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# Cognitive Biases in Social Anxiety Disorder: Examining Interpretation and Attention Biases and Their Relation to Anxious Behavior

Natasha Mehta

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COGNITIVE BIASES IN SOCIAL ANXIETY DISORDER: EXAMINING  
INTERPRETATION AND ATTENTION BIASES AND THEIR RELATION TO ANXIOUS  
BEHAVIOR

by

NATASHA MEHTA, MA

Under the Direction of Page L. Anderson, PhD and Erin B. Tone, PhD

ABSTRACT

Information processing biases, such as interpretation bias and attention bias, play a significant role in social anxiety disorder (Williams et al., 1997). Interpretation bias refers to the tendency to interpret both negative and neutral stimuli as more negative than they are objectively. Attention bias refers to the tendency to attend preferentially to threatening stimuli. Socially anxious individuals display a negative interpretation bias for ambiguous social stimuli (e.g., social scenarios) (for review see, Amir & Bomyea, 2010). In addition, socially anxious individuals exhibit a bias to orient attention either towards or away from threatening social stimuli (e.g., facial expressions; see Bar-Haim et al., 2007). Whereas an extensive body of

research focuses on both interpretation bias and attention bias in social anxiety in isolation, very few studies have concurrently examined the associations between these two biases and social anxiety symptoms and evaluated their distinct predictive power. Further, no studies have examined their relation to behavioral avoidance, which is a key symptom of social anxiety that directly contributes to clinical severity (Kazdin, 1999).

The current study examined how interpretation and attention biases independently relate to symptomology, situational anxiety, and behavior in adults diagnosed with social anxiety disorder. Thirty-four participants diagnosed with social anxiety completed computerized interpretation bias and attention bias tasks, a behavioral avoidance speech task, and self-report measures of state and trait social anxiety and general state anxiety. Results indicated that a negative interpretation bias was significantly related to state and trait social anxiety and a lack of benign interpretation bias was related to general state anxiety. There were no associations between attention bias and anxiety or behavior. Findings highlight the unique importance of both negative and benign interpretation biases in social phobia. Suggestions for future research include incorporating benign interpretation training, particularly under stress, into treatment programs such as cognitive modification or exposure therapy for social phobia.

**INDEX WORDS:** Social anxiety, Interpretation bias, Attention bias, Behavior,

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NATASHA MEHTA

A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree of

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In the College of Arts and Sciences

Georgia State University

2015

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Natasha Mehta  
2015

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## **DEDICATION**

To my parents for their unconditional love and support. Thank you always.

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## **1 INTRODUCTION**

### **1.1 Overview of social anxiety**

Social Anxiety Disorder (SAD) is characterized by persistent and exaggerated fear and apprehension of social or performance situations involving possible negative evaluations by others (American Psychiatric Association, 2013). Individuals with SAD experience anxiety in, and avoid, socially evaluative situations such as conversations, speaking with authorities, public speaking, asserting themselves, and attending social events. Between 10-13% of the general United States (US) population have SAD, making it the fourth most prevalent psychological disorder (Magee, Eaton, Wittchen, McGonagle, & Kessler, 1996) and the second most common anxiety disorder in the US (Kessler, Chiu, Demler, & Walters, 2005). SAD is debilitating—individuals with SAD attain lower levels of educational achievement and earn less income; they are also less likely to be married than their less anxious peers (Turner & Beidel, 1988). More individuals with SAD fail to receive treatment than do individuals with other major psychiatric disorders, and between 72% and 95% of individuals diagnosed report never having received mental health treatment (Schneier, Johnson, Hornig, Liebowitz, & Weissman, 1992). Individuals with social phobia participating in National Anxiety Disorders Screening Day indicated that the most common barriers to treatment were uncertainty over where to go for treatment, inability to afford services, and fear of what others might think if they sought help (Olsson et al., 2000).

### **1.2 Information processing biases in anxiety**

Theoretical models of anxiety suggest that information processing biases (also referred to as cognitive or cognitive processing biases) are crucial factors in the etiology, maintenance, and treatment process of anxiety disorders, including SAD (Beck, Emery, & Greenberg, 2005; Eysenck & Calvo, 1992; Williams, Watts, MacLeod, & Mathews, 1997; Williams, Watts,

MacLeod, & Mathews, 1988). These biases involve the preferential or selective processing of information: in the context of anxiety, information processing biases are specific to threat-relevant stimuli. Experimental psychopathologists have examined information processing biases within three domains: attention, memory, and interpretation. These biases can manifest at two stages of information processing: automatic and strategic. Automatic processing is effortless, involuntary, and unintentional, whereas strategic or controlled processing is considered effortful, voluntary, and intentional (Shiffrin & Schneider, 1977).

Information processing models of anxiety typically treat attention to and interpretation of threat cues as two distinct processes that unfold sequentially. In general, these models posit that threat identification (first at the automatic and second at the strategic stage) leads to allocation of attention toward threatening stimuli (at both the automatic and strategic stages) (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007; Beck & Clark, 1997; Bradley, Mogg, Falla, & Hamilton, 1998). People with pathological anxiety overestimate the threat value of information and allocate excessive attention toward processing the information that they have perceived as threat-relevant. The current study focuses on these two processing biases—interpretation and attention—in SAD.

### **1.3 Interpretation bias in social anxiety disorder**

Interpretation biases lead anxious individuals to interpret ambiguous situations in a negative manner (Mathews & MacLeod, 1994, 2005). Cognitive models of social anxiety maintain that socially anxious individuals interpret interpersonal cues or evaluative feedback in social situations, which are characteristically ambiguous, in a negative way (Clark & Wells, 1995; Rapee & Heimberg, 1997). A number of studies reveal a significant association between social anxiety and interpretation bias (for review see, Amir & Bomyea, 2010) and show that

socially anxious individuals interpret negative and ambiguous stimuli (e.g., social situations) presented in the context of a variety of tasks more negatively than do non-anxious individuals.

Two studies have used questionnaire measures that comprise ambiguous social and non-social scenarios and verbal scripts to investigate interpretation bias in socially anxious samples (Amin, Foa, & Coles, 1998; Stopa & Clark, 2000). These questionnaires require participants to read ambiguous nonsocial (e.g., “You get your cable bill and notice that . . .”) and social scenarios (e.g., “Someone you are interested in says 'Hello' to you), each followed by three possible interpretations: positive (e.g., “S/he wants to get to know you”), negative (e.g., “S/he feels sorry for you”), and neutral (e.g., “S/he says ‘Hello’ to everyone”). Participants rank order the interpretations according to how likely they think each would come to mind, or they rate which interpretation they believe more. Results from these two studies indicated that in both clinical and non-clinical populations, socially anxious individuals endorsed negative interpretations for ambiguous social scenarios as more readily accessible and more believable, even when neutral and positive interpretations were available, than did less socially anxious individuals.

Other studies have used visual stimuli, including images of facial expressions (Lira Yoon & Zinbarg, 2007; Winton, Clark, & Edelman, 1995) and video clips (Amir, Beard, & Bower, 2005), to measure interpretation bias in social anxiety, based in part on the idea that such stimuli, which participants routinely encounter in day-to-day social life, may be more ecologically valid (Risko, Laidlaw, Freeth, Foulsham, & Kingstone, 2012). In a study with a small non-clinical sample (N=24) of individuals scoring high (n=13) or low (n=11) on the Fear of Negative Evaluation (FNE) scale, participants in the high-FNE group labeled the affect displayed on both negative (e.g., anger, sadness, disgust, fear) and neutral facial expressions as negative more often

than did low-FNE subjects after members of both groups were told they might be chosen to give a speech (Winton et al., 1995). In another study of non-clinical undergraduate participants, individuals who were more socially anxious interpreted neutral facial expressions as more threatening than did those who were less anxious, both when they were shown different types of facial expressions and asked to label the emotions as positive, negative, neutral, bored or other and when they were asked to tell stories about the pictures (e.g., “He was angry that he got a lower grade than her.”) (Lira Yoon & Zinbarg, 2007).

Amir and colleagues (2005) examined the specificity of a negative interpretation bias to social anxiety by comparing valence ratings (e.g., “very negative emotion” to “very positive emotion”) of video clips of positive (e.g., “I really like your shoes), negative (e.g., “That is a horrible hair cut”) and ambiguous (e.g., “That is an interesting shirt you have on”) statements across socially anxious, anxious-dysphoric (i.e., trait anxious and depressed but not social anxious), and non-anxious groups. In a sample of 75 undergraduates, participants were divided into groups based on percentile scores on continuous measures of social anxiety and depression (non-anxious controls scored in the bottom 15 percent on both measures, whereas the socially anxious group scored higher on social anxiety measures than did the anxious-dysphoric group). Results showed that the socially anxious group rated the ambiguous video clips as significantly more negative (using a 7-point Likert rating scale) than did both non-anxious and anxious-dysphoric groups. In sum, studies using various stimulus types and methodologies suggest that socially anxious individuals display a negative interpretation bias.

Although the studies described above yielded findings consistent with the hypothesis that there is an association between interpretation bias and social anxiety, their methodologies revolve around self-reported perceptions of stimuli, which may be subject to multiple layers of

bias. Direct performance-based measures may yield more accurate estimates of interpretation bias, because they assess the biased process itself rather than individuals' perceptions of their bias. Interpretive processes are thought to occur quickly; individuals may even be unaware that the processes are occurring (Rozenman, Amir, & Weersing, 2014). Self-report measures require the use of higher level processing that may not reflect automatic interpretation; these measures also may preferentially elicit desirability-based responses (e.g., "responding the way one thinks he or she should") (Rozenman et al., 2014). A measure that provides a more direct evaluation of interpretation bias than self-report measures may yield more accurate and more real-world consistent estimates.

Beard and Amir developed the Word Sentence Association Paradigm (WSAP; Beard & Amir, 2008) as a more direct measure of interpretation bias. During administration of this computerized measure, participants view threatening (e.g., "weird" or "warning") and non-threatening words (e.g., "cool" and "awake") followed by social (e.g., "Someone looks at you as you walk by") and non-social sentences (e.g., "The alarm goes off"). Participants are then asked to indicate whether the word and sentence are related or not. The rationale behind the task is to target an online and unconscious measure of interpretation by asking participants to make a short evaluation of seemingly irrelevant content (e.g., subjects are not being asked to trigger their own bias by imagining being in a situation; rather, they are simply responding to sentences and words). Beard and Amir (2008) found that social anxiety correlated negatively with non-threatening endorsement (i.e., indicating that a neutral word and a social sentence pair were related) and positively with threatening endorsement (i.e., indicating that a threat word and a social sentence pair were related) in two samples, one undergraduate sample and one sample of people scoring high on a measure of social anxiety. In other words, individuals with higher

levels of social anxiety more often endorsed non-threatening word-sentence pairs as non-related and threatening pairs as related than did individuals with lower levels of anxiety, leading the authors to conclude that socially anxious individuals display a negative interpretation bias.

Researchers have also experimentally manipulated socially anxious individuals' interpretation biases by training individuals to interpret social stimuli in a certain way by rewarding non-threatening interpretations more often than threatening ones, in order to induce a benign interpretation bias. For example, in such an interpretation modification paradigm, a "Correct!" message might appear after an individual indicates that a sentence and neutral word are related. Murphy and colleagues (2007) found that after one session of interpretation modification, socially anxious participants who received a benign interpretation induction reported feeling less anxious about a future social situation than did socially anxious participants who received no interpretation manipulation. Beard and Amir (2008) found that after eight sessions of interpretation modification or no modification (i.e., participants complete the task without any feedback), participants who completed the benign induction modification generated fewer threat interpretations and more benign interpretations and also endorsed fewer social anxiety symptoms than participants in the no modification condition. They interpreted their results as indicating that changes in interpretation patterns mediated the program's effect on social anxiety, because increases in benign interpretation correlated with decreases in social anxiety symptoms.

Empirical data indicate that socially anxious individuals exhibit a negative interpretation bias for verbal and non-verbal stimuli, as measured by self-report questionnaires and by direct assessment of performance on an interpretation task. What is still unknown is whether interpretation bias is related to behavioral avoidance in individuals with SAD. This question is

important to address, because behavioral avoidance is a significant and impairing symptom of the disorder. If interpretation bias is related to behavioral avoidance, then perhaps modifying bias as a form of treatment could provide an alternative to gold standards of treatment, such as exposure therapy, that is more accessible (requiring access only to a computer versus to a trained clinician).

#### **1.4 Attention bias in social anxiety disorder**

The relation between behavioral avoidance and attention bias also has yet to be studied. General cognitive models of anxiety posit that anxious individuals display an attention bias; in other words, they preferentially attend to threatening stimuli (e.g., Eysenck & Derakshan, 1997; Mogg & Bradley, 1998; Williams et al., 1997). Prominent cognitive models of social anxiety have linked attention bias to the maintenance and development of social phobia. Interestingly, however, whereas one cognitive model of social anxiety proposes an attention bias, or vigilance, toward socially threatening stimuli external to the person (such as a frowning face (Rapee & Heimberg, 1997), another posits that social anxiety is characterized by self-focused attention (Clark & Wells, 1995), which implies that affected individuals will display an attention bias away from, or avoidance of, threatening stimuli in the external environment. In their model, Rapee and Heimberg (1997) propose that socially anxious individuals scan their environments for threatening cues (e.g., signs of negative evaluation) and have difficulty disengaging attention from them. Clark and Wells (1995), on the other hand, propose that during socially threatening situations socially anxious individuals avoid external cues, turn their attention inward, and become self-focused, attending preferentially to internal cues for information (e.g., "My face feels flushed, other people know I am nervous"). According to this model, socially anxious individuals miss signals regarding the persistence of threat or markers of safety from the

environment because they are focused on the internal experiences of anxiety. To address these competing models, Schultz and Heimberg (2008) conducted a review of the literature and concluded that while current research lacks direct investigation of these models (e.g., we do not know if participants are self-focused if they avoid external cues), it is likely that socially anxious individuals attend to both external and internal cues throughout the course of a social situation.

Most studies have used dot probe tasks to measure attention bias (MacLeod, Mathews, & Tata, 1986). In a typical dot probe task, participants are first presented with a fixation marker (e.g. a “+” sign) in the middle of a computer screen, followed by a pair of words presented either horizontally (one next to the other) or vertically (one directly above the other). On critical trials, one of the words in the pair is neutral (e.g., "table") and the other is threatening (e.g., "humiliation"). Other trials may consist of two neutral words or one positive and one neutral word. Each pair of words appears on the screen for a brief duration, usually in the range of 500 to 1500 milliseconds. Immediately following the word pair, a probe (a dot or an asterisk) appears in the location of one of the words from the pair. Participants must then press one of two buttons on a keyboard to identify the location of the probe (left versus right or top versus bottom) on the screen. The probe stimulus that participants respond more quickly to is assumed to be the region of display (threatening or neutral) preferentially attended to. Therefore faster response times to probes behind the threatening words relative to the non-threatening words reflect a bias toward threat (vigilance), and slower response times indicate a bias away from threat (avoidance).

Recent research on attention bias in socially anxious individuals has used a modified version of the dot probe task that incorporates emotional facial stimuli rather than social verbal stimuli, based on the idea that expressive faces should constitute more salient stimuli than do

words in a social interaction (Planalp, De Francisco, & Rutherford, 1996). In the modified version of the task, individuals view neutral faces paired with happy, threatening, or neutral faces. Researchers have argued that the modified dot probe task is a more ecologically valid measure of attention bias in social phobia than the original dot probe task, because facial expressions are a major source of information in social situations (Planalp et al., 1996).

Studies using dot probe tasks to measure attentional bias within non-clinical and clinical populations of socially anxious people have variously found evidence of a vigilant bias (Mogg & Bradley, 2002; Mogg, Philippot, & Bradley, 2004; Pishyar, Harris, & Menzies, 2004; Sposari & Rapee, 2007), an avoidant bias (Chen, Ehlers, Clark, & Mansell, 2002; Mansell, Clark, Ehlers, & Chen, 1999), and an absence of any significant bias (Bradley et al., 1997; Pineless & Mineka, 2005). For example, in clinical samples of socially anxious individuals, Sposari and Rapee (2007) found a vigilant attention bias for social threat stimuli, while Chen et al. (2002) found an avoidant attention bias for socially threatening stimuli. Both studies used the modified dot probe task described above and included the same number of trials with stimuli presented for the same duration of time.

Another study of individuals with social phobia suggest that they may in fact display one of two distinct subtypes of attention bias – vigilant and avoidant—that differentially respond to treatment (Calamaras, Tone, & Anderson, 2012). In a sample of 24 socially phobic adults, Calamaras and colleagues (2012) found that participants displayed either attentional vigilance for threat (62%) or attentional avoidance (38%) prior to treatment, and that these distinct groups showed different patterns of attentional change following treatment - the vigilant group became less vigilant and the avoidant group became less avoidant and even slightly vigilant.

Research has also examined the manipulability of attention biases by either inducing an attention bias to increase social anxiety (Heeren, Peschard, & Philippot, 2012) or by using attention retraining paradigms as a treatment method for SAD (Amir et al., 2009). In attention retraining paradigms, the probe is placed behind the neutral face rather than the threat face the majority of the time, with the aim of reducing attention to threatening stimuli and decreasing anxiety symptoms in an anxious individual (e.g., Amir et al., 2009; Bunnell, Beidel, & Mesa, 2013; Schmidt, Richey, Buckner, & Timpano, 2009). Initially, studies supported attention retraining as a means to reduce social anxiety; people with social anxiety randomly assigned to attention retraining reported less social anxiety. Two randomized-controlled studies, which used the same attention retraining procedures and equal numbers of sessions, found significant differences in post-treatment anxiety levels between social phobics who received attention retraining and those who completed a control version of the task (Amir et al., 2009 and Schmidt et al., 2009). Gains in the retraining groups were maintained four months later. Both studies utilized clinician-administered (blinded to treatment condition) and self-report measures of anxiety, including the Liebowitz Social Anxiety Scale (LSAS) and the Social Phobia and Anxiety Inventory (SPAI). Interestingly, Schmidt and colleagues (2009) found no significant differences between retraining and control groups on self-report measures at post treatment (only clinician administered ones); however, there were significant differences at the 4-month follow-up across all measures. In both studies, greater proportions of participants in the retraining group (50% and 72%) no longer met DSM criteria for SAD compared to the control groups (14% and 11%) after treatment.

Recent randomized controlled trials of attention retraining interventions have failed to replicate the initial positive results (e.g., Bunnell et al., 2013; Carlbring et al., 2012; Neubauer et

al., 2013). For example, using the same procedures within a sample (N=31) that was comparable to those enrolled in the Amir et al. (2009) and Schmidt et al. (2009) studies, Bunnell and colleagues (2013) found no post-treatment differences between groups on both clinician-administered and self-report measures of anxiety after treatment. Similarly, randomized-controlled studies examining internet-delivered attention retraining have revealed null findings using self-report measures of social anxiety (Carlbring et al., 2012; Neubauer et al., 2013). While it is unclear why subsequent studies have failed to replicate the initial positive findings regarding attention retraining and its effects, it is clear that future research is warranted—particularly research that includes assessments of behavior in addition to self and clinician rated measures (Hereen et al., 2015).

### **1.5 The relation between cognition and behavior**

Cognitive behavioral models of anxiety describe theoretical relations among anxiety-relevant thoughts (e.g., cognitive biases), feelings (e.g., anxiety), and behavior (e.g., escape or avoidance). These models suggest that thoughts (e.g., "This situation is scary") related to a stimulus (e.g., "a party") likely evoke or perpetuate an emotion (e.g., anxiety) that guides specific behavior (e.g., "only socialize with friends or don't attend"). According to classic fear response models, anxiety engenders one of two behavioral responses: flight (flee the situation) or fight (prepare to defend oneself) (Cannon, 1929; McFarland, 1981). In most social situations, a socially phobic individual is likely to respond with a flight response or behavioral avoidance; in other words, the individual will typically leave or elect not to enter the situation (American Psychiatric Association, 2013).

Cognitive behavioral models of anxiety suggest that maladaptive cognitions lead to increased anxiety and behavioral avoidance (Beck & Clark, 1997; Mathews & MacLeod, 1994).

Therefore, cognitive-behavioral theorists propose that a cognitive bias—involving attention or interpretation—activated when a person is faced with a feared situation leads that individual to experience anxiety and to engage in behavioral avoidance (Rapee & Heimberg, 1997). For example, a socially anxious individual who is giving a speech may seek out and attend to negative facial expressions (e.g., bored) to confirm her belief that she is performing poorly. Her negative interpretation of the audience's expressions, which leads her to continue to attend to them, increases her anxiety and discomfort. This distress, in turn, leads her to cut her speech short in order to get off of the stage (behavioral avoidance). When she thinks about her experience in this situation, she is likely to avoid similar situations in the future because she does not want to experience the same distress. Behavioral avoidance is critical in the maintenance of anxiety disorders, particularly social anxiety, because by avoiding objectively safe social situations, socially anxious individuals miss opportunities to learn that situations that they find anxiety-provoking will not necessarily result in rejection or other negative consequences. This lack of learning opportunities, in turn, leaves them unable to recalibrate their anxiety response.

Behavioral avoidance leads to a narrowing of an individual's life experiences. Consequently, it is associated with significant functional impairment—avoidant individuals restrict themselves to only experiencing situations that do not induce anxiety (e.g. staying home), and thus they miss out on numerous other potentially rewarding experiences (e.g., meeting new people) and fail to engage in necessary activities for life (e.g., having a job) (Ledley et al., 2008). Further, because avoidant individuals deny themselves opportunities to learn that feared consequences of more varied experiences are unlikely, they are prone to remain anxious about those experiences.

Because behavioral avoidance is thus thought to contribute to the maintenance of social anxiety disorders (American Psychiatric Association, 2013), current gold standard treatment models are built around exposure paradigms. These paradigms require anxious individuals to face feared situations in order to extinguish their exaggerated fear responses (Feske & Chambless, 1995; Hope, Heimberg, & Bruch, 1995). Exposure therapy leads to reduced symptoms of distress and avoidance measured by self-report questionnaires and behavioral laboratory tasks (e.g., giving an impromptu speech) (Taylor et al., 1996; Gould et al., 1997). Exposure therapy has also been shown to result in reduced cognitive biases (e.g., reduced negative thoughts relating to a social situation or reduced fears of negative evaluation) in social anxiety (Newman, Hofmann, Trabert, Roth, & Taylor, 1994).

Very little research has examined relations between information processing biases and behavior in social anxiety. One study examined the effects of attention retraining on behavioral outcomes including length of eye contact, time spent speaking, and whether participants ended the conversation or discontinued speaking early (escape) in a clinical sample, and found no significant differences at post treatment between the retraining condition and the control group (Bunnell et al., 2012). Lange and colleagues (2010) manipulated interpretation bias in a sample of participants who scored in the average range on an anxiety measure. Specifically, they induced a positive or negative interpretation bias using a task in which participants completed socially ambiguous vignettes by filling in the missing letter of the last word, resulting in either a positive or negative scene. Results showed no differences in what the authors termed “reflexive anxious behavior” (e.g., moving away from faces in a crowd) between those who were trained to interpret social situations negatively and those in the positive training condition. Notably, the researchers used a sample of individuals with average levels of anxiety; members of such a

sample may respond differently than do people in a clinical sample. Interestingly, neither Bunnell et al. (2012) nor Lange et al. (2010) looked at whether attention or interpretation bias scores were related to anxious behavior. Examining relations among cognitive biases and actual behavior would add further value by providing a more ecologically valid assessment of “real-world” functional impairment and help to inform newly developing treatments targeting bias modification (Kazdin, 1999).

### **1.6 Examining interpretation bias and attention bias together**

Cognitive models of social anxiety propose that information processing biases, such as interpretation bias and attention bias, interact with one another to affect social anxiety and maladaptive behavior, and that cognitive and behavioral processes may influence one another in various ways (Hirsch, Clark, & Mathews, 2006). For example, negatively interpreting a stimulus is likely to lead a socially anxious individual to further allocate attention towards the stimulus (e.g., Beck & Clark, 1997). Conversely, preferential attention to a negative stimulus may facilitate negative interpretations of negative, neutral, or even positive stimuli because in order to evaluate a stimulus, one must perceive and attend to it first. Researchers highlight the need for further empirical data examining multiple biases simultaneously, as most of the body of literature on cognitive biases in anxiety, and specifically social anxiety, have examined these processes only in isolation (Hirsch et al., 2006). One question that needs examination is whether interpretation bias and attention bias may be differentially related to distress levels and behavior in social anxiety. For example, negative interpretation of stimuli could lead an individual to flee a situation, while excessive attention to negative stimuli results in heightened anxiety. It is also plausible that both types of bias may make equal contributions to symptomology. Theoretical models propose that these biases are unique components of information processing that together

influence anxiety (e.g., Clark & Wells, 1995; Rapee & Heimberg, 1997); however, research has yet to determine whether they have distinct effects on symptom severity and/or behavior.

To date, two studies have examined attention and interpretation biases simultaneously in anxious individuals (Brosan, Hoppitt, Shelfer, Silence, & Mackintosh, 2011; Beard, Wiesberg, & Amir, 2011). Brosan and colleagues (2011) examined the efficacy of combined cognitive bias modification (CBM) for attention and interpretation biases (i.e., participants completed an attention retraining program and an interpretation bias modification program) for decreasing both state and trait anxiety in a small outpatient sample of 12 individuals diagnosed with social anxiety or generalized anxiety. Results indicated that after four weeks of both attention and interpretation retraining, patients showed reductions in attention for threat and negative interpretation bias, as well as reductions in trait and state anxiety. Beard and colleagues (2011) conducted a randomized-controlled trial to examine the efficacy of combined CBM in a sample of 34 individuals diagnosed with social anxiety disorder. Results indicated that after 8 weeks of combined CBM, participants receiving CBM had significantly reduced self-reported symptoms of social anxiety and improved performance on an impromptu speech compared to the placebo group. Thus, these results suggest that targeting both biases in combination results in reduced state and trait anxiety; however, whether this effect is driven by one type of training more than the other is unknown.

The findings' of the above studies are difficult to evaluate because of many methodological limitations. Because the study was conducted within a routine clinical practice, standardized research diagnostic measures were not used. Instead, clinical or counseling psychologists identified the presence or absence of primary anxiety problems using semi-structured assessments that covered the main symptoms of disorders based on DSM-IV criteria.

The authors did not report what proportion of the sample endorsed problems associated primarily with social anxiety versus generalized anxiety. Therefore, it could not be determined whether the results were driven primarily by the generalized anxiety participants or by the social anxiety participants. Additionally, the authors did not specify which type of training (attention or interpretation) was more strongly associated with symptom reduction, nor did they report whether either bias related to anxiety severity at baseline. Further, only five of the participants had clinically significant changes in anxiety levels after treatment. Finally, the study did not include a behavioral measure of anxiety, which Kazdin (1999) contends can provide a more valid measure of “real-world” functioning and assessment of the clinical significance of a psychological disorder. Therefore, associations among attention bias, interpretation bias, and baseline anxiety or behavior remain unclear, as does the degree to which each contributes to anxious symptomology.

While there is a lack of published studies that offer direct evidence, the current literature could suggest that interpretation bias may be more directly related to anxiety symptomology and behavioral avoidance for several reasons. First, information processing models of anxiety specifically suggest that overestimation of the threat posed by benign stimuli is the main problem that needs to be addressed in the treatment of anxiety disorders (Beck, Emery, & Greenberg, 1985). Furthermore, in theory, interpretation guides further allocation of attention for processing, such that if a stimulus is evaluated as threatening, further attention will be given to that stimulus. Therefore, if a person does not interpret a stimulus as threatening, that person is unlikely to attend to it further. Consequently, the person may not generate negative interpretations of the stimulus that influence behavior. For example, if a person does not perceive an audience to be negatively evaluating him, any anxiety that he feels about his

performance will likely decrease and he will not be motivated to engage in avoidant behavior, such as cutting his speech short.

Second, evidence for the positive relation between interpretation bias and social anxiety symptoms is robust across numerous studies of varied methodology, including some that employed experimental designs (Murphy et al., 2007; Beard 2008). In contrast, the literature on attention bias and social anxiety is variable, with some studies finding no evidence for an attention bias in social phobia (Bradley et al., 1997; Pineless & Mineka, 2005). In addition, literature supports the idea that reducing negative interpretations is related to reduced anxiety, while the attention bias retraining literature is not promising (e.g., Bunnell et al., 2013; Carlbring et al., 2012; Neubauer et al., 2013). Finally, anecdotal comments from participants in treatment studies suggest that people find interpretation bias retraining to be more beneficial than attention retraining. In their combined cognitive bias treatment study, Brosan and colleagues (2011) reported that patients described the attention retraining task as boring, and the interpretation bias task as helpful in “getting you to alter your perception and realize there are a different ways of seeing things” (p. 262).

## **1.7 Justification and hypotheses**

The current study aimed to add to the literature on cognitive processes in social anxiety by examining relations among interpretation bias, attention bias, symptom severity, and both behavior and self-reported situational anxiety during a socially threatening situation. The current study also aimed to examine whether interpretation bias and/or attention bias are distinct predictors of anxiety and behavior in a clinical sample of socially anxious individuals. I hypothesized that both attention bias and interpretation bias would relate significantly to behavior, as measured by speech length during a laboratory impromptu speech task, which is

commonly associated with higher levels of anxiety (Beidel, Turner, Jacob, & Cooley, 1989) and self-reported anxiety during and immediately after the task. I also hypothesized that interpretation bias would be a stronger predictor of both anxiety levels and behavioral avoidance.

## 2 EXPERIMENT

### 2.1 Participants

Participants were 34 English-speaking individuals with a primary diagnosis of social anxiety disorder, as assessed by the Structured Clinical Interview for the DSM-IV (SCID; First, Spitzer, Gibbon, & Williams, 2002). Participants were recruited through advertisements (e.g., newspaper, Internet, flyers), referrals from local clinicians, and the Georgia State University SONA undergraduate psychology research participant pool. Participants on psychoactive medication were required to be stabilized on their current medication(s) and dosage(s) for at least 3 months and to remain at the stabilized dosage throughout the course of the study. Individuals meeting any of the following criteria were excluded: history of mania or psychoses, recent suicidal ideation (within the past 3 months), and/or current alcohol or substance abuse or dependence.

The sample was mostly female (65%) with a mean age of 23 (SD= 6.07). Half of the sample identified as Black/African American, about a third as White/Caucasian (29%), less than a quarter as Asian American (14%) and the rest as Hispanic (6%). The majority of the sample was single (91%) and the rest described themselves as living with someone (8%). The sample comprised mostly college students (65%) and the median total annual household income was \$10,000-20,000.

### 2.2 Measures

*Structured Clinical Interview for the DSM-IV* (SCID; First et al., 2002). The SCID is a structured, well-validated diagnostic clinical interview used to assess psychological disorders based upon DSM-IV criteria. Several studies (Basco et al., 2000; Kranzler, Kadden, Babor, Tennen, & Rounsaville, 1996) have demonstrated superior diagnostic validity of the SCID over

standard clinical interviews at intake, particularly for Axis I disorders (Lobbestael, Leurgans, & Arntz, 2011). For the current project, the SCID was used to establish whether potential participants meet the inclusion criterion of a diagnosis of social phobia, as well as whether they demonstrate presence of co-morbid Axis I conditions within the mood, alcohol/substance use, and anxiety disorders modules.

*Liebowitz Social Anxiety Scale– Self Report Version* (LSAS-SR; Liebowitz, 1987). The LSAS-SR, a 24-item self-report instrument assessing fear and avoidance across a variety of social interactions and performance situations, was used to assess symptom severity. The measure is appropriate to complete electronically (Hedman et al., 2010). Participants used a Likert-type scale to provide ratings of fear (0 = none, 1 = mild, 2 = moderate, 3 = severe) and avoidance (0 = never, 1 = occasionally, 2 = often, 3 = usually) for each item. Higher total scores on the fear and avoidance subscales, respectively, indicate greater anxiety and avoidance. Total scores on each scale (fear and avoidance) served as dependent variables.

The LSAS-SR has demonstrated high internal consistency among clinically socially anxious individuals ( $\alpha = .95$ ) as well as among individuals without an Axis I disorder ( $\alpha = .94$ ), and it appears to have strong convergent and discriminant validity (Fresco et al., 2001). Furthermore, responses and scores obtained using the LSAS-SR have not been found to differ from those obtained using a clinician-administered version of the LSAS, and subscale intercorrelations for the two forms are extremely similar (Fresco et al., 2001). Normative data for a sample of 382 patients diagnosed with social phobia yielded a mean fear score of 35.5 ( $SD = 13.6$ ), and a mean avoidance score of 31.6 ( $SD = 14.5$ ) (Heimberg et al., 1999). In the current study, both scales—fear and avoidance—showed excellent reliability, with Cronbach alphas of .97 and .96, respectively.

*Word Sentence Association Paradigm* (WSAP; Beard & Amir, 2008). The WSAP, a computerized task used to assess interpretation bias in social anxiety, served as the measure of interpretation bias. Prior to starting the task, participants reviewed instructions on the computer screen with the assessor. The task consisted of four steps. First, a fixation cross, used to direct participants' attention towards the middle of the screen and alert them that a trial is beginning, appeared on the screen for 500 milliseconds (ms). Second, a word representing either a threat interpretation (e.g., "embarrassing") or a non-threat interpretation (e.g., "funny") appeared in the center of the screen for 500 ms. Next, an ambiguous sentence (e.g., "People laugh after something you said") appeared on the screen until the participant pressed the space bar to indicate that he or she had finished reading it. Finally, the prompt "Are they related?" appeared on the screen. Participants pressed "#1" on the keypad if the word and sentence appeared to be related, and "#3" on the keypad if they did not appear to be related.

Participants completed 110 trials of the WSAP. Seventy-six trials included sentences with social themes and 34 trials were non-social filler sentences (e.g., "A loud noise is heard at night"). All text appeared in black font against a gray background. For each participant, I calculated the proportion of threat interpretation trials and benign interpretation trials endorsed out of the total number of respective trials presented. Endorsed trials are those in which the word and sentence are identified as related. The percentage of threat trials endorsed served as an independent variable in study analyses. Previous research has shown that the WSAP task validly discriminates between socially anxious individuals and non-anxious controls (Beard & Amir, 2009). Furthermore, symptom severity is positively correlated with threat endorsement rates and negatively correlated with non-threat endorsement rates.

*Dot Probe Task.* A modified version of the dot probe task was used to assess attention bias toward threatening faces relative to neutral and positive faces. The stimuli and task were developed by Mogg and Bradley (1999); the measure consists of 128 stimulus faces, 2 from each of 64 different models. Each model presents both a threatening or happy pose and a neutral pose. Thus, there are 32 threatening faces and 32 happy faces, each matched with a neutral image of the same person. Stimuli were presented in pairs, threat-neutral and happy-neutral, with one image on each side of the screen (e.g., threat on the right and neutral on the left). Each pair was presented twice, with the location of each image reversed (e.g., threat on the left and neutral on the right). Thus, there were 128 critical trials. In addition, 32 filler trials consisting of neutral-neutral pairs were randomly interspersed throughout the task. Trials were presented in a new random order for each participant. Participants completed a practice run of 5 trials before completing the actual task.

Participants completed the modified dot probe task on a desktop computer. They were instructed to use the “#1” and “#2” buttons on the keyboard to provide their responses; these keys were marked with white labels. An instruction screen appeared at the start of the task and the assessor reviewed it with participants. First, a fixation cross appeared on the screen for 500 ms to direct the participant’s attention to the screen. Second, a pair of faces (approximately 4.5 x 7 cm each) was presented on the screen for 500 ms and a small asterisk appeared for 1100 ms immediately afterwards, in place of one of the faces. As quickly as possible, participants pressed the “#1” key to indicate that the dot was on the left or the “#2” to indicate that it was on the right. The probe appeared an equal number of times on each side of the screen. The inter-trial interval varied randomly between 500 and 1250 ms.

Given that attention bias in social anxiety is typically specific to the processing of threatening stimuli (Bar-Haim et al., 2007), the current study examined responses to threatening and neutral faces. Threat bias scores were calculated by subtracting response time on trials in which a probe that replaces a neutral stimulus face from response time on trials in which a probe replaces a threat stimulus face. A positive average value indicated a vigilant bias (preferential attention toward threatening faces relative to neutral faces) and a negative average value indicated an avoidance bias (preferential attention away from threatening faces toward neutral faces). This score served as an independent variable in study analyses. Previous research suggests that the task accurately discriminates between adults diagnosed with Social Phobia and controls (Mogg et al., 2004). It also has been shown to discriminate between controls and adults with Generalized Anxiety Disorder (Bradley, Mogg, White, Groom, & Bono, 1999).

*State-Trait Anxiety Inventory* (STAI; Spielberger, Gorsuch, & Lushene, 1970). The STAI, a 20-item measure that assesses in-the-moment symptoms of general anxiety, was used to assess anxiety immediately following the speech task. Participants rated their current anxiety using a 4-point Likert scale, (1= not at all, 2= somewhat, 3= moderately so, and 4= very much so). The measure has adequate psychometric properties, with internal consistency coefficients ranging from .86 to .95 (Spielberger & Gorsuch, 1983). In the current study, the STAI-state showed excellent reliability with a Cronbach's alpha of .93.

*The Center for Epidemiological Studies-Depression* (CES-D; Radloff, 1977). The CES-D is a 20-item measure of depression symptomology, including restless sleep, poor appetite, and feelings of loneliness. Individuals are asked to rate how they have felt over the past week on a 4-point Likert scale (0= rarely or none of the time, 1= some or little of the time, 2= moderately or much of the time, and 3= most or almost all the time). Scores range from 0 to 60, with higher

scores indicating more, and more frequently experienced, depressive symptoms. The measure is often used to identify individuals at risk for clinical depression and has good sensitivity and specificity and high internal consistency (Lewinsohn, Seeley, Roberts, & Allen, 1997). It can also be used appropriately with racially diverse populations, with internal consistency coefficients ranging from .85 to .91 and similar to those found in the general population and patient samples (Roberts, 1980). Depression scores were included a covariate in study analyses. In the current study, the CESD showed excellent reliability with a Cronbach's alpha of .91.

*Subjective Units of Distress Scale (SUDS; Wolpe, 1973).* The SUDS is a self-report face-valid scale that is used to assess current distress or anxiety. SUDS ratings served as an index of situational anxiety; this rating score was included as a dependent variable in study analyses. A SUDS of 0 represents the absence of any distress or anxiety, 50 represents moderate distress or anxiety, and 100 represents the most distress or anxiety imaginable. SUDS ratings are commonly used during exposure therapy and emotion-focused therapy for trauma-related and anxiety disorders, as well as during assessment (e. g., during a behavioral avoidance task; see below) (Kim, Bae, & Chon Park, 2008; Wolpe & Lazarus, 1966).

*Behavioral Avoidance Test (BAT).* The BAT is based on a commonly-used standardized speech assessment protocol (Beidel et al., 1989) and involves the delivery of an impromptu speech. The BAT is widely used in research, particularly in social anxiety treatment studies, where it serves as a measure of efficacy (Heimberg, 1998; Coles & Heimberg 2000). Speech length, which has been shown to be a reliable measure of "escape" or behavioral avoidance (Beidel et al., 1989), was included as a dependent variable in study analyses. Participants were asked to give a 10-minute speech on up to three chosen topics while they were videotaped. Participants spoke in front of the lab assessor and two other research team members. Participants

were not forced or coerced to complete the task in any way and were allowed to discontinue speaking at any point. Topics were intended to be challenging or controversial, so that they would elicit high anxiety. Examples of topics included: capital punishment, abortion, and nuclear power. Participants were given 5 minutes to take notes and prepare. Participants were asked to give SUDS anxiety ratings prior to speaking, every 2 minutes while speaking, and at the end of speaking. Audience members were instructed to display neutral facial expressions during the speech and were asked to privately rate the participant's performance and perceived anxiety level, using a 0 to 10 Likert scale, after the speech.

### **2.3 Procedure**

This project was approved by the Georgia State University Institutional Review Board (IRB). The study was advertised via flyers and radio public service announcements. Individuals interested in participating in the study contacted the lab via telephone or email. A trained graduate student conducted the initial screening segment of a two-part assessment process via telephone to determine initial eligibility (i.e., no suicidal ideation, meets basic inclusion/exclusion criteria, passes brief initial diagnostic screening and rule-out process). Potentially eligible participants were scheduled for the second, in-person part of the assessment process (Time 1 visit) to confirm eligibility. All assessments took place in a psychology laboratory on the 10<sup>th</sup> floor of the Urban Life building at Georgia State University. During the in-person segment of the eligibility-ascertainment process, a trained graduate student administered the SCID. Participants meeting DSM-IV criteria for social anxiety disorder as their primary diagnosis were enrolled in the study, assigned a study participant number, and scheduled for a Time 2 visit one week later (parking passes for that visit was provided when needed). At Time 2, participants completed the self-report questionnaires, the dot-probe task, the WSAP, and

the BAT. They also completed the STAI immediately following their impromptu speech (BAT). The order of administration for the dot-probe and WSAP was randomized for each participant to reduce the risk that confounds due to task order would impede interpretation of results. All other tasks remained in a standard order. Random task order was determined by flipping a coin (heads = dot-probe first, tails = WSAP first) prior to the start of the assessment; the order was noted in the participant's data. At the end of Time 2, participants were compensated \$50 and provided with referrals for psychotherapy and other resources (e.g., information about Toastmasters). Figure 1 provides a flow chart of participation in the study.

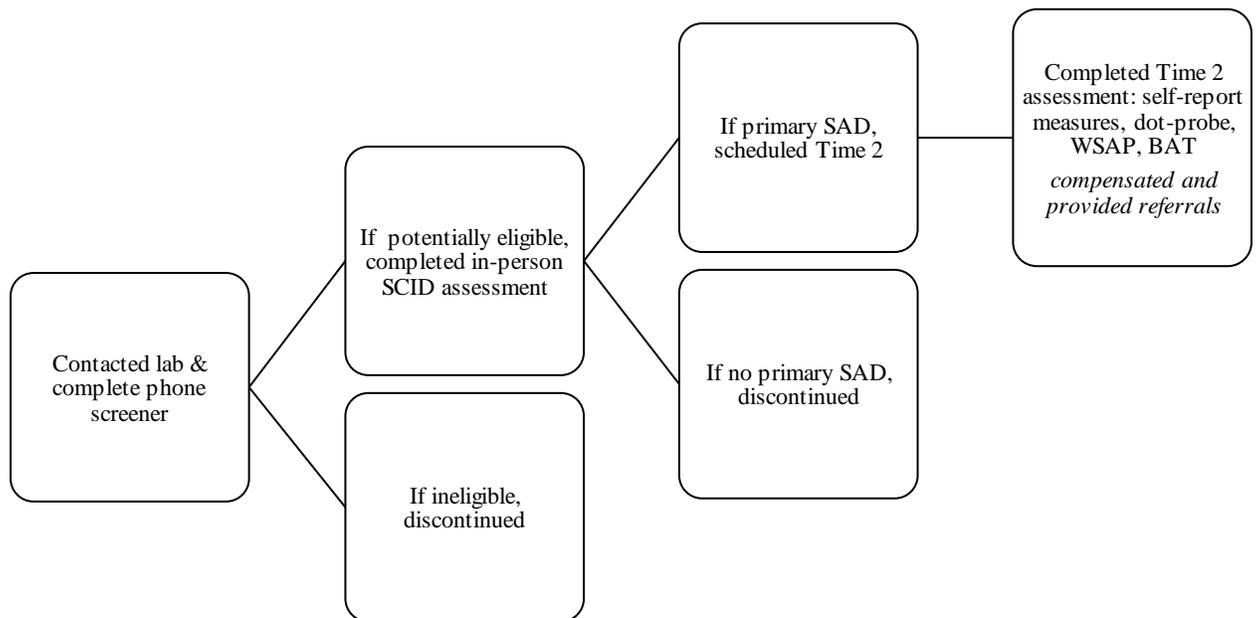


Figure 1: Participation flow chart

## 2.4 Analyses and sample size

Multiple regression analyses were conducted to test the hypothesis that attention bias and interpretation bias would differentially predict symptom severity (measured by the LSAS-SR total fear and avoidance subscale scores), situational anxiety (measured by the highest SUDS

rating during the BAT), and behavioral avoidance (measured by BAT speech length). Partial correlations were examined to further explore the distinct contributions of each predictor to variance in the outcome while all other independent variables were covaried.

A sample size of 34 was determined (using GPower) to be sufficient to detect expected moderate effect sizes (.25) with a power of .80. I expected to find similar effect sizes to those reported in the existing literature. A meta-analysis of studies on attention bias and anxiety indicated an average effect size of  $d=.45$ , with a range of  $d= .23-.69$  (Bar-Haim et al., 2007). Effect sizes for interpretation bias and anxiety in previous literature range from  $d = .25$  to 1.13 (e.g., Franklin, Huppert, Langner, Leiberg, & Foa, 2005; Stopa & Clark, 2000). A review of cognitive bias modification and anxiety indicated an average effect size of  $d=.51$ , with a range of  $d=.35-.69$  (Hakamata et al., 2010). I used the smallest effect size reported in the previous literature in my power analysis to ensure a sufficient sample size.

### 3 RESULTS

#### 3.1 Data inspection and score calculation

Analyses were conducted using the SPSS 21.0 program. Data were first inspected for outliers and evaluated for fit between variable distributions and the assumptions of multivariate analysis, which they met satisfactorily (Cohen & Cohen, 2003). Means and standard deviations of all variables are presented in Table 1. Simple correlations were examined among all variables to determine appropriate covariates (see Table 2).

Table 1: Means and standard deviations (N=34)

	Mean	SD
LSASfear	51.029	19.457
LSASavoid	49.353	18.627
CESD	33.618	13.880
ThreatEndorse (%)	.681	.205
BenignEndorse (%)	.649	.213
AttnBias	8.622	16.540
STAI- State	59.876	11.872
Peak SUDS	8.265	1.463
Speech Length (in seconds)	347.765	213.145

Table 2: Zero-order correlations between variables (N=34)

	LSAS Fear	LSAS Avoid	CESD	Threat Endorse	Benign Endorse	Attn Bias	STAI- State	Peak SUDS	Speech Length
LSASfear	-	.956**	.813**	.498*	-.513**	-.052	.217	.019	.196
LSASavoid	-	-	.743**	.448**	-.496**	-.051	.230	.022	.158
CESD	-	-	-	.270	-.450**	.044	.159	-.002	.184
ThreatEndorse	-	-	-	-	-.277	-.036	.236	.340*	.159
BenignEndorse	-	-	-	-	-	.108	-.584*	-.206	.077
AttnBias	-	-	-	-	-	-	.121	.029	-.053
STAI-State	-	-	-	-	-	-	-	.462**	-.130
Peak SUDS	-	-	-	-	-	-	-	-	.232
SpeechLength	-	-	-	-	-	-	-	-	-

Note. \* $p < .05$ , \*\* $p < .01$

### 3.1.1 Interpretation bias scores

Data from trials with reaction times greater than 2 standard deviations above the participant's mean reaction time were considered outliers and excluded from analyses. Two scores were computed for each participant – threat endorsement and benign endorsement. Threat endorsement scores were calculated by taking the sum of threatening word-sentence pairs identified as related and dividing by the total number of threatening word-sentence pairs, resulting in a percentage for each participant. Benign endorsement scores were calculated in the same way using benign word-sentence pairs.

### 3.1.2 Attention bias scores

Data from trials with errors were excluded from analyses. Reaction times less than 200 ms and greater than two standard deviations above the participant's mean reaction time were

considered outliers and excluded from analyses. Attention bias scores were calculated by subtracting average reaction time to probes following neutral faces from average reaction time when problems follow threatening faces (MacLeod and Mathews, 1988). Bias scores represent an average reaction time across trials, with positive scores indicating vigilance and negative scores indicating avoidance.

### **3.2 Results of analyses**

A series of linear multiple regressions was conducted to test the hypotheses that interpretation bias (measured as percentages of threat endorsement and of benign endorsement) and attention bias (measured by the dot-probe score) would differentially predict symptom severity (measured by the LSAS fear and avoidance scales), situational social anxiety (measured by peak SUDS rating and the STAI-state) and behavioral avoidance (measured by speech length in seconds). Depression was controlled for by including CESD scores as a covariate in all regressions. Either symptom severity or situational anxiety (depending on the outcome variable) was also included as a covariate, so that results would more strongly reflect the type of anxiety being examined (i.e., state or trait).

#### **3.2.1 Symptom severity**

Two linear multiple regressions were conducted to test the hypothesis that interpretation bias and attention bias would be significantly related to symptom severity. Interpretation bias (threat endorsement and benign endorsement) and attention bias were the predictor variables and LSAS fear and LSAS avoidance were the outcome variables, with depression and situational anxiety included as covariates (see Tables 3 and 4). For both fear and avoidance models,  $R^2$  differed significantly from zero ( $F(6,25)=16.135, p<.01, R^2=.795$ ;  $F(6,25)=9.122, p<.01, R^2=.686$ , respectively). Two variables made significant independent contributions to the

variance; one was the CES-D score included as a covariate. The second, as predicted, was the percentage of threatening word-sentence pairs endorsed. These results suggest that a greater threat interpretation bias is related to greater symptom severity, while controlling for attention bias. Contrary to study hypotheses, attention bias was not significantly related to fear or avoidance.

**Table 3: Multiple regression with variables predicting LSAS Fear scores (N=32)**

	<i>B</i>	<i>SE B</i>	$\beta$	<i>p</i>	<i>95% CI</i>
CESD	.862	.151	.618	<.001	.550-1.173
STAI-State	.007	.199	.004	.974	-.403-.416
Peak SUDS	-3.143	1.666	-.220	.071	-6.573-.287
AttnBias	-.083	.110	-.070	.459	-.310-.144
ThreatEndorse	36.298	9.982	.382	.001	15.738-56.857
BenignEndorse	-23.128	13.156	-.231	.091	-50.222-3.966

*Note.*  $R^2 = .795$ , adjusted  $R^2 = .745$

**Table 4: Multiple regression with variables predicting LSAS avoidance scores (N=32)**

	<i>B</i>	<i>SE B</i>	$\beta$	<i>p</i>	<i>95% CI</i>
CESD	.730	.177	.552	.000	.365-1.095
STAI-State	.059	.233	.038	.801	-.421-.540
Peak SUDS	-3.132	1.953	-.231	.121	-7.155-.891
AttnBias	-.084	.129	-.074	.523	-.350-.182
ThreatEndorse	32.686	11.707	.363	.010	8.575-56.798
BenignEndorse	-21.946	15.429	-.231	.167	-53.722-9.829

*Note.*  $R^2 = .686$ , adjusted  $R^2 = .611$

### 3.2.2 *Situational anxiety*

Two linear multiple regressions were conducted to test the hypothesis that interpretation bias and attention bias would be significantly related to situational anxiety. Two outcome variables were used to examine situational anxiety—highest or peak SUDS rating and the STAI-state score (see Tables 5 and 6). When CES-D score, symptom severity, and STAI-state score were covaried, the overall model for predicting peak SUDS was significant;  $R^2$  differed significantly from zero ( $F(6,25)=3.719, p<.01, R^2=.472$ ) and one variable made a significant independent contribution to the variance: the percentage of threat word-sentence pairs endorsed. When the STAI-state score was used as the outcome variable and peak SUDS was covaried along with CES-D score and symptom severity,  $R^2$  differed significantly from zero ( $F(6,25)=3.070, p=.022, R^2=.424$ ) and one variable made a significant independent contribution to the variance: the percentage of benign word-sentence pairs endorsed. These results suggest that a weaker benign interpretation bias is related to greater general state anxiety following the speech task, while a stronger threat interpretation bias is related to greater anxiety during a socially stressful task, when controlling for attention bias. Contrary to study hypotheses, attention bias was not significantly related to situational anxiety, as measured by peak SUDS or by general state anxiety following the speech task.

Table 5: Multiple regression with variables predicting peak SUDS scores (N=32)

	<i>B</i>	<i>SE B</i>	$\beta$	<i>p</i>	<i>95% CI</i>
CESD	.015	.026	.152	.568	-.038-.067
LSASfear	-.040	.021	-.567	.071	-.083-.004
STAI-State	.024	.022	.204	.286	-.021-.069
AttnBias	-.007	.012	-.088	.561	-.033-.018
ThreatEndorse	3.539	1.192	.532	.007	1.083-5.995
BenignEndorse	-2.906	1.455	-.414	.057	-5.902-.091

Note.  $R^2 = .472$ , adjusted  $R^2 = .345$

Table 6: Multiple regression with variables predicting STAI-State scores (N=32)

	<i>B</i>	<i>SE B</i>	$\beta$	<i>p</i>	<i>95% CI</i>
CESD	-.097	.230	-.116	.677	-.570-.376
LSASfear	.007	.201	.011	.974	-.407-.421
Peak SUDS	1.907	1.748	.223	.286	-1.693-5.507
Tbias	.112	.110	.158	.315	-.114-.338
ThreatEndorse	2.770	12.392	.049	.825	-22.752-28.292
BenignEndorse	-31.605	12.508	-.525	.018	-57.366—5.844

Note.  $R^2 = .424$ , adjusted  $R^2 = .286$

### 3.2.3 Behavioral avoidance

A linear multiple regression was conducted to examine the hypothesis that both interpretation bias and attention bias would be significantly related to behavioral avoidance, which was measured by speech length in seconds (see Table 7). When CES-D score was covaried, the overall model for predicting speech length was not significant ( $F(5,28)=.596$ ,  $p=.703$ ,  $R^2=.096$ ). The results suggest that, contrary to study hypotheses, neither interpretation bias nor attention bias are significantly related to behavioral avoidance.

Table 7: Multiple regression with variables predicting speech length (N=32)

	<i>B</i>	<i>SE B</i>	$\beta$	<i>p</i>	<i>95% CI</i>
CESD	3.902	3.121	.254	.221	-2.480-10.285
AttnBias	-1.093	2.309	-.085	.639	-5.814-3.629
ThreatEndorse	145.801	192.809	.140	.456	-248.538-540.140
BenignEndorse	232.930	202.180	.232	.259	-180.575-646.435

*Note. Speech length measured in seconds. Overall model was not significant*

### 3.2.4 Exploratory Analyses

A series of post-hoc regression analyses were conducted to examine alternative indices of constructs of interest. Audience ratings of participants' speech quality and how anxious the speakers looked were used as measures of behavior and included as outcome variables. In addition, both attention bias towards positive faces and an attention bias variability index were used as measures of attention bias and included as independent variables.

*Audience ratings of speech quality and anxiety appearance:* When completing the BAT, participants were rated by 2-3 audience members on how good the talk was and how anxious the speaker was using a 0 to 10 Likert scale. Mean ratings across audience members were calculated to form a speech quality score and anxious appearance score for each participant. These variables served as markers of behavior.

*Attention bias towards positive faces:* Positive attention bias scores were calculated by subtracting average reaction time to probes following neutral faces from average reaction time when probes follow positive faces. Bias scores represent an average reaction time across trials, with positive scores indicating vigilance and negative scores indicating avoidance.

*Attention bias variability index:* An attention bias variability (ABV) index represents intrasession variability as a marker of attentional control impairment and inconsistency of

response to threatening stimuli, and has been previously validated as an index of attention bias (Iacoviello et al., 2014). ABV index scores were calculated by first dividing dot-probe trials into bins of 20 sequential trials and then calculating threat bias scores for each bin. The standard deviation of the threat bias scores was calculated across all bins and divided by the individual's mean RT to all critical trials (threat-neutral pair trials) (Price et al., 2014) to determine the ABV.

The first series of exploratory regression analyses were conducted to examine whether interpretation bias (measured by threat endorsement and benign endorsement scores) and attention bias (measured by threat bias scores) would be significantly related to behavior (measured by speech quality and anxious appearance). The overall model predicting audience ratings of speech quality was not significant ( $F(5,27)= 1.15, p= .364, R^2=.207$ ). In addition, the overall model predicting audience ratings of anxious appearance was not significant ( $F(5,27)= 1.21, p= .378, R^2=.203$ ).

The second series of regression analyses were conducted to examine whether attention bias towards positive faces (instead of attention bias towards threatening faces) would be significantly related to symptom severity (measured by the LSAS fear and avoidance scales), situational social anxiety (measured by peak SUDS rating and the STAI-state) and behavioral avoidance (measured by speech length in seconds, audience ratings of speech performance, and audience ratings of anxious appearance), when interpretation bias was also included as an independent variable. Depression was controlled for by including CESD scores as a covariate in all regressions. When CESD score and interpretation bias scores were controlled for, positive attention bias was not significantly related to symptom severity (LSAS fear and avoidance:  $\beta = -.164, t(27)= -1.502, p= .148$ ;  $\beta = -.139, t(27)= -1.012, p= .323$ ) or situational anxiety (peak SUDS and STAI-state:  $\beta = -.094, t(29)= -.471, p= .642$ ;  $\beta = -.319, t(27)= -1.931, p= .067$ ). In

addition, the overall models predicting behavioral outcomes were not significant; speech length ( $F(5,29)=1.030, p=.423, R^2=.177$ ), speech quality ( $F(5,26)= 1.368, p=.276, R^2=.246$ ), and anxious appearance ( $F(5,26)= 1.234, p=.338, R^2=.227$ ). These results are consistent with the primary results of the study, which used threat bias scores as an index of attention bias.

The final series of exploratory of regression analyses were conducted to examine whether attention bias variability (instead of threat bias) would be significantly related to symptom severity (measured by the LSAS fear and avoidance scales), situational social anxiety (measured by peak SUDS rating and the STAI-state) and behavioral avoidance (measured by speech length in seconds, speech quality, and anxious appearance), when interpretation bias was also included as an independent. Depression was controlled for by including CESD scores as a covariate in all regressions. When CESD score and interpretation bias scores were controlled for, ABV was not significantly related to symptom severity (LSAS fear and avoidance:  $\beta = .089, t(28)= .867, p=.396$ ;  $\beta = .120, t(28)= .957, p=.349$ ) or situational anxiety (peak SUDS and STAI-state:  $\beta = .256, t(28)= .1427, p=.166$ ;  $\beta = .093, t(28)= .536, p=.597$ ). In addition, the overall models predicting behavioral outcomes were not significant; speech length ( $F(5,30)=.627, p=.681, R^2=.111$ ), speech quality ( $F(5,27)= .653, p=.662, R^2=.129$ ), and anxious appearance ( $F(5,27)= 1.155, p=.362, R^2=.208$ ). These results are consistent with the primary results of the study, which used threat bias scores as an index of attention bias.

## 4 DISCUSSION

The current study examined the associations of both interpretation bias and attention bias with symptom severity, situational social anxiety, and behavioral avoidance in adults with social phobia. Results indicated that there were distinct associations between the two types of biases and social anxiety, as indexed by some, but not all measures. A clear link was found between interpretation bias and social anxiety but, contrary to expectations, not between attention bias and social anxiety. More specifically, interpretation bias was related to both symptom severity (LSAS fear and avoidance) and situational anxiety (SUDS ratings and STAI-state), while attention bias was not significantly associated with any measure of anxiety. In addition, neither interpretation nor attention biases were related to behavioral avoidance, operationalized as speech length during an impromptu speech task.

In the following sections, I examine more closely both the significant findings with regard to interpretation biases and the null findings for attention biases. In doing so, I attempt to integrate the present results into both the social anxiety and the broader anxiety literatures. I also suggest theoretical models that provide a context for understanding and interpreting the observed pattern of findings. I conclude by discussing limitations of the current study and suggesting future directions for research on cognitive biases and social anxiety.

### 4.1 Interpretation bias and anxiety

The key finding of the current study is a pattern of significant and distinct associations between interpretation bias and both symptom severity and situational anxiety. Specifically, greater endorsement of threat word-sentence pairs, or a threat bias, was significantly related to both self-reported fear and avoidance symptomology, as well as to peak anxiety while giving a speech. In addition, less endorsement of benign sentence-word pairs, or a lack of a benign bias,

was significantly related to self-reported state anxiety immediately after giving a speech.

In the current study, symptomology was operationalized as self-reported trait social anxiety and general behavioral avoidance. Scores from the LSAS fear and avoidance scales, which have been used to measure social anxiety over time (Heimberg, 1999) and to distinguish between clinical and sub-clinical levels of social anxiety (Mennin, 2002), served as the basis for the operational definition of trait social anxiety. The LSAS has added advantages in that it has been widely used to capture general social anxiety in research contexts and often serves as an outcome measure in treatment studies (Heimberg 1999). To capture state or situational social anxiety, I used a peak SUDS rating during an impromptu speech and the STAI-state scale, which participants completed immediately after the speech. These measures provided estimates of state anxiety.

Observed associations between interpretation biases and anxiety indices differed across measures that capture anxiety over varying time courses (trait vs. state). The the present results suggest that whereas an interpretation bias for threat relates both to enduring trait anxiety and to anxiety experienced transiently (in the moment), failure to produce benign interpretations is related more narrowly to anxiety in the moment.

This pattern is consistent with previous research that has linked clinical social anxiety with an online and offline negative interpretation bias (e.g., Amir & Bomyea, 2010) as well as a lack of an online benign bias (e.g., Hirsch & Mathews, 2000), even using the same WSAP task (Amir et al., 2012). It is also consistent with findings from Huppert and colleagues (2007), which indicated a negative interpretation bias in socially phobic and non-socially phobic anxious individuals (at both high and low social anxiety levels), but a lack of a positive bias only in those with high levels of social anxiety. These biases were present at both the interpretation generation

phase (i.e., providing more negative interpretations and less non-threatening ones) and the interpretation selection phase (i.e., endorsing more negative interpretations and less non-threatening ones). The authors interpreted these findings, along with previous studies, as support for a time course of processing that may shift from a presence of chronic threat bias to a lack of an online benign bias and presence of a threat bias to the presence of a negative appraisal of the self. The current findings, in which negative interpretation relates to characteristic and situational social anxiety and the lack of benign interpretation relates to situational anxiety, seem consistent with this theory. The current study extends prior work by suggesting that lack of benign bias is linked to state, but not to trait, anxiety in a diagnosed socially anxious sample.

The current study's evidence of specific associations between social anxiety and each type of interpretation bias is consistent with previous research findings suggesting that social anxiety involves both a presence of threat bias and a lack of benign bias (e.g., Amir, Prouvost, & Kuckertz, 2012; Beard & Amir, 2009; Hirsch & Mathews, 2000). In a non-clinical sample, Beard and Amir (2009) found that high socially anxious individuals endorsed more social threat interpretations and fewer benign interpretations than non-anxious controls, using the WSAP task administered in the present study. Furthermore, in Beard and Amir's (2009) study, although socially anxious individuals endorsed threatening interpretation and non-threatening interpretations at equal rates (consistent with the present study's findings), the speeds at which they endorsed each type of interpretation correlated positively and negatively with social anxiety, respectively.

The comparable endorsement rates for threatening and benign interpretations found in the current and Beard and Amir (2009) studies, but not in other research (e.g., Amin et al., 1998; Stopa & Clark, 2000) may, at least in part, reflect differences in methodology. For example, in

the WSAP task used in both the present study and Beard and Amir's (2009) work, participants decide only whether a word and sentence are related. They do not, as participants have been asked to do in related research, choose whether one word (e.g., "bored") is more closely related to a sentence (e.g., "A person yawns during your speech") than another (e.g., "tired"). As such, one method allows for the measurement of endorsement of both negative and benign interpretations, while the other only allows for the measurement of preference of one over the other. Therefore, in studies that utilize measurement of preference, it would be impossible to obtain equal endorsement rates because only one option (negative or neutral) can be selected. Regardless, however, of the role that study methodology plays in shaping the pattern of associations observed, the emergence of distinct relationships between anxiety and threat and benign biases suggests, as Beard and Amir (2009) noted, that there is value in treating these bias types as separate constructs, which other researchers have done in related studies (Huppert, Foa, Furr, Filip, & Mathews, 2003). The current findings lend credence to this assertion.

Thus, the current findings suggest that cultivation of benign biases may be just as important in efforts to decrease anxiety, particularly anxiety in the moment, as the reduction of threat biases, which is more commonly a focus of intervention. Indeed, cognitive bias modification studies that have measured state and/or trait anxiety have shown that inducing a benign interpretation bias results in reduced trait anxiety (measured by the STAI-trait) in anxious individuals (Mathews, Ridgeway, Cook, & Yiend, 2007). Similarly, induction of a benign interpretation bias has been linked to decreases in state anxiety (measured by the STAI-state) in a non-clinical community sample adults (Mathews & Mackintosh, 2000).

Finally, in addition to lending support to prior findings, the current study advances the literature by suggesting, consistent with cognitive theories, that affect, particularly anxiety, is an

influential force in shaping higher level cognitive processes, such as interpretation of information. For example, cognitive models suggest that people sampled from the general population tend to interpret self-relevant information as more positive than it may objectively be (Alicke et al., 1995). Put simply, they have positive interpretation biases, which are likely informed by their beliefs or expectations about the world around them (Dagmar Stahlberg, 1999). This bias pattern stands in contrast to that observed in socially anxious individuals who appear to be primed, due to long-standing or pre-existing fears of negative evaluation, to interpret self-relevant information as negative rather than as positive or benign. In other words, socially anxious individuals seem to be “wired” with a negative interpretation bias that their non-anxious peers do not have (e.g., Amir & Bomyea, 2010).

Thus, not only do socially anxious individuals typically default to negative interpretations of social stimuli in general, but also, under stressful situations (when state anxiety is high), such negative interpretations may be especially accessible for them. The current study’s findings are consistent with this assertion because endorsement of negative interpretations was positively related to situational anxiety and endorsement of benign interpretations was inversely (or negatively) related to situational anxiety. Further, people with social anxiety may preferentially select such interpretations, even when they are able to identify or generate appropriate benign or positive alternatives. Indeed, previous studies have found socially anxious individuals to endorse negative interpretations for ambiguous social scenarios as more readily accessible and more believable, even when neutral and positive interpretations were made available to them (Amin, Foa, & Coles, 1998; Stopa & Clark, 2000).

In sum, the current findings regarding interpretation bias are consistent with two key points. First, they suggest that individuals with social phobia may be able to generate more non-

threatening interpretations as easily as they do threatening interpretations; however, they are less likely to select them to guide their behavior during anxiety-provoking situations. Second, these findings are consistent with predictions based on theories about the influence of affect on social information processing and suggest that enduring and situational manifestations of anxiety exercise particular influences over information processing in socially anxious individuals.

#### **4.2 Attention bias and anxiety**

The failure to detect a significant relationship between attention bias and symptom severity and situational anxiety in a clinical sample is unexpected, though not unprecedented. While many studies have yielded findings that indicate the presence of a significant attention bias either towards or away from threatening stimuli in socially anxious individuals (e.g., Bar-Haim et al., 2007; Spasori & Rapee, 2007; Chen et al., 2002), a few earlier studies have not found significant attention biases, particularly in non-clinical samples (Bradley et al., 1997; Pineles & Mineka, 2005). Given that the current study used a clinical sample and administered a facial dot-probe task used in much of the prior research, it is notable that no significant associations with anxiety symptoms or avoidance were evident. This may lend credence to Schultz and Heimberg's (2008) assertion that socially anxious individuals direct attention to both external cues (consistent with a vigilant stance) and internal cues (consistent with an avoidant stance) throughout a social situation, an idea that was not possible to detect using the current study's methodology but clearly warrants closer examination.

Indeed, a hypervigilance-avoidance hypothesis has been proposed in previous work (e.g., Williams, Watts, MacLeod, & Mathews, 1988; Mogg & Bradley, 1998), which states that attentional bias is a dynamic process, rather than a static response pattern. According to this hypothesis, people are first vigilant to external threat cues. They then direct attention away from

the threat to avoid detailed processing and to minimize anxiety. One study tested this hypothesis by tracking eye movements during presentation of paired threatening and neutral cues and found that individuals with higher levels of social anxiety were faster to attend to threat cues but looked at them more briefly than did individuals with lower levels of social anxiety. The authors interpreted these results as consistent with a vigilant-avoidant pattern of bias (Garner, Mogg, & Bradley, 2006). Although some participants' data may have been consistent with this idea, the model did not fit all of the participants' data (i.e., some had avoidant scores). Thus, it may be that the course of attention to external and internal cues varies amongst individuals with social anxiety.

The null attention bias findings in the current study may also reflect within-sample variability in attention bias scores, which ranged from -25.50 to 42.53. Given that some participants showed avoidant biases (negative bias scores) and others showed hypervigilant biases (positive bias scores), the present sample could comprise members of both of Calamaras and colleagues' (2012) proposed attentional subtypes for socially anxious individuals. Thus, the decision in the present study to treat attention bias scores as varying along a single continuum may have obscured distinct relations between attention bias and social anxiety that might be evident for each subtype. For example, among attentionally vigilant people with social anxiety, associations between bias scores and symptom measures might emerge only for indices of fear, while among attentionally avoidant people, such associations might emerge only for indices of behavioral avoidance.

To date, no published study has examined differential associations between bias scores for individuals who display different attention bias subtypes and social anxiety symptomology. Price and colleagues (2011) found no significant differences between subtypes in total LSAS

scores; however, they did not look at differences between subtypes on fear and avoidance subscale scores, nor did they conduct correlational analyses within subtype groups. Although the current study was inadequately powered to examine subtype groups separately, inspection of individual threat bias scores indicated that 10 of the 34 participants had negative scores, suggesting an avoidant bias. Future research using larger samples would allow for analyses in which participants are grouped based on bias type.

### **4.3 Behavioral avoidance**

The absence of significant associations between behavioral avoidance during an impromptu speech and both interpretation and attention biases was unexpected. One possible explanation is that a single “snapshot” of avoidance, even under circumstances—like the BAT—that are likely to elicit such behavior, may be inadequate to elicit or capture such associations, if they are indeed present. Rather than engaging in behavioral avoidance in every anxiety-provoking situation, socially anxious individuals may, on average, avoid situations more often than non-anxious individuals. Therefore it may be that research focused on patterns of avoidance over time (e.g., if people continuously interpret party environments negatively, they will develop a pattern of avoiding parties) would be more likely to yield evidence of associations with cognitive biases.

Alternatively, a few methodological issues may have contributed to the null findings with regard to behavioral avoidance. First, a single-variable measurement of behavioral avoidance, in this case speech length, may not be adequate to capture the hypothesized associations. Instead, cognitive biases may be related to other, and perhaps more subtle, behavioral manifestations of avoidance such as lack of eye contact or speaking speed. For example, if a socially anxious individual interprets an audience member’s yawn as boredom

rather than tiredness, she may cut her talk short. Alternatively, someone who interprets the audience as disapproving may attempt to explain himself and end up rambling or fumbling with his words. Indeed, previous research has shown that socially anxious individuals not only escape social situations sooner than non-anxious individuals but also engage in other forms of avoidance such as engaging in less eye contact, speaking faster or skipping material (e.g., Baker & Edelmann, 2002; Voncken & Bögels, 2008) compared to non-anxious controls. Future research would benefit from treating behavioral avoidance as a multifaceted construct that may have complex and varied relationships with cognitive processes.

Further, the chosen behavioral avoidance task version may not have optimally elicited behavioral avoidance. In the current study, all participants completed the same impromptu speech task and were provided with the same topics to choose from. Although the task seemed likely to be personally relevant for each participant (all participants endorsed public speaking fears), previous research recommends personalized stimulus situations for BATs (e.g., a conversation, presenting material at a meeting) (Chiauzzi, Heimberg, Becker, & Gansler, 1985), which may provide a more relevant or accurate observation of the individual's behavioral repertoire. For example, Heimberg and colleagues (1993) found that individuals who had received cognitive behavioral group therapy for social phobia received lower anxiety ratings and better performance ratings by independent judges on an individually-tailored behavioral test compared to those who received educational-supportive therapy. They also reported less anxiety during the behavioral test after treatment.

Finally, it may have been important to consider self-focused negative interpretations when examining associations between interpretation biases and behavioral outcome. Indeed, previous research has posited that the reduction of negative self-statements may play a role in

behavior change (Kendall & Hollon, 1981). Therefore, a self-specific negative interpretation (e.g., “I look shaky and nervous”) versus an environment-focused negative interpretation (e.g., “That person looks bored”) may be more relevant to behavioral avoidance.

Indeed, research has shown that socially anxious individuals endorse more negative self-statements than non-socially anxious individuals and that negative self-statement endorsement is significantly correlated to anxiety levels and performance skill during a social interaction task (Glass et al., 1982). Thus, it is likely that a negative self-bias in a given situation will be more tightly linked to behavior than will a general negative interpretation bias. In the current study, interpretation bias was measured by examining the number of threat-sentences pair endorsed for a variety of ambiguous situations (e.g., “You share an idea with someone”), rather than examining the number of negative self-statements endorsed. Similarly, it may be that general trait negative interpretations (e.g., measured in general or not specifically during an anxiety provoking situation) may not be directly related to avoidant behavior; instead behavior may be more closely related to specific negative interpretations exhibited in the moment. The current study measured interpretation bias prior to the impromptu task.

#### **4.4 Limitations and strengths of the present study**

The current study is not without limitations. First, the sample was small, primarily female, and relatively young (mean age =23). Results of a power analysis, which determined that a sample of 34 should be sufficient to detect expected effect sizes, suggest that the small number of participants is not necessarily problematic, although it may have been a contributing factor to the null behavioral findings. The homogeneity of the sample limits generalizability of findings to the broader social phobic population. Although this study provides an important initial examination of both interpretation bias and attention bias and their distinct relations to

behavior, it should be replicated, particularly in light of the small and somewhat homogenous sample.

Second, the current study utilized cross-sectional data from a single laboratory assessment. Therefore, consistency of the associations found could not be determined (i.e., do these relational patterns exist at any given moment or do they change). Future research that includes longitudinal methodology would be beneficial in order to examine the reliability of relational patterns of interest over time.

Despite these limitations, this study has notable strengths, including being the first to examine separately the relations between interpretation bias and attention bias and behavior in a clinically socially anxious sample. The findings suggest that interpretation bias, but not attention bias, is related to both enduring and situational anxiety in social phobia. Future research is needed to better understand in what ways interpretation bias relates to both social anxiety and behavior.

#### **4.5 Future directions**

The current study's findings (both significant and null) provide a foundation for several avenues of future research. First, the pattern of significant associations between interpretation bias (both threat and lack of benign bias) and social anxiety (trait versus state) is informative because they suggest that when considering treatments for social anxiety, not only it is important to challenge and reduce negative biases, but it is also useful to teach skills for producing alternative benign interpretations, particularly in stressful moments. Indeed, results of cognitive bias modification studies for social anxiety suggest that increasing familiarity with and access to benign interpretations can help reduce anxiety symptoms (Beard & Amir, 2008).

There may thus be value, as Beard and Amir (2009) propose, in extending current bias

modification paradigms to include training in the generation and selection of benign interpretations, particularly during anxiety-provoking social situations. One study found cognitive bias modification that involved increasing benign interpretations to be superior to computerized cognitive behavior therapy at maintaining a positive cognitive bias during a high mental load task (unscrambling socially relevant sentences while remembering a six digit number), in individuals with high social anxiety (Bowler et al., 2012). Therefore, further exploration of potential benefits associated with including benign interpretation training during exposure might be one avenue for future treatment work. For example, having an individual practice producing benign interpretations (e.g., “That person is checking his phone because he got an important text, not because I am giving a bad speech”) while in a stressful situation could potentially enhance exposure treatment outcomes.

Currently, the literature on cognitive behavioral therapy suggests that the addition of cognitive treatment techniques, such as restructuring, do not necessarily have any added value towards enhancing outcomes beyond that which exposure provides (e.g., Emmelkamp, Mersch, Vissia, & van der Helm, 1985; Feske & Chambless, 1995; Longmore & Worrell, 2007). However, most cognitive components of therapy focus on challenging or reducing negative cognitions prior to exposure; rarely do they focus on generating benign interpretations *during* exposure. Further, therapists typically spend little time (e.g., one or two sessions) on these techniques (Longmore, 2007).

It may be that these cognitive components seem unnecessary because they are not explicitly practiced during exposure, which research has identified as a key mechanism of change in CBT for anxiety (Nortje, Posthumus, & Moller, 2008). It may also be that brief cognitive training is inadequate to affect long-standing negative beliefs (Longmore, 2007). The

present findings, however, add to a growing literature, which suggests instead that focusing on enhancing exposure sessions with on-line benign interpretation training could actually render treatment *more* effective.

Additional exposure-enhancing benefits could accrue from focusing on benign interpretation training under stress to the point of automaticity prior to exposure (i.e., computerized training with the knowledge of exposure immediately afterwards), so that individuals do not resort to old tendencies when faced with stressful cues. Indeed, exposure may be more effective when combined with benign interpretation training because anxious individuals treated with this combination will not only learn that they can tolerate their anxiety, but they may also be more likely to have corrective or positive experiences during exposure due to more accessible benign or positive thoughts (e.g., “That went well” vs. “I guess I was able to do that this time”). Not only might this combination be more reinforcing than exposure alone, but it could also lead clients to require fewer exposure sessions to achieve symptom reduction or result in longer-lasting treatment gains (e.g., relapse prevention). This is one theory that may warrant future research.

Second, the current findings support further examination of interpretation bias and its associations with symptomology (both subjectively-reported anxiety levels and behavior), with particular emphasis on the temporal contexts in which interpretation biases may arise. Therefore, in order to further elucidate the patterns of associations found in the current study, it would be beneficial for future research to examine individually generated, on-line interpretations in socially anxious individuals (e.g., asking participants how they are interpreting audience members’ behaviors while they giving a speech). It may also be worthwhile for future research to

include measures of interpretation that are not social anxiety specific (e.g., other anxiety specific situations to interpret) as well as examine these relations in other anxiety disorders.

Finally, given the unexpected null findings in the current study and the inconsistencies in the current literature regarding associations between attention bias and both anxiety and behavior, a more thorough and detailed understanding of attention bias patterns in social anxiety is needed. One direction for future research may be to include eye-tracking methodology to measure attention bias over the course of a task (e.g., facial dot-probe) or social situation (e.g., speech task). Future research may also benefit from utilizing BATs that may yield more valid measures of behavioral avoidance. Such BATs might be individually tailored (e.g., conversation versus speech) or might include more indices of avoidance (e.g., eye contact, speech speed).

#### **4.6 Conclusions**

The current study is the first to our knowledge to have examined the independent associations between interpretation bias and attention bias and social anxiety symptomology, situational anxiety, and behavioral avoidance in a sample of adults with social phobia. Key findings revealed significant associations between negative interpretation bias and both trait and state social anxiety and a significant relationship between lack of benign interpretation bias and state anxiety. There were no significant associations between attention bias and anxiety or behavioral avoidance. The findings are consistent with both social anxiety and cognitive processing theories and contribute to the literature by highlighting the importance of benign or positive interpretation bias in social phobia. They also suggest distinct links of negative and positive interpretation bias to both state and trait anxiety. Examining the contribution of online benign interpretation training to treatment programs for social anxiety (e.g., cognitive bias modification, exposure therapy) in future research may be warranted.



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## APPENDIX A

### LSAS-SR

Please read each situation carefully and provide an answer to each column for that situation. The first column refers to how anxious or fearful you feel in the situation. The second refers to how often you avoid the situation. If you come across a situation that you ordinarily do not experience, we ask that you imagine "what if you were faced with that situation," and then, rate the degree to which you would fear this hypothetical situation and how often you would tend to avoid it. Please base your ratings on the way that the situations have affected you in the last week.

		Fear or Anxiety  0 = None 1 = Mild 2 = Moderate 3 = Severe	Avoidance  0 = Never (0%) 1 = Occasionally (1-33%) 2 = Often (33-67%) 3 = Usually (67-100%)
1.	Telephoning in public (P)		
2.	Participating in small groups (P)		
3.	Eating in public places (P)		
4.	Drinking with others in public places (P)		
5.	Talking to people in authority (S)		
6.	Acting, performing or giving a talk in front of an audience (P)		
7.	Going to a party (S)		
8.	Working while being observed (P)		
9.	Writing while being observed (P)		
10.	Calling someone you don't know very well (S)		
11.	Talking with people you don't know very well (S)		
12.	Meeting strangers (S)		
13.	Urinating in a public bathroom (P)		
14.	Entering a room when others are already		

	seated (P)		
15.	Being the center of attention (S)		
16.	Speaking up at a meeting (P)		
17.	Taking a test (P)		
18.	Expressing a disagreement or disapproval to people you don't know very well (S)		
19.	Looking at people you don't know very well in the eyes (S)		
20.	Giving a report to a group (P)		
21.	Trying to pick up someone (P)		
22.	Returning goods to a store (S)		
23.	Giving a party (S)		
24.	Resisting a high pressure salesperson (S)		

## Appendix B

Sample items of the STAI-State:

**DIRECTIONS:**

A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you feel *right now*, that is, *at this moment*. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

- |                          |  | 1 | 2 | 3 | 4 |
|--------------------------|--|---|---|---|---|
| 1. I feel calm.....      |  | 1 | 2 | 3 | 4 |
| 2. I feel secure .....   |  | 1 | 2 | 3 | 4 |
| 3. I am tense .....      |  | 1 | 2 | 3 | 4 |
| 4. I feel strained ..... |  | 1 | 2 | 3 | 4 |

NOT AT ALL  
 SOMEWHAT  
 MODERATELY SO  
 VERY MUCH SO

## Appendix C

### Center for Epidemiologic Studies Depression Scale (CES-D), NIMH

Below is a list of the ways you might have felt or behaved. Please tell me how often you have felt this way during the past week.

Week	During the Past			
	Rarely or none of the time (less than 1 day )	Some or a little of the time (1-2 days)	Occasionally or a moderate amount of time (3-4 days)	Most or all of the time (5-7 days)
1. I was bothered by things that usually don't bother me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. I did not feel like eating; my appetite was poor.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. I felt that I could not shake off the blues even with help from my family or friends.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. I felt I was just as good as other people.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I had trouble keeping my mind on what I was doing.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. I felt depressed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. I felt that everything I did was an effort.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. I felt hopeful about the future.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. I thought my life had been a failure.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. I felt fearful.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. My sleep was restless.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. I was happy.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. I talked less than usual.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. I felt lonely.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. People were unfriendly.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. I enjoyed life.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17. I had crying spells.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18. I felt sad.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19. I felt that people dislike me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20. I could not get "going."	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**SCORING:** zero for answers in the first column, 1 for answers in the second column, 2 for answers in the third column, 3 for answers in the fourth column. The scoring of positive items is reversed. Possible range of scores is zero to 60, with the higher scores indicating the presence of more symptomatology.