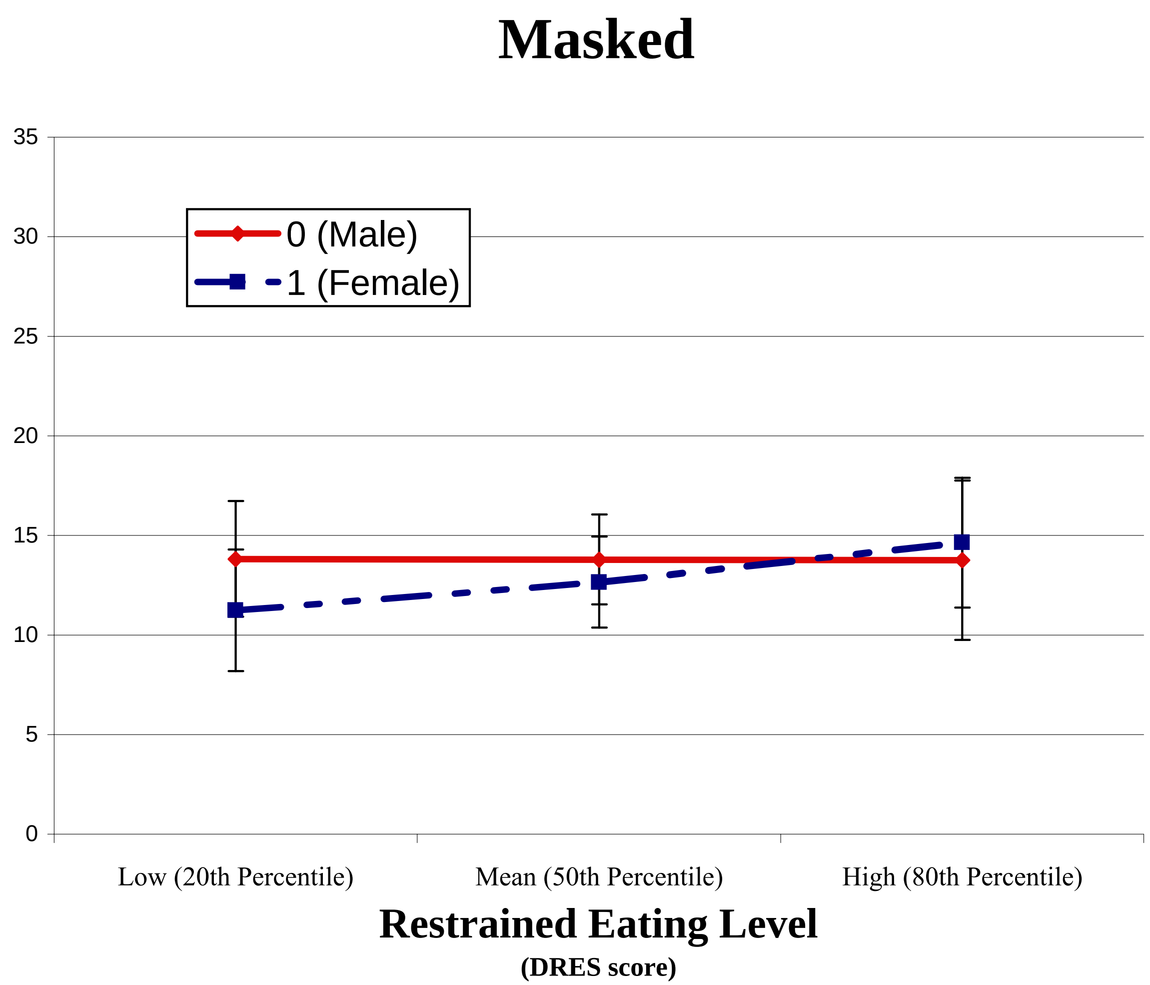

Figure 2b. *Change in Cortisol After Food Priming, Masked Only (Study 1)*

Note: Error bars reflect standard error.

2.5 Discussion

Study 1 found that those with higher levels of restrained eating experienced more interference by food words in a lexical Stroop task. Interpreted within an expanded transactional theory of stress, restrained eaters attach more personal meaning to the food words. The food words may represent a stressful internal conflict for restrained eaters: the food is seen as pleasurable and desired, but at the same time "forbidden" or associated with negative body- and self-image. As such, restrained eaters are more likely to categorize the stimulus as relevant and devote attentional resources to it. This increases stress level, as their cognitive processes are spotlighting this internal conflict. The finding that highly restrained eaters devote more cognitive resources to food words may in part explain why bingeing is often preceded by a period of restrained eating and/or stress (Francis et al., 1997; Gluck et al., 2004; Van Strein et al., 1986). Increased attention and sensitivity to food related stimuli may be the mechanism by which restrained eating is a precursor to bingeing; restrained eaters are, through their preferential processing of food stimuli, being bombarded with stressful, conflicting thoughts of food which may lead to a bingeing episode. This highly negative emotional experience may exacerbate the internal conflict regarding food and thus contribute to more binging symptoms through this cognitive process.

Interestingly, gender differences were not found in the relationship between restrained eating and food stimuli. This cognitive component of eating disorders may be one part of this highly gendered disorder group that is truly common to both men and women. Although this finding must be replicated, components that are common to both men and women may provide a way to remove the female bias in diagnosis of eating disorders.

Study 1 also demonstrated a novel finding, that restrained eating men are more physiologically reactive to food priming than women in the long, unmasked presentation condition only. After being exposed to food words at longer (about 1000 ms) durations, male restrained eaters exhibited rises in cortisol, the stress hormone. Within an expanded transactional theory of stress framework, this would suggest that male restrained eaters are cognitively appraising the food words in later stages of processing as more stressful than women. However, it is a female predominance in eating disorder prevalence that has been solidly demonstrated in the literature.

There are several possible explanations for this gender difference. Males, as discussed above, face different eating and restrained eating norms than females. For men, restrained eating may be much more counter-normative than females. As such, a score of “2” on the DRES may reflect greater severity of symptoms for males than for females. Alternatively, women may have habituated to ED-related food stimuli by this age, about 19 years old (see Green & Rogers, 1993). Girls are targeted with more media images and other stimuli related to dieting and body appearance earlier than boys, and they also start dieting in greater numbers earlier in life than boys (Ricciardelli & McCabe, 2004). By the time they reach college age, the age of our sample, women may have habituated to ED-related stimuli such that physiological responses are attenuated. However, men may not yet have habituated to ED-related stimuli, because they have fewer years of exposure to large amounts of these messages. In this study, using a non-clinical population, habituation did occur even within the duration of the task, which consisted of thirty trials. Comparing the average reaction time from the first two food words to the last two food words, there was a significant decrease in reaction time to food words from the beginning of the task to the end ($t(40) = 3.435$, $p = .001$). A prospective longitudinal study that monitors amount and length of exposure to ED-relevant media messages in males and females could test whether or when physiological habituation occurs. At the same time, varying pressures at different developmental stages and through different cultural epochs must also be taken into account.

Study 1 demonstrated that biases in cognitive appraisal are related to both high ED-risk behavior, restrained eating, as well as physiological stress response in men and women, as would be predicted by an expanded transactional theory of stress. Study 2 aimed to extend these findings to another disorder group, depressive disorders, in which gender differences might be explained using the expanded transactional theory of stress as a framework for interpretation.

3. STUDY 2

3.1 Background: Depressive Disorders

Depression, or depressive disorders, are primarily marked by depressed (“sad”, “empty”, or “irritated”) mood and negative feelings and thoughts (“I’m worthless, guilty, hopeless, etc.”; APA, 2000). In addition to affective dysfunction, depressive disorders are also associated with cognitive impairment, such as difficulty making decisions or concentrating, as well as physiological difficulties, such as insomnia/hypersomnia and loss of appetite (APA, 2000). Major Depressive Disorder (MDD) is characterized by at least one severe episode of depression; dysthymia is less severe, yet longer term than MDD, lasting more than two years (APA, 2000). National epidemiological studies have consistently shown depression to be significantly more prevalent in women than in men (Weissman, Bruce, Leaf, & Holzer, 1991). As in eating disorders, recent research in depressive disorders has been heavily influenced by Beck’s (1967) conception of depressogenic cognitive biases.

Bias in cognitive processes has been shown to play a role in depression. A attentional bias toward negative stimuli presented for longer (about 1000 ms) durations has been well documented among clinically depressed populations using several different tasks. For example, similar to the ED-relevant Stroop task, in the lexical emotional Stroop task, participants see an emotionally charged word colored a primary color and are instructed to name the color as quickly as possible. A greater latency to name the color is thought to reflect interference from the emotionally charged word itself as participants' resources are used to orient attention toward the word; alternatively, a tendency to categorize the word as negative or threatening, and therefore, needing more attention, could also contribute to the interference effect (Williams, Mathews, & MacLeod, 1996). Clinically depressed persons in many studies have had slower reaction times to negative lexical stimuli in the emotional Stroop task than to neutral or positive stimuli (e.g., Dozois & Dobson, 2001; McNeil et al., 1999; Spinks & Dalgleish, 2001). This effect has also been found in dysphoric student samples (Gotlib & McCann, 1984; Williams & Nulty, 1986); however, efforts to replicate attentional bias in non-clinically depressed populations (i.e., individuals with dysphoria) have not always been successful (e.g., Gilboa & Gotlib, 1997; Hill & Knowles, 1991). The link that the emotional Stroop task establishes between negative attentional bias and depression reflects a cognitive pattern of identifying and preferentially processing negative-related information which can make individuals vulnerable to depression by increasing stress levels.

The lexical dot probe task has also been used to demonstrate that depressed persons orient attention to negative stimuli more than positive or neutral stimuli. The same task that was used in this experiment (see detailed explanation of this attention measure in "2.3 METHOD"), the lexical dot probe task displays two words, usually one emotional and one neutral, and measures attentional deployment to one stimulus over the other through reaction time to a probe. Using the lexical dot probe task, Bradley, Mogg, and Lee (1997) found that induced dysphoria was associated with greater vigilance to depression-related words and that naturally occurring depression was also correlated with increased attention to such words. Mathews, Ridgeway, and Williamson (1996) also found that an attentional bias was associated with socially threatening, but not physically threatening words, in depressed participants. It would be expected that depressed persons pay more attention to socially but not physically threatening words because the content of the thoughts that cause depression are often related to social situations (i.e., "No one likes me"). However, as with the emotional Stroop task, this effect has not been consistently found in dysphoric student populations (e.g., Hill & Dutton, 1989). Using the lexical dot probe task, researchers have largely shown that depressed persons preferentially devote attentional resources to stimuli emotionally relevant to depression, specifically negative and socially threatening stimuli. Linking attentional bias and depression through the lexical dot probe task further solidifies the path from negative attentional bias to negative cognitions, which in turn can cause depressogenic stress.

While the link between dysfunctional cognitive processes and depression has been previously explored, there have been few published studies that focus on or report gender differences in depressogenic attentional bias. An expanded transactional theory of stress predicts that women and men may diverge in their cognitive processes when categorizing stimuli valence and when orienting attention toward relevant stimuli, both of which may affect performance on the dot probe task.

A "negativity bias" has also been well documented among healthy participants, though depressogenic "negativity bias" has been shown to be greater in magnitude. For example, Smith, Cacioppo, Larsen, & Chartrand (2003), using the P1 component of event-related potentials as a measure of attention, found that participants attend to negative stimuli more than other stimuli. Ito, Larsen, Smith, & Cacioppo (1998) found that brain activity was greatest (largest amplitude late positive event-related brain potentials) when viewing negative pictures as compared to positive or neutral pictures. Finally, Pratto and John (1991) demonstrated, using a modified Stroop task with negative and positive social information, that participants attended more to negative social information. Although there may exist a slight negativity bias in normal populations, the negativity bias in depressed populations is much greater and clearly demonstrated in behavioral tasks such as the dot probe task.

The research cited above all used stimuli shown at long, unmasked durations (750 – 1500 ms). Researchers have attempted, but largely failed, to demonstrate differences in response latency in depressed persons using stimuli presented at very short stimulus durations (about 16 ms) with a mask (see review by Matthews & Wells, 2000). For example, using the emotional Stroop task with masked stimuli, Mogg, Bradley, Williams, & Mathews (1993) failed to find a preattentive response bias for negative words in depressed persons but did find one for anxious participants. Bradley et al. (1997) also failed to find a preattentive response bias for negative words in depressed persons, although there was a bias toward negative stimuli presented at longer durations. An expanded transactional theory of stress would suggest that this task is tapping cognitive processes at the preattentive categorization level. However, a bias toward categorizing stimuli as negative on a preattentive level has not been reliably found in depression.

Study 2 will use short (16 ms) and long (1000 ms) presentations of depressogenic words to investigate preattentive categorization bias and attentional orientation bias, respectively, in men and women with a range of depressive symptoms. If this study shows that depression does in fact have a preattentive element to its associated attentional bias in either men or women, there would be significant implications for the treatment of depression. For example, a bias in processes occurring within milliseconds of stimulus presentation may represent a biological or “hard-wired” depression that is more difficult to treat. It may be that individuals who consistently do not respond to cognitive-behavioral therapy have a preattentive depressogenic bias is resilient to treatment.

The expanded transactional theory of stress focuses on cognitive appraisals that raise stress levels, which can lead to depression. Physiological evidence for the role of stress in depression has also been found in several studies, particularly with cortisol, the stress hormone. High levels of cortisol have been associated with depression (Posener et al., 2000), although this difference may be most visible after waking, due to changing levels of cortisol in the diurnal cycle (Bhagwagar, Hafizi, & Cowen, 2005). Also, repeated negative emotional responses lead to chronic elevation of cortisol levels (Parker & Baxter, 1985). Long-term exposure to elevated cortisol levels can have such deleterious effects as hippocampal damage, which affects memory and learning, and immune suppression (Freeman, 2002). Gender differences have been observed in cortisol responses to stress, as men exhibited a larger response in one sample (Kirschbaum, Wust, & Hellhammer, 1992). However, others have found the opposite with a depressed and/or abused sample: women had HPA axes that were more reactive than males' (Weiss, Longhurst, & Mazure, 1999). It may be that level of depressogenic cognitive bias has an influence on cortisol reactivity in men and women. The expanded transactional theory of stress includes the role of stress in depression; as such, gender differences in cortisol, which has been so closely tied to stress that it is often used as a physiological proxy in the literature, is logical to investigate. Biases in cognitive processes at the early, preattentive categorization level or later at the attentional orienting level might influence stress hormone reactivity differently in men and women.

In summary, an expanded transactional theory of stress may provide a framework within which to clarify gender differences in depression. While a strong cognitive component has been demonstrated in depression, gender differences in the type of cognitive bias has not been fully addressed. Although the expanded transactional theory of stress can predict junctures at which men and women may diverge in their paths to depression, such as in preattentive categorization and attentional biases, the specific ways in which their cognition biases differ is exploratory. It may be that attention toward negative stimuli and attention away from positive stimuli are separate processes that affect men and women's vulnerability to depression differentially. The current study will attempt to address this through separate analysis of the different types of trials, which may represent separate and independent processes.

Moreover, these differences in cognitive processes may influence stress output, particularly physiologically. While gender differences have been documented in stress hormone levels, conflicting findings suggest that a moderator, such as type of depressogenic cognitive bias, may exist. The current study aims to address these questions.

3.2 Hypotheses

1. Those who endorse more affective depression symptoms may display a cognitive bias toward negative stimuli or away from positive stimuli (depressogenic bias) in the dot probe task, and this relationship may be moderated by gender and/or presentation level.
2. Those who exhibit depressogenic cognitive bias may be more physiologically reactive to stress, showing greater increases in cortisol after undergoing the stressor, and this relationship may be moderated by gender and/or presentation level.
3. There may be a gender difference in physiological reactivity to stress, with men or women exhibiting greater increases in cortisol after undergoing the stressor, and this relationship may be moderated by affective depression level.
4. Those who endorse affective depressive symptoms may be more cognitively reactive to stress, displaying a greater depressogenic bias after undergoing the stressor, and this relationship may be moderated by gender and/or presentation level.

3.3 Method

3.3.1 Participants

One hundred eighty-six students from the Texas A&M University subject pool participated in this study. Mean age was 19.17 (SD = 1.19) years old, and approximately 55% of the sample was female. Details about sample characteristics are in Table 7, 8a & b (pp. 52 to 54). Two participants were eliminated from the final dataset due to suspicion.

3.3.2 Measures

Demographic Questionnaire

Each participant completed a demographic questionnaire, providing information about his or her gender, age, self-identified race/ethnicity, year in school, socioeconomic status of the participant and the participant's parents, height, weight and weight history, relationship status, and smoking, eating, and exercise habits. Females only reported on menstruation.

Affective Component of Depression

PAI

The Depression – Affective Symptoms subscale of the Personality Assessment Inventory (PAI; Morey, 1991, 1996) was used to assess severity of depression symptoms specific to the affective dimension. The PAI measures manifestation of clinical symptoms, which parallel DSM-IV categories. The Depression scale has three subscales, Affective, Cognitive, and Physiological aspects. Just the Affective subscale of the Depression scale was used, as it was used to predict cognitive (attention and categorization) and physiological (cortisol) aspects of depression. In this 8 item scale, participants were presented with statements such as, “Much of the time, I am sad for no reason,” and are required to respond with one of four choices: “False, not at all true”, “Slightly true”, “Mainly true”, or “Very true”. Internal consistency estimates for this subscale across different demographic strata in census-matched normative sample was .79 (Morey, 1991). This subscale of the PAI has median alphas of .81, .86 and .82 for normative, clinical and college samples respectively (Morey, 1991). In this study, the internal consistency of the affective depression subscale was comparable (Cronbach’s α = .78).

State Stress (Manipulation Check)

VAS

A manipulation check was necessary to test the effectiveness of the study’s method of inducing a state of stress. This was accomplished via the Visual Analogue Scale (VAS; Bech, 1993). The VAS consists of a line divided by 11 tick marks with anchors at 1 (“No Stress”), 3 (“Mild Stress”), 6 (“Moderate Stress”), 9 (“Severe Stress”), and 11 (“Profound Stress”). Participants were instructed to mark an X on the line where their stress level falls. The VAS was scored by measuring from the left how many millimeters the X is from the beginning of the line, with higher numbers indicating more stress. The VAS, especially as a repeated measure of stress, is sensitive to changes in stress level and is widely used in many settings (Bech, 1993).

3.3.3 Procedure

All testing took place in a room in the Psychology department's clinic. Each room was equipped with a computer with microphone for the dot probe task, a two-way mirror on the wall, and a video camera with microphone installed in the ceiling which the participant could clearly see. Participants were required to attend one session that lasted at most 2.5 hours. Participants were tested one at a time by a female experimenter and received verbal and written information regarding their consent, including the voluntary and non-binding nature of their participation without penalty for early withdrawal. The consent form led the participants to believe that the study was on "cognitive tasks." It was necessary to conceal the exact nature of the study from the participants to obtain a natural reaction to the stress induction.

The participant first completed a demographic questionnaire before giving their baseline saliva sample. Spending about fifteen minutes answering routine questions had the added benefit of allowing cortisol levels to fall back to non-stressed levels in case the participant encountered a stressor before coming to the experiment room.

The participant then provided a saliva sample. This was later analyzed for baseline cortisol levels. A significant benefit of using cortisol as a measure of stress is that it does not depend on self-report.

Next, participants completed questionnaires, among them the VAS (Bech, 1993), a state stress measure. After completing the questionnaires, participants completed the dot probe tasks with stimuli presented at short, masked durations and long, unmasked durations (MacLeod, Mathews, & Tata, 1986) using positive, negative, and neutral words matched for frequency and length. The dot probe task was programmed and displayed with the computer program DMDX (Foster, 2005). The order was counterbalanced for short, masked and long, unmasked presentation blocks. The experimenter was not in the room when participants were doing the dot probe task. These reaction times acted as a baseline.

In the dot probe task, participants sat in front of a computer screen with a microphone. First, a fixation cross appeared in the middle of the screen for 1250 milliseconds to show the participants where to fixate their gaze. Then, two words appeared, one on the left and one on the right. There were positive-neutral, negative-neutral, and positive-negative pairs. Dot could replace either word. The words in the dot probe task were presented at both long and short durations. For long presentation, words were presented for 1000 milliseconds. For short, masked presentation, the stimuli appeared for approximately 16.67 milliseconds before being replaced by a mask, a meaningless string of pound signs (#############), for about 300 ms. A mask was necessary after word presentation to prevent the image lingering on the retina, thereby allowing it to be perceived for longer than 16.67 milliseconds.

After being presented with or without a mask, the words disappeared and a dot appeared either on the right or the left. Participants were instructed to say "right" or "left" into the microphone as quickly and accurately as possible to indicate the location of the dot. Reaction time was recorded via microphone input. Participants had a maximum of 2500 milliseconds to respond before the screen cleared, and there was an inter-trial interval of 2000 milliseconds before the next trial was presented.

The dot probe task measures attention through reaction times. If the participant is slow to locate and report the position of the dot, one can infer that attentional resources were diverted to the word which was not replaced by the dot. That is, it takes time to disengage attention from the side of the screen that displayed the word not replaced by the dot and move attention to the other side of the screen to find the dot. However, if attention is already focused on the side of the screen that contained the word replaced by the dot, the participant should be relatively quicker to name the location of the dot. For example, if a neutral word appears on the left and a negative word on the right, and after the pictures disappear the dot appears on the right, reaction time will be fast if there is an attentional bias toward the negative stimulus. Within the expanded transactional theory of stress, this response pattern could be indicative of a preattentive categorization bias, such that the subject is more likely to categorize a stimulus as threatening, and thus, devoting more attentional resources to it; or, it could reflect a pattern of preferentially orienting attention and resources to negative stimuli.

The following is a list of all possible combinations of stimuli that were shown and what latency would indicate depressogenic bias in comparison to the Neutral-Neutral control trials. The notation "Negative(dot)-Neutral", for example, refers to a trial with a negative word and a neutral word when the dot replaces the negative word. The word with “(dot)” could appear on either the right or the left.

1. Unmasked
    a. Negative(dot)-Neutral – Fast
    b. Negative-Neutral(dot) – Slow
    c. Positive(dot)-Neutral – Slow
    d. Positive-Neutral(dot) – Fast
    e. Positive(dot)-Negative – Slow
    f. Positive-Negative(dot) – Fast
    g. Neutral(dot)-Neutral – Control
2. Masked
    a. Negative(dot)-Neutral – Fast
    b. Negative-Neutral(dot) – Slow
    c. Positive(dot)-Neutral – Slow
    d. Positive-Neutral(dot) – Fast
    e. Neutral(dot)-Neutral – Control

After the baseline dot probe task, the participants underwent the Trier Social Stress Test (TSST; Kirshbaum, Pirke, & Hellhammer, 1993), modified slightly to fit the equipment available, in order to manipulate their stress level. In the TSST, participants were informed that they would now undergo a cognitive task that would be analyzed for “psychopathology”. During this time, participants delivered a five minute extemporaneous speech, with only five minutes preparation time, on why they should be hired for their dream job. The participant was told that there were three judges behind the two-way mirror noting and analyzing the participant's behavior during the speech and that the judges were trained in behavioral observation. In truth, there was no one behind the two-way mirror. Telling the participants that there were experts watching and evaluating their performance added to the induced stress level. The experimenter sat next to the two-way mirror during the speech, giving subtle negative social cues, such as frowning, sighing, crossing her arms, and tapping her foot. Participants were typically able to speak on their own for 1-3 minutes. After a 20 second lapse of silence, the experimenter prompted the participant with a variant of the following: "You still have time, please continue" or "What personal characteristics qualify you in particular for this position?" Then, participant was led to believe that the "judges" relayed a message through the experimenter asking for a second task. The participant was now to count backward from 2083 by 13's as quickly as possible without making mistakes for five minutes. If the participant made an error in her mental math, she was asked to start over from the beginning. The participant was also erroneously led to believe that their performance was videotaped and sent to their professors to check for signs of psychopathology related to job employment. Since this procedure's inception into the field, it has been used many times to reliably induce stress and cause increase in cortisol levels (see Kirschbaum et al., 1995; Kirschbaum & Helhammer, 1994).

After undergoing the TSST, participants completed the single-item state stress questionnaire as a manipulation check (VAS; Bech, 1993), then completed the short, masked and long, unmasked presentation dot probe tasks a second time to assess change in reaction times from the baseline. The dot probe tasks immediately followed the stress manipulation and the single-item manipulation check to ensure that the effect of the manipulation was still strong.

Participants then completed the other state questionnaires to assess change in emotion from baseline.

Participants provided a second saliva sample, which was assayed for change in cortisol levels. Because both the short, masked and long, unmasked presentation dot probe tasks take about sixteen to eighteen minutes to complete, plus approximately ten minutes to fill out the state affect questionnaires, twenty-five to thirty minutes from the time of the stress manipulation to the saliva sample passed, enough time for cortisol levels to rise in reaction to a stressor.

After completion of the session, participants were carefully probed for suspicion, using a funneled debriefing, as to the real objectives of the study and the stress induction. If they volunteered that they suspected that the study was actually about stress, they were asked at what point they started to have suspicion. If they started to have suspicion after all relevant measures were taken, then the data was kept. If they had suspicion earlier in the study but expressed that they "acted naturally" and experienced an increase in stress level despite their suspicion, then the data was kept. Two participants who reported having suspicion early in the study, not acting naturally, and not experiencing an increase in stress were eliminated from the dataset.

After being probed for suspicion, participants were debriefed about the true nature of the study and reassured that they were not actually being videotaped.

Participants were informed that because there was no actual videotaping, their professors would not be checking the tape for signs of psychopathology. They were told that the Trier Social Stress Test is intended to cause performance stress in everyone; their performance had no bearing at all on their personal worth, skill as a speaker, or ability to land their "dream job." If, upon questioning, the participant rated their stress level as medium to high due to the stress manipulation, he or she was given the opportunity to sit quietly or undergo guided imagery to relieve stress. Participants were then thanked and dismissed.

To abbrieviate, the experiment protocol outline was as follows:

1. Demographic questionnaire
2. Baseline saliva sample (assayed for baseline cortisol)
3. Questionnaires – state stress
4. Dot probe task (baseline)
5. Trier Social Stress Test
6. Dot probe task
7. Questionnaires – state stress, affective depressive symptoms
8. 2nd saliva sample (assayed for cortisol change)
9. Debriefing

3.4 Results

Tables 7, 8a and b present the means and standard deviations of characteristics of the sample.

Table 7. *Descriptive Statistics of Sample (Study 2)*

	All	Men	Women
N	183	74	103
Age	19.17 (1.19)	19.11 (1.18)	19.14 (1.21)
Race/Ethnicity			
Asian-American	8.9%	4.1%	12.6%
African-American	2.8%	2.7%	2.9%
Euro-American	12.3%	13.5%	11.7%
Hispanic/Latino	72.6%	78.4%	68.0%
Mixed/Other	3.4%	1.4%	4.9%
Cortisol (ug/dL)			
T1	.18268933 (.26088694)	.23073404 (.3241699)	.15267092 (.21145281)
T2	.1606832 (.2127606)	.2281634 (.29039464)	.11723253 (.12648046)
PAI Depression scale	20.793 (5.915)	21.070 (6.069)	20.644 (5.829)
Affective subscale	5.613 (2.222)	6.000 (2.563)	5.330 (1.913)
Cognitive subscale	7.891 (2.639)	8.056 (2.777)	7.772 (2.537)
Physiological subscale	7.322 (2.843)	7.014 (2.911)	7.594 (2.783)
PAI Anxiety Scale	18.434 (5.933)	18.507 (6.169)	18.180 (5.647)
Affective subscale	6.936 (2.637)	7.394 (2.538)	6.560 (2.657)
Cognitive subscale	6.509 (3.080)	6.000 (3.203)	6.810 (2.939)
Physiological subscale	5.077 (2.208)	5.186 (2.009)	4.908 (5.647)
POMS Reverse scored - higher scores reflect more negative affect			
T1	1.429 (.418)	1.407 (.394)	1.448 (.438)
T2	3.420 (.854)	3.146 (.871)	3.601 (.804)

Table 8a. *Mean Latency in Dot Probe Task (Short & Masked Only, Study 2)*

		All	Men	Women
Short, Masked Reaction Times				
Negative* (dot) - *Neutral*				
	T1	412.6145 (73.729)	389.7878 (66.34808)	428.6762 (75.80065)
	T2	417.4022 (80.57125)	393.5481 (61.76599)	435.9578 (89.26807)
***Negative* - *Neutral* (dot)**				
	T1	442.1944 (85.05251)	419.5535 (79.27607)	457.3913 (86.818)
	T2	414.8537 (83.56135)	386.6442 (62.38058)	435.1556 (92.04583)
Positive* (dot) - *Neutral				
	T1	425.532 (93.45743)	400.5173 (77.44599)	443.3943 (101.42429)
	T2	427.6302 (91.6298)	393.3432 (70.0926)	454.1667 (98.25317)
***Positive* - *Neutral* (dot)**				
	T1	419.74 (81.06802)	401.8943 (82.25454)	433.4795 (79.09873)
	T2	422.6547 (82.97674)	397.6258 (70.57629)	441.6877 (88.23719)
Neutral - Neutral				
	T1	423.8404 (85.93004)	401.9643 (87.74876)	439.7034 (83.45021)
	T2	422.1616 (86.70292)	394.1976 (69.40218)	443.3788 (93.89019)

Table 8b. *Mean Latency in Dot Probe Task (Long & Unmasked Only, Study 2)*

		All	Men	Women
Long, Unmasked Reaction Times				
Negative* (dot) - *Neutral				
	T1	452.3269 (93.58998)	432.0931 (88.39956)	463.7251 (93.57278)
	T2	451.438 (96.83608)	425.0312 (79.38263)	466.1327 (98.92272)
***Negative* - *Neutral* (dot)**				
	T1	466.4744 (93.70895)	439.5815 (85.29749)	483.6778 (96.03552)
	T2	466.3157 (110.35686)	429.9467 (77.612)	486.8224 (114.85527)
Positive* (dot) - *Neutral				
	T1	451.0641 (88.86956)	432.9309 (84.85359)	463.5889 (90.3808)
	T2	456.667 (101.35715)	426.0213 (85.87604)	475.9512 (102.70338)
***Positive* - *Neutral* (dot)**				
	T1	466.6696 (103.24389)	440.2091 (92.46412)	483.3516 (107.47475)
	T2	461.9033 (104.55819)	427.6886 (83.94777)	481.8098 (103.88322)
Negative* (dot) - *Positive				
	T1	472.4254 (100.01071)	446.0485 (93.19379)	489.7207 (101.96302)
	T2	468.5791 (101.56393)	450.3303 (88.6321)	478.3205 (108.24204)
***Negative* - *Positive* (dot)**				
	T1	456.4438 (108.14188)	418.1509 (88.87474)	481.3308 (113.98148)
	T2	451.8065 (110.52235)	414.0832 (81.7253)	471.987 (111.69325)
Neutral - Neutral				
	T1	473.3204 (101.73538)	451.1839 (99.30212)	488.3679 (101.30399)
	T2	457.8197 (98.57164)	427.2598 (76.74761)	474.2123 (94.26862)

3.4.1 Testing Hypothesis 1

To test whether the affective dimension of depression predicted depressogenic response bias to emotional stimuli, and whether that would be different by gender or presentation level, regressed change was used. Short, masked stimuli trials and long, unmasked stimuli trials were analyzed separately. Reaction time to emotional trial type was the dependent variable. Reaction times for each type of emotional trial, masked and unmasked, were analyzed separately. (Emotional trials are those where at least one of the stimuli in the word pair was a positively or negatively valenced word. This is in contrast to neutral trials, where both stimuli were neutral words; these acted as control trials. (See list of trial types in “3.3.3 PROCEDURE”.) Affective symptoms of depression, gender, and the interaction of the two were entered as predictors. Reaction to neutral trials controlled for overall quickness.

Ten regression equations were run, one for each emotional trial type, masked and unmasked. In the current study, each different type of trial was analyzed separately, unlike previous studies that often created attentional indexes from a sum of the trial types (e.g., Mogg, Bradley, & Williams, 1995). This more flexible, exploratory approach will lay the groundwork for more rigid hypothesis testing in the future. Two of the regression equations produced significant interactions: Unmasked Negative(dot)-Neutral (R^2 = .752, $F(4,144) = 109.000$, $p < .001$) and Unmasked Positive(dot)-Neutral (R^2 = .728, $F(4,144) = 96.403$, $p < .001$). Tables 9a & b show the details of the regression equations.

Table 9a. *Gender x Depression Predicting Unmasked Negative(dot)-Neutral RT (Study 2)*

	β	*t*	Sig.
Unmasked Neutral RT	0.849	19.858	<.001
Gender	-0.286□	-2.487	0.014
PAI Depression Affective	-0.075	-1.380	0.170
2 way interaction			
Female x PAI Dep. Aff.	0.324†	2.787	0.006

p < .05; † p < .01, * p < .001 **df = 148**

Table 9b. *Gender x Depression Predicting Unmasked Positive(dot)-Neutral RT (Study 2)*

	β	*t*	Sig.
Unmasked Neutral RT	0.826*	18.495	<.001
Gender	-0.334†	-2.776	0.006
PAI Depression Affective	-0.026	-0.458	0.648
2 way interaction			
Female x PAI Dep. Aff.	0.395†	3.243	0.001

p < .05; † p < .01, * p < .001 **df = 148**

Figure 3a shows the interaction effect of gender and affective depression symptoms in predicting reaction time in the negative-neutral word pair where the dot replaces the negative word. A short latency to name the dot indicates more attention to negative stimuli. At the 90th percentile score of the affective depression measure, men and women have significantly different reaction times from each other ($t(148) = 2.416$, $p = .017$), as well as at the 10th percentile level ($t(148) = 1.951$, $p = .053$). As shown in Figure 3a, males show the pattern shown in previous literature; latency to name the dot replacing the negative word decreases as affective depression symptoms increase. On the other hand, women who endorsed more affective depression symptoms had increased reaction time.

Figure 3b shows the gender difference patterns for positive-neutral pairs where the dot replaces the positive word. Bias away from positive stimuli would be indicated by a larger latency to name the location of the dot. In this regression equation, the pattern is reversed. Women show more depressogenic bias with more affective depression symptoms, but increase in affective depressive symptoms in men is not associated with an increase in bias away from positive stimuli. Sex differences in simple slope of reaction time are significant at both the affective depression 90th percentile ($t(148) = 2.999$, $p = .003$) and at the 10th percentile ($t(148) = -2.064$, $p = .041$).

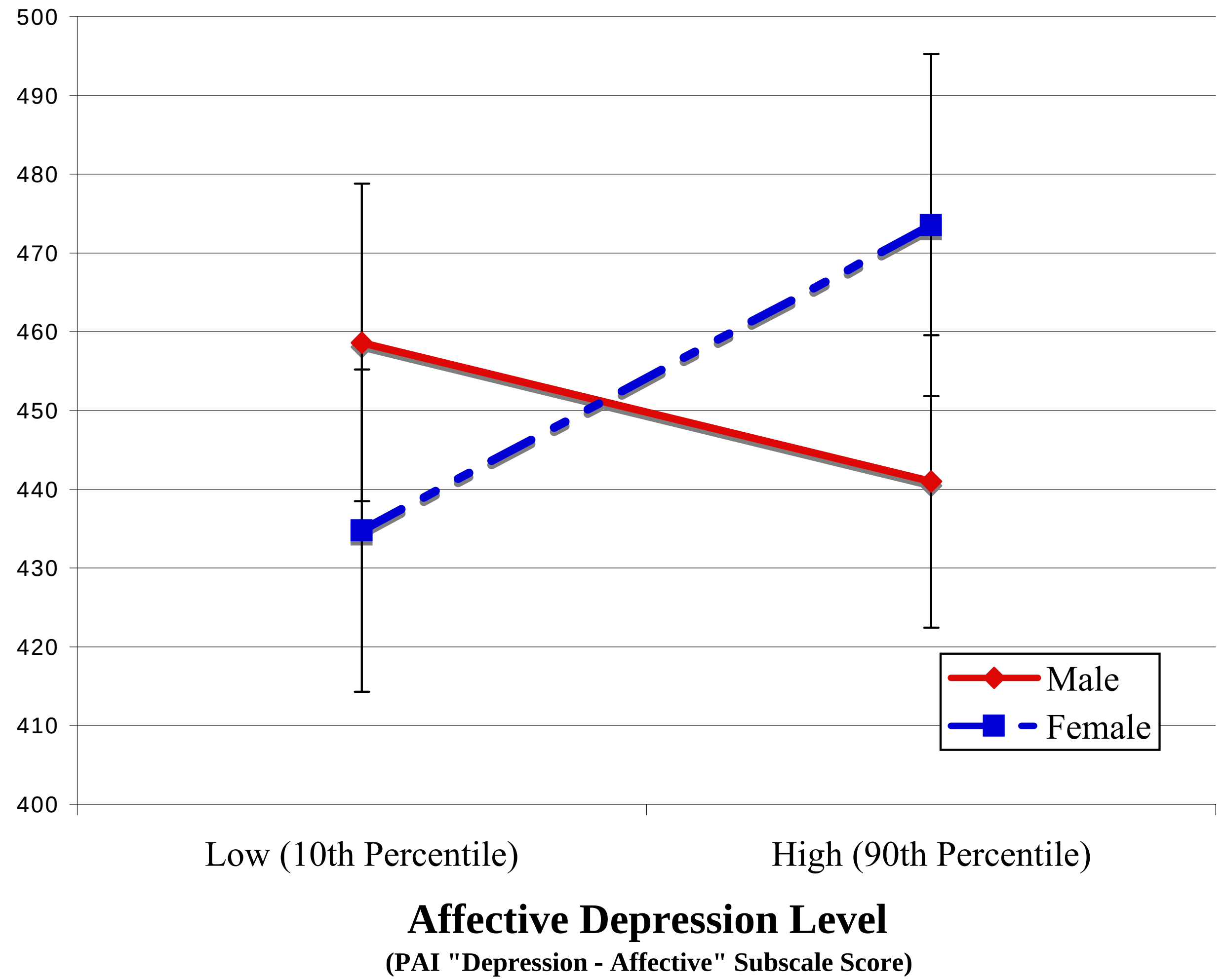

Figure 3a. *Gender by Affective Depression Predicting Unmasked Negative(dot)-Neutral RT (Study 2)*

Note: Error bars reflect standard error.

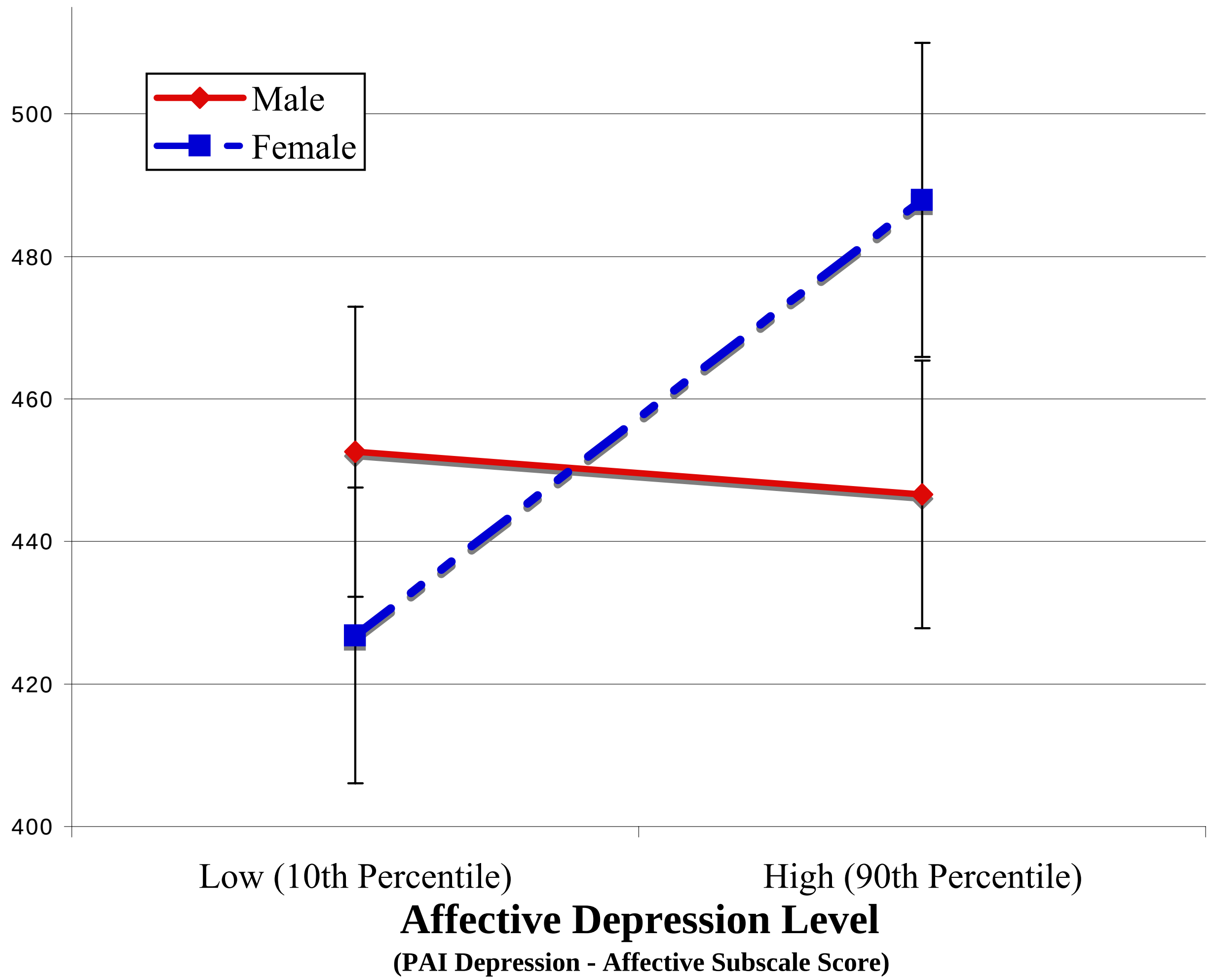

Figure 3b. *Gender by Affective Depression Predicting Unmasked Positive(dot)-Neutral RT (Study 2)*

Note: Error bars reflect standard error.

3.4.2 Testing Hypothesis 2

It was hypothesized that those who exhibit depressogenic bias in the dot probe task may be more physiologically reactive to stress, showing greater increases in cortisol after undergoing the stressor, and that this relationship might be different by gender or by presentation level. Again, regressed change was used to analyze this hypothesis. Reaction times for each type of emotional trial, masked and unmasked, were analyzed separately. Cortisol level after undergoing the stressor was the dependent variable, and reaction time to emotional trial type, gender, and the interaction of gender and emotional trial reaction time were entered as predictors. Baseline cortisol and neutral trial reaction time were entered as covariates. Ten regression equations were run, one for each emotional trial type. None produced significant β-weights for the two way interaction of gender and emotional trial type. One trial type, unmasked positive-negative pair with the dot replacing the positive word, produced an interaction that approached significance ($\beta = .746$, $t\,(139) = 1.824$, $p = .070$). The overall regression equation was significant ($R^2 = .235$, $F(5,134) = 8.255$, $p < .001$). Table 10 shows the details of the regression.

Table 10. *Predicting Cortisol Reactivity with Depressogenic Bias and Gender (Study 2)*

	β	***t***	**Sig.**
Baseline Cortisol	0.339*	4.406	<.001
Neutral RT	0.159	1.211	0.228
Emotional RT - Pos(dot)-Neg	-0.456†	-2.673	0.008
Female	-0.847□	-2.251	0.026
2 way interaction			
Emotional RT x Female	0.746	1.824	0.070

In this emotional trial type, a positive-negative word pair appeared, then the positive word was replaced by the dot. A large latency to name the location of the dot would indicate that attentional resources were deployed away from positive stimuli and toward negative stimuli (depressogenic bias), while a short latency would indicate the opposite. As Figure 4 illustrates, level of depressogenic bias had no impact on cortisol reactivity in women, while in men, higher levels of depressogenic bias actually predicted less cortisol reactivity. A scatterplot of the raw data (see Figure 5) demonstrates that this trend seems to have been highly influenced by two outliers low in depressogenic bias but very high in cortisol, both male.

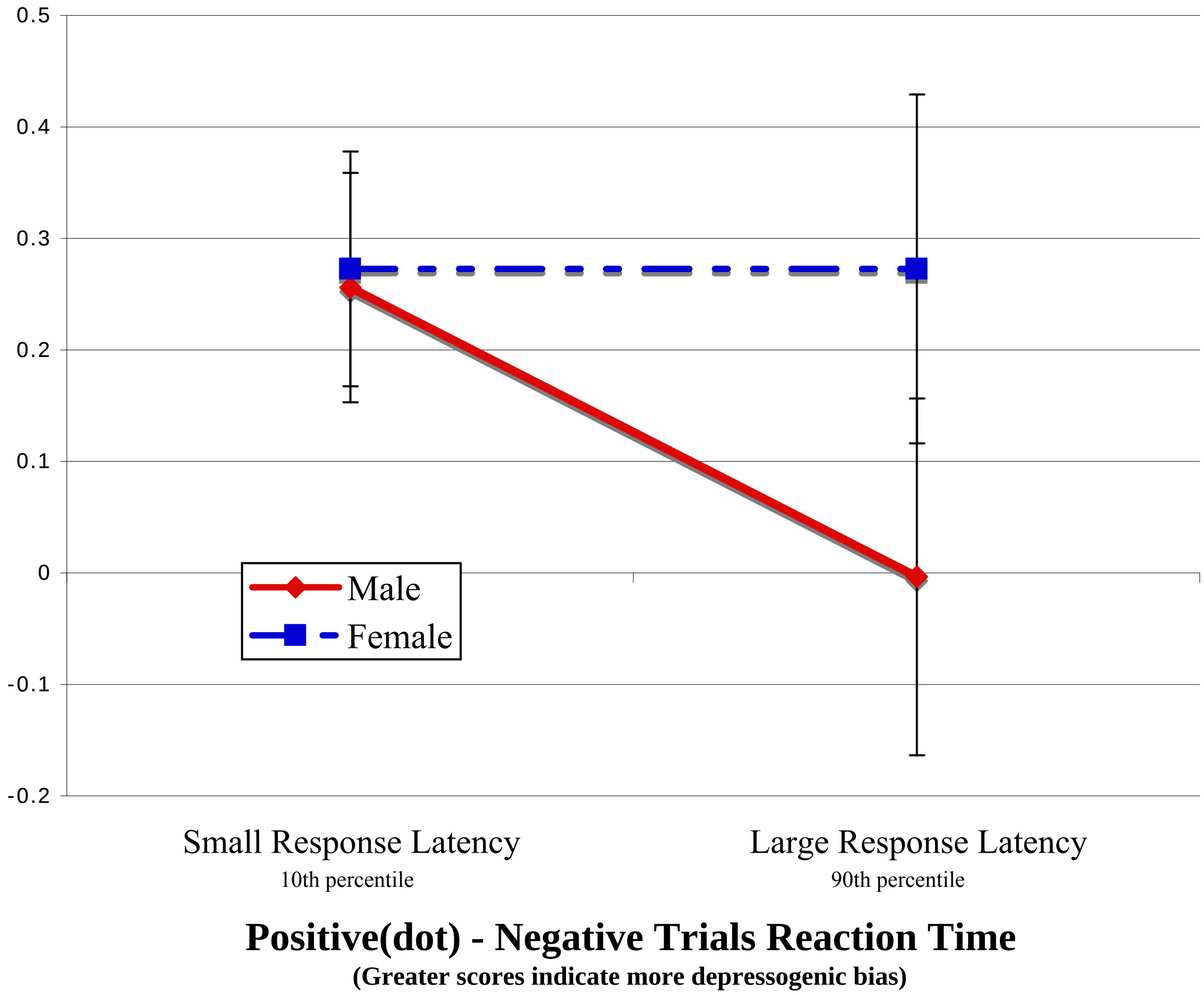

Figure 4. *Trend of Gender by Affective Depression Predicting Cortisol Reactivity (Study 2)*

Note: Error bars reflect standard error.

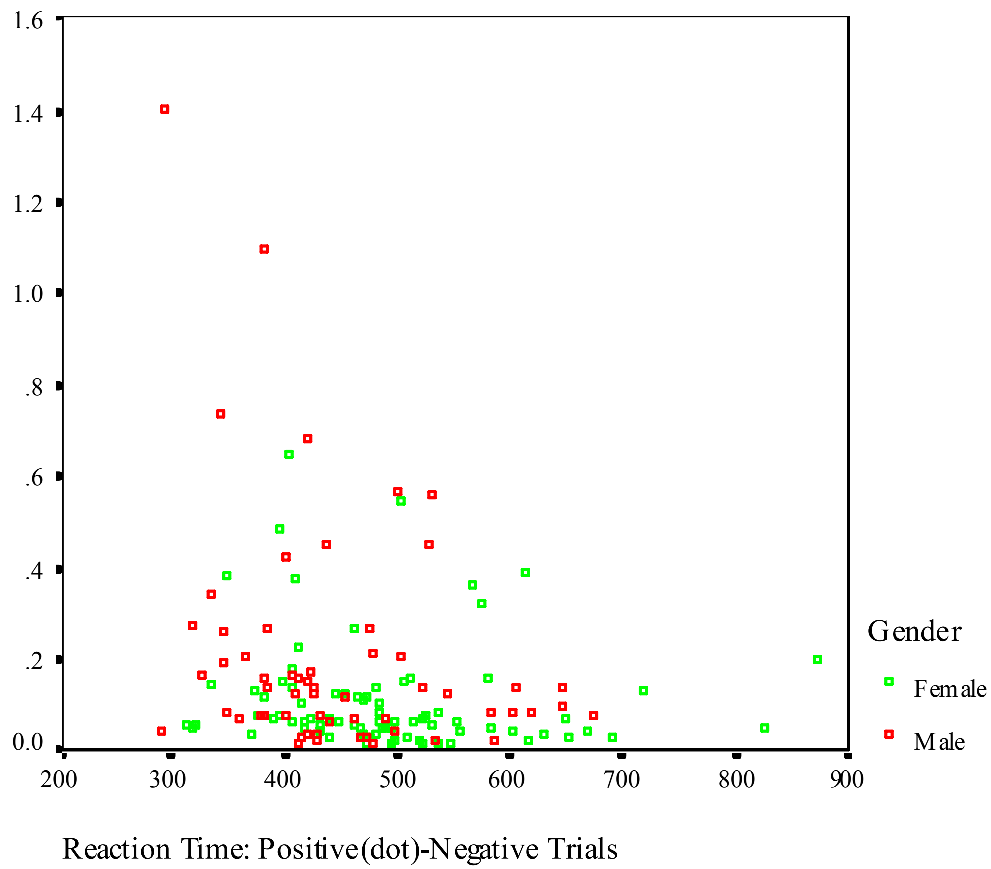

Figure 5. *Scatterplot of Raw Data, Positive(dot)-Negative Trial Type Depressogenic Bias and Cortisol Level After Stressor (Study 2).* Note: Error bars reflect standard error.

3.4.3 Testing Hypothesis 3

To test whether there is a gender difference in physiological reactivity to stress at varied levels of affective depression, changes in cortisol were examined in men and women using regressed change. With cortisol levels after the stressor as the dependent variable, gender, affective depression, and the interaction of the two were entered as predictors into the regression equation, controlling for baseline cortisol. While the overall model was highly significant ($R^2 = .239$, $F(4,158) = 12.438$, $p < .001$), the interaction of gender and affective depression only approached significance ($\beta = -.327$, $t(162) = -1.722$, $p = .087$; see Table 11a).

Table 11a. *Predicting Cortisol Reactivity with Gender and Depression (Model 1, Study 2)*

Baseline Cortisol	0.365*	5.177	<.001
Female	0.094	0.502	0.617
PAI Dep. Affective	0.217□	2.292	0.023
2 way interaction			
Female x PAI Dep. Aff.	-0.327	-1.722	0.087

p < .05,† p < .01, * p < .001 **df = 162**

Figure 6 shows the direction of the interaction trend of gender and affective symptoms of depression in predicting cortisol reactivity. Men tend to be more physiologically reactive after stress if they are more depressed, though this relationship did not meet α-level cutoffs.

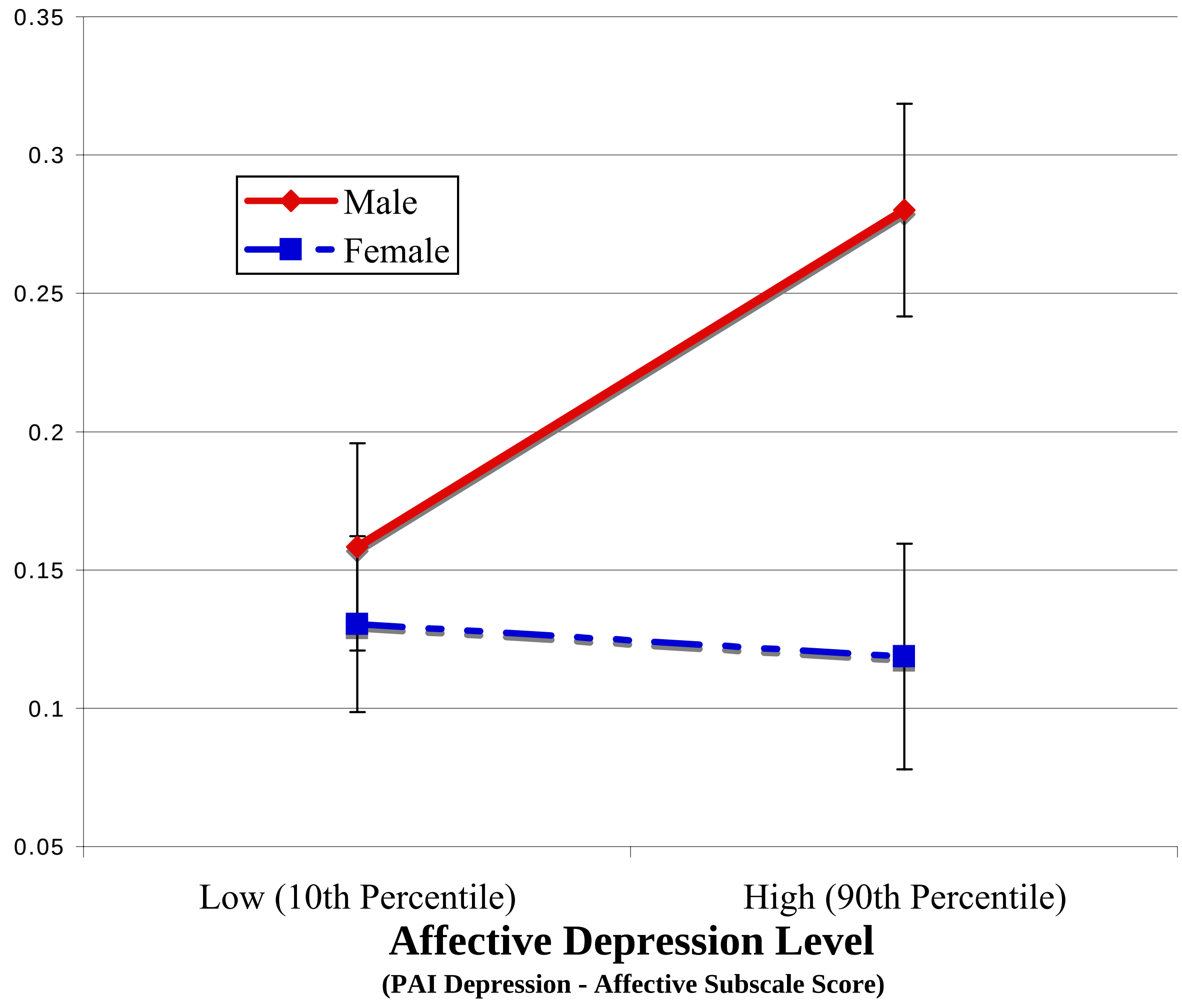

Figure 6. *Gender by Affective Depression Interaction Trend Predicting Cortisol Reactivity (Study 2)*

Note: Error bars reflect standard error.

Through backward deletion, the 2 way interaction was eliminated. Gender and affective depression as main effects were re-entered into the regression equation. Also a significant model ($R^2 = .225$, $F(3,159) = 12.438$, $p < .001$), gender is significant ($\beta = -.204$, $t(162) = -2.869$, $p < .01$), while affective depression is not ($\beta = .107$, $t(162) = 1.524$, $p = .130$). Table 11b shows the details of the revised model.

Table 11b. *Predicting Cortisol Reactivity with Gender and Depression (Model 2, Study 2)*

	β	***t***	**Sig.**
Baseline Cortisol	0.370*	5.225	<.001
PAI Dep. Affective	0.107	1.524	0.130
Female	-0.204†	-2.869	0.005

p < .05,† p < .01, * p < .001 **df = 162**

As shown in Table 11b, controlling for depression, men are more physiologically reactive to induced stress. To make the most parsimonious model, affective symptoms of depression were eliminated from the model, and the model was run again with just gender predicting cortisol after the stressor, controlling for baseline cortisol. The overall model was highly significant ($R^2 = .205$, $F(2,164) = 21.355$, $p < .001$). There was also a strong main effect of gender, as shown in Table 12.

Table 12. *Gender Differences in Cortisol Reactivity (Study 2)*

	β	***t***	**Sig.**
Baseline Cortisol	0.380*	5.426	<.001
Female	-0.196†	-2.796	0.005

† p < .01, * p < .001 **df = 166**

As shown in Figure 7, men are more physiologically reactive to the social stressor, exhibiting larger increases in cortisol than women.

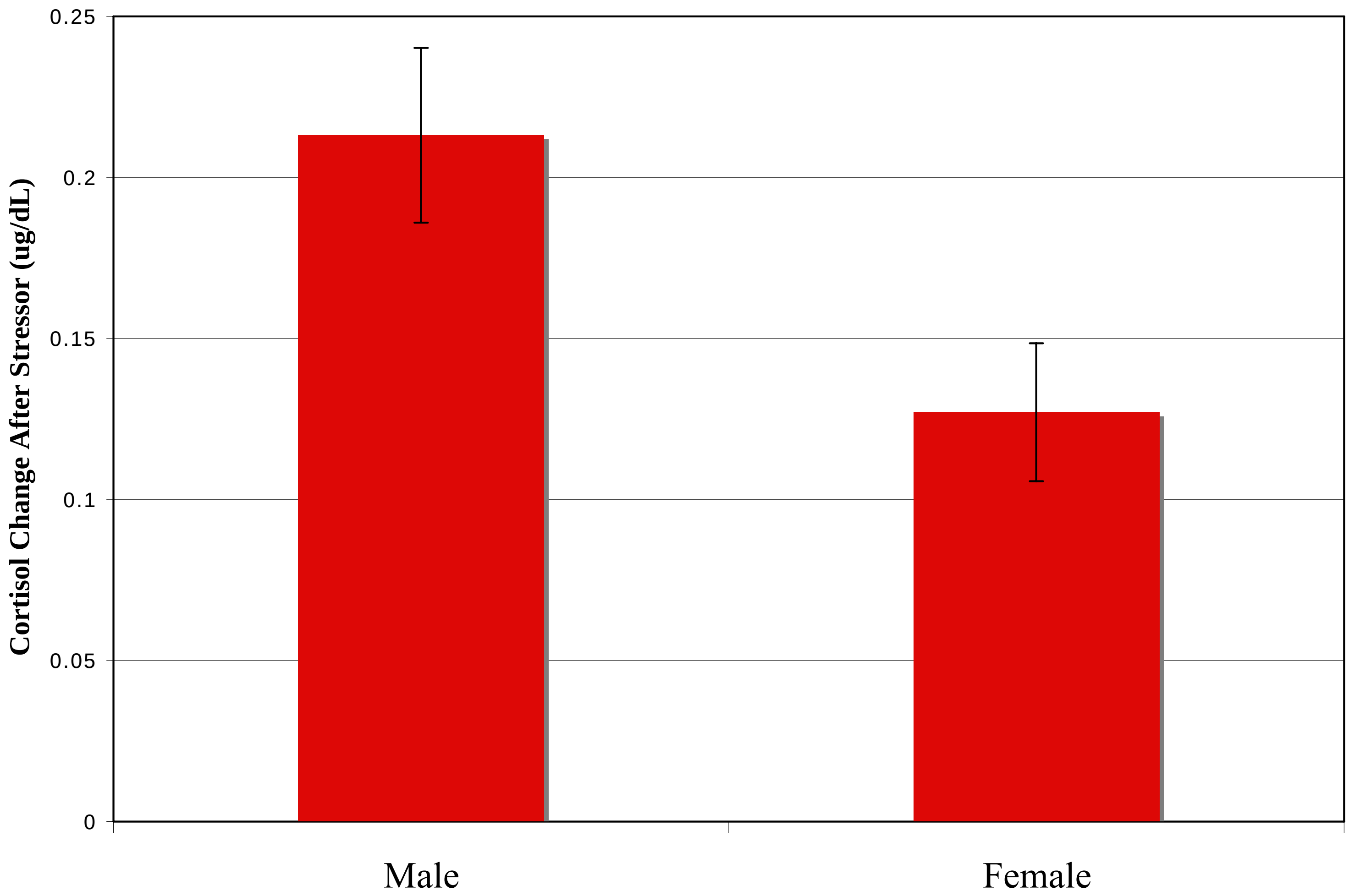

Figure 7. *Gender Differences in Cortisol Reactivity (Study 2)*

Note: Error bars reflect standard error.

3.4.4 Testing Hypothesis 4

Regressed change was used to test whether the interaction of gender and affective depressive symptoms predicted an increase in depressogenic bias, either with masked or unmasked stimuli, occurred after the stressor. Emotional trial reaction time after the stressor was the dependent variable. Neutral trial reaction time after the stressor and emotional reaction time before the stressor were covaried to detect change. Gender, affective symptoms of depression, and the interaction of gender and affective depression were entered as predictors. Ten regression equations were run, one for each emotional trial type, masked and unmasked. None of the regression equations produced significant interaction terms. One trial type, masked with a negative-neutral pair, dot replacing the negative, did produce an interaction term that approached significance ($\beta = .277$, $t(129) = 1.817$, $p = .072$). Table 13 shows the results of the regression ($R^2 = .632$, $F(5,124) = 42.590$, $p < .001$).

Table 13. *Gender x Depression Trend Predicting Attentional Bias Reactivity (Study 2)*

	β	***t***	**Sig.**
Masked Neutral RT T2	0.756*	11.240	<.001
Masked Neg(dot)-Neu RT T1	0.024	0.356	0.723
Gender	-0.207	-1.380	0.170
PAI Depression Affective	-0.081	-1.092	0.277
2 way interaction			
Female x PAI Dep. Aff.	0.277	1.817	0.072

p < .05,† p < .01, * p < .001 **df = 129**

As Figure 8 shows, men tend to show more of an increase in bias toward negative stimuli after the stressor if they are more depressed, while women show the opposite. Differences at the 90th percentile level of affective depression approach significance ($t(129) = 1.911$, $p = .058$), while at the 10th percentile level they do not ($t(129) = -.850$, $p = .397$). However, as neither slope reached significance, these trends must be carefully interpreted.

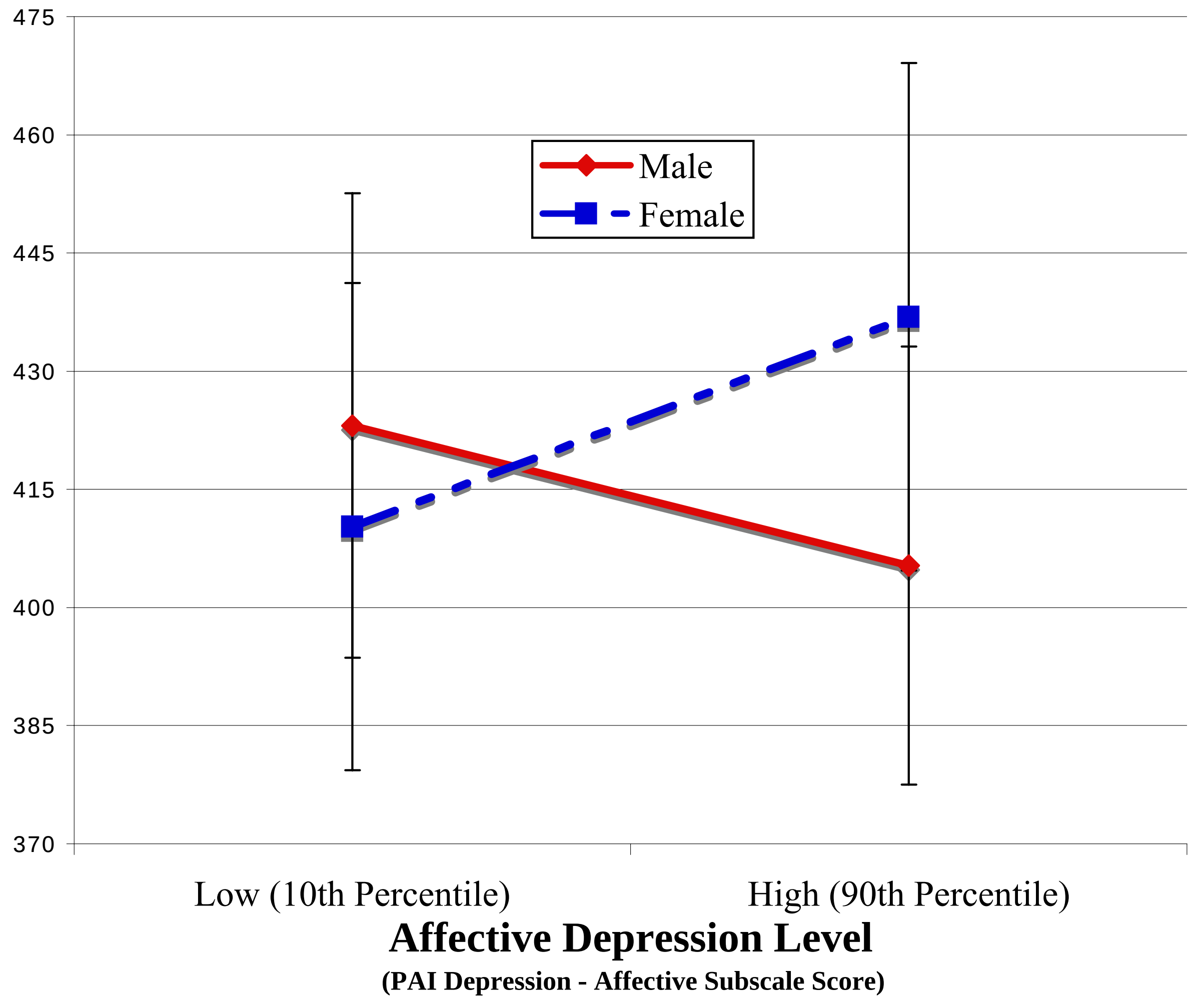

Figure 8. *Trend of Gender by Affective Depression Predicting Change in Attentional Bias for Masked Negative(dot)-Neutral Trials After Stressor (Study 2).* Note: Error bars reflect standard error.

3.5 Discussion

In this study, men showed the pattern found in most attentional bias research: depressogenic bias toward negative stimuli increased with affective depression level. On the other hand, women endorsing more affective depression symptoms showed more depressogenic bias away from positive stimuli. Interpreted within an expanded transactional theory of stress, this suggests that there are different types of cognitive biases that are depressogenic for men and women. Men may be more apt to devote attentional resources to negative stimuli, thereby raising stress levels that make them vulnerable to depression. Conversely, women may be more likely to fail to devote resources to positive stimuli. The effects of these two types of bias, though both depressogenic, could be different. For women, a failure to deploy cognitive resources to positive stimuli could result in delayed recovery or increased chances of relapse, as they are less able to successfully employ coping strategies dependent on focusing on positive information. For example, rumination, which is thought to cause depression in women (Nolen-Hoeksema et al., 1999), could be seen as a failure to consider positive events and feedback, similar to the pattern seen here.

It was observed that women with more affective depression had longer latencies to name the dot in the Negative(dot)-Neutral trials, controlling for neutral trials, than women with less affective depression symptoms. Because these analyses controlled for overall quickness with neutral trials, psychomotor retardation in just women would be an unlikely explanation; psychomotor retardation would affect all trials, including neutral and Negative(dot)-Neutral trials. More likely, it may be that attention to negative stimuli and attention away from positive stimuli are different attentional processes that differently maintain depression in men and women. The current study design, which separated different types of emotional trials in the dot probe task, instead of creating an overall "attentional bias index", allowed this to come to light.

Similarly, only one type of depressogenic bias was found to predict a trend of cortisol reactivity to a social stressor in men, but not in women. Men who were slower to identify the dot in positive-negative trials where the dot replaced the positive word tended to have greater cortisol increases after the stressor. According to an expanded transactional theory of stress, men who had cognitive processes biased toward negative stimuli exhibited increased stress, which was then measurable physiologically. This parallels the first finding, pairing men specifically with depressogenic attention toward negative stimuli and may reflect similar processes. However, these results must be interpreted carefully, as they represent a trend.

Supporting Kirschbaum and colleagues' (1992) finding on gender differences in cortisol reactivity, men were robustly found to be more physiologically reactive to the stressor, exhibiting larger increases in cortisol than women. Depression also may have played a role, as there was also an gender by affective depression interaction trend. More depressed men tended to be more physiologically reactive than less depressed men or women at any depression level, which contrasts with the findings of Weiss et al. (1999) in men and women with depression and histories of sexual abuse. The divergent findings of Kirschbaum et al. (1992), Weiss et al. (1999) and the current study may be due to the different type of stressors used in each study. In both Kirschbaum and colleagues' (1992) study and the current study, a performance-based social stressor was used, while in Weiss and colleagues' (1999) study, self-reported, retrospectively recalled stress over a lifetime was assessed. The performance-based stress induction may be more stressful for men than for women because of males' tendency to attribute outcomes to self or ability (Levine, Gillman, & Reis, 1982), and to rely on performance and social comparison as a basis of self-esteem (Schwalbe & Staples, 1991). Within a transactional theory of stress framework, men may mark different stimuli as relevant, negative, and depressogenic than women and deploy attentional resources accordingly.

Alternatively, as with the eating disorder study, men may experience expressing negative feelings as more counter-normative than women. Females are more likely than men to express negative emotions, which is thought to be a product of gender socialization at an early age (Nolen-Hoeksema et al., 1999). As such, a certain score on an affective depression measure, which requires the subject to acknowledge and express his feelings, may reflect more severe symptoms for a male than for a female.

Finally, men, but not women, tended to show more of an increase in bias toward negative stimuli after the stressor if they endorsed more affective depression symptoms. This, again, is consistent with the other findings in this study that men may be more sensitive to the process associated with attention toward negative stimuli. However, unlike the rest of the findings in this study, this was with masked stimuli presented at short durations. This may represent a preattentive categorization bias, where participants are more likely to see the stimulus as negative and relevant. A short, masked presentation is designed to capture response bias reflecting this early process. However, again, these results should be interpreted carefully as they did not meet α-level cutoffs.

A potential limitation of this study was that in the analyses, a regression equation was run for each emotional trial type. This increases family-wise error and inflates actual α levels. However, this was one of the first studies to separate out each different type of emotional trials to uncover whether they are different processes, and whether these processes work differently in men or women. The method of analysis was flexible and anti-conservative enough to reveal these differences, which would otherwise have been obscured. This study, through its exploratory nature, provides the basis for other studies that examine these separate processes in depth with more rigid tests.

4. CONCLUSION

The main objective of this paper was to present and empirically test a model of psychopathology sufficiently detailed to serve as a framework within which to investigate gender differences. In this paper, it was demonstrated that the transactional theory of stress and the information processing bias model each were inadequate to explain gender differences in psychopathology, but combined provided a broad yet specific enough framework. Then, some key cognitive junctures identified within the new model were tested in Study 1, focusing on eating disorders, and Study 2, with depressive disorders. In Study 1, using the Stroop task, gender differences were examined in the relationship between one component of eating disorders, restrained eating, and several aspects of the expanded transactional theory of stress: preattentive categorization, attentional orienting, and physiological evidence of stress. It was found that those with higher levels of restrained eating, whether male or female, oriented attention more readily to food stimuli. Also, men were demonstrated to have greater physiological stress responses after exposure to food stimuli presented at long durations. In Study 2, the dot probe task was used to examine attentional orienting and preattentive categorization in men and women with affective symptoms of depression; the relationship of these cognitive processes to stress hormone levels after induced social stress in males and females was also investigated. It was found that depressogenic attentional bias differed for men and women. In men, it was toward negative stimuli; in women, it was away from positive stimuli. Similarly, attention toward negative stimuli was the only type of depressogenic bias that predicted physiological reactivity to the induced stress in men, although this trend did not meet significance cutoffs. Men in general showed more cortisol reactivity to the social stressor, but there was also a gender by affective depression interaction trend. Men who endorsed more affective symptoms of depression were more physiologically reactive to the stressor than less depressed men or women at any depression level. Finally, men with more affective depression symptoms tended to show a response bias to negative stimuli at the preattentive categorization level.

The expanded transactional theory of stress was able to capture these differences because of strengths in the model. It is detailed enough to allow more specific hypotheses to be made. The expanded transactional theory of stress distinguishes between different levels of cognitive processing, which allowed gender differences and differences in cognitive processes be revealed in both Study 1, which found physiological reactions in men to late processed stimuli, but not early processed stimuli, and Study 2, which found depressogenic bias to be focused in late processes in both men and women. Also, the expanded transactional theory of stress differentiated between deployment of cognitive resources toward negative stimuli and away from positive stimuli as potentially separate processes; this permitted the novel finding that depressogenic bias may be different for men and women. Study 2 found that in men, it is toward negative stimuli, while in women is away from positive stimuli. Lastly, while not directly tested in Study 1 or Study 2, the transactional element in the new model provides an interpretive framework for understanding one of the sources of these cognitive biases. That is, negative feedback from the environment due to poor coping may exacerbate cognitive biases. While previous models, such as the information processing bias model and the transactional theory of stress, identified major factors contributing to gender differences in psychopathology, the expanded transactional theory of stress combines both models into a more detailed model that is better able to serve as an interpretive framework.

While the expanded transactional theory of stress is a powerful model to generate hypotheses and provide interpretation, it does have limitations. For the purposes of this paper, only one early process, preattentive categorization, and one late process, attentional orienting, were elaborated upon. However, future research can specify the place of other processes, such as memory processes, within the model and in relation to each other. Secondly, this paper did not delineate the role of specific genetic or biological predispositions in the expanded transactional theory of stress, but future research will investigate how genetic and biological factors affect the detrimental attitudes and beliefs that contribute to cognitive bias. Despite these limitations, the expanded transactional theory of stress is a powerful framework within which to understand gender differences in psychopathology, and will be more so when future research addresses these issues.

These studies have important implications for understanding gender differences in psychopathology within an expanded transactional theory of stress framework, particularly for treatment options and research. As this study found that men have a stronger physiological arousal component to their psychopathology, treatments that focus on lowering stress hormone levels, whether pharmacologically or otherwise, might be more effective for men. A future study could test this hypothesis. Also, the finding in Study 2 that, generally, men's depressogenic bias is toward negative stimuli, while women's is away from positive stimuli may be useful in cognitive-behavioral therapy. While these findings must be replicated, these studies raise interesting questions for future research and continue the dialogue on gender differences in psychopathology.

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APPENDIX A

Expanded Transactional Theory of Stress Flowchart

Stimulus input

Primary Cognitive Appraisal

- Personal meaning and significance of stimulus
- Influenced by beliefs/expectations

Preattentive – Categorization

Relevant [Irrelevant]

Negative [Positive]

(Stress increased)

Attentional Orienting

Toward Negative **Away from Positive** [Away from Negative/Toward Positive]

(Stress increased)

Elaboration

Facilitated Elaboration [Inhibited Elaboration]

(Stress increased)

Secondary Cognitive Appraisal

- Evaluate possible coping responses and likelihood of success
- Influenced by prior beliefs/expectations

Implementation of Coping

Passive, Emotion- or Self-focused, Unsuccessful Implementation [Successful Coping]

(Stress Increased)

Stress Outcome

Reappraisal

- Feedback is incorporated into beliefs/expectations

VITA

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