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THE EFFECTS OF STRESS INDUCTION ON PRE-ATTENTIVE AND ATTENTIONAL BIAS FOR THREAT IN SOCIAL ANXIETY

By

Kristin M. Maki

B.A. Trinity College, 1993

A THESIS

Submitted in Partial Fulfillment of the

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(in Psychology)

The Graduate School

The University of Maine

May, 2003

Advisory Committee:

Jeffrey E. Hecker, Professor of Psychology, Advisor

Geoffrey Thorpe, Professor of Psychology

Sandra T. Sigmon, Associate Professor of Psychology

Colin Martindale, Professor of Psychology

Christine Fink, Cooperating Assistant Professor of Psychology

THE EFFECTS OF STRESS INDUCTION ON PRE-ATTENTIVE AND ATTENTIONAL BIAS FOR THREAT IN SOCIAL ANXIETY

By Kristin M. Maki

Thesis Advisor: Dr. Jeffrey E. Hecker

An Abstract of the Thesis Presented
in Partial Fulfillment of the Requirements for the
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The current investigation is a test of the vigilance-avoidance model of attentional processing in a socially anxious sample (Mogg, Bradley, de Bono, & Painter, 1997). The theory proposes that individuals with social phobia possess a pre-attentive bias for social threat cues in their environment, however, they subsequently fail to process this information due to strategic cognitive avoidance, that is, conscious efforts to disengage attention from threatening information. A combined subliminal/supraliminal emotional Stroop paradigm was employed in order to examine patterns of pre-attentive and attentional processing of threat cues in an analogue sample of undergraduate students with high versus low levels of social anxiety. Attentional patterns were assessed both prior to and after the initiation of an anxiety induction procedure. It was predicted that, when subjected to stress, socially anxious individuals would automatically orient their attention to social threat cues, however, they would not maintain their attentional focus on the cues sufficiently to allow objective evaluation of them. Thus, theoretically, habituation to the

anxiety produced by the social threat cues would be prevented and anxiety would be maintained over the long term.

Socially anxious individuals demonstrated pre-attentive vigilance for both social and physical threat cues, followed by avoidance of such cues in later, voluntary stages of attention (ie., the vigilance-avoidance pattern) in the absence of stress. However, when subjected to an anxiety induction procedure, the attentional pattern of the socially anxious individuals was altered. The initial pre-attentive vigilance for threat appeared to continue into later, strategic stages of attention. That is, they did not appear to be capable of overriding their preattentive bias for threat and attention remained engaged on the threat cues. Contrastingly, under stress, the non-anxious control group demonstrated a pattern of avoidance of threat cues in preattentive and attentional stages. These findings are discussed in light of the vigilance-avoidance model and another recently-proposed theory of attentional bias (Fox et al., 2001, 2002).

TABLE OF CONTENTS

LIST OF TABLES v

LIST OF FIGURES vi

INTRODUCTION 1

Social Phobia: Descriptive Psychopathology 2

Etiological Models of Social Phobia 4

Social Skills Deficit Model 4

Conditioning Models 6

Cognitive Models 8

Attentional Bias in Social Phobia 10

Detection Paradigms 10

Facilitation Paradigms 11

Interference Paradigms 13

Automatic versus Strategic Processing: The Failure of Beck and Emery's (1985) Model 21

Williams' Reformulated Cognitive Model 22

Problems with Gauging Automaticity with Traditional Measures of Attentional Bias 25

Pre-attentive Processing Paradigms 27

Subliminal Dot-Probe Task 27

Masked Stroop Color-Naming Task 28

A Test of Williams' Model: The Masked Stroop Task 29

Interaction Hypothesis 29

Pre-attentive Processing Biases in Clinical Populations..... 32

Discrepant Findings..... 36

Effects of Treatment on Pre-attentive Bias..... 36

Discrepant Findings II: Stroop Suppression in Clinical Samples..... 39

The Vigilance-Avoidance Model..... 40

Summary of Proposal and Hypotheses..... 42

Significance of the Proposal..... 47

METHOD..... 49

Participants..... 49

Assessment..... 49

Liebowitz Social Anxiety Scale..... 49

Social Phobia and Anxiety Inventory..... 51

Fear of Negative Evaluation Scale..... 54

Social Avoidance and Distress Scale—Avoidance Subscale..... 55

State-Trait Anxiety Inventory—State Scale..... 55

Beck Depression Inventory-II..... 57

Emotional Stroop Color-Naming Task..... 58

Awareness Checks..... 60

Procedure..... 60

Participant Selection..... 60

Questionnaire Assessment..... 61

Stroop Color-Naming Tasks..... 61

Debriefing..... 62

RESULTS 63

Participant Characteristics 63

Response to Induction Procedure 63

Stroop Color-Naming Task 64

Awareness Checks 72

Post-hoc Analyses 73

DISCUSSION 74

Principal Findings and Implications 74

Methodological Weaknesses 80

Recent Developments 83

Future Directions 86

REFERENCES 89

APPENDICES 105

Appendix A. Informed Consent I 106

Appendix B. Stroop Word Stimuli 107

Appendix C. Awareness Check Stimuli 108

Appendix D. Telephone Screening Transcript 109

Appendix E. Informed Consent 110

Appendix F. Debriefing Statement 111

BIOGRAPHY OF THE AUTHOR 112

LIST OF TABLES

Table 1. Participant Demographic and Clinical Characteristics..... 63

Table 2. Mean Color Naming Latencies in Milliseconds by Group for Pre- and Post-Induction Stroop Tasks..... 65

Table 3. Awareness Check Results (Mean Percentage Correct on Each of Four Sets of Lexical Decision Tasks)..... 72

Table B1. Stroop Color-Naming Task Word Stimuli..... 107

Table C1. Awareness Check Stimuli Sets..... 108

LIST OF FIGURES

Figure 1. Pre- and Post-Induction Mean Interference Scores for Subliminal Threat Words (Combined Physical and Social Threat)..... 67

Figure 2. Pre-Induction Mean Interference Scores for Supraliminal Threat Words..... 68

Figure 3. Pre-Induction Mean Interference Scores for Threatening Words.....69

Figure 4. Post-Induction Mean Interference Scores for Threatening Words..... 70

Figure 5. Comparison of Color-Naming Latencies for Categorized and Uncategorized Word Stimuli (in Milliseconds)..... 71

INTRODUCTION

Cognitive processing models of psychopathology have proposed that individuals who suffer from anxiety disorders exhibit a tendency to process preferentially threatening information in their environment (Williams, Watts, MacLeod, & Mathews, 1997). In social phobia, this processing bias is specific for social threat cues and has been demonstrated for attention and interpretation, but not for memory (Amir et al., 1996; Foa, Franklin, Perry, & Herbert, 1996; Rapee, McCallum, & Melville, 1994). According to Williams and colleagues (1997), anxiety is characterized by a bias that favors threat stimuli in both pre-attentive (i.e., prior to awareness) and attentional (i.e., subject to strategic control) processes. Moreover, the pre-attentive vigilance for threat is hypothesized to represent a cognitive vulnerability factor for clinical anxiety.

Williams and colleagues (1997) have suggested that what distinguishes non-clinically anxious from clinically anxious individuals is their ability to "override" their attentional bias in times of stress. However, recent investigations have demonstrated that strategic override is not limited to the non-clinically anxious (Amir et al., 1996; Mathews & Sebastian, 1993). In particular, initial data suggest that, when faced with stress, individuals with social phobia are able to suppress their attentional bias for socially threatening information, suggesting that they are particularly adept at avoidance.

Recently, a two-stage, vigilance-avoidance cognitive processing model has been outlined which would appear both to explain recent discrepant findings and to elucidate the maintenance of clinically significant anxiety (Mogg, Bradley, de Bono, & Painter, 1997). The authors posit that individuals with social phobia possess a pre-attentive bias for social threat cues in their environment, however, they subsequently fail to process this

information due to strategic cognitive avoidance, that is, conscious efforts to avoid attending to threatening information. Avoidance of the processing of social threat cues prevents habituation, or objective evaluation, of such information. As a result, the threatening information retains its anxiety-provoking effects.

The current study is a test of the vigilance-avoidance hypothesis in a socially anxious analogue sample. A variant of MacLeod and Hagan's (1992) subliminal Stroop color-naming paradigm was employed in order to examine patterns of pre-attentive and attentional processing of threat cues in undergraduate students with and without significant levels of social anxiety. Moreover, by examining these attentional patterns prior to and subsequent to an anxiety induction procedure, the study aimed to elucidate whether these patterns change as a function of the degree of situational stress that an individual experiences.

Social Phobia: Descriptive Psychopathology

Social phobia was once labeled the "neglected anxiety disorder" because it had received less empirical study than other anxiety disorders (e.g., panic disorder, agoraphobia, specific phobia). However, the past ten to twenty years have seen a dramatic increase in research with respect to the etiology and treatment of social phobia. This interest has been due, in part, to the recognition that the disorder represents a significant mental health problem affecting approximately 13% of the general population at some point in their lifetime (Kessler et al., 1994).

According to the Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition, the hallmark of social phobia is a marked and persistent fear of one or more social or performance situations in which a person is exposed to unfamiliar people or to possible

scrutiny by others (American Psychiatric Association, 1994). Individuals who suffer from social phobia fear critical evaluation from others and perceive a high likelihood of being disapproved of or humiliated as a result of social scrutiny. As a result, they frequently avoid social situations or endure them with a great degree of emotional or somatic distress. Social anxiety may be limited to a circumscribed area (i.e., public speaking), in which case it is referred to as specific subtype, or it may be pervasive and extend across a variety of situations, in which case it is referred to as generalized subtype (APA, 1994).

Social phobia is associated with significant comorbidity and impairment in quality of life. For example, Turner, Beidel, Borden, Stanley, and Jacob (1991) found that 43% of a sample of 71 individuals diagnosed with social phobia received an additional Axis I diagnosis (GAD was most common). Another study found that 60% of a sample of individuals with social phobia had an additional Axis I diagnosis, with specific phobia (25%), dysthymia (21%), and avoidant personality disorder (17%) being the most common comorbid diagnoses (Sanderson, DiNardo, Rapee, & Barlow, 1990). Alcohol and substance abuse are also common comorbid conditions that may represent attempts by individuals to alleviate anxiety through self-medication. One study reported that 19% of a community sample of individuals with social phobia met criteria for alcohol abuse (Schneier, Johnson, Hornig, Liebowitz, & Wissman, 1992). In addition, mood disorders are another common comorbid condition, with approximately one-third of social phobics meeting criteria for depression (Liebowitz, Gorman, Fyer, & Klein, 1985).

Historically, there has been some confusion in the literature about the nature of the relationship between social phobia and avoidant personality disorder (APD). APD is a long-standing pattern of avoidance of interpersonal contact, fear of rejection, fear of

blushing, or concerns about performing inadequately in social encounters (APA, 1994). According to Johnson and Lydiard (1995) approximately 40-70% of social phobics receive an additional diagnosis of APD. The two disorders share a similar age of onset, although those who suffer from APD are more likely to have comorbid depression. Thus, some researchers hypothesize that the two disorders differ quantitatively, not qualitatively.

Social phobia is also associated with significant impairment in educational, occupational, and social functioning. Individuals with social phobia frequently avoid occupations which require social contact, pass up opportunities for higher education, and fail to develop friendships and relationships outside of their immediate family (Ross, 1994). The disorder is equally prevalent in men and women, and age of onset is generally between 15 and 20 years (Liebowitz et al., 1985; Turner, Biedel, & Townsley, 1992). In one study of individuals with social phobia, the mean age of participants seeking treatment ranged from 27 to 41 years, with duration of illness ranging from 8 to 22 years (Heimberg, 1989). Thus, although onset of social phobia is early relative to the other anxiety disorders, treatment-seeking behavior is not.

Etiological Models of Social Phobia

Social Skills Deficit Model. Early conceptualizations of social phobia were grounded on the belief that afflicted individuals lacked the social skills necessary to engage in successful social interactions (Curran, 1977; Twentyman & McFall, 1975). According to social skills models, individuals who lack social skills find social interaction particularly aversive, prompting them to avoid social situations and to experience fewer opportunities to increase their repertoire of social behavior. Research on whether individuals with social phobia do, in fact, perform more poorly in social evaluative situations than do non-

anxious participants has been far from consistent. Whereas some studies have found socially anxious participants to score lower on independent ratings of social performance (Pilkonis, 1977; Twentyman & McFall, 1975), others have not found significant differences (Clark & Arkowitz, 1975; Glasgow & Arkowitz, 1975; Rapee & Lim, 1992).

Treatments which spawned from these early conceptualizations of social phobia focused on the development of social skills through the use of instruction, participant modeling, corrective feedback, and role playing. However, research evaluating the effectiveness of social skills training for social anxiety has demonstrated only modest outcome effects. In an early study, systematic desensitization (progressive relaxation training with the presentation of increasingly anxiety-provoking imaginal scenes) was compared to social skills training for social anxiety. Neither treatment demonstrated effects clearly superior to attention placebo controls (Marzillier, Lambert, and Kellett, 1976). Similarly, a follow-up study comparing individuals with social phobia with and without social skills deficits found that both groups improved equally with either treatment, however, improvement was restricted to self-report of anxiety rather than behavioral change (Trower, Yardley, Bryant, & Shaw, 1978). Another study found that individuals with social phobia who were treated with either social skills training alone or in combination with cognitive modification (a treatment based on Ellis's Rational Emotive Therapy) found that both groups demonstrated modest improvement on measures of social interaction, anxiety, depression, and irrational beliefs (Stravynski, Marks, & Yule, 1982). Given inconsistent empirical findings with respect to the existence of social skills deficits in social phobics and the success of social skills training in alleviating anxiety, the

social skills model would appear to an incomplete explanation for the development and maintenance of social phobia.

Conditioning Models. One of the most prominent theories of social phobia proposes that it may develop in the same way as many specific phobias, that is, as a result of one or more traumatic conditioning experiences. For example, social situations (e.g., public speaking or eating in public) become conditioned stimuli (CS) in that they acquire the capacity to elicit fear after being paired with an unconditioned stimulus (UCS) such as social defeat or a humiliating experience. Consistent with this theory, one study found that 58% of a sample of individuals diagnosed with social phobia could recall a direct conditioning experience that may have been involved in the onset of social anxiety (Ost & Hugdahl, 1981). After the social fear is classically conditioned, Two Factor Theory posits that subsequent avoidance behavior develops through operant learning (Mowrer, 1960). That is, avoidance of both the aversive social situation and the physiological arousal that it produces becomes negatively reinforcing.

Social fears also may be acquired through observational or vicarious conditioning. Although there is little empirical evidence for this theory in humans, strong empirical support exists for the observational conditioning of phobic-like fears in animals. For example, laboratory-raised monkeys who have never been exposed to snakes acquire an intense fear of them after observing wild monkeys behaving fearfully in their presence (Mineka & Cook, 1993). Although this evidence is indirect, it at least offers some support for the notion that the vicarious learning of social fears is feasible in humans.

Early exposure-based therapies developed from conditioning models, which predicted that repeated exposure to feared stimuli would result in extinction of the

conditioned fear response. Typically, an exposure experience involves the drafting of a list of anxiety provoking situations, after which a therapist and a client progress up the list, sometimes aided by relaxation therapy, until each situation is adequately tolerated by the client. In this way, the client learns to participate in social situations with reduced anxiety. Homework assignments also require clients to practice exposing themselves to a variety of feared social situations in order to gain valuable experience with feared social situations and to develop a sense of social competence and increased amenability to entering social situations.

Empirical testing of exposure therapy has produced promising results. For example, in a study comparing rational-emotive therapy (RET) and self-instructional training (SIT) to exposure therapy (Emmelkamp, Mersch, Vissia, Van der Helm, 1985), only exposure therapy resulted in a significant reduction in social anxiety and significantly greater reductions in heart rate before and after a behavioral test compared to the other two treatments. When group-administered exposure was compared to individual social skills training (SST), both interventions produced significant within-group changes on measures of social fear and avoidance (Wlazlo, Schroeder-Hartwig, Hand, Kaiser, & Munchau, 1990). However, exposure therapy resulted in a greater reduction of fear of social contact and greater gains in assertiveness than did SST.

Despite the success of exposure-based treatments for social phobia, the conditioning models upon which they are based have weaknesses as etiological models. First, not all individuals with social phobia can recall experiencing or witnessing a traumatic event that could account for their classically conditioned fear response to social situations (Ost & Hugdahl, 1981). Second, many individuals who do experience social

humiliation fail to develop lasting fears of social situations. Third, historically, conditioned fear has been very difficult to produce experimentally in humans (Harris, 1979). These and other difficulties have prompted researchers to explore cognitive factors in an attempt to explain the origin and maintenance of social phobia.

Cognitive Models. In general, cognitive theories of anxiety disorders focus both on the content of cognitions and on the information processing strategies and cognitive structures that support anxious functioning. According to Beck and Emery's (1985) cognitive model, anxiety disorders result from "hypersensitive alarm systems...sensitive to any stimuli that might be taken as indicating imminent disaster or harm" (p. 31). This hypersensitivity is characterized by a style of cognitive processing known as the "vulnerability mode," which facilitates the processing of danger or threat cues. According to the cognitive model, a mode represents an organization of cognitive structures called schemata, or rules based on experience, which "orient the individual to a situation and help him [her] to select relevant details from the environment and to recall relevant data" (p. 54). According to the cognitive model, the vulnerability mode, which is predominant in those who suffer with anxiety disorders, involves the activation of dysfunctional schemata which are hypersensitive to threat cues and hyposensitive to safety cues.

According to the cognitive model, individuals who are afflicted with anxiety disorders are thought to process information in a biased manner as a result of dysfunctional schemata (Beck & Emery, 1985). For example, the schemata of individuals with panic disorder render them particularly vulnerable to physical threat and elicit increased vigilance to changes in bodily sensations (e.g., increases in heart rate or respiration, chest pain, dizziness). Individuals who suffer from social phobia, on the other

hand, possess schemata which render them particularly vulnerable to negative evaluation from others. In response to threatening social situations, their vulnerability mode becomes active and their schemata define them as incompetent or lacking the resources to meet social demands. As a result, individuals with social phobia interpret social situations as challenges or confrontations in which they are at risk of revealing signs of vulnerability or weakness. These individuals scan their environment for threat-related material and allocate more resources to its processing. Although schematic hypersensitivity to threat cues is meant to protect the socially anxious from the perceived hazards of social interaction, it results in an overestimation of their vulnerability and confirms their expectations of negative evaluation.

Clearly, one disadvantage of cognitive models is that they include inferential, higher-order constructs (e.g., schemata) which can only be measured indirectly. However, two important criteria by which a construct may be evaluated are its ability to further our understanding of a disorder and to generate clinical interventions. Cognitive factors have been hypothesized to be more central to the development and maintenance of social phobia than is the case with any other anxiety disorder (Butler, 1985; Emmelkamp, 1982). At its very core, fear of negative evaluation by others is a problem of the perception of other people's motives and behavior. Thus, interventions that address distorted thoughts and perceptions should be especially important components of the treatment of social phobia. Indeed, research has suggested that individuals with social phobia who receive exposure-based treatment with cognitive restructuring tend to be more successful in maintaining treatment gains than are individuals who receive exposure treatment by itself (Mattick et al., 1989; 1991).

Beck and Emery's model (1985) also has been successful in generating a great deal of research into the development and maintenance of anxiety disorders. Consistent with cognitive conceptualizations of attentional processes in clinical populations, several studies have confirmed that clinically anxious individuals do, in fact, process information differently than do non-clinical populations. Although these information-processing studies span the varied domains of interpretation, attention, memory, and interoception, for the purposes of the present research proposal, the succeeding review will be limited to the domain of attentional bias.

Attentional Bias in Social Phobia

Attentional bias refers to an individual's tendency, given limited information-processing capacity, to selectively allocate attentional resources to particular stimuli in his/her environment. The ability to detect signs of threat in one's environment, in particular, would appear to have adaptive value, in that it would allow one to prepare for defensive action. However, individuals who suffer from anxiety disorders are thought to possess a particularly low threshold for detecting threat. As a result, they misinterpret harmless situations as potentially threatening and quickly shift into a defensive mode characterized by increased physiological arousal and behavioral avoidance. A number of investigations have utilized detection, facilitation, and interference paradigms to examine attentional bias in the anxiety disorders, in general, and in the socially anxious, in particular (McNally, 1996).

Detection Paradigms. Detection paradigms are designed to assess an individual's propensity to shift attentional resources to threatening information while he/she is engaged in another task. For example, the dichotic listening task requires a participant to attend to

one of two passages being presented to opposite ears while performing a response when specific target words occur in the unattended passage. In the past, the dichotic listening task has been adapted for a sample of agoraphobics, social phobics, and controls (Burgess, Jones, Robertson, Radcliffe, & Emerson, 1981). Participants repeated aloud (shadowed) one of two passages presented to opposite ears. They were required to push a button whenever they detected threat (e.g., shopping alone) and neutral (e.g., pick) targets that occurred out of context in either passage. Both clinical groups detected significantly more threat targets than neutral targets in the unattended passage. Thus, the clinical groups, but not the control group, exhibited an attentional bias for threat.

Facilitation Paradigms. If threat cues do, in fact, command attentional resources in social anxiety, then such cues would be expected to facilitate performance on tasks that require attentional shifts to threat cues. This premise lies behind facilitation paradigms such as the dot-probe attention deployment task. The traditional dot-probe task requires participants to perform a response (e.g., a button press) to a neutral visual stimulus (e.g., a dot) which replaces either member of a pair of words that appear on a computer screen. Participants read the top word of each pair and press a button whenever they detect a dot. In a typical study, on a proportion of trials, one of the two words has a threatening meaning. For example, performing the dot-probe task, clients with generalized social phobia responded faster to probes (i.e., dots) that followed social threat words than to probes that followed either neutral or physical threat words (Asmundson & Stein, 1994). An earlier study had found that individuals with panic disorder responded faster to probes that followed physical threat words than to probes that replaced social threat words (Asmundson, Sandler, Wilson, & Walker, 1992). However, a more recent study failed to

replicate those findings (Horenstein & Segui, 1997). In this recent study, responses of individuals with social phobia and panic disorder were compared to control on a dot-probe task consisting of social threat, physical threat, and neutral words. Although individuals with panic disorder responded significantly faster to words denoting physical threat, the same pattern of results was not observed with respect to individuals with social phobia and social threat words.

Believing that social threat words did not possess sufficient threat value for individuals with social phobia, Yuen (1994) modified the dot-probe task, using neutral and negative facial expressions rather than words. Participants were presented with two faces, one above the other, for one second. The faces were then replaced with a dot that appeared on the location of the top or bottom face. Analyses revealed that highly socially anxious individuals showed longer reaction times for detecting dots that appeared on a site of a previously presented negative face, as compared to a neutral face. There were no significant differences found in reaction times for nonanxious individuals. Thus, these findings are at odds with the attentional bias hypothesis, which would predict that individuals with social anxiety will exhibit shorter reaction times for negative faces.

The "face-in-the-crowd" task represents another type of facilitation paradigm. Using stimuli consisting of facial expressions may represent a more ecologically valid means of investigating cognitive bias in individuals with social phobia for several reasons. For example, facial expressions of anger or disapproval connote negative social evaluation, which is a highly salient concern for social phobics. In addition, the detection of facial features and expressions is extremely efficient, operates on a preattentive level, and appears early in human development, suggesting that it is of particular evolutionary

significance (Ekman, 1992; Hansen & Hansen, 1994; Ohman, 1986; Young & Ellis, 1989). In the face-in-the-crowd task, participants are presented with computer-generated images of a "crowd" consisting of twelve faces. In some trials all faces have identical emotional expressions, whereas on others one "target" face displays a different emotion than the rest (the "distractors"). The task of the participant is to report either the presence or location of the target face.

Consistent with the attentional bias hypothesis, individuals with social phobia are significantly faster to detect angry than happy faces within a neutral crowd (Schechtman, Foa, & Amir, 1999). When attempting to detect a target face, social phobics are significantly more impaired by the presence of both angry and happy crowds, implying a sensitivity for emotional expression in general. Inconsistent with the attentional bias hypothesis, however, both clinical and control groups have been shown to allocate disproportionate attention to angry faces which are presented in a background of happy faces (Schechtman et al., 1999). In summary, findings from the dot-probe and the face-in-a-crowd paradigms would appear to offer mixed support for Beck and Emery's assertion that social phobics are unique in their propensity to attend to social threat cues.

Interference Paradigms. A third approach to investigating attentional bias, the interference paradigm, requires participants to ignore extraneous stimuli while performing a task which is unrelated to the detection of threat. Selective attention to threat is suggested by task performance decrements induced by the presence of threat cues. To date, interference paradigms, particularly the Stroop color-naming task (Stroop, 1935), have received the most empirical attention of the three methods of studying attentional biases. In the original Stroop task, participants are shown a series of color words ("blue,"

"green," "yellow") on cards or on a computer screen. The participant is required to name the color in which each word is printed. The modified emotional Stroop task involves using emotionally laden words rather than color words. Efficient color-naming necessitates that the participant ignore the meaning of the word, despite the fact that words vary in emotional valence. When a participant exhibits delays in color-naming certain classes of words (e.g., highly emotional), "Stroop interference" is said to occur. In such a case, a participant's attention is drawn to the meaning of the word, resulting in a slowed reaction time to color-name the word. According to Beck and Emery's (1985) cognitive theory, anxious patients, who exhibit an attentional bias for threatening stimuli, should take longer to name the colors of threat words than to name the colors of non-threat words.

Several studies have examined the performance of socially anxious samples on the emotional Stroop task. The first study compared the response times of individuals with social phobia and panic disorder to color-name sets of neutral, social threat, and physical threat words (Hope, Rapee, Heimberg, & Dombeck, 1990). Social threat words were chosen to evoke self-descriptive constructs (e.g., inadequate, inferior) or to describe socially anxious individuals' expectations for their performance in social situations (e.g., criticized, failure). Similarly, physical threat words were chosen to reflect the theorized schemata of individuals with panic disorder and thus reflected vulnerability to physical threat (e.g., stroke, hospital, fatal, insane). Both the social and physical threat words were matched with neutral words which were similar in number of letters, number of syllables, and frequency of occurrence in the language (Caroll, Davies, & Richman, 1971). In addition, a fifth control set consisted of words denoting color names and groups of five

Xs. The words and the colors of the words were presented randomly on six cards, with the restrictions that no one word would appear sequentially or more than twice in one row or column. Participants also completed written measures of verbal ability, mood, and phobic avoidance.

As the researchers had hypothesized, individuals with social phobia, but not panic disorder, took longer to color-name social threat words than matched control words. In contrast, individuals with panic disorder, but not social phobia, showed longer latencies to color name threat words than matched controls. According to the researchers, despite instructions to the contrary, both clinical groups allocated more processing resources to information which was consistent with their schemata. Outside of the laboratory, such a tendency might result in the socially anxious individual's tendency to disproportionately attend to negative cues during the course of social interaction, confirming his/her self-concept as an inept social communicator. The study also found a correlation between social threat interference (a difference score between interference on control and social threat words) and self-reported social avoidance. The researchers hypothesized that their index of social threat interference may be a gauge of how vulnerable individuals perceive themselves to be in social situations (Hope et al., 1990).

This study (Hope et al., 1990), however, suffers from a number of methodological limitations. First, because social and physical threat words were matched for length and frequency of use to control sets, but not to each other, latencies for the two sets of threat words could not be directly compared. Second, a question still remains as to whether schemata need to be activated before they influence information processing. The authors theorized that schemas likely were activated by the treatment setting in which the

experiment took place. Third, the authors speculated that their use of a standardized set of stimuli, versus one which is tailored to an individual social phobic's primary concerns, may have resulted in smaller effect sizes. Because social phobics are a heterogeneous group who often use idiosyncratic language to describe their social fears, the use of individualized stimulus words may be more effective in activating their self-schemata and, in turn, in causing greater interference on the Stroop task.

A recent study failed to replicate the Hope and colleagues' (1990) findings (Niekerk, Moller, & Nortje, 1999). Participants were individuals with DSM-III-R (APA, 1987) diagnosed social phobia and panic disorder. Because a proportion of participants were Afrikaans-speaking, a separate Stroop task consisting of translations of Hope and colleagues' (1990) word sets had to be constructed. Unfortunately, data analyses failed to reveal significant differences in color-naming latencies between the physical or social threat words and their corresponding control words for either the social phobia or panic disorder group. In explaining their null findings, the authors proposed that recent completion of psychotherapy and concurrent pharmacotherapy received by a large proportion of their sample had contributed to an attenuation of the traditionally-observed schema-priming effects of the threat words.

Although the Stroop performance of social phobics had been compared to that of panic disorder patients, a later study contrasted the Stroop task performance of individuals with DSM-III-R (APA, 1987) diagnosed social phobia to a matched sample of community volunteers (Mattia, Heimberg, & Hope, 1993). Although individuals with social phobia were slower to color-name all word types than were community controls, they were especially disrupted by social threat words. Thus, it appears that individuals with social

phobia, in comparison to those with panic disorder (Hope et al., 1990) and community controls, have a distinct pattern of response to social stimuli. The authors speculated that the general slowing on the Stroop task exhibited by individuals with social phobia may be due to social-evaluative anxiety produced by the task itself, the environment (a treatment clinic), and the presence of the experimenter.

According to Beck and Emery's (1985) theory, increased self-focus should activate the dysfunctional schema of persons with social phobia, resulting in increased selective attention for social threat. Lundh and Ost (1996) sought to test this assumption by experimentally inducing self-focus with a mirror present in the room in which the Stroop task was performed. Individuals with DSM-III-R (APA, 1987) diagnosed social phobia and matched controls were randomly assigned to either the mirror or no mirror condition. All participants completed a computer generated Stroop task, consisting of two threat word categories (social and physical), two matched neutral sets, a color word set, and a set of Xs. Each category of words was presented on a separate stimulus screen and the six stimulus screens were randomly ordered for each participant.

Consistent with previous research (Mattia et al.,1993), the researchers observed a Stroop interference effect for social threat words, but not for physical threat or color words. However, this interference effect was not significantly enhanced by the presence of the mirror. The authors speculated that the presence of a mirror may not have been sufficient to produce enhanced self-focus. They suggested that future studies examine the effects of having a camera in the room with participants, because this manipulation previously has been found to induce self-focus in normal participants (Geller & Shaver, 1976). An alternative explanation is that the presence of the mirror may have been

successful in enhancing self-focus, but that this condition did not affect participants' performance on the Stroop. Because no measure of self-awareness was taken during testing, it is difficult to determine which possibility accounted for the absence of enhanced Stroop interference effects.

According to Beck and Emery's (1985) theory, anxious individuals allocate disproportionate attentional resources specifically to threat-related cues in their environment. However, Maidenberg and colleagues questioned whether Stroop interference effects represented a tendency for anxious individuals to attend to emotional stimuli in general (Maidenberg, Chen, Craske, Bohn, and Bystritsky, 1996). Individuals with panic disorder and social phobia, and controls completed a computerized Stroop task including neutral, positive, and threatening words related to panic, social concerns, and general concerns. Words were drawn randomly from each category and were displayed individually in the center of the computer screen. A voice-activated relay recorded response latency to color name each word.

As evidenced by longer response times to all types of threatening words (social, physical, and general) individuals with panic disorder in this study displayed a generality to their attentional bias. In contrast, individuals with social phobia exhibited a specificity to their attentional bias, as evidenced by longer response times to social threat, as compared to neutral words. Positively valenced words did not produce interference effects in any of the groups. The researchers hypothesized that individuals with panic disorder may possess a broader fear network, such that a wide range of threat stimuli capture their attention. Lang (1985) has previously suggested that fear networks of anxiety patients exist on a continuum, from the cohesive network of individuals with specific phobias, to the less

cohesive networks of panic disorder and generalized anxiety disorder patients. This assertion is consistent with previous research by Barlow and colleagues which suggests that a wide range of environmental stimuli elicit physiological arousal in individuals with panic disorder (Barlow et al., 1985). Such arousal is cognitively misinterpreted as dangerous, resulting in the onset of a panic attack (Barlow, 1988). The fear network of an individual with social phobia, on the other hand, would lie somewhere between that of a person with specific phobia and panic disorder and would be activated by a more restricted range of threat stimuli pertaining to social-evaluative concerns.

In the face of increasing evidence of an anxiety-specific attentional bias for threat, the validity of the Stroop task as a measure of selective attention has been challenged. Holle, Neely, and Heimberg (1997) recently speculated that increased latencies to color-name threat words could be a by-product of the manner in which the words are presented. Indeed, all previous investigations of Stroop effects in social phobia (with the exception of the aforementioned Maidenberg et al. study) had presented each word category in a "blocked" format. That is, words of the same type (e.g., social threat) appeared together on a single card or computer screen and were read sequentially by the participant. The theorized problem with this presentation format is that interference effects for threat words may not solely be the result of attentional bias, but of rumination over the meaning of previously presented threat words, or semantic priming effects (Foa, Feske, Murdock, Kozak, & McCarthy, 1991). Thus, Stroop interference effects on individual threat words may represent a "spillover" of the effects of previously presented words onto responses to subsequent words (Holle et al., 1997).

The effects of presentation format on color-naming of social threat words by social phobics has also been investigated (Holle et al.,1997). Individuals with previously diagnosed social phobia (DSM-III-R; APA, 1987) completed two sequential versions of the Stroop task. One version presented words in a blocked format (all words of one category type were presented sequentially), whereas the other version presented words in a random format (words were taken at random from all of the categories). The experimental design ensured that the presentation order of the two versions of the Stroop task was counterbalanced. Three categories of stimulus words were utilized: social threat words, semantically-related neutral words (animal names) and unrelated neutral words. Unlike previous Stroop investigations, words were presented individually in the center of a computer screen and reaction time to color-name them was recorded via a voice-activated relay attached to a microphone headset.

Although individuals with social phobia showed increased latencies for color-naming social threat words in comparison to neutral words, these differences in color-naming were found only for the stimuli presented in the blocked format. Interestingly, the magnitude of the color-naming latency difference for social threat versus neutral words found in the blocked format also was influenced by whether the neutral words were semantically related. Thus, this study underscores the importance of modifying the Stroop format in order to control for semantic priming effects. The effects of semantic priming may be controlled by presenting words from various categories randomly and individually, as opposed to massed presentation. Also, control word sets should be matched to stimulus word sets for semantic relatedness.

In summary, results obtained from studies using the emotional Stroop task provide moderate support for Beck and Emery's (1985) model, which predicts that anxiety disorders should be characterized by a processing selectivity for threat-related information. With respect to the validity of the Stroop as a measure of selective attention, the study by Holle and colleagues (1997) highlights the importance of modifying traditional Stroop procedures to control for the confounding effects of semantic priming. The one study of individuals with social phobia which controlled for these effects still found significant Stroop interference for social threat words (Maidenberg et al., 1996). Moreover, studies of color-naming in individuals with other anxiety disorders have continued to find significant differences in response latencies for threat words when words of all categories are presented in a random format (Foa et al, 1991; McNally, Riemann, Louro, Lukach, & Kim, 1992). Thus, it appears that threat value, and not semantic priming effects, accounts for a significant proportion of Stroop interference effects on social threat words.

Automatic versus Strategic Processing: The Failure of Beck and Emery's (1985) Model

The cognitive model proposed by Beck and Emery (1985) would predict that both anxiety and depression should be characterized by processing biases, with anxious individuals favoring the processing of threat-related information, and depressed individuals favoring the processing of depressogenic material. Theoretically, such biases should be reflected in performance on tasks assessing various stages of cognitive processing, including attention, encoding, and memory. However, a comparison of empirical studies of cognitive biases associated with the two disorders reveals that the patterns of processing associated with anxiety appear to differ significantly from those associated with depression. In particular, anxious individuals appear to selectively encode more

emotionally-negative aspects of their environment, even when they are instructed to avoid encoding such material or when they are unaware that such stimuli are present. Moreover, they show enhanced implicit memory for negatively valenced information, yet do not show such a bias in explicit, or intentional, memory tasks such as recall (e.g., Mogg, Mathews, & Weinman, 1987). In general, these findings suggest that anxiety is associated with cognitive biases which operate at an automatic level of processing, without volition and operating outside of conscious awareness (MacLeod & Rutherford, 1998).

Individuals suffering with depression, on the other hand, do not exhibit a selective processing bias for negatively valenced material (MacLeod, Mathews, & Tata, 1986). Nor do they show enhanced implicit memory for negative information, although, they do exhibit a strong explicit memory advantage for negative information (Blaney, 1986). These findings would imply that the cognitive biases associated with depression operate on a strategic, rather than an automatic, level of processing. Such discrepancies in the cognitive processing findings for anxiety and depression present a problem for Beck's theory, which would predict similar styles of processing bias for both disorders. Thus, the discrepant findings have prompted investigators to account for disorder-specific processing styles with more refined cognitive processing models.

Williams' Reformulated Cognitive Model

In response to growing evidence of disorder-specific patterns of cognitive processing, Williams and colleagues proposed a revised cognitive formulation of anxiety and depression (Williams, Watts, MacLeod, & Mathews, 1988, 1997). They propose that anxiety is primarily characterized by a bias which favors threat stimuli in pre-attentive processes (i.e., prior to awareness) and in selective attention. In particular, they

hypothesize that pre-attentive vigilance for threat reflects a cognitive vulnerability factor for clinical anxiety. Thus, individuals who display a permanent tendency to attend to threat are more susceptible to the development of anxiety disorders when under stress. In contrast, the revised model hypothesizes that depression is associated with biases in post-attentive, elaborative processes, thus facilitating recall of negative information.

In attempting to explain the discrepancies between anxious and depressed cognitive processing, Williams and colleagues (1988) invoked Graf and Mandler's (1984) model of memory. These authors delineated two processes that can act on mental representations: integration and elaboration. Integration is thought to be an automatic cognitive process which proceeds without awareness and which serves to strengthen the internal structure of a mental representation. A highly integrated representation will be accessed more efficiently, since activation of any part will quickly and reliably activate the whole. Thus, presentation with one, some, or most of the features consistent with, for instance, threat, will activate the whole mental representation of threat. According to Williams and colleagues, those with a heightened vulnerability to anxiety will exhibit increased integrative processing of mental representations for emotionally negative information when they experience an anxious mood state.

In contrast, elaboration is a strategic process, operating under conscious control and serving to strengthen connections between mental representations (Graf & Mandler, 1984). Highly elaborated mental representations are thought to be retrieved more efficiently through explicit, or intentional, memory search due to enriched associative connections. According to Williams and colleagues, those with an elevated vulnerability to depression will exhibit increased elaborative processing of negative mental

representations when they experience a depressed mood state. Williams' theory provides one explanation why anxious individuals demonstrate an automatic increase in the accessibility of negative mental representations when cued with their features in perceptual and implicit memory tasks, whereas depressed individuals demonstrate only a strategic enhancement of their ability to intentionally retrieve such negative representations during explicit memory tasks.

According to Williams' model, there are two mechanisms which are responsible for the pre-attentive and attentional bias to threat in anxiety. First, an Affective Decision Mechanism (ADM) is thought to assess the threat value of environmental stimuli. The ADM acts to tag certain input units with a threat value, making them subject to neuromodulatory control. Second, the output of the ADM feeds into a Resource Allocation Mechanism (RAM), which determines how processing resources are allocated. The functioning of the RAM is thought to be influenced by trait anxiety. Specifically, high trait anxious individuals have permanent tendency to selectively attend to threat, whereas low trait anxious individuals tend to avoid threat. As output from the ADM increases as a result of increased state anxiety or stimulus threat value, processing discrepancies between low and high trait anxious individuals becomes more marked. In other words, in the absense of stress, when the activation of threat input units is low, attentional differences between high and low trait anxious individuals may not be apparent. However, as stress increases, high trait anxious individuals become more vigilant, and low trait anxious individuals become more avoidant of threat. Williams labels this process the "interaction hypothesis," because state and trait anxiety interact to determine pre-attentive and

attentional biases. The direction of these pre-attentive and attentional biases provide an index of vulnerability to generalized anxiety.

Some researchers have speculated that the specific patterns of bias proposed by Williams and colleagues may have developed because of their evolutionary value under the circumstances that typically elicit anxiety and depression (MacLeod & McLaughlin, 1995). Because depression typically results when actions or plans have resulted in loss or failure, it may be adaptive to respond to the emotion by strengthening associative connections between current and past cognitive representations of loss and failure, and attempting to extract rules to guide future behavior in a way that will lessen the risk of repetition. In contrast, because anxiety is typically elicited when one is faced with the threat of personal harm, an adaptive response to this emotion may be a strengthening of the structure of one's mental representations of what constitutes "threat," such that these representations will be quickly and easily accessed when one is presented with external threat.

Problems with Gauging Automaticity with Traditional Measures of Attentional Bias

Clearly, a crucial tenet of Williams and colleagues' theory is that differing roles are assigned to automatic and strategic processing in explaining the patterns of cognitive bias found in anxiety and depression. Specifically, the cognitive biases found in anxious individuals are thought to operate at a pre-attentive, or automatic level. However, the bulk of the research on attentional bias (and all of the research reviewed thus far) has used measures which have recently been called into question in terms of their ability to gauge automatic processing (MacLeod, 1991).

Detection paradigms generally require a participant to shift attentional resources to threatening information while he/she is engaged in another task. For example, in the

dichotic listening task, a participant attends to one of two passages being presented to opposite ears while performing a response when specific target words occur in the unattended passage. Since the task restricts, but does not prevent, conscious processing of information from the unattended passage, one cannot rule out the possibility that a bias for processing threatening information is due to strategic, rather than automatic, processing.

As previously mentioned, facilitation tasks examine whether the anxious are more adept at performing tasks that require attentional shifts to threat cues. In the traditional dot-probe task, participants perform a response (e.g., a button press) to a neutral visual stimulus (e.g., a dot) that replaces either member of a pair of words that appear on a computer screen. They read the top word of each pair and press a button whenever they detect a dot. On a proportion of trials, one of the two words has a threatening meaning. Regrettably, the traditional dot-probe task suffers from the same problem as the dichotic listening task as a measure of automatic processing. Because words are presented to the participant at durations that permit conscious awareness, there is no guarantee that they have not been subject to strategic processing.

Finally, interference tasks require participants to ignore extraneous stimuli while performing a task which is unrelated to the detection of threat. Selective attention to threat is suggested by performance decrements induced by the presence of threat cues. In the aforementioned Stroop task, participants are presented with words on cards or on a computer screen and are required to name the color in which each word is printed. The task demands that the participant ignore the meaning of the word, despite the fact that words vary in emotional valence. Selective attention to threat is reflected by slowed

reaction times to color-name threat words, because the meaning of the word captures the participant's attention, despite his/her effort to attend to the color of the word.

The emotional Stroop paradigm also has been criticized as being an impure measure of automatic processing. Word presentation in the emotional Stroop typically is supraliminal, or within the participant's awareness. Supraliminal color naming interference effects could reflect biases operating at an automatic, preattentive stage or at later, controlled stages of processing (MacLeod, 1991). Thus, previous Stroop investigations utilizing supraliminal presentation do not provide a direct test of Williams et al.'s (1988, 1997) model.

Pre-attentive Processing Paradigms

Subliminal Dot-Probe Task. A number of investigators have revised traditional selective attention paradigms such that target stimuli are presented subliminally, that is, at exposure durations that do not permit conscious awareness. Preattentive biases for face stimuli have recently been investigated using a revised version of the dot probe task (Mogg & Bradley, 1998). In their task, a pair of faces was presented on a computer screen for 14 milliseconds, immediately followed by a pair of masks consisting of photographs of faces that had been cut up and randomly reassembled. Then, a dot probe was immediately presented in the location of one of the two masks. Participants were faster to detect probes occurring in the same location of masked threat faces, particularly when the threat face and probe were presented to the left visual field. The results not only suggest a preattentive bias for threat, but also indicate a right hemisphere dominance in the processing of threat. Mogg and colleagues have since replicated these findings, and have

found that the preattentive bias for threat faces is more marked in high, rather than low, trait anxious individuals (Mogg et al., 1998).

Masked Stroop Color-Naming Task. A masked version of the emotional Stroop task, in which each target word is presented on a computer screen very briefly (20 milliseconds) in white letters superimposed on a background patch of color (e.g., red, blue, green or yellow) has been developed and tested (MacLeod & Hagan, 1992). The word is immediately replaced by a string of rotated or inverted letter fragments of equivalent length on the same colored background. This mask remains on the screen until a voice key detects the participant's color-naming response. The masking procedure is intended to block the participant's conscious awareness of the stimulus word, without preventing semantic processing.

In order to ensure that participants are unable to consciously perceive stimulus words under the masked condition, the masked Stroop procedure has included "awareness checks" after each block of color-naming trials (MacLeod & Hagan, 1992). These checks replicate the masked exposure condition exactly, in that a letter string is presented for 20 msec followed by a pattern mask in the same screen location. The participant's task is to identify whether the letter string is an English word or not, and to record his/her decision by pressing one of two buttons on a response box. Half of the letter strings presented by the computer are actual English words, while half are random letter strings. If participants indeed are unable to perceive consciously the stimulus words, their accuracy rate on the awareness task should not exceed chance levels (i.e., 50%).

A Test of Williams' Model: The Masked Stroop Task

Interaction Hypothesis. MacLeod and Hagan (1992) were the first researchers to test Williams and colleagues' (1988, 1997) interaction hypothesis using both the masked and unmasked versions of the Stroop. They were interested in gauging the effects of state and trait anxiety on the automatic and strategic patterns of processing selectivity of gynecological outpatients awaiting colposcopy investigation. In addition to completing questionnaire measures of depression, trait and state anxiety, participants completed the two Stroop versions. The masked and unmasked trials were presented randomly, such that each stimulus word was shown twice in the masked condition and twice in the unmasked condition. The word set consisted of threat-related words (e.g., disease, fatal) and length-matched non-threat words (e.g., leisure, hobby). Approximately eight weeks after completing the Stroop, a proportion of the women, all of whom had received a diagnosis of cervical pathology, were asked to complete a mood assessment questionnaire. The investigators were interested in whether initial questionnaire scores would be associated with color-naming performance on the two Stroop versions. Also, they questioned whether any of the initial assessment measures would predict subsequent emotional reactions to a later diagnosis of cervical pathology.

Elevated levels of depression, state, and trait anxiety were not associated with increased color-naming latencies for threat words on the unmasked Stroop. However, elevated levels of both trait and state anxiety were significantly associated with an inflation of color-naming latencies to threat, relative to nonthreat, words in the masked condition. These results are consistent with Williams' hypothesis that the anxious pattern of selective processing is initiated at an automatic, unconscious level of processing. However,

somewhat unexpectedly, when stimuli were presented in a manner that allowed their conscious identification, high trait anxious participants appeared to be capable of strategically negating this automatic processing bias. Interestingly, an index of masked threat interference predicted the intensity of depressive and anxiety symptoms when participants were later informed of their cervical pathology, whereas questionnaire measures failed to do so.

The researchers suggested that the preattentive bias for threat demonstrated by the Stroop task may reflect a vulnerability factor for anxiety (MacLeod & Hagan, 1992). Thus, specific patterns of processing selectivity, in this case, selective processing of threat information, may moderate emotional response to stressful life events. A subsequent cross-sectional study found a similar relationship between preconscious bias and self-reported vulnerability to life stress in healthy volunteers (van den Hout, Tenney, Huygens, & De Jong, 1995). Thus, individuals who demonstrate an increased tendency to be vigilant for threat may be more susceptible to developing emotional disorders when confronted with stress.

In an effort to further investigate the interactive effects of state and trait anxiety on selective attention, one study examined masked and unmasked Stroop performance of high and low trait anxious undergraduate students who were exposed to stress or relaxation inductions (Mogg, Kentish, & Bradley, 1993). The Stroop task consisted of four categories of words matched for word length and frequency: threat-related (e.g., paralysis, ridicule), positive (e.g., beauty, bliss), categorized neutral (household terms, e.g. bookcase, furnished), and uncategorized neutral (e.g., emblem, downwind). Presentation

mode (i.e., blocked versus random) was varied in order to gauge its effect on color-naming interference.

Consistent with the interaction hypothesis (Williams et al., 1988, 1997), high trait anxiety was found to correlate with enhanced interference with the color-naming of threat stimuli. The authors hypothesized that their method of dividing groups with a median split on trait scores did not lend itself well to an ANOVA, which would treat trait anxiety as a dichotomous variable. Interestingly, lower state anxiety was associated with greater interference with the color-naming of positive stimuli in the subliminal condition. This finding appeared to be consistent with a mood-congruent processing bias, such that induction of a pleasant mood (via relaxation training) was associated with selective processing of positive stimuli. The fact that this result was only evident in the subliminal condition suggests that the selective processing of mood-congruent information occurs at an automatic, or preattentive, level.

The study's third finding was somewhat unexpected in the context of Williams' model. Low state anxiety was found to be associated with enhanced interference effects for color-naming threat stimuli, but only in the supraliminal condition. This finding suggests a mood-incongruent processing bias for threat information that is available to conscious awareness. The authors hypothesized that normal participants in whom an anxious state has been induced may employ a cognitive strategy that inhibits further processing of threatening information. A cognitive processing strategy of this sort would serve the adaptive function of counteracting temporary, negative mood states.

In summary, the studies by Mogg et al. (1993) and MacLeod and Hagan (1992), would seem to indicate that, when stimuli are presented under conditions of little or no

awareness, Stroop interference effects appear to be consistently mood-congruent. Consistent with Williams' model, high trait anxious individuals exhibit an automatic, pre-attentive processing bias for threat information. However, unexplained by the model is the finding that high trait anxious individuals are able to strategically suppress this automatic bias when they are consciously aware of negative stimuli in their environment. That is, they appear to adopt controlled, mood-incongruent processing strategies which serve to regulate mood. If this is, indeed, the case then the subliminal Stroop task may provide a more reliable measure of anxiety-related processing biases, in that it is not confounded by the participant's response strategies.

Pre-attentive Processing Biases in Clinical Populations. In light of the aforementioned findings, Williams and colleagues (1997) updated their cognitive model, arguing that the critical difference between high trait anxious and clinically anxious individuals may be their differential use of cognitive strategies to override the effects of pre-attentive processing biases for threatening information. Specifically, clinically significant anxiety is characterized by an absence of conscious strategies to over-ride the pre-attentive bias for threat cues. If this is the case, then clinically-anxious individuals should show equivalent patterns of elevated Stroop color-naming interference on both subliminally- and supraliminally-presented threat words. Mogg, Bradley, Williams, and Mathews (1993) were the first researchers to administer both versions of the Stroop task to a clinical sample. They hoped to confirm Williams et al.'s assertion that anxiety, but not depression, is associated with a pre-attentive bias for threatening information.

Participants in Mogg et al.'s (1993) investigation were individuals with a DSM-III-R (APA, 1987) diagnosis of generalized anxiety disorder or major depression, and normal

controls. Stroop stimuli consisted of five categories of words: anxiety-relevant (e.g., embarrassed, cancer), depression-relevant (e.g., misery, discouraged), categorized neutral (e.g., household items such as carpet and domestic), positive words (e.g., adorable, bliss), and uncategorized neutral (e.g., geometry, exchange). All word types were matched for length and frequency of use in the language. Participants also completed questionnaire measures of verbal ability, depression, and state and trait anxiety.

The results of the study supported Williams' hypothesis that there is a preattentive processing bias in anxiety, but not in depression. However, the processing bias was not specific to anxiety-related words. Instead, anxious individuals were slower to name negative words, in general, that were subliminally presented. This result is somewhat at odds with previous studies demonstrating interference effects that are specific to the primary concerns of anxious individuals. However, the authors noted that earlier findings were obtained with stimuli that were presented supraliminally and in a blocked format. Both of these presentation features may have provided increased opportunity for elaborative processing of the semantic content of the word stimuli. In the present study, the absence of such an opportunity for elaborative processing resulted in selective processing effects of a relatively non-specific fashion. Thus, interference effects may occur when stimuli have undergone a relatively superficial level of semantic analysis regarding their global negative characteristics (Mogg et al., 1993).

Mogg and colleagues found that the pre-attentive bias for negative stimuli found in the clinically anxious extended to stimuli that were presented to conscious awareness. However, the effect of interference for supraliminal threat words was confounded with the effects of word category. In particular, anxious individuals were slower in color naming

uncategorized than categorized neutral words, but only for supraliminally-presented material. The authors suggested that supraliminal color-naming, which is subject to controlled, strategic processes, may be influenced by categorical priming effects. This underscores the necessity of including matched sets of neutral, categorized words when administering the supraliminal Stroop. In contrast, there was no evidence that interference effects in the subliminal condition were confounded by word categorization.

A more recent study suggests that, in panic patients, pre-attentive bias may be specific to physical threat information. Lundh and colleagues compared DSM-IV (APA, 1994) diagnosed panic disorder patients to age- and sex-matched controls on a Stroop task consisting of panic-related threat, interpersonal threat and neutral words presented both subliminally and supraliminally (Lundh, Wikstrom, Westerlund, & Ost, 1999). Their methodology differed somewhat from past Stroop studies in that each participant's threshold for conscious word identification was determined by a pre-test. The rationale for this procedure was to decrease the possibility that participants with higher thresholds would be presented with words at durations that not only barred conscious word identification, but also semantic activation of meaning structures.

Individuals with panic disorder exhibited significant Stroop interference for panic-related words both at the subliminal and supraliminal level. A similar but less robust effect was seen for interpersonal threat words, but this effect did not remain significant when tested separately at the subliminal and supraliminal levels. It should be noted, however, that supraliminal Stroop findings in this study may be confounded with the effects of word categorization, because the set of control words was not semantically-related. Interestingly, indices of subliminal and supraliminal Stroop interference for panic-related

words did not correlate with each other, suggesting that the two tasks measure separate kinds of processes. None of the measures of Stroop interference correlated with anxiety sensitivity, suggesting that interference for threat words is not related to the "fear of fear" that is characteristic of panic disorder. Consistent with previous studies, subliminal, but not supraliminal, interference for panic-related words correlated with measures of trait anxiety and depression. Accordingly, the authors suggested that subliminal Stroop interference seems to be a marker for a more general disposition to negative affect.

Although previous research indicates that non-clinical samples with high trait anxiety are able to counteract their automatic, preattentive bias for threat-related information by means of consciously controlled, strategic processes (MacLeod & Hagan, 1992; Mogg et al., 1993), the study by Lundh and colleagues (1999) suggests that panic disorder patients lack the ability to neutralize their automatic, pre-attentive biases through conscious strategies. Researchers have previously suggested that this discrepancy accounts for the exaggerated severity of anxiety symptoms in clinical populations (MacLeod & Hagan, 1992). However, according to Lundh and colleagues, this line of reasoning does not explain why the subliminal and supraliminal interference indices did not correlate. They suggest that panic patients differ in the degree to which they are able to counteract preattentive biases for threat-related information by means of conscious strategies, and that this ability is unrelated to general negative affect.

Of particular relevance to the current proposal, van den Hout and colleagues demonstrated a pre-attentive bias for threat in a phobic sample (van den Hout, Tenney, Huygens, & De Jong, 1997). They administered both the masked and unmasked Stroop tasks to a sample with highly circumscribed fears: specific (spider) phobics. The Stroop

stimulus words consisted of spider words (e.g., spider, web, hairy, legs, insect) and neutral words (e.g., square, potato, fork, blanket, pen) which were matched for word length and frequency of use. Because previous studies have demonstrated that general trait anxiety is related to subliminal Stroop interference, the authors hypothesized that the severity of spider phobia would most strongly correlate with such interference.

As predicted, selective interference for spider words presented both subliminally and supraliminally was significantly associated with a questionnaire measure of severity of spider phobia. Furthermore, the association between pre-conscious processing bias and phobia severity was not moderated by anxiety sensitivity, neuroticism or other psychological problems. Previous studies have found a positive correlation between threat interference on the masked Stroop and both generalized anxiety and trait anxiety, phenomena which are thought to be associated with generalized negative affectivity, or neuroticism. However, the present results indicate that the preconscious processing bias may not be an artifact of general negative affectivity, but may be tied to anxiety itself.

Discrepant Findings

Effects of Treatment on Pre-attentive Biases. If pre-attentive vigilance for threat represents a permanent, automatic cognitive vulnerability factor, as is suggested by Williams et al. (1988, 1997), one would expect that it would be resistant to change by strategic means, such as cognitive-behavior therapy. However, two studies suggest that this is not the case.

The aforementioned study of individuals with spider phobia found that masked and unmasked Stroop interference for spider-related, versus neutral, words significantly decreased after a one-session treatment of in-vivo exposure (van den Hout et al., 1997).

Although the conclusions drawn from this study are limited by the fact that no comparison group was included in the design, the results are suggestive of the idea that conscious and preconscious processing biases may be altered by treatment. The authors hypothesize that exposure therapy "eliminates the erroneous perception of a probabilistic association between a phobic CS (regardless of whether it is a spider, a palpitation, or an obsessional intrusion) and an aversive US (whether it be a spider bite, a heart attack, or catching an infectious disease)" (Davey, 1992 as cited in van den Hout et al., 1997).

A second study indicates that combined cognitive and behavioral strategies are capable of altering processing biases for threat words presented both supraliminally and subliminally (Mogg, Bradley, Millar, & White, 1995). Clients with generalized anxiety disorder (without depression) and non-anxious controls completed both versions of the Stroop task and questionnaire measures of verbal ability, depression, and anxiety. In addition, they were asked to rate the frequency of their negative thoughts and worries related to physical concerns, social concerns, and depression. The Stroop stimuli consisted of anxiety-relevant, depression-relevant, categorized neutral, and uncategorized neutral words. The GAD group then participated in a 6-session cognitive-behavioral treatment, consisting of anxiety management training (i.e., relaxation) and cognitive coping procedures. Both groups completed the Stroop task and questionnaires two months after the initial testing. In addition, the GAD group completed the task again 20 months after the initial testing.

Prior to treatment, clients with GAD showed significantly greater interference than controls in color-naming negative words in both supra- and sub-threshold exposure conditions. However, after treatment, there was no significant difference in bias between

the groups, suggesting that the processing bias was altered by psychological treatment. Although trait anxiety did not change significantly from pre- to post-treatment, significant reductions were observed in all measures of anxiety and depression from pre-treatment to 20-month follow-up. Furthermore, the reduction in preconscious bias correlated with reduction in anxious thoughts, and this relationship was maintained throughout the 20-month follow-up period. Reductions in state anxiety did not correlate with reductions in Stroop interference, but reductions in trait anxiety correlated with unmasked Stroop interference for both anxiety and depression-related words.

These results suggest that the preconscious bias for negative information in GAD clients is not an immutable feature of anxiety-prone individuals, because it was amenable to reduction by cognitive behavioral strategies. This finding seems inconsistent with Williams' assertion that the pre-attentive bias is a permanent vulnerability factor and raises renewed question as to what such a bias represents. The study did not find significant correlations between change in preconscious bias and change in questionnaire measures of state anxiety. Significant correlations were found, however, between reductions in preconscious bias and reductions in reports of anxious thoughts and worries. This finding suggests that these two factors may reflect a common underlying mechanism which is susceptible to psychological treatment. Although the nature of this mechanism has yet to be determined, it would appear that it operates automatically, "outside conscious awareness, that it is responsive to the presence of threat stimuli, and that it is responsible for interrupting and diverting processing resources away from on-going activities in favour of negative information." Thus, the findings of Mogg and colleagues' longitudinal study suggest the subliminal Stroop task may be particularly sensitive to the cognitive

mechanism that underlies the production of anxious thoughts and worries in clinical anxiety states.

Discrepant Findings II: Stroop Suppression in Clinical Samples. Williams and colleagues (1997) argue that the critical difference between high trait anxious and clinically anxious individuals is their differential use of cognitive strategies to override the effects of pre-attentive processing biases for threatening information. Consistent with this hypothesis, MacLeod and Rutherford (1992) found that, under conditions of high state anxiety, both high and low trait anxious individuals showed significant decreases in color-naming latencies for supraliminal threat words. That is, regardless of trait anxiety level, normal individuals who were exposed to an anxiety-inducing stressor were able to strategically avoid processing threat stimuli associated with the source of this anxiety.

If it is the case that clinically significant anxiety is characterized by an absence of conscious strategies to over-ride the pre-attentive bias for threat cues, then such individuals should show equivalent patterns of elevated Stroop color-naming interference on both subliminally- and supraliminally-presented threat words. However, at least a couple of investigations suggest that, when confronted with stress, individuals with phobias are able to strategically suppress their attentional bias for threatening information. First, using the unmasked Stroop task, Mathews and Sebastian (1993) found that highly snake-phobic undergraduate students who were induced to be state anxious through exposure to a live snake exhibited suppression of their previous attentional bias for snake-related words.

This finding has since been replicated in a DSM-III-R diagnosed sample of individuals with social phobia (Amir, McNally, Riemann, & Burns, 1996). Both

individuals with social phobia and community controls completed an unmasked Stroop task consisting of social threat words, physical threat words, and two sets of neutral control words. The Stroop task was the earlier card version, such that word categories were presented in a blocked, massed format. After completing the Stroop task and a set of questionnaire measures, participants were told that they would shortly be giving a brief, 3-minute speech on a topic of their choosing. They were told that their speech would be audiotaped for later scoring. However, prior to giving the speech, they were asked to complete the second Stroop task and set of questionnaires. After the second set of measures, the participants were told that they would not be giving a speech and were debriefed.

The anxiety manipulation proved effective in significantly increasing state anxiety, although only in the social phobia group. Both groups showed an overall speeding of response latencies when confronted with anxiety. When individuals with social phobia were tested under conditions of low anxiety, they exhibited significantly greater interference effects for social threat than physical threat words. However, under conditions of high anxiety this pattern was reversed: interference for physical threat words in individuals with social phobia was significantly greater than that for social threat words. Thus, inconsistent with Williams and colleagues' model, under stressful conditions, even clinical populations possess the capacity to suppress their attentional bias for threatening information.

The Vigilance-Avoidance Model

Mogg and colleagues (1997) have recently outlined a two-stage, vigilance-avoidance model of information processing which both explains the maintenance of

anxiety and would seem to account for recent discrepant findings of Stroop effect suppression. They posit that individuals with social phobia, for example, may possess the capacity to swiftly identify socially threatening information, but subsequently may fail to extensively process such information due to cognitive avoidance. Avoidance of strategic processing of this information would prevent habituation, or objective evaluation, of such material. As a result, the threatening information would retain its anxiety-provoking effects.

With respect to Stroop performance, the vigilance/avoidance model would predict an initial, pre-attentive bias for threatening information, followed by suppression of this bias in the attentive stage. This theory is consistent with the pattern of attention found in phobics under stress. Furthermore, this sequence of events also could account for the puzzling lack of findings of a memory bias for such threatening information in the anxious. To date, the masked and unmasked versions of the Stroop have yet to be employed in order to examine patterns of pre-attentive and attentional biases of phobic samples under stress. However, one study by Amir and colleagues (1998) suggests that the attentional process is not a unitary one. Generalized social phobics were asked to respond to cue words following sentences ending either in threat homographs (e.g., "She wrote down the mean.....UNFRIENDLY") or nonhomographs (e.g., "He dug with a spade.....ACE"). At short presentation intervals (100 ms), individuals with social phobia took longer to respond to cue words following sentences ending in threat homographs than cue words following sentences ending in non-homographs, suggesting that the inappropriate meaning of the threat homograph was initially activated. At longer intervals (850 ms), however, activation of the inappropriate meaning was suppressed. Although these results appear to

support a vigilance/avoidance attentional pattern, both presentation intervals allowed for conscious awareness of stimuli and thus no conclusions can be drawn regarding pre-attentive processing.

A pattern of activation and inhibition of threat information would explain the discrepant Stroop findings with respect to attentional bias in phobic individuals. When anxious, phobic clients may be particularly adept at avoiding the threat meaning of socially relevant material. In the case of individuals with social phobia, this process plays a role in the maintenance of social fears. Avoidance of threatening social cues may result in an inability to encode relevant aspects of social performance. In the absence of elaborate representations of social interaction, individuals with social phobia may evaluate their performance based on their emotional reaction during the interaction, rather than what actually transpired. Indeed, this sequence of events is consistent with the finding that individuals with social phobia are more likely to negatively evaluate their social performance on behavioral tasks than are independent judges (Rapee & Lim, 1992).

Summary of Proposal and Hypotheses

Current cognitive processing models of psychopathology theorize that those who suffer with anxiety disorders will exhibit the tendency to preferentially process threatening information in their environment (Williams et al., 1997). In individuals with social phobia, this processing bias has been shown for attention (Amir et al, 1996) and interpretation (Foa, Franklin, Perry, & Herbert, 1996), but not for memory (Rapee et al., 1994). Despite the fact that preferential processing of threatening information has been proposed as an explanation for the etiology and maintenance of emotional disorders, little is known about the mechanism underlying this preference (Williams et al., 1997).

Williams and colleagues (1997) have suggested that, when anxious, normal participants may increase their effort in order to compensate for color-naming interference. Thus, they possess the ability to "override" their attentional bias under times of stress. However, inconsistent with Williams' explanation, Amir and colleagues (1996) found that this "override" effect is not limited to non-patients. Both groups of controls and individuals with social phobia showed a general speeding of response latencies under stress. Contrary to prediction, individuals with social phobia were better able to suppress interference for socially threatening words, suggesting that they are more adept at avoidance when they are anxious.

Mogg and colleagues' (Mogg, Bradley, Bono, & Painter, 1997) two-stage, vigilance/avoidance model of information processing would appear to be effective both in explaining the maintenance of clinical anxiety and in clarifying recent discrepant findings of Stroop-effect suppression. The authors posit that individuals with phobias may possess the capacity to swiftly identify socially threatening information, but subsequently may fail to process extensively such information due to cognitive avoidance. Avoidance of strategic processing of threatening information would prevent habituation, or objective evaluation, of such material. As a result, the threatening information retains its anxiety-provoking effects.

The featured study is a test of the vigilance/avoidance model in a socially anxious analogue sample. A variant of MacLeod and Hagan's (1992) subliminal Stroop paradigm was employed in order to examine patterns of pre-attentive and attentional processing of threat cues in undergraduate students with and without significant social anxiety. Participants were exposed to words related to social threat (e.g., embarrass), physical

threat (e.g., stroke), categorized neutral words denoting household items (e.g., carpet), and uncategorized neutral words (e.g., reported). Each word was presented in a subliminal and supraliminal format. In addition, examination of Stroop performance prior to and after the initiation of an anxiety induction procedure served to elucidate the effects of stress on pre-selective and selective attention for threatening information. There were five chief predictions.

The first aim of the current experiment was to test the hypothesis that there is a pre-attentive bias in social anxiety. Specifically, socially anxious individuals, but not control participants, were expected to demonstrate a processing bias for threatening information that is automatic in the sense that it operates outside of conscious awareness. Relative to non-anxious controls, individuals with high levels of social anxiety would exhibit greater interference for subliminal threat words than for neutral words. Although pre-attentive processes have been examined in other clinical populations (i.e., PTSD, panic disorder, specific phobia, GAD), to date, the subliminal Stroop has not been administered to a clinical or sub-clinical socially anxious sample.

The second hypothesis concerns the content-specificity of the processing bias. This experiment examined whether the processing bias is specific to socially threatening information or to other types of threatening information (e.g., physical threat). Although this question has not been examined in a socially anxious population, previous research indicates that clients with GAD exhibit a pre-attentive bias for both subliminally-presented anxiety and depression-related words, suggesting that interference effects may occur after stimuli have undergone a relatively superficial level of semantic analysis regarding their global negative characteristics (Mogg et al., 1993). Consistent with these findings,

individuals with panic disorder have been found to exhibit subliminal interference for physical threat and, to a lesser degree, social threat words (Lundh et al., 1999). Van den Hout and colleagues (1997) found significant subliminal Stroop interference for spider-specific versus neutral words in spider phobics, however, their design did not include a control set of threatening, non-spider-related words.

The third hypothesis concerns the attentional pattern of the socially anxious under non-stressful conditions. In the absence of stress, it has already been predicted that the experimental group will demonstrate greater interference, or vigilance, for threat word presented at intervals too short for elaborate processing. However, what happens later in the attentional process, when threatening information is presented for time intervals allowing for more elaborate processing? Given the opportunity for more elaborate processing of meaning, those with high social anxiety were expected to exhibit greater interference for supraliminal social threat words than for physical threat or neutral words. That is, the attentional bias should become more content specific with longer exposure durations and increased time for processing. This hypothesis is consistent with previous research in which individuals with social phobia displayed an attentional bias that was largely specific for supraliminally-presented social threat words (Hope et al., 1990; Mattia et al., 1993; Lundh & Ost, 1996). However, these studies have been criticized on methodological grounds for their choice of a blocked versus random format of word category presentation. A blocked form of presentation may promote semantic priming, which could produce Stroop interference effects. Only one study of individuals with social phobia has demonstrated selective interference for supraliminal social threat words presented in a random format (Maidenberg et al., 1996). Two other studies failed to find

Stroop interference for social threat even when words were presented in a blocked format (Holle et al., 1997; Niekerk et al., 1999). The present study utilized a random mode of word presentation in an attempt to replicate Maidenberg and colleagues' (1996) findings in a socially anxious analogue sample.

The fourth hypothesis concerns the effects of exposure to a stress induction (i.e., the threat of giving a speech) on attentional patterns in the socially anxious. It was predicted that increased state anxiety would increase pre-attentive vigilance for threat, but only in the high socially anxious sample. This prediction is consistent with the Williams et al. (1988, 1997) interaction hypothesis of information processing. Because the vigilant processing mode is hypothesized to operate at a preconscious level, a stress-induced increase in subliminal color naming interference was expected to be evident in the socially anxious sample, but only for subliminally-presented threat stimuli. No significant increase in pre-attentive processing was predicted in the low socially anxious group as they are presented with the stress induction.

When under stress, it was hypothesized that the socially anxious sample would demonstrate greater suppression of interference (i.e., facilitation) for socially threatening information that is presented at durations permitting elaborate processing of meaning (supraliminal presentation). Thus, consistent with Mogg and colleagues' (1997) two-stage, vigilance-avoidance model of information processing, after subjection to a stress induction, the socially anxious sample would demonstrate an initial automatic orientation (or vigilance) for threat, followed by avoidance of social threat in later attentional processes. Avoidance of social threat would be evident in facilitation of processing of socially threatening information. As cognitive avoidance is seen as a strategic process, this

pattern of Stroop effect suppression would be evident only for social threat words presented within conscious awareness (supraliminal presentation).

The fifth hypothesis concerns the relationship between Stroop performance and self-reported social fear, avoidance, and depression. It was predicted that both phobic fear and avoidance would be significantly and positively associated with a pre-attentive vigilance for threat words. Increases in state anxiety brought on by the anxiety induction would further strengthen these correlations. However, self-reported social fear and avoidance would be negatively associated with interference for social threat words after initiation of the stress induction. Depression severity was not expected to correlate with any measure of attentional bias, as it was hypothesized that depression is characterized by biases in later stages of processing. High state anxiety was expected to positively correlate with interference for subliminal and facilitation for supraliminal threat words in the socially anxious.

Significance of the Proposal

The current investigation sought to elucidate the patterns of pre-attentive and attentional bias for threatening information in a socially anxious sample. Moreover, it investigated whether these patterns change as a function of the degree of situational stress that an individual experiences. A pre-attentive or attentional bias for threat, in general, may not necessarily be a sign of anxiety proneness. Indeed, such a bias has been found in low trait anxious individuals when external stimuli have high threat value. Certainly, orientation towards real environmental threat has substantial adaptive value in terms of protection from harm. However, the presence of pre-attentive and attentional biases for mild threat stimuli such as words not only would be unhelpful in maintaining attention on

current goals, but would be counterproductive in maintaining a positive mood state. Although only research of a longitudinal nature can address whether such biases are a determinant of anxiety vulnerability, current research strongly suggests that they represent a sign of anxiety vulnerability.

Of central importance to the current investigation, however, is the role of preattentive and attentional biases in the maintenance of anxiety states. As a result of such biases, minor threat cues in the environment may be more likely to enter the focus of anxiety-prone individuals. This, in turn, would both reinforce anxious individuals' perception of the world as being an aversive or unsafe place and enhance their anxious mood. Moreover, if anxiety-prone individuals automatically orient their attention to minor threats in the environment, but do not maintain their attentional focus on such stimuli sufficiently to allow objective evaluation of them, this might increase sensitivity to such stimuli and interfere with habituation. Thus, anxiety would be maintained over the long term.

METHOD

Participants

Participants were recruited from undergraduate psychology classes at the University of Maine/Orono campus. Classes were screened using the Liebowitz Social Anxiety Scale (LSAS; Liebowitz, 1987), which was re-named the "Reactions to Social Situations Questionnaire" in order to minimize response bias. In total, 377 undergraduates consented to participate in the questionnaire screening process (Consent Form I, Appendix A). Respondents who obtained a LSAS Total score corresponding to at least 1.5 standard deviations above the sample mean were eligible to participate as a member of the socially anxious group. Control group participants scored at least 1.3 standard deviations below the sample mean. All participants were required to be 18 to 65 years old, free of current psychotropic medications, free of current panic attacks, and not suffering from color-blindness. All participants were offered two hours worth of extra credit for use in their undergraduate psychology class. If they had already obtained their extra credit, they were offered $15 for their participation.

Sixty-six individuals completed the full set of procedures, although data from four individuals were excluded due to loss of more than 10% of their Stroop data. The final sample size still allowed for sufficient statistical power to detect significant differences between subgroups (n=31 low socially anxious, n=31 high socially anxious). The control group was matched to the experimental group on the variables of age and gender.

Assessment

Liebowitz Social Anxiety Scale (LSAS; Liebowitz, 1987). The LSAS is a 24-item self-report measure of social anxiety and avoidance of situations that involve either

observation by or interaction with others. The scale consists of 13 items pertaining to performance situations (Performance Subscale), and 11 items pertaining to social interaction situations (Social Interaction Subscale). Sample Social Interaction Subscale items include "meeting strangers" and "talking to people in authority", whereas sample Performance Subscale items include "speaking up at a meeting" or "acting, performing, or giving a talk in front of an audience". Each item is rated separately for Fear (0="none," 1="mild," 2="moderate," 3="severe") and for Avoidance Behavior (0="never [0%]," 1="occasionally [10%]," 2="often [33-67%]," 3="usually [67-100%]"). The LSAS yields an Overall Severity rating, as well as scores on four subscales: Performance Fear, Performance Avoidance, Social Fear, and Social Avoidance.

An initial demonstration of the two-week test-retest reliability in a sample of 60 DSM-III-R diagnosed social phobics showed high reliability coefficients for the Performance (r=.91) and Social (r=.89) Subscales (Liebowitz, 1987). With respect to the concurrent validity of the LSAS, Heimberg, Mueller, Holt, Hope, and Liebowitz (1992) found that the LSAS Performance Fear Subscale was moderately correlated (r=.69) with the Social Phobia Scale, which is a self-report measure of the fear of being scrutinized. Futhermore, the LSAS Social Interaction Subscale was moderately correlated (r=.60) with the Social Interaction Anxiety Scale, which assesses positive and negative self-statements concerning heterosocial interaction.

Brown, Heimberg, and Juster (1995) demonstrated the discriminant validity of the LSAS. For the purposes of a treatment study, 108 participants were divided, based on DSM-III-R criteria, into three groups: 1) those with generalized social phobia and avoidant personality disorder (n=28), 2) those with generalized SP without APD (n=36),

and 3) those with non-generalized social phobia without APD (n=38). Baseline assessment including the LSAS showed significant differences in severity among the three groups, with generalized SP with APD demonstrating the most fear and avoidance, followed by generalized SP without APD, and non-generalized SP. Holt and colleagues found a similar pattern of differences in LSAS Fear and Avoidance Subscale scores among a sample of 33 individuals with social phobia divided into the same categories (Holt, Heimberg, & Hope, 1992).

As an outcome measure, the LSAS has been used successfully in several pharmacologic trials for social phobia as well as in studies of psychosocial treatment. In each of these studies, the LSAS reliably assessed clinically significant changes following treatment with pharmacologic agents (Liebowitz et al., 1992) and CBT (Brown, Heimberg, & Juster, 1995).

The LSAS's relevance to the present study lies in its ability to discriminate reliably normal from socially anxious populations. Published normative data (Liebowitz, 1987) on the LSAS were used to determine cut-off scores corresponding to low and high levels of social anxiety.

Social Phobia and Anxiety Inventory (SPAI; Turner et al., 1989). The SPAI is an empirically-derived, 45-item self-report measure of social phobia across a range of potentially distressing situations. The SPAI includes two subscales: Social Phobia (SP) and Agoraphobia (AG). The former subscale consists of 32 items and assesses the cognitive, behavioral, and somatic manifestations of social phobia across a number of social-evaluative situations. In addition, 21 of the 32 SP items assess degree of distress in various social situations based on the presence of four different audience groups:

strangers, authority figures, the opposite sex, and people in general. Other SP items ask respondents to rate the degree to which they experience various somatic symptoms prior to or during social situations. The Agoraphobia subscale, consisting of 13 items, assesses fear in situations typically avoided by individuals with agoraphobia (e.g., crowds, public transportation, waiting in lines) and was added to help differentiate social phobia from the social anxiety that frequently accompanies agoraphobia. A 7-point Likert-scale format is used to assess the frequency with which each item is experienced, with 0 indicating "never" and 7 indicating "always".

The Agoraphobia and Social Phobia subscales are scored separately. A Total score for the SPAI is derived by calculating the difference between the Social Phobia and Agoraphobia subscale scores. Turner et al. (1989) suggest that this Difference score is the best measure of social phobia since it controls for the anxiety associated with agoraphobia situations. However, Herbert, Bellack, and Hope (1991) found that both the Social Phobia score and the Difference score had similar correlations with other measures of social anxiety, whereas the Agoraphobia score was not related to any of them.

Turner et al. (1989) provided initial data on the reliability and discriminant validity of the SPAI in a sample of 306 participants recruited from undergraduate psychology classes, 56 of whom were determined to be socially anxious based on a screening battery of previously proven valid and reliable measures as well as the Anxiety Disorders Interview Schedule (ADIS; DiNardo, O'Brien, Barlow, Waddell, & Blanchard, 1983). Test-retest reliability for the Difference score over a span of two weeks was .86 (separate reliabilities were not reported for each subscale). Internal consistency, as gauged by Cronbach's alpha, was calculated for the Social Phobia and Agoraphobia subscales,

producing coefficients of .96 and .85 respectively. Participants identified as socially phobic based on the screening battery and structured clinical interview scored significantly higher on the SPAI than their non-socially anxious counterparts, thus demonstrating the discriminative validity of the SPAI in a college student sample.

With respect to the SPAI's construct validity, a confirmatory factor analysis has validated the existence of the two subscales in both a population of 72 individuals with a DSM-III diagnosis of social phobia and 308 introductory psychology students (Turner et al., 1989). The results suggested that the subscales were unique and useful in differentiating various anxious and normal groups. The SPAI's concurrent validity with respect to other measures of social anxiety and avoidance also has been demonstrated in a sample of 25 patients meeting DSM-III-R criteria for social phobia (Herbert, Bellack, & Hope, 1991).

The SPAI has been shown to distinguish clients with social phobia from normals and from those with other anxiety disorders. Beidel and colleagues (1989) found that the SPAI correctly classified 74.1% of individuals with social phobia and 75% of controls (a statistically significant finding) in a sample of 308 undergraduate students. In a clinical population (N=84), the subscales were useful in differentiating the responses of individuals with social phobia, agoraphobia, and obsessive-compulsive disorder (Turner et al., 1989). Individuals with social phobia had significantly higher SPAI Difference scores than did clients with panic disorder with or without agoraphobia or obsessive-compulsive disorder. Based on their initial findings, Turner et al. (1989) suggested that a cut-off SPAI Difference score of 60 should warrant evaluation for social phobia. A cut-off score of 80 maximizes the identification rate, although it may lead to some false negatives. Finally, the

SPAI is a sensitive measure of clinically significant change following treatment with pharmacologic or behavior therapy (Beidel, Turner, & Cooley, 1993).

The SPAI's relevance to the current study lies both in its ability to thoroughly assess the severity of cognitive, overt behavioral, and physiological symptoms of social anxiety.

Fear of Negative Evaluation Scale (FNE; Watson & Friend, 1969). The FNE is a measure of cognitions hypothesized to be representative of social phobia. The original measure is a 30-item, true-false questionnaire. However, Leary (1983) has developed a shortened, 12-item version of the form. Items on the short form gauge the degree to which the respondent endorses various self-statements related to social situations (e.g., "When I am talking with someone, I worry about what they may be thinking of me"). Items are rated on a five-point Likert scale (1="not at all characteristic of me" to 5="extremely characteristic of me") with possible total FNE scores ranging from 12 to 60. Four items are reverse scored.

The short form correlates highly with the original scale (r=.96) and has been found to possess inter-item and test-retest reliabilities of .92 and .75, respectively (Leary, 1983). With respect to concurrent validity, Smith and Sarason (1975) found that individuals who obtained high scores on the FNE experienced significantly more distress in response to receiving negative feedback and rated themselves as more likely to receive negative evaluations from others than did those who scored low on the FNE. Likewise, high scorers are significantly more inclined to avoid threatening social comparison information (Friend & Gilbert, 1973). Finally, scores on the FNE are sensitive to clinical

improvements resulting from psychosocial treatment (Mattick & Peters, 1988; Mattick, Peters, & Clark, 1989).

In the present study, the FNE was administered as a primary measure of the severity of participants' social evaluative cognitions. The FNE was expected to correlate with Stroop color-naming interference for social threat words.

Social Avoidance and Distress Scale--Avoidance Subscale (SAD; Watson & Friend, 1969). The SAD is a 28-item, true-false questionnaire assessing anxiety and avoidance associated with social situations (e.g., "I often find social situations upsetting," "I try to avoid situations which force me to be very sociable"). The SAD includes both Avoidance and Distress Subscales.

The SAD possesses excellent internal consistency of r=.94 and adequate test-retest reliabililty (r=.68) after a one month interval in a college student sample (Watson & Friend, 1969). With respect to the SAD's validity, scores on the questionnaire have been found to be significantly related to global ratings of social skills obtained from peers (r=-.70) and to specific behavioral measures of social skills, including gaze time (r=-.34), speech latency (r=.48), and number of words spoken (r=.-31) during social interaction tests (Arkowitz, Lichtenstein, McGovern, & Hines, 1975). In addition, SAD scores correlate significantly with other measures of social anxiety (Wallander, Conger, Mariotto, Curran, & Farrell, 1980).

The SAD's avoidance subscale was employed in the current study as a measure of social avoidance due to social-evaluative concerns.

State-Trait Anxiety Inventory-State Scale (STAI-Form Y; Spielberger, 1983). The STAI is a 2-scale, 40-item, self-report questionnaire assessing two forms of anxiety.

The first subscale, State Anxiety, is conceptualized as a temporary emotional state characterized by subjective tension, apprehension, nervousness, and physiological arousal. State Anxiety is thought to vary in response to external stressors. In contrast, Trait Anxiety is conceptualized as a stable, individual propensity to experience anxiety in the face of stressful situations. Both subscales require the respondent to rate the intensity of subjective anxiety (e.g., "I feel frightened") by utilizing a 4-point likert rating system (1="not at all" to 4="very much so"). Whereas the State Anxiety Subcale solicits self-report of how the individual feels "at a particular moment in time," the Trait Anxiety Subscale solicits self-report of how a respondent "generally feels."

Both the State and Trait Anxiety Subscales demonstrate high internal consistency (alpha=.90 or higher) for both psychiatric and normal samples (Spielberger, 1988). In addition, test-retest reliabilities for the Trait Subscale range from r=.73 to r=.86, indicating that this scale measures a stable construct. In contrast, test-retest reliabilities for the State Subscale are low, which is to be expected for a scale which is theorized to assess changes in anxiety in response to situational stress (Spielberger, 1988). The construct validity of the Trait Subscale has been demonstrated by significantly higher scores for psychiatric patient samples as compared to normal samples (Spielberger, 1983). Moreover, studies finding changes in State Anxiety scores in response to situational stress lend support to the construct validity of the State Subscale (Spielberger, 1983, 1984).

The STAI-S was included as a measure in the present study in order to ensure that the stress induction procedure was successful in eliciting anxiety and to examine the hypothesis that increased anxiety is related to increased vigilance for threat cues presented subliminally, and strategic avoidance of threat cues presented supraliminally.

Beck Depression Inventory-II (BDI-II; Beck, Steer, & Garbin, 1988). The BDI-II is a 21-item, self-report measure of depression severity. The psychometric properties of the BDI-II have been extensively investigated in both psychiatric and normal populations. Steer and colleagues (1985) studied the internal consistency of the BDI-II, noting mean coefficient alphas of .87 for both psychiatric and normal samples. In a review of the test-retest reliability of the BDI-II, Beck and colleagues (1988) noted that Pearson product-moment correlations ranged from .48 to .86 for psychiatric samples and from .60 to .90 for nonpsychiatric samples depending on the length of the time interval between administrations.

With respect to the concurrent validity of the BDI-II, Beck and colleagues (1988) reported high correlations between scores on the measure and clinical ratings of depression for both psychiatric (r=.72) and nonpsychiatric (r=.60) samples. Moreover, scores on the questionnaire correlate with measures of hopelessness, suicidal ideation, and depressogenic thoughts (Beck et al., 1988). In addition, the BDI-II's discriminant validity has been demonstrated by its ability to successfully differentiate normal from clinical samples (Steer et al., 1986).

The BDI-II was included in the current study as a measure of severity of comorbid depression. Previous research has indicated that individuals suffering with depression do not exhibit a selective processing bias for negatively valenced material, although they do exhibit a strong explicit memory advantage for negative information. These findings would imply that the cognitive biases associated with depression operate on a strategic, rather than an automatic, level of processing. Thus, BDI-II scores allowed for the

statistical examination of inhibitory effects of comorbid depression on selective attention for threat.

Emotional Stroop Color-Naming Task (Mathews & MacLeod, 1985; Stroop, 1935). The Emotional Stroop color-naming task employed in the current study is a revised version of the original Stroop color-naming task (Stroop, 1935). The Stroop procedure was performed on an IBM-compatible personal computer, using E-Prime software language (Psychology Software Tools, Inc., 2000) to control stimulus presentation and to record response latencies. Instructions were presented verbally and on the computer screen, stating that the task is a measure of "how people see events in their environment" (Holle et al., 1997). Participants were asked to quickly and accurately name the color in which individual words were presented to the center of the computer screen while ignoring the meaning of the word.

Two sets of stimulus words were prepared for the pre- and post-induction Stroop tasks (Appendix B). Each set contained four types of stimulus words: social threat words, physical threat words, semantically-related neutral words (household items), and semantically-unrelated neutral words. The word sets were matched for word length and frequency of usage in the English language (Caroll, Davies, & Richman, 1971). In a pilot study, 47 undergraduates were asked to rate on a Likert scale (i.e., 0="not at all emotional" to 5="very emotional") the intensity of emotion elicited by a preliminary list of stimulus words (Appendix B). These data were used to match the final word sets on the factor of emotional valence.

Word presentation and recording of response latencies were controlled via a voice-activated relay through a microphone clipped to the participant's shirt. The individual's

vocal response terminated each trial and initiated the next one. Responses were recorded via audiotape for later coding of errors in color-naming.

Initially, participants were asked to color-name the words "one," "two," "three," and "four" presented individually on the monitor screen in the colors red, blue, green and yellow. This presentation provided a check for color blindness and ensured proper naming of colors. Second, a practice color-naming trial consisting of 5 unrelated neutral words which were not included in the experimental trials was presented. Each of the words was presented twice: once subliminally and once supraliminally. Finally, participants began the first experimental phase, which consisted of 256 color-naming trials.

During the pre- and post-induction experimental trials, each of the 32 stimulus words was shown twice in the unmasked condition and twice in the masked condition. Consistent with past research (MacLeod & Hagan, 1992) the color used in each trial was randomized, with the stipulation that for every participant, 25% of trials in each of the two exposure conditions was presented on each of the four possible background ink colors and no word appeared on the same color block more than once. In the unmasked exposure condition, a trial consisted of the presentation of an uppercase, 30 point, black stimulus word shown on an equivalent-sized rectangular color block at a central screen location. The word remained on the screen until the participant's verbal response triggered the voice key which, in turn, cleared the screen. In the masked condition, a trial also began with the presentation of a black stimulus word on a color block to a central screen location. However, the word remained on the screen for duration of 20 msec, after which it was replaced by a pattern mask consisting of an equivalent-length string of black Xs. The pattern mask and color block remained on the screen until the participant's verbal

response triggered the voice key, again clearing the screen. Within each experimental phase, the controlling software program presented the word set in masked format, followed by in unmasked format. Within each format, word types were presented in a fully randomized order.

Awareness Checks. In order to gauge the success of the masking procedure in preventing awareness of the meaning of the stimulus words, four blocks of "awareness check" trials were included in each of the experimental phases. The trials consisted of having the participant decide whether a series of 16 briefly-presented (20 msec), masked letter strings were words or non-words (Appendix C). Only half of the letter strings were, in fact, words. Thus, chance levels of performance on the discrimination task (e.g., 50% correct), would suggest that the meaning of the masked stimulus words could not be consciously perceived.

Procedure

Participant Selection. All individuals who met initial entrance criteria with respect to questionnaire responses (see Participants) were contacted by telephone and asked a series of short questions regarding the study exclusion criteria (Appendix D). Those who appeared to meet inclusion criteria (no current panic attacks, psychotropic medications, or color-blindness) were invited to the Psychological Services Center (PSC) in order to participate in the study. Those who did not meet inclusion criteria were provided with a brief explanation for why they could not take part in the research project (e.g., "We are seeking people who are not color-blind").

Upon arrival at the PSC, the study coordinator escorted the participant to a private clinic room in order to explain the consent form (Appendix E). Participants were not

given a detailed rationale for the study, but were informed that they would be taking part in a project about "how people feel about social situations" which involved completing a series of questionnaires and computer tasks. Interested students were asked to read and sign the consent form.

As stated in the consent form, individuals were informed that they would not be required to undergo any unduly stressful procedures that are outside of those typically encountered in daily life or routine psychological testing. They were informed that they could become anxious at some point during the procedures and that, if they wished, they could terminate participation in the project at any time. They were informed that the study would take two hours to complete.

Questionnaire Assessment. After signing the consent form, the participant was asked to complete a battery of questionnaires consisting of the SPAI, BDI, SADS, STAI-S, and FNE. Questionnaires were presented in a randomized order within groups in order to minimize any possible order effects. Participants were asked to read and follow each questionnaire's instructions carefully.

Stroop Color-Naming Tasks. Following completion of the questionnaire measures, participants were ushered to a separate room for completion of the emotional Stroop task. As described previously, the purpose of the Stroop task was to assess for selective attentional processing biases toward threatening information. Participants were seated within arm's reach of a computer monitor in a quiet, dimly lit room. Instructions were presented verbally and on the computer screen, stating that the task is a measure of "how people see events in their environment" (Holle et al., 1997). Standardized instructions asked that participants quickly and accurately name the color block on which

individual words were presented to the center of a computer screen, while ignoring the meaning of the word. After completing a set of practice color-naming trials, participants completed the STAI-S and the experimental phase of the first Stroop task.

After completing the first Stroop task, participants were told that they would shortly be going to another room in order to give a brief, 3-minute speech on a topic of their choosing to an audience of three graduate students (Amir et al., 1996). They were told that various aspects of the speech would be rated by the audience members. At this time, the STAI-S was re-administered in order to check the efficacy of the anxiety induction manipulation. Next, participants were told that prior to giving the speech, they would be completing a second Stroop task. The second Stroop task was identical in format to the first. However, a different set of word stimuli (Appendix B) was used in order to reduce priming effects.

Debriefing. Subsequent to the completion of the aforementioned procedures, participants were thanked for their participation and were debriefed (Appendix F). The study coordinator provided participants with the necessary paperwork for them to obtain extra credit for their undergraduate psychology class.

RESULTS

Participant Characteristics

Table 1 reports the demographic and clinical characteristics of the socially anxious and control groups. The two groups did not differ significantly with respect to sex, age, or receipt of current mental health treatment (e.g., counseling, psychotherapy). The socially anxious group scored significantly higher on measures of anxiety (SPAI-total, STAI-pre, STAI-post, FNE-total, SADS-total, LSAS-total) and depression (BDI-total) than did the control group.

Table 1. Participant Demographic and Clinical Characteristics

Characteristic	Group		
	Control	Socially Anxious	$\chi^2(1,62)$ $F(1,62)$
n	31	31	
Sex (F/M)	23/8	22/9	.08
Age	20.55	21.25	.26
Current Psychological Tx. (no tx./tx)	29/2	27/4	.74
Anxiety Measures			
SPAI-total	20.86	91.65	144.39*
LSAS-total	15.13	84.39	839.02*
FNE-total	29.39	46.61	76.39*
SADS-total	2.45	16.42	110.28*
STAI-pre-induction	28.71	45.00	32.01*
STAI-post-induction	30.79	61.30	145.02*
Depression Measure			
BDI-total	7.42	18.74	28.61*

*$p<.001$

Response to Induction Procedure

In order to check the efficacy of the anxiety induction, each group's STAI-State scores before and after the anxiety manipulation were submitted to a 2 (Group: Socially Anxious, Control) x 2 (Time: Pre-, Post-Induction) Analysis of Variance (ANOVA) with repeated measurement on the second factor. This analysis revealed significant main effects

of Group, $F(1, 120)=92.53$, $p<.0001$, and Time, $F(1,120)=48.65$, $p<.0001$, that were modified by a significant interaction of Group x Time, $F(1,120)=25.87$, $p<.0001$. Simple main effects analysis revealed that participants had significantly higher STAI-S scores after the anxiety manipulation than before the anxiety manipulation, $F(1,30)=20.84$, $p<01$. The increase in STAI-S scores exhibited by the control group was not significant, $F(1,30)=4.39$, ns. Thus, the manipulation was successful in increasing subjective anxiety across both experimental groups.

Stroop Color-Naming Task

Color-identification latency data were excluded when participants made errors in color-naming or when latencies were less than 100 ms or more than 3 seconds (Mogg et al., 1992). Four participants were excluded because more than 10% of their data were lost due to errors or outliers. Thus, the final sample consisted of 62 participants and the mean percentage of lost data for these participants was 4.4% (4.3% and 4.5% for control and socially anxious groups, respectively). The mean color-naming latencies in each condition for both pre- and post-anxiety induction are given in Table 2.

Initially, an exploratory repeated measures analysis of variance (ANOVA) was carried out for the whole data with Group (2: control, socially anxious) as a between-subjects variable and Time (2: pre-, post-induction), Exposure (2: subliminal, supraliminal), and Word Type (4: social threat, physical threat, categorized neutral, uncategorized neutral) as within-subjects variables. The results showed a significant main effect for Time, $F(1,976)=34.43$, $p<.0001$; latencies were slower post-induction ($M=579.09$) than they were pre-induction ($M=539.58$). There was also a significant main effect for Exposure, $F(1,976)=49.43$, $p<.0001$; latencies were faster in the subliminal

Table 2. Mean Color Naming Latencies in Milliseconds by Group for Pre- and Post-Induction Stroop Tasks

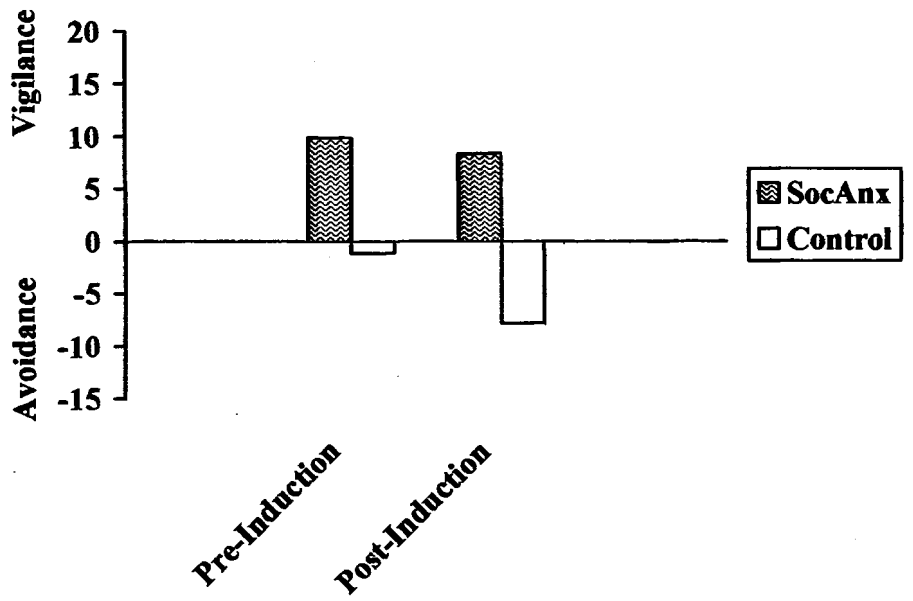
Word Type	Group			
	Control		Socially Anxious	
	Pre	Post	Pre	Post
	M	M	M	M
	(SD)	(SD)	(SD)	(SD)
Supraliminal (Unmasked) Condition				
Social Threat	559.71	572.09	571.32	627.94
	(91.37)	(119.76)	(83.62)	(82.93)
Physical Threat	548.69	570.28	562.90	623.63
	(86.90)	(108.39)	(84.53)	(84.26)
Categorized Neutral	539.54	583.34	575.19	624.39
	(75.74)	(117.81)	(81.87)	(92.74)
Uncategorized Neutral	555.68	578.37	556.72	623.09
	(82.53)	(105.21)	(75.21)	(79.81)
Subliminal (Masked) Condition				
Social Threat	508.39	518.03	521.41	604.94
	(81.89)	(108.00)	(68.74)	(101.34)
Physical Threat	503.96	520.51	528.66	595.08
	(86.27)	(104.78)	(77.23)	(105.29)
Categorized Neutral	507.27	527.08	515.22	591.68
	(103.04)	(115.25)	(69.59)	(108.36)
Uncategorized Neutral	504.45	508.87	520.70	596.14
	(95.47)	(95.05)	(74.75)	(89.95)

(M=535.77) than the supraliminal (M=579.56) condition. In addition, a significant main effect of Group, $F(1, 976)=4.13$, $p<.05$, revealed slower latencies for the socially anxious group (M=577.44) than for the control group (M=537.89). Finally, a significant Group x Time interaction was found, $F(1, 976)=10.79$, $p<.01$, revealing a pattern of significantly slower latencies pre- to post-induction for the socially anxious group (pre-, M=544.02; post-, M=610.86) than for the control group (pre-, M=535.14; post-, M=547.32). Further analyses of the latency data were hypothesis-driven and will be discussed in turn.

Interference scores were calculated for each participant and exposure condition by subtracting the mean latencies for categorized neutral words from those for social threat words. Similarly, the physical threat interference score was calculated by subtracting the latencies for categorized neutral words from those for physical threat words. Larger interference scores, for example, for social threat words, indicate that participants were relatively slower in color-naming anxiety-relevant words than neutral words.

To test the first hypothesis regarding the presence of a pre-attentive bias for threatening information in anxious individuals compared with normal controls, an ANOVA was carried out for interference scores for subliminal words only across pre- and post-induction. The results confirmed the predicted group differences within the subliminal condition (main effect of Group; $F(1,240)=4.12$, $p<.05$). As demonstrated in Figure 1, the socially-anxious group showed relatively greater color-naming interference for threat words in comparison with the control group across pre- and post-induction. The results from the subliminal condition support our first hypothesis that there is a pre-attentive processing bias for threatening information in social anxiety.

Figure 1. Pre- and Post-Induction Mean Interference Scores for Subliminal Threat Words (Combined Physical and Social Threat)

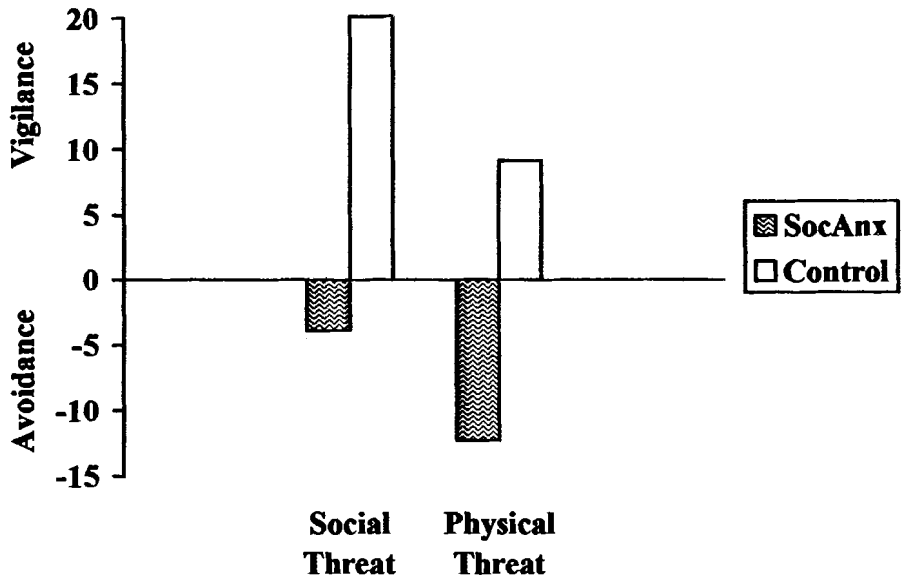


The second hypothesis concerned the content specificity of the bias. That is, is the processing bias in anxious individuals more evident for social-threat words than for physical threat words? The ANOVA of interference scores for threat words showed no evidence of an interaction between Group and Type of threat word, $F(1,240)=.00$, ns, or between Group, Wordtype, and Exposure, $F(1,240)=1.54$, ns. Thus, there was no evidence to support the notion of content specificity.

The third hypothesis concerned the attentional pattern of the socially anxious under non-stressful conditions. It was expected that the socially anxious individual's attentional bias would become more content-specific given the increased time to process the semantic meaning of the stimulus words. In other words, whereas the pre-attentive bias would be evident for all types of threatening information, the attentional bias would be specific to socially threatening information. An ANOVA of pre-induction interference

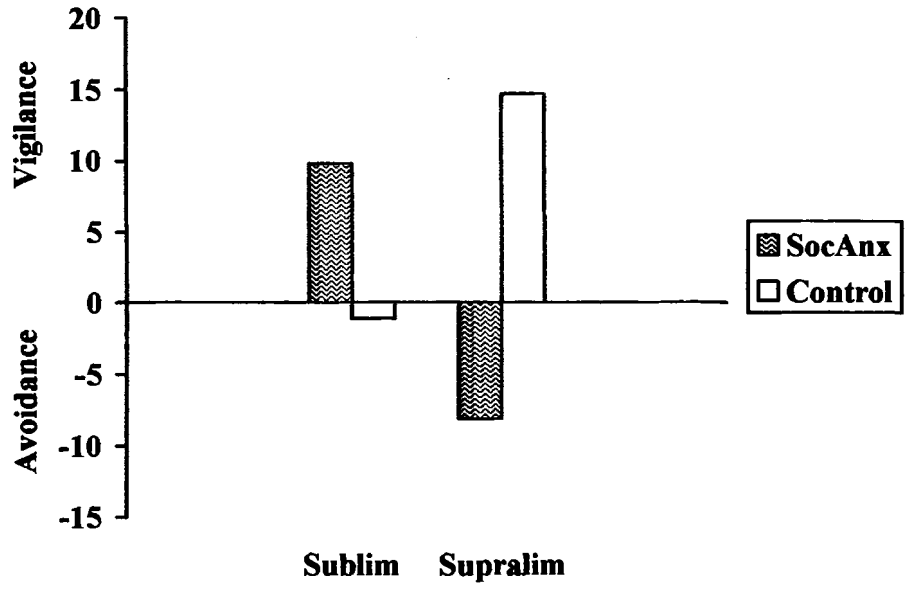
scores for supraliminally-presented words revealed a trend toward a main effect of Group, $F(1,120)=3.81$, $p=.06$, and insignificant findings with respect to a main effect of Wordtype, $F(1,120)=1.72$, ns, and a Group x Wordtype interaction, $F(1,120)=.03$, ns (see Figure 2).

Figure 2. Pre-Induction Mean Interference Scores for Supraliminal Threat Words



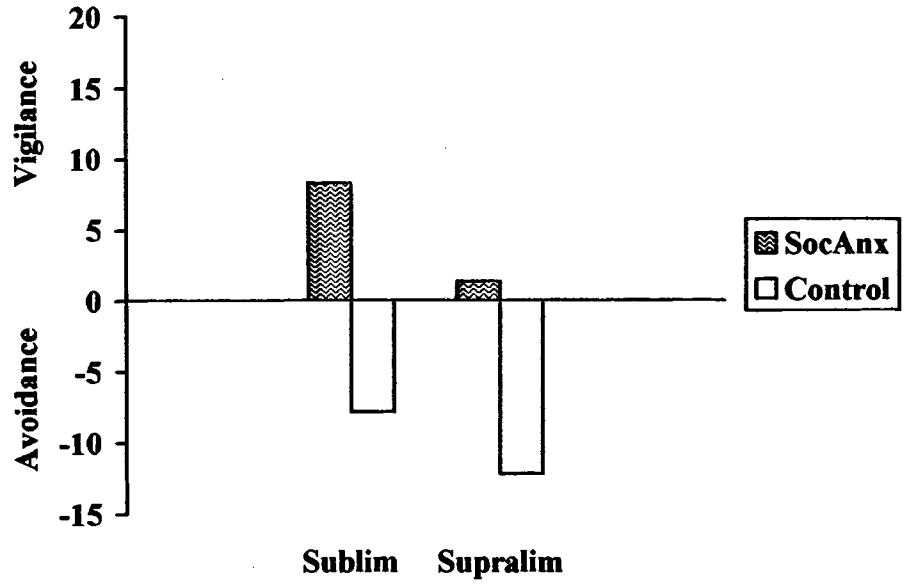
These results were contrary to what was predicted for two reasons. First, in the absence of stress, the socially anxious group demonstrated avoidance of, rather than the predicted vigilance toward, threatening information. Second, this avoidance was not specific to social threat words, but to both social and physical threat words. Thus, the attentional pattern of the socially anxious under non-stressful conditions appears to be one of vigilance toward threatening information at early, non-conscious, automatic stages of processing, followed by avoidance of such information in later, conscious, strategic stages of processing (see Figure 3).

Figure 3. Pre-Induction Mean Interference Scores for Threatening Words



The fourth hypothesis concerned the effects of the anxiety-induction procedure on interference for social threat words. It was hypothesized that, for the socially anxious group, the induction would result in facilitation of color-naming of social threat words presented subliminally and increased interference for those presented supraliminally (e.g., a vigilance-avoidance pattern). An ANOVA of post-induction interference scores for threatening words was carried out, with Group (2: socially anxious, control) as the between-subjects variable and Exposure (2: subliminal, supraliminal) and Wordtype (2: social threat, physical threat) as within-subject variables. The results showed no evidence of a Group x Exposure interaction, $F(1,240)=.03$, ns, or main effects of Exposure, $F(1,240)=.49$, ns, or Wordtype, $F(1,240)=.60$, ns. However, the main effect of Group approached significance, $F(1,240)=3.29$, $p=.08$ (see Figure 4).

Figure 4. Post-Induction Mean Interference Scores for Threatening Words



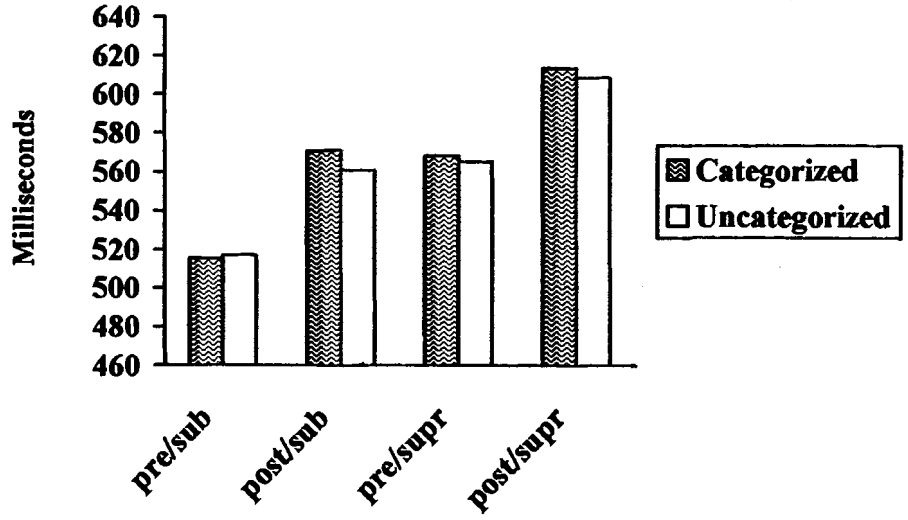
Under stress, the socially anxious group showed more interference for both types of threat words, regardless of exposure, than did the control group (e.g., a vigilance-vigilance pattern). The control group, however, demonstrated relative facilitation for threat words, regardless of exposure duration.

In order to explore hypotheses regarding the relationship between Stroop performance and questionnaire measures of anxiety and depression, Pearson correlations were calculated between color-naming interference scores and SPAI, SADS, FNE, STAI-pre, STAI-post, and BDI. It was predicted that phobic fear and avoidance would be significantly and positively associated with a pre-attentive vigilance for threat words. Furthermore, these correlations were expected to be stronger post-induction. Consistent with our prediction, SPAI total scores were positively associated with vigilance for subliminally-presented social threat words, but only after the anxiety induction (r=.23, $p<.05$). Inconsistent with our prediction, none of the self-report measures of social fear and avoidance were found to correlate negatively with interference for supraliminal social

threat words after initiation of the stress induction. State anxiety did not correlate significantly with any measure of color-naming interference. Although depression severity was not expected to correlate with any measure of attentional bias, BDI scores were positively associated with vigilance for subliminally presented social threat words after anxiety induction (r=.279, p<.05).

A subsidiary question concerned the extent to which color naming interference effects are influenced by word categorization. An ANOVA was carried out on color naming latencies for uncategorized and categorized neutral words, with Group (2: socially anxious, control) as a between subjects factor and Exposure (2: supraliminal, subliminal), Time (2: pre-, post-induction), and Categorization (2: categorized, uncategorized) as within-subjects variables (see Table 1 for means). There were no main effects or interactions involving the Categorization factor, suggesting that differences in response to physical or social threat words were not due to the effects of categorization (see Figure 5).

Figure 5. Comparison of Color-Naming Latencies for Categorized and Uncategorized Word Stimuli (in Milliseconds)



Awareness Checks

Results of the awareness checks are presented in Table 3.

Table 3. Awareness Check Results (Mean Percentage Correct on Each of Four Sets of Lexical Decision Tasks)

	Check 1	Check 2	Check 3	Check 4	Total
Socially Anxious (N=31)	49.8	50.4	49.9	48.6	49.7
Control (N=31)	47.6	49.6	48.5	48.2	48.5
Total Sample (N=62)	48.7	50.0	49.2	48.4	49.1

Across the four sets of lexical decision tasks, the mean percentages of trials with correct responses were 49.7% and 48.5% for the socially anxious and control groups, respectively. There was no significant difference between the two groups in their performance as indicated by percentage correct scores, $t(61)=-1.67$, ns. Additionally, there was no increase in accuracy over time. A paired samples t-test was carried out to assess the extent to which participants' percentage correct scores deviated from chance (50%). This showed that the overall performance of the sample ($M=.49$, $SD=.03$) was not significantly different from that expected by chance, $t(61)=2.57$, $p<.05$. Examining each awareness check separately, participant accuracy on the first, $t(61)=2.17$, $p<.05$, and last set, $t(61)=2.01$, $p<.05$ was significantly worse than that expected by chance (48.7% and 48.4%, respectively). These results suggest that the masking procedure was successful in preventing elaborate processing of the meaning of the stimulus words.

Post-hoc Analyses

Previous research indicates that individuals who suffer from depression tend not to exhibit attentional biases, but biases in later, more strategic stages of processing, such as memory. In order to investigate the hypothesis that participants' depressive symptoms may have impacted the general pattern of the attentional data, depression severity (total BDI score) was used as a covariate in a repeated measures ANOVA for the whole data. Once again, Group (2: control, socially anxious) was the between-subjects variable and Time (2: pre-, post-induction), Exposure (2: subliminal, supraliminal), and Word Type (4: social threat, physical threat, categorized neutral, uncategorized neutral) were the within-subjects variables. The general pattern of results was relatively unchanged. There were significant main effects for Time, $F(1,976)=8.79$, $p<.01$, and Exposure, $F(1,976)=11.74$, $p<.001$, however, there was no longer a main effect of Group, $F(1,976)=2.461$, ns. The significant Group x Time, $F(1,976)=7.67$, $p<.01$, and Group x Time x Exposure, $F(1, 976)=4.07$, $p<.05$, interactions remained. Thus, covariation of the factor of depression did not serve to strengthen, but rather somewhat weakened, the significance of the results. It should be noted, though, that the measure of depression severity used in the study, the BDI, correlated highly and significantly with each of the measures of anxiety, including the SPAI ($r=.59$, $p<.001$), the FNE ($r=.50$, $p<.001$), the SADS ($r=.68$, $p<.001$), and the STAI ($r=.23$, $p<.05$). Thus, covariation of this variable probably did not serve the intended purpose of controlling for symptomatology unique to depression.

DISCUSSION

Principal Findings and Implications

The current study yielded several interesting findings, both expected and unforeseen. First, as initially predicted, highly socially anxious individuals demonstrated greater interference with color-identification of threatening stimuli that were presented in a masked format. This was true both prior and subsequent to an anxiety induction procedure. The finding supports the hypothesis that social anxiety is associated with a bias for threatening information which operates at an automatic, pre-attentive stage of processing (Williams et al., 1997). That is, the attentional bias does not depend on conscious awareness of the threat stimuli.

It is important to note that proof of subliminality, or lack of awareness, is a complex and controversial issue. Cheesman and Merikle (1985) have made a distinction between subjective and objective thresholds of awareness. For example, when participants report that they are guessing in response to a forced-choice task, yet their performance is significantly above chance levels, they would be performing below the subjective threshold, but above the objective threshold. When actual performance on the task is no better than chance, participants are performing below objective thresholds of awareness. In the present experiment, the more stringent standard of objective threshold was used. Awareness checks requiring participants to decide whether masked stimuli were words or non-words were presented at four points during the experiment. During each of these awareness checks, participant accuracy was never significantly better than chance levels. Thus, the results of present experiment provide convincing evidence that color naming

interference effects due to the threatening emotional meaning of words in socially anxious individuals occur even when their ability to detect the stimuli are at chance level, or below the objective threshold. In addition, perceptual processing of word meaning can occur without awareness, as defined by an objective threshold standard.

The second finding was that, at automatic levels of attentional processing, this bias was not specific to social threat words, but extended to other types of threat as well. This finding was consistent with prediction and suggests that interference effects occur when word stimuli have undergone a relatively superficial level of semantic analysis regarding their global negative emotional characteristics. It is consistent with previous investigations of pre-attentive bias in panic disorder, which found interference for both physical threat words and social threat words (Lundh et al., 1999). From an evolutionary perspective, an attentional system that is sensitive to grossly threatening stimuli would be an adaptive survival mechanism. The emotion of fear likely evolved to enable an organism to detect and react swiftly to danger in its environment (LeDoux, 1996). Indeed, animal research to date has suggested that the brain's fear pathway and, in particular, the amygdala, is highly sensitive to a wide range of fear-relevant stimuli. A system that is adept at quickly perceiving grossly threatening environmental cues would theoretically have greater survival value than a visual-attentional system which is slower and reactive to a more restricted range of threatening stimuli. However, it should be noted that such a reactive attentional system would lose survival value if there were not a back-up system to ensure that the organism could disengage attention from cues which did not represent an immediate threat to its survival. This point will be addressed further in later discussion.

The third finding concerned the attentional pattern of the socially anxious under non-stressful conditions. It was originally predicted that the preattentive bias for threatening information would give way to a more content specific bias (i.e., to social threat) with longer exposure durations and increased time for elaborate processing of the stimuli. This result would have been consistent with previous research in which individuals with social phobia displayed an attentional bias that was largely specific for supraliminally presented social threat words (Hope et al., 1990; Mattia et al., 1993). However, this was not reflected in the data. Contrary to prediction, under non-stressful conditions, the socially anxious group tended to avoid both social and physical threat words that were presented at intervals permitting conscious awareness. Thus, the pattern of attention of this group under non-stressful conditions was one of pre-attentive vigilance toward threatening information, followed by avoidance of threatening information in later, strategic stages of processing. This was the vigilance-avoidance pattern that was predicted for the post-induction phase. Interestingly, the control group demonstrated little to no bias for threat in pre-attentive stages of processing, but vigilance for threat in later stages of attentional processing.

Two questions arise from these unexpected findings that warrant discussion. First, why was the attentional bias not specific to social threat? At first glance, this result appears incongruent with previous findings suggesting that interference effects are highly specific to the primary concerns of anxious patients (e.g., Mathews & MacLeoad, 1985; Mogg et al., 1989). However, these earlier results were obtained with a version of the Stroop featuring blocked presentation of stimulus words of the same semantic category. The blocked presentation may be more likely to elicit content-specific interference effects

because of increased opportunity for more elaborate processing of the semantic content of the word stimuli. In the present experiment, stimulus types were not blocked, but were randomly interspersed. This random presentation prevents elaborate processing from occurring, thus decreasing the risk of content-specific effects. In sum, when there is limited opportunity for elaborate processing of the stimuli to occur, the attentional bias of socially anxious individuals appears to operate in a nonspecific manner for all types of threatening information.

The second question pertains to why there was avoidance rather than the predicted vigilance toward threat in controlled stages of processing. It may be that, under conditions of low stress, the socially anxious are able to avoid cognitively, or rapidly disengage attention from, threat-related stimuli. Cognitive avoidance may be a coping strategy which serves the immediate purpose of keeping anxiety low. The control group, which did not demonstrate a preattentive bias toward threat, did not (need to) utilize such a strategy.

The fourth finding concerns the effects of the anxiety-induction procedure on the bias for threatening information in the socially anxious group. It was originally hypothesized that, for the socially anxious group, the induction would result in a heightened pre-attentive bias for social threat words, followed by an avoidance of such cues when they are presented in exposure durations permitting semantic processing (i.e., a vigilance-avoidance pattern). Instead, the results suggested a vigilance-vigilance pattern, with the pre-attentive bias for threatening words remaining, but somewhat weakened, during later, conscious stages of attentional processing. Interestingly, the control group

demonstrated avoidance of threatening material during preattentive and attentional processes following the stress-induction.

When this study was first proposed, it was assumed that cognitive avoidance was a maladaptive coping mechanism in the sense that it would prevent objective evaluation of, and habituation to, threat stimuli. However, the fourth finding calls this assumption into question and raises an alternative explanation. In fact, it may be that cognitive avoidance, or disengagement of attention from threat, is an adaptive strategy which functions to keep anxiety levels low during times of stress. Such a strategy was employed by the non-anxious control group in the present study. In contrast, the inability to disengage attention from threat would maintain cognitive resources on the source of stress and would serve to maintain or heighten anxiety states. Thus, the propensity to dwell on threat-related stimuli may engender feelings of anxiety and lead to the constant rumination and worry characteristic of clinical anxiety. It is interesting to note that, despite the fact that both experimental groups endorsed significant increases in state anxiety following the anxiety induction, the Stroop task revealed that they employed drastically different cognitive strategies in responding to threat stimuli under stressful conditions.

An alternative explanation of attentional dwell is that it represents a cognitive form of behavioral freezing (Fox, Russo, Bowles, & Dutton, 2001). When faced with a predator or other source of threat, freezing prevents unnecessary movements that may trigger attack. LeDoux (1996) has described freezing as an evolutionary gift designed to increase an animal's chance of survival under threatening circumstances. Interestingly, there is some evidence that the amygdala, which is a mediator of the fear reaction in humans, is also a mediator in the freezing behavior of animals (Fanselow 1994; Armony &

LeDoux, 2000). Thus, prolonged engagement of attention by threat cues may represent a vestige of a once-adaptive fear response. Future investigations are needed to test this hypothesis.

With respect to the relationship between self-reported fear and performance on the Stroop, few of the initial predictions bore fruit. Consistent with initial hypotheses, there was a significant, positive correlation between scores on the SPAI and a pre-attentive bias for social threat words after the anxiety induction. However, contrary to prediction, scores on the BDI were also found to correlate positively with post-induction pre-attentive bias for social threat words. Consistent with the latter finding, when the factor of depression severity was covaried out of the Stroop analyses, the significance of the findings was weakened. This was a somewhat surprising result and appears inconsistent with the Williams et al. (1997) theory that depression is not associated with automatic attentional biases. However, it should be noted that diagnoses of depression were not made in the current study, and it is possible that the BDI is an inexact measure of depression in that its scores may be sensitive to inflation by anxiety symptoms. This is supported by the fact that the BDI correlated highly and significantly with each of the measures of anxiety. Another factor which may have served to weaken the correlational results is the fact that the design of the current study, which features samples which are stratified by the factor of social anxiety, is not ideal for correlational analyses. If the study used a unified sample of individuals representative of the full range of social anxiety, perhaps there would have been greater power to detect correlational relationships. However, such a design would not have suited the primary objectives of this study. A third explanation of the weakness of the correlations is that Stroop performance may, in

fact, have little relationship to self-reported anxiety. If measures of attention represent a purer measure of vulnerability to anxiety, impervious to the demand-effects and response biases of questionnaire measures, then correlations between the two measures would be expected to be poor.

In sum, the current data suggest that the attentional patterns of the socially anxious differ from non-anxious controls and that these patterns are affected by exposure to stress induction. The data suggest that, in the absence of stress, the socially anxious sample was able to counteract a pre-attentive bias for threat through conscious efforts to avoid attending to the threatening stimuli. That is, they were able to disengage their attention from threat. However, once exposed to a stressor, it appears that they were unable to use strategic processes to disengage their attention from threat. The non-anxious control participants, however, exhibited a drastically different pattern of attention. Under conditions of stress, they appeared to exhibit a preattentive bias against processing threat, which continued in later, strategic stages of attention. This tendency to disengage from prolonged processing of threat may be an adaptive mechanism aimed at preventing a "fight or flight" response.

Methodological Weaknesses

Both general methodological weaknesses and the limitations of the Stroop task in particular will be discussed in turn. With respect to general methodological weaknesses, it would have been preferable to utilize an experimental group composed of individuals diagnosed with social anxiety disorder. However, given restrictions in time and resources, it was not possible to recruit from the community and to administer a diagnostic interview to potential participants. Such a process would have allowed for increased generalizability

of the study results to a clinical population. In addition, it would have permitted the exclusion of individuals with significant psychiatric comorbidity that may have influenced attentional processing. Thus, theoretically, it may have been possible to isolate and observe the attentional patterns associated with uncomplicated social anxiety disorder. Use of a clinical sample, in combination with a larger sample size, may have served to increase the robustness of our findings.

In defense of the recruitment strategies utilized in the current study, every effort was made to identify an undergraduate sample with relatively extreme social fears. Their scores on the screening questionnaire were at least 1.5 standard deviations above the mean of their undergraduate peers. The experimental sample demonstrated mean performance on questionnaire measures of social anxiety (e.g., SPAI, SADS) which was comparable to that seen in clinical samples cited in the literature. Moreover, another powerful argument in favor of the use analogue samples involves the conceptualization of forms of psychopathology as continuous phenomena. If social anxiety is, indeed, a continuous variable, then clinical anxiety should differ from subclinical anxiety in quantity but not quality. Thus, an analogue sample of socially anxious individuals should demonstrate similar attentional patterns, albeit perhaps less robust, than a clinical sample.

The current study was designed, in part, with the aim of addressing many of the methodological weaknesses of previous investigations of attentional processes using the Stroop color-naming task. A computerized version of the Stroop, versus the older card version, was used in order to standardize the presentation of stimuli across trials and across participants. Word stimuli were matched for the degree of emotion elicited, character length, number of syllables, and frequency of usage in the English language. The

two sets of word control groups, also matched on the aforementioned variables, served to ensure that the semantic similarity of each group's words did not contribute to the observed attentional biases. Semantic priming was also reduced by presenting word-types in a random sequence rather than blocked by category. Furthermore, unlike the majority of previous Stroop investigations, the current study included periodic awareness checks in the Stroop protocol to serve as an internal check that participants were, indeed, unaware of the subliminally-presented material.

Despite the aforementioned upgrades in Stroop methodology, the paradigm itself is several decades old and has come under increasing criticism in recent years. A fundamental weakness of traditional means of measuring attention such as the Stroop and dot-probe tasks is that they rely on cross-sectional "snapshots" of attention at specific time points. Such paradigms measure attention at very specific moments in time, usually following the presentation of an emotional stimulus. However, by its nature, attention is a fluid, continuous process characterized by constant shifts. In order to arrive at a more complete and accurate picture of attention, more sophisticated methods of assessing the fluidity of attention over longer time periods are needed.

One paradigm with potential utility as a continuous index of attention is the registration of eye movements. In this paradigm, eye movements are continuously monitored for several seconds using an eye-tracking device which sends an infrared beam of light to one of the eyes of the participant. Part of the light is reflected by the cornea and part is reflected through the pupil by the retina. An infrared sensitive camera records these reflections and, on the basis of the images, computes a vector between the pupil center and corneal reflection. The fixation point is the intersection of the two moving

axes. Eye movement registration was utilized recently in an effort to measure the viewing patterns of spider-phobic participants toward emotionally relevant (i.e., spiders) or irrelevant (i.e., flowers) stimuli (Hermans, Vansteenwegen, & Eelen, 1999). The investigators found that spider-phobic participants initially oriented toward pictures of spiders relative to flowers, when stimuli were presented for durations up to 500 ms. However, when exposure to the stimulus continued beyond 500 ms, there was a strong tendency for spider phobics to shift their gaze away from the spider-related pictures. This pattern was not observed in the control group and suggests that initial dwell time on threatening stimuli gives way to selective avoidance of such stimuli at longer durations. Future research with such paradigms will greatly improve our knowledge of the fluidity of the attentional system.

Recent Developments

In recent years, the area of attention has benefited from advances in technology and an attenuation of the schism between pure cognitive research and clinical research. Increasingly, clinical researchers in this area are incorporating in their investigations technology that is considered state-of-the-art by the standards of pure cognitive research. Such cross-disciplinary study is, undoubtedly, a promising development and will likely quickly advance our knowledge of how complex attentional processes contribute to psychopathology.

Very recently, an article by such a group of cross-disciplinary investigators has revolutionized the conceptualization of attentional bias (Fox, Russo, Bowles, & Dutton, 2001). This article warrants thorough discussion in that its proposals influence the interpretation of the results of the current study. In essence, the authors challenged the

popular notion that Stroop interference is due to a bias in the initial orientation of attentive resources toward threat-related stimuli. They argue that threat-related material instead affects "attentional dwell time," or the ability to disengage attentional resources from threatening stimuli in anxious people. They note that the emotional Stroop and dot-probe tests are not apt measures of attentional shift because the information to be ignored is always presented within foveal vision. Although foveal vision and attention are not the same thing, there is a consensus in cognitive psychology that it is impossible not to attend to information presented within a 1 degree radius from fixation (e.g. Ericksen & Eriksen, 1974; Treisman, 1969 as cited in Fox et al., 2001). Therefore, with both Stroop and dot-probe tasks, it is impossible to determine whether the threatening information draws attention or whether, once detected, threatening information holds attention. Both processes would be reflected in longer color-naming latencies on the Stroop task.

In a series of studies, Fox and colleagues investigated the notion of attentional dwell time using a paradigm that more directly measured attentional disengagement (Fox et al., 2001, 2002). In their investigations, a threat-related or neutral word cue is presented alone for a very brief period in one of two possible locations. A target could then appear in either a validly cued location (i.e., cue and target appear in the same location) or an invalidly cued location (i.e., cue and target appear in different locations). The invalidly cued trials are of particular interest, since reaction times can be compared following neutral, positive, and threat-related cues, yielding a more direct measure of disengagement from threatening stimuli. If threatening material increases dwell time in anxious participants, this should be reflected in slower reaction times to detect a target on invalid trials following a threat-related cue, relative to a positive or neutral one. In a series

of studies using schematic facial expressions and photographs of real facial expressions as cues, Fox et al. (2001) found that individuals with high levels of state anxiety took longer to respond to a target on invalid trials when the cue had been an angry facial expression. Low state anxiety individuals did not show this pattern. Both Fox and colleagues (2002) and Yiend and Mathews (in press; as cited in Fox et al., 2002) have since found a similar pattern of results in high trait anxious participants. These findings argue against the idea that anxiety is characterized by a hypervigilance of the attentional system or a bias in the shifting of attention (Eysenck, 1992) but, rather, a problem with disengaging attention from threatening information in the environment. Fox and colleagues' recent data are convincing and have been considered landmark by many investigators who are involved in the study of attentional processing. Their implications for the interpretation of the current study's results will be discussed presently.

From the perspective of Fox and colleagues, attention is best conceptualized as a fluid process, but one involving various stages including shifting, engagement, and disengagement (Posner & Petersen, 1990). The shifting component is thought to be an encapsulated system that is not affected by higher level cognitive influences. Because shifting of attention is considered to be a reflexive action, the speed of orientation to novel cues in the environment is not thought to be affected by the meaning or valence of the cue. This would be an adaptive feature of an attentional system from the standpoint of facilitating quick and accurate perception of changes in the environment. However, an additional function of attentional systems is to maintain processing resources on relevant stimuli. Stimulus relevance may be determined both by characteristics of the scene itself and by the expectations, beliefs, and goals of the observer (Yantis, 1996). Thus, stages

beyond the shifting of attention are thought to be influenced by higher level variables. According to Fox and colleagues, attentional biases occur subsequent to the initial shifting and amount to an inability to disengage attention from certain types of stimuli.

There is some evidence to suggest that there is a biological basis for fear-relevant stimuli (e.g., snakes, spiders, angry faces) to be given precedence by the attentional system. Indeed, psychophysiological studies show that the conditioning of autonomic responses to such stimuli is much easier than to fear-irrelevant stimuli such as flowers (Ohman & Soares, 1998). With respect to the present study, this biological vestige or predisposition may account for why the attentional systems of anxious individuals are hypersensitive to the fear-relevant stimuli in the environment. Furthermore, these attentional biases may underlie the other types of cognitive biases observed in clinical anxiety. Data from the present study lend some preliminary support to the Fox's notion that the socially anxious have difficulty disengaging from threat cues. When exposed to a stressor, the socially anxious group was unable to use strategic processes to disengage their attention from threat, while the control participants were able to disengage attention from such cues. The result of this apparent inability to disengage attention from social threat cues may be gross overestimations of the threat of disapproval from others. Furthermore, such a process may ensure that cognitive resources are shunted away from cues relevant to successful task performance, thus leading to impoverished performance in social situations.

Future Directions

With continued improvements in methodology/technology, measures of attentional deployment have potential utility in the clinical setting. Such procedures could be used

diagnostically, as measures of emotional vulnerability. That is, they may be useful in predicting who is and who is not susceptible to developing anxiety problems or extreme emotional reactions to stressors. For example, knowledge of an individual's information processing style during childhood could be used to predict risk of subsequent development of anxiety disorders in adolescence or adulthood. The same process could apply to determining one's risk of developing PTSD after exposure to a traumatic event.

As an assessment tool, information processing measures would be superior to questionnaire measures in the sense that they are not susceptible to demand effects or intentional distortion. Whereas, on self-report measures, patients may exaggerate or minimize changes in symptoms to please the therapist or to prevent termination, this would not be possible on the measures of involuntary attention. It has already been established that clinically significant improvements in social phobia symptoms following treatment with cognitive-behavioral therapy or phenelzine are associated with decreases in the bias for social threat cues that are presented at intervals permitting conscious awareness (Mattia et al., 1993). However, investigations have yet to reveal whether treatment affects automatic, preconscious processing biases. Residual information processing biases following a course of treatment, in fact, may be predictive of subsequent relapse and could signal the need for additional treatment. These questions have yet to be examined empirically, however, and future research should address the potential utility of attentional measures as an assessment tool and a means of quantifying treatment effectiveness.

One area in which the utility of attentional measures has been investigated is as a treatment apparatus. Masia and colleagues (Masia, McNeil, Cohn, & Hope, 1999) used

the Stroop as a language-based means of exposing individuals to social threat cues (e.g., words such as "speech" and "conversation"). They likened the procedures to imaginal exposure in that patients were not placed in feared situations, but were exposed to word stimuli that had become associated with those situations and, thus, had acquired the ability to elicit fear. They present preliminary data indicating that exposure therapy using brief presentations of social threat cues is effective in reducing social fears. The authors argue that exposure using the Stroop holds promise as a preliminary or adjunctive treatment for the socially anxious as a means of reducing anxiety prior to undertaking group cognitive-behavioral therapy and in-vivo exposure exercises.

In the immediate future, it would seem prudent to focus research pursuits on developing a clearer picture of what the attentional bias represents and what is its relationship to observable aspects of anxiety. Traditional measures such as the Stroop offer only a glimpse at this phenomenon, however, the newly developed paradigms previously discussed will undoubtedly provide a more complete and accurate view of the fluid nature of the attentional process. Furthermore, at this point in time, researchers can only speculate about the origins of the bias and its biological substrates. Moreover, it is still unclear as to how such a bias contributes to the development or maintenance of the behavioral avoidance characteristic of anxiety disorders. Future cross-disciplinary research in cognitive-behavioral psychology, neuropsychology, and clinical neurobiology may shed some light on these questions.

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APPENDICES

Appendix A

Informed Consent I

Screen # _____

Thank you for taking the time to complete this brief questionnaire. Please sign and print your name below, along with your telephone number or e-mail address. This is to say that you are at least 18 years old, you give your consent to complete the attached questionnaire, and you understand that you do not receive research credit for completing this questionnaire. In addition, your signature indicates that you are interested in participating in a related study, and that you give permission for an experimenter to contact you by telephone or e-mail to set up a time for you to participate in a voluntary study. The experimenter is looking for participants who score in various ranges on the questionnaires, so you may or may not be contacted to participate in the study. The study is entitled "Attitudes and Reactions to Social Situations" and involves completing a set of questionnaires and a computer task.

If you have any questions you may contact Kristin Maki, 166 Little Hall, phone: 581-2031. Thanks again for your help.

_____ _____ _____

Signature Age Gender

_____ _____

Name (please print) Phone Number

_____

E-mail address

Appendix B

Table B1. Stroop Color-Naming Task Word Stimuli
(with mean number of letters, frequency of usage, and emotionality ratings)

Stroop A															
word	*#ltr*	*freq*	*emot*												
social threat				**physical threat**				**categorized neutral**				**uncategorized neutral**			
embarrassed	11	41	3.02	ambulance	9	15	2.20	microwave	9	2	.12	notify	6	5	.16
stupid	6	69	2.29	illness	7	78	2.04	bookcase	8	17	.12	obsidian	8	7	.49
failure	7	71	2.71	cancer	6	39	3.41	vase	4	28	.06	fiber	5	57	.03
inferior	8	18	2.43	insane	8	14	2.65	upstairs	8	114	.31	network	7	74	.27
boring	6	36	1.14	suffocated	10	3	2.59	furnished	9	43	.08	sediment	8	28	.04
inadequate	10	10	2.47	trapped	7	82	2.80	towel	5	48	.42	demonstrate	11	50	.44
pathetic	8	8	2.59	tumor	5	32	3.08	mantelpiece	11	7	.06	baton	5	11	.07
ignorant	8	30	2.49	coffin	6	22	2.41	staircase	9	19	.04	handwriting	11	60	.11
	8.00	35.38	2.39		7.25	35.63	2.65		7.88	34.75	.15		7.63	36.50	.20

Stroop B															
social threat				**physical threat**				**categorized neutral**				**uncategorized neutral**			
foolish	7	126	1.61	stroke	6	143	1.94	dishwasher	10	6	.04	portal	6	5	.06
criticized	10	15	2.29	collapse	8	18	1.73	cushion	7	16	.32	wrapper	7	9	.13
shameful	8	2	2.22	emergency	9	56	2.58	mattress	8	26	.27	specialized	11	72	.51
hated	5	96	3.04	cemetery	8	14	2.90	shelves	7	92	.06	metric	6	57	.10
humiliated	10	5	2.81	lethal	6	4	2.71	cabinet	7	43	.08	generate	8	18	.07
rejected	8	25	2.84	choking	7	26	2.35	chimney	7	76	.04	tailor	6	37	.24
unpopular	9	10	1.88	paralysis	9	18	2.58	freezer	7	10	.14	previously	10	52	.20
insult	6	9	2.31	fatal	5	37	2.80	linoleum	8	17	.32	clauses	7	55	.14
	7.88	36.00	2.38		7.25	39.50	2.45		7.63	35.75	.16		7.63	38.12	.18

Appendix C

Table C1. Awareness Check Stimuli Sets

Check 1		Check 2		Check 3		Check 4	
words	***# letters***	***words***	***#letters***	***words***	***# letters***	***words***	***#letters***
embarrassed	11	failure	7	boring	6	pathetic	8
stupid	6	inferior	8	inadequate	10	ignorant	8
ambulance	9	cancer	6	suffocated	10	tumor	5
illness	7	insane	6	trapped	7	coffin	6
microwave	9	vase	4	furnished	9	mantelpiece	11
bookcase	8	upstairs	8	towel	5	staircase	9
notify	6	fiber	5	sediment	8	baton	5
obsidian	8	network	7	demonstrate	11	handwriting	11
	8.00		6.38		8.25		7.88
non-words	***# letters***	***non-words***	***# letters***	***non-words***	***# letters***	***non-words***	***# letters***
levofmr	7	mopecer	7	cepran	6	tordrane	8
omvurn	6	gatricep	8	hipresmalt	10	culpaser	8
hltadime	8	srapud	6	yarltrenad	10	wuvig	5
sltwmep	7	arpaltid	8	getaser	7	sliban	6
apleyrnhs	9	kerp	4	pochwelft	9	jentrilpany	11
csaflipnemd	11	fibaltor	8	mareg	5	buleshant	9
rhayxd	6	cirne	5	wuzilter	8	umtar	5
dsivamiru	9	lorpien	7	telignoffer	11	holgracten	10
	7.88		6.63		8.25		7.75

Appendix D

Telephone Screening Transcript

Screen # _____

My name is Kristin Maki and I am a graduate student in the psychology department. I recently spoke to your undergraduate psychology class about my research project about attitudes and reactions to social situations. You had agreed to complete a screening questionnaire and to be contacted if you met initial study criteria. Based upon your responses, you may be eligible to participate in the study. However, I would need to ask you some additional questions about your mental health and medical history. Would you mind answering some questions? (yes / no)

1.) Are you currently taking medication for, or participating in therapy for, problems with anxiety or depression? (yes / no) [If no, skip to question 2.]

> [If yes...] Unfortunately, we are looking for participants who are not receiving medication treatment for difficulties with anxiety or depression.

2.) Have you recently experienced panic attacks? A panic attack is a sudden rush of intense fear or discomfort, which may include such symptoms as heart palpitations, sweating, shortness of breath, feeling faint, and a fear of dying or losing control. (yes / no) [If no, skip to question 3.]

> [If yes...] In what types of situations do these attacks occur? _____.
> Are you worried about having another attack? (yes / no) [If yes, go to **]

3.) Have you been feeling depressed or have you lost interest or pleasure in nearly all of your usual activities? (yes / no) [If no, skip to question 4.]

> [If yes...] Have you experienced other symptoms, such as significant changes in weight, or appetite; sleep difficulties; restlessness or feeling slowed down; fatigue or loss of energy; feelings of worthlessness or guilt; inability to concentrate; or thoughts about death or suicide? (yes / no) [If yes, go to **]

[**If the client endorses recurrent, unexpected panic attacks or depression...] It sounds as though you may be having some difficulties with anxiety/depression. Unfortunately, this would make you ineligible to participate in the research project. However, if you would like to obtain treatment, the University of Maine has a Counseling Center at Cutler Health Center. If you would like to call them, their number is 581-1392 (on nights or weekends, their crisis number is 581-4020).]

4.) Are you color blind? (yes / no)

> [If yes...] Unfortunately, because of the type of computer tasks we are using in the study, you would be ineligible to participate.
>
> [If no...] Based on your answers to these questions, you would be eligible to participate in the study. Would you like to set up an appointment time in order to come in, hear more about the study and, perhaps, participate? (yes / no)

Appendix E

Informed Consent

Participant # _____

I have been asked to participate in a study entitled "Attitudes and Reactions to Social Situations" because I am at least 18 years old and have met initial study entry criteria based on my previous responses on a screening questionnaire. The procedures used in this study involve completing a set of questionnaires and computer tasks. The questionnaires measure levels of anxiety and depression, and include such items as, "I feel anxious before entering a social situation," and "I feel sad much of the time." If any of the questions are disturbing or upsetting to me, I may leave them blank. The computer tasks involve quickly identifying the color in which various words are presented on a monitor. The study requires approximately two hours to complete and I will receive two credit-hours to apply to my undergraduate psychology course grade. I understand that my participation is voluntary and that I may terminate participation at any point without penalty.

Risks/Benefits

All of the information that I provide will be kept confidential and separate from identifying information. Questionnaires will be identified by code number only. No information that could identify me will ever be released. Only group information will be reported. Furthermore, all of the information that I provide will be stored in a locked laboratory. One risk of participating in this study is that I may feel uncomfortable or anxious at some point during the questionnaire or computer procedures. However, I will not be required to undergo any unduly stressful procedures that are outside of those typically encountered in daily life or routine psychological testing. The potential benefits of the study include learning more about both people's attitudes and reactions to social situations and the experience of participating in a research project. As a result of my participation, I will also obtain 2 hours worth of research credit to apply to my undergraduate psychology course grade.

This study is being conducted by Kristin Maki, B.A., and supervised by Jeffrey E. Hecker, Ph.D. If I have any questions, comments or concerns, I may contact Kristin Maki at 301 Little Hall, Department of Psychology, Orono, Maine 04469, 581-2031 or Dr. Hecker at 341 Corbett Hall, Orono, Maine, 04469-5717, 581-2065.

I have read and understood the contents of this consent form. I have been given a copy of this form.

Participant's Signature: _____ Date: _____

Appendix F

Debriefing Statement

The purpose of the research study that you have just completed was to investigate the relationship between social anxiety and one's propensity to attend to social threat cues in his/her environment. You were invited to participate because you scored either high or low on a screening questionnaire which measures level of anxiety in social situations (i.e., meeting other people, parties, etc.). The purpose of the computer tasks was to see whether your attention was drawn to words denoting social threat (i.e., embarrass, speech), making it more time-consuming for you to color-name them. It was necessary for us to tell you that you would be required to give a speech in order for us to examine whether the anxiety produced by the request (if any) had an effect on your attention to specific types of words.

We are requesting that you please do not share this information with others who are likely to participate in this study. Having detailed knowledge about the purpose of the study may affect the way that they respond to the questionnaires or other procedures.

If, in the future, you have any questions or comments about the study, please feel free to contact the study coordinator, Kristin Maki, B.A. at 301 Little Hall, Department of Psychology, Orono, Maine 04469, 581-2031 or her supervisor, Jeffrey E. Hecker, Ph.D. at 341 Corbett Hall, Orono, Maine, 04469-5717, 581-2065.

Thank you very much for your participation.

BIOGRAPHY OF THE AUTHOR

Kristin Maki was born in Weymouth, Massachusetts on October 10, 1971. She was raised in Cohasset, Massachusetts and graduated from Cohasset High School in 1989. She attended Trinity College and graduated in 1993 with a Bachelor's degree in Psychology. After completing research assistantships at Wayne State School of Medicine and Massachusetts General Hospital, she entered the Clinical Psychology graduate program at The University of Maine in the Fall of 1997.

Kristin completed her pre-doctoral internship through the Brown University Consortium in Clinical Psychology. She is a candidate for the Doctor of Philosophy degree in Psychology from The University of Maine in May, 2003. After receiving her doctoral degree, she will undertake a two-year research post-doctoral fellowship at Brown focusing on the study of anxiety disorders.