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# Visual Attention and Social Anxiety: Oculomotor Behavior when Threatened

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# VISUAL ATTENTION AND SOCIAL ANXIETY: OCULOMOTOR BEHAVIOR WHEN THREATENED

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# VISUAL ATTENTION AND SOCIAL ANXIETY: OCULOMOTOR BEHAVIOR WHEN THREATENED

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A growing theoretical and research literature suggests that trait and state social anxiety can predict attentional patterns in the presence of emotional stimuli. The current study addressed some inconsistencies and gaps in the literature using eye tracking methodology. Participants with high and low trait social anxiety were randomly assigned to either give a speech or to watch a video of another individual delivering a speech (state social anxiety manipulation). Next, participants were asked to engage in a free view task in which pairs of emotional facial stimuli (angry-happy, angry-neutral, or happy-neutral) were presented for 3 s. Eye movements were monitored continuously. Results revealed that individuals with high trait social anxiety are faster to make their first fixation on neutral and positive stimuli on trials that contain threatening stimuli, and that they are faster to disengage attention from threatening stimuli after their initial fixation on trials that contain neutral stimuli than low trait social anxiety participants. The trait social anxiety groups do not differ with regard to how often their attention returns to emotional stimuli or to how long they attend to emotional stimuli over the course of the trial. State social anxiety influences how often attention returns to each type of stimulus and the duration of the fixations on each type of stimulus. State social anxiety does not influence the timing or duration of the first fixation on emotional stimuli. Results are discussed in

reference to the vigilance-avoidance hypothesis and basic attentional processes. Treatment implications, limitations of the study, and suggestions for future research are also discussed.

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# CHAPTER 1: INTRODUCTION

Social anxiety, which involves the fear of being negatively evaluated in social and performance situations, is a normal transient experience for most people. However, some people experience more intense and frequent social anxiety than others, in a broader range of situations, and it interferes with their lives. Social anxiety disorder (also known as social phobia), the diagnostic term for someone who suffers from excessive anxiety in situations with the potential for negative evaluation from others (American Psychiatric Association, 2000), has been found to have a lifetime prevalence rate of over 10% (Kessler, Berglund, Demler, Jin, & Walters, 2005). The experience of anxiety and avoidance behaviors that characterize the disorder lead to a poorer quality of life than individuals without social anxiety disorder as it detrimentally affects the interpersonal (including both platonic and romantic relationships), educational, familial, occupational, and emotional realms (Katzelnick et al., 2001; Schneier et al., 1994). Additionally, researchers have found substantial comorbidity between social anxiety disorder and other mental disorders including other anxiety disorders, mood disorders, and substance abuse (Chartier, Walker, & Stein, 2003), with the onset of social anxiety often preceding the onset of the mood disorder (Stein et al., 2001) or substance dependence (Buckner, Schmidt, Lang, Small, Schlauch, & Lewinsohn, 2008). The high prevalence of social anxiety disorder, as well as the suffering associated with it, highlights the need for research that leads to effective interventions.

Fortunately, effective interventions for social anxiety disorder exist (for meta-analytical evidence see Chambless & Hope, 1996; Fedoroff & Taylor, 2001; Feske & Chambless, 1995; Hofmann & Smits, 2008; Norton & Price, 2007; Powers, Sigmarsson,

& Emmelkamp, 2008; Taylor, 1996). However, empirical studies of treatment response consistently indicate that there is a substantial group of treatment non-responders associated with both psychosocial and psychopharmacological treatments (e.g., Heimberg, Liebowitz, Hope, Schneier, Holt, Welkowitz, et al., 1998). In order to develop more effective interventions for social anxiety disorder, it is necessary to better understand the nature of the processes that underlie social anxiety.

As will be discussed later, many theoretical conceptualizations of anxiety have implicated attentional processes, including attention to threat, as playing an important role in the development and maintenance of anxiety. For example, Barlow (2000) hypothesized that the presence of a cue associated with threat initiates a series of reactions that result in the experience of anxiety. Theories of the etiology and maintenance of social anxiety (e.g., Rapee & Heimberg, 2007) have reached conclusions that are similar to the conclusions of broader theories (e.g., Barlow, 2000). In addition, empirical evidence suggests that attentional patterns change concurrently with social anxiety symptoms (e.g., Lundh & Öst, 2001), supporting the hypothesis that attention and anxiety are related constructs. Despite the theoretical importance of attention in models of anxiety and the empirical evidence of an association between attentional patterns and anxiety, few treatments attempt to directly alter attentional processes (although many indirectly influence attention; for a notable exception see Clark et al., 2003).

Recently, empirical investigations of interventions based solely on the modification of attention to threat have been conducted and there is at least some evidence for the efficacy of those types of interventions with individuals with social anxiety disorder (Amir, Weber, Beard, Bomyea, & Taylor, 2008; Li, Tan, Qian, & Liu,

2008; Schmidt, Richey, Buckner, & Timpano, 2009). However, in order for psychologists to continue to refine interventions for social anxiety that aim to alter attentional processes, more information concerning the maladaptive attentional processes should be gathered.

Despite the large number of research studies investigating patterns of attention to threat for individuals with high levels of social anxiety disorder, there are a number of gaps in the literature. First, there is controversy regarding the vigilance-avoidance pattern of attention to threat hypothesized to characterize the attentional patterns of individuals with high levels of social anxiety (Mogg, Bradley, Miles & Dixon, 2004). As will be discussed later, some empirical research supports the vigilance-avoidance hypothesis and suggests that anxious individuals initially orient towards, but subsequently avoid, highly threatening, anxiety-provoking stimuli (Mogg, Bradley et al., 2004). However, some studies have failed to find evidence that anxiety influences attention to threat (e.g., Esteves, 1999; Fox et al., 2000). In addition, studies of the time course of the attentional process that occur when anxious individuals are presented with threat have provided inconsistent results. Second, there is debate in the attention to threat literature concerning whether social anxiety is better characterized as associated with attention to threat or attention to emotional stimuli in general. Research suggests that state anxiety predicts attention to emotional stimuli, whereas trait anxiety predicts attention to threatening stimuli (e.g., Rutherford, MacLeod, and Campbell, 2004). Third, the cognitive processes that underlie the patterns of attention to threat that have been associated with social anxiety have been debated. In particular, it is unclear whether individuals with social anxiety exhibit an attentional bias towards threat because threatening stimuli draw their

attention more quickly (Juth, Lundqvist, Karlsson, & Öhman, 2005) or if they have difficulty disengaging their attention from threatening stimuli (Amir, Elias, Klumpp, & Przeworski, 2003). Fourth, it is not clear whether patterns of attention to threat associated with social anxiety are due to social anxiety per se, or if the effects of negative affect can provide a better explanation for the findings.

The purpose of this dissertation research is to provide an overview of the theoretical and empirical literature relevant to attention to threat and social anxiety. The literature review will include a discussion of methodological problems in previous studies. In addition, this dissertation addresses some of the inconsistencies in the literature. Specifically, this dissertation explores questions relevant to the vigilance-avoidance hypothesis, and the effects of state and trait anxiety on attention to threatening and other emotional stimuli, while controlling for negative affect. Also, this dissertation provides insight into the cognitive processes responsible for patterns of attention to threat.

## 1.1. Models of Attention to Threat and the Maintenance of Anxiety

There are a number of models of anxiety that associate attentional processes with the development and maintenance of anxiety. The current section will describe four of these models. Two of the models are relevant to anxiety in general and two of the models are specific to social anxiety.

### 1.1a. The Process of Anxious Apprehension (Barlow, 2000).

Barlow (2000), in an overview and update of his conceptualization presented in Barlow (1988), asserted that attention plays an important role in the elicitation of anxiety. He postulated that anxiety (or anxious apprehension) is the product of the activation of

cognitive-affective structures located in our defensive motivational system that facilitate attention for threat.

According to the theory, the presence of a cue associated with threat initiates the process that results in the experience of anxiety. The cue triggers physical tension and arousal, as well as negative affect. Increased physiological arousal associated with anxiety includes accelerated heart rate, blushing, and sweating (Turk, Lerner, Heimberg, & Rapee, 2001). The tension and arousal physically prepare the individual for negotiating a threatening situation and the negative affect is the result of the uncertainty that the individual will be able to deal effectively with or control an impending threatening situation. In support of the idea that uncertainty is an important factor in the development of anxiety, there is evidence to suggest that individuals with an anxiety disorder exhibit less physiological reactivity to predictable, as opposed to unpredictable, threatening cues (Fonteyne, Vervliet, Hermans, Baeyens,& Vansteenwegen, 2009; Grillon, et al., 2008).

In an effort to evaluate the individual's ability to handle the future threat effectively, there is a switch from focusing on threatening cues to focusing on aspects of the self (such as physiological state). The shift in attention leads to an intensification of arousal and negative affect. Empirical evidence has supported the presence of an internal bias for individuals experiencing social anxiety. For example, Mansell, Clark, and Ehlers (2003) reported that, when asked to respond to both external (e.g., facial stimuli) and internal (i.e., pulsing of the participant's finger) cues, participants with high social anxiety showed a greater bias towards attending to the internal cue than low anxious participants when threatened.

Furthermore, there is evidence that perceived changes in physiology can affect anxiety. For example, in a study by Wild, Clark, Ehlers, and McManus (2008), participants wore equipment that they believed provided them feedback concerning their state of physiological arousal. In reality, the participants received false feedback. Participants who believed that their physiological arousal had increased reported more anxiety, poorer perceptions of their performance during a conversation, and perceptions of greater visibility of their anxiety than the participants who believed that their physiological response had decreased over time.

According to Barlow (2000), following the focus on physiological state, there is another shift of attention towards threatening cues and attention is focused more narrowly on threat. Barlow (2000) asserted that, while in a threatening situation, an individual can cope by avoiding. There is some empirical evidence that anxious individuals avoid threat following their attention to it (e.g., Vassilopoulos, 2005). One implication of the theory is that anxiety can be adaptive. Anxiety appears to stimulate a concern with the uncontrollability and unpredictability of a possible future negative event. This concern produces a negative affective reaction and the unwanted presence of the negative affect serves as motivation for the individual to prepare to deal with the threatening situation. One avoidance mechanism is worry, which simultaneously allows the individual to avoid negative affect and to plan possible resolutions to their dilemma (Borkovec, Alcaine, & Behar, 2004; Szabó & Lovibond, 2006). Therefore, anxiety, like other emotions, has evolved as an innate pattern of responding because it has been useful throughout human history as a promoter of survival.

1.1b. Threat Evaluation System (Mathews & Mackintosh, 1998)

Like Barlow (2000), Mathews and Mackintosh (1998) presented a model to explain the role of anxiety in the detection of threat and the selective processing of threatening stimuli. The authors contended that their theory improved upon a number of prior theories of the patterns of attention to threat associated with anxiety (i.e., Mogg & Bradley, 1998; Ohman, 1993; Wells & Matthews, 1994; Williams, Watts, MacLeod, & Mathews, 1988;). The theory posited the presence of a threat evaluation system (TES) that serves to increase the saliency of threatening information prior to conscious awareness based on stimulus properties, priming effects, and stored meanings of the stimulus. Furthermore, cognitive processes, such as worry and interpretation biases, serve to maintain high levels of vigilance for people with high anxiety (Mathews, 1990). Therefore, consistent with evidence from visual search tasks (e.g., Esteves, 1999), threat is detected more quickly and easily than non-threatening stimuli. The increase in saliency for threatening information is especially adaptive in the presence of more than one stimulus because the threatening information receives processing priority over non-threatening stimuli.

According to Mathews and Mackintosh (1998), both trait and state anxiety levels modulate the determination of saliency of threat such that more anxious individuals assign a higher importance to threatening information than non-anxious individuals. Indeed, the results of a number of research studies on attention to threat have suggested that individuals with high trait anxiety exhibit an attentional bias towards threat, in comparison to low trait anxiety individuals (e.g., Bradley, Mogg, Falla, & Hamilton,

1998), and that high state anxiety exaggerates the difference between the groups (e.g., Lee & Telch, 2008).

Threatening information is more salient for anxious individuals than for non-anxious individuals because anxious individuals are thought to have a lower threshold for TES output and a greater number of stored representations of threat due to their greater ability to associate stimuli with punishment. In support of this assertion, learning studies have shown that high anxiety individuals learn some information better through the use of punishment, whereas low anxiety individuals exhibited difficulty learning through the use of punishment (Corr, Pickering, & Gray, 1997).

Furthermore, Mathews and Mackintosh (1998) asserted that, following the detection of threat, the Behavioral Inhibition System (BIS; Gray & McNaughton, 1996) causes physiological arousal and the allocation of attention to threat, which disrupts ongoing behavior and promotes survival. Increased physiological arousal associated with anxiety includes accelerated heart rate, blushing, and sweating (Turk et al., 2001) and the perception of physiological arousal has been shown to have a negative effect on quality of task performance (Wild et al., 2008). Consistent with Barlow's (2000) model, Mathews and Mackintosh (1998) proposed that the physiological arousal associated with anxiety has adaptive value as it prepares the body for fight or flight (Mathews et al., 1997).

Finally, according to Mathews and Mackintosh (1998), the individual incorporates aspects of the environment into their stored representations of threatening stimuli, making it more likely that the individual will exhibit anxiety when they encounter similar stimuli in the future. This assertion is consistent with leading theories

concerning anxiety and the activation of fear-relevant stimuli (Foa, Huppert, & Cahill, 2006; Foa & Kozak, 1986).

1.1c. A Cognitive Model (Clark & Wells, 1995)

Clark and Wells (1995) outlined the cognitive and behavioral events that occur when an individual experiences social anxiety. The model suggests that the process of experiencing social anxiety begins in the presence of an audience. When the individual encounters the audience, they activate dysfunctional beliefs. These beliefs might include the ideas that others have high standards of expected behavior set for them and that they are at risk for not acting in accordance with those standards. In addition, there will be negative consequences for not behaving in an appropriate manner, including social rejection and negative affect. Foa, Franklin, Perry, and Herbert (1996) reported evidence of these dysfunctional beliefs in a study of individuals with social anxiety disorder.

The perception of the social danger leads to physiological arousal and the activation of an "anxiety programme." The "anxiety programme" leads the individual to switch their attention to the self as the object of attention, with an emphasis on the individual's physiological state. Then, the individual uses information derived from their physiological sensations to evaluate how he or she appears to others, believing this evaluation to be correct. Instead of using information from others with whom the individual is interacting, the individual uses information derived from the experience of anxiety, thus biasing their own self-image and leading to more anxiety. In turn, the increase in anxiety is likely to lead the individual to believe that the social dangers are even greater.

According to Clark and Wells (1995), social anxiety is maintained through a number of processes. For example, the process of focusing on oneself consumes cognitive resources such that there might not be enough resources to complete the task at hand. If anxiety interferes with task completion, then the individual has evidence of their insufficient behavior. Unfortunately, evidence suggests that anxiety does interfere with task completion (Wild et al., 2008). Similarly, if many cognitive resources are being used for self-focused attention, then there are fewer resources available to process the positive reaction of others. The only information about the individual's performance comes from the individual's process of focusing on the self. Consistent with this assertion, research suggests that observers rate the performance of anxious speakers more highly than the speakers rate themselves (Wild et al., 2008).

In addition, socially anxious individuals often engage in safety behaviors that are enacted with the goal of making negative evaluation less likely (McManus, Sacadura, & Clark, 2008). For example, if an individual is afraid that they will fall while walking up a flight of stairs, they might proceed very slowly up the stairs. Despite their common use, individuals with social anxiety might have knowledge that safety behaviors can be interpreted as negative by others (Vassilopoulos, 2009). These types of safety behaviors also use cognitive resources, again making successful task completion and the recognition of positive feedback less likely (McManus et al., 2008). Finally, individuals might attribute their success in a situation to the presence of a safety behavior, as opposed to their own social competence.

### 1.1d. A Cognitive-Behavioral Model (Rapee & Heimberg, 1997)

Like Clark and Wells (1995), Rapee and Heimberg (1997) provided a cognitive-behavioral model of social anxiety disorder. Their model emphasizes the perceptual and information processing activities of an individual when confronted with the possibility of social evaluation and how distortions in those processes lead to the elevation and maintenance of social anxiety. According to the model, the chain of events that leads to social anxiety begins when the individual perceives an audience with the potential to evaluate the individual and forms a mental representation of themselves from the perspective of the audience. Individuals with social anxiety disorder are more likely than nonanxious individuals to view themselves from the perspective of an observer (Coles, Turk, & Heimberg, 2002; Hackmann, Surawy, & Clark, 1998) and this difference in perspective taking is specific to social situations that involve high levels of anxiety (Coles, Turk, Heimberg, & Fresco, 2001; Wells, Clark, Ahmad, 1998). For individuals with social anxiety disorder, the observer perspective becomes more prominent as time elapses (up to three weeks; Coles et al., 2002), however, the increase in the observer perspective is not seen with non-anxious controls (Coles et al., 2002).

Various sources of information contribute to the formation of the baseline image of the self including pre-existing images of the self, previous feedback from others, and prior experiences that are stored in long-term memory (Hackmann, Clark, & McManus, 2000). However, the baseline image is not static. Instead, in the presence of the perceived audience, the individual updates the mental representation of the self using information from the perception of internal cues, such as the physiological symptoms of anxiety (e.g.,

increased heart rate), and external cues, such as audience feedback (e.g., frowning, laughter).

Unfortunately, the mental images that individuals with social anxiety disorder form are more negative than the images formed by control individuals (Hackmann et al., 1998) and are thought to play a causal role in the maintenance of social anxiety disorder (Hirsch, Clark, Mathews, & Williams, 2003). The Rapee and Heimberg model explains the prevalence of negative mental images in individuals with social anxiety disorder by asserting that individuals with social anxiety disorder tend to allocate attentional resources toward both internal and external sources of threat as has been shown in a various experimental studies using attention tasks (e.g., Mansell et al., 2003). The biased attentional patterns are thought to lead to the development of a more negative mental image. Furthermore, the combination of the negative self-imagery and interpretation bias results in greater deficits than the results of either mechanism acting alone and they serve to maintain the disorder (Hirsch, Clark, & Mathews, 2006).

Following the formation of the mental representation of the self, the individual with social anxiety compares their mental representation to the expectations that the individual believes that the audience holds based on both situational and audience characteristics (Mahone, Bruch, & Heimberg, 1993; Rapee & Heimberg, 1997). The resulting estimation of the likelihood of negative evaluation is the discrepancy between one's mental representation and the expected standards of the audience. Individuals with social anxiety disorder usually expect that negative evaluation is probable and that the consequences are great (Foa et al., 1996).

The expected negative evaluation results in the behavioral, cognitive, and physical symptoms of social anxiety. The behavioral resultants of social anxiety disorder can be obvious, such as the avoidance or escape of social situations, or understated behaviors, such as the avoidance of eye contact (Turk et al., 2001). The cognitive symptoms of social anxiety disorder are comprised of the thoughts of negative evaluation that are formed in social situations (Turk et al., 2001), such as "They will think that I am stupid," or "I am a loser." Finally, physical symptoms of social anxiety disorder typically involve increased physiological arousal, including accelerated heart rate, blushing, and sweating (Turk et al., 2001).

1.1e. Summary

There are at least two commonalities among the models described above that are relevant to the current study. First, in each of the models, the experience of anxiety is directly related to the detection of threat. The relationship is thought to be bidirectional; the detection of threat has been hypothesized to cause anxiety and the presence of anxiety has been hypothesized to facilitate the detection of threat. Second, many of the models suggest that anxiety (and the accompanying arousal) is intensified through attentional focus on threat and decreased when attention is allocated toward less threatening behaviors. For example, an individual's anxiety is thought to increase when focusing on their uncomfortable physiological state, but to decrease while engaging in safety behaviors.

In support of the aforementioned theories of anxiety, empirical evidence from a variety of methodologies suggests that attentional biases are associated with social anxiety disorder. An overview of that literature is presented below with an emphasis on

the vigilance-avoidance hypothesis, the effects of state and trait anxiety, as well as negative affect, the cognitive processes responsible to the vigilance-avoidance pattern of attention to threat, and the methodologies used to examine attention to threat.

## 1.2. Empirical Evaluation of the Vigilance-Avoidance Hypothesis

According to the vigilance-avoidance hypothesis, highly anxious individuals are initially hyper-vigilant for threat, but subsequently avoid the threat at longer exposure durations (Mogg, Bradley et al., 2004). This section contains a review of the empirical evidence pertaining to the assertions of the vigilance-avoidance hypothesis, with an emphasis on studies using highly socially anxious participants. As will be argued below, the empirical data are mixed with regard to support of the vigilance-avoidance hypothesis. The seemingly inconsistent results are not surprising given that there is great variation among the methodological aspects of the relevant studies.

Vassilopoulos (2005) reported evidence of an attentional pattern consistent with the vigilance-avoidance pattern using a sample of undergraduates selected for having high or low levels of social anxiety. Participants in the study completed measures of social anxiety and mood, as well as a task designed to assess attention to threat. Participants were told that they would give a speech that would be recorded and evaluated later. This manipulation was designed to increase state social anxiety prior to the start of the attention task.

The attention task was a variation of the dot probe paradigm (MacLeod, Mathews, & Tata, 1986) conducted on a computer. The task included 144 experimental trials. At the start of each trial, a cross appeared in the center of the computer screen for 500 ms and participants were asked to focus their attention on the cross. Next, a neutral word and

an emotional word appeared side by side on the computer screen. The words were matched for length. The emotional word was a social-threat, a positive-social, or a physical-threat word. The stimuli remained for 200 ms on half of the trials and for 500 ms on the other half of the trials. Immediately following the disappearance of the stimuli, a probe appeared in a place formerly occupied by one of the two words. The participants' task was to indicate the location of the probe by pressing one of two response buttons that corresponded with the location of the probe. Word types appeared with equal frequency and the emotional words appeared on the right side of the screen for 50% of the trials and on the left side of the screen on the remaining trials.

For each trial, a bias score was calculated. The bias score served was a measure of reaction speeding when the probe replaced the emotional word, as opposed to when it replaced the neutral word. The theory is that, if an individual were allocating attention towards the emotional word, then they should be faster to respond to a probe that appears in the location formerly occupied by the emotional word because an attentional shift is not necessary. If the participant were attending to the neutral word, then they would be slower to attend to a probe that appeared in the location formerly occupied by the emotional word because, in order to attend to that stimulus, the individual would have to disengage their attention from the location of the neutral word and reorient to the location formerly occupied by the emotional word.

The study demonstrated that individuals with high levels of social anxiety were initially vigilant for emotional words (at 200 ms), although individuals who had low levels of social anxiety did not show an attentional bias during that time frame. In addition, the authors reported that individuals with high levels of social anxiety

subsequently avoided the emotional stimuli (at 500 ms), but that individuals with low levels of social anxiety did not exhibit an attentional bias at that time point either.

Consistent with Vassilopoulos (2005), Mogg and Bradley (2002) presented evidence that individuals with high social anxiety exhibit an early vigilance for threatening stimuli. Researchers asked participants with high and low social anxiety to complete a variation of the dot-probe task. On each trial of the task, participants were presented with a fixation point in the middle of the screen for 500 ms. Next, a pair of faces was presented for 17 ms. On critical trials, one face was threatening and one face was neutral. A pair of masks was presented for 68 ms immediately following the pairs of faces. Then, a probe appeared in a location formerly occupied by one of the masks. The task of the participants was to identify the location of the probe (left or right) via a keyboard response. Participants with high levels of social anxiety were faster to identify the location of the probes that replaced the masked threat. Results suggested that individuals with high levels of social anxiety attend quickly to threatening information, even when that information might not be accessible in consciousness.

Similarly, Chen, Ehlers, Clark, and Mansell (2002) found evidence that individuals with social anxiety disorder avoid threatening stimuli 500 ms after the onset of the stimuli. Both individuals with social anxiety disorder and control participants participated in a variation of the dot probe paradigm. The task consisted of 96 trials. At the start of each trial, a fixation cross was presented for 1000 ms. Then, a picture of a face (displaying a neutral, positive, or negative expression) and a picture of a household object appeared in positions that were diagonal from each other for 500 ms. Then, the pictures were replaced by either an “E” or an “F.” The participants’ task was to identify

the letter by pressing the appropriate button on a response box. The participants were informed that the probe could only appear in one of the locations in which a stimulus appeared on that trial.

Bias scores were calculated based on the idea that slower reaction times on trials during which the probe replaced the household object than on trials when the probe replaced the facial image are an indication of attention to faces. Chen et al. (2002) reported that individuals with social anxiety disorder directed their attention away from facial stimuli that were positive, neutral, or negative when the stimuli were presented simultaneously with images of household objects (Chen et al., 2002). The control group did not exhibit any attentional biases.

The decision to use a symbol identification task, as opposed to a symbol location task, was made in hopes of maximizing the differences between the groups (Chen et al., 2002). The use of the symbol identification task impairs the ability of an individual to identify the probe when their attention is not directed in the area occupied by the probe. In other words, the stimulus location task can be completed using peripheral vision, while the stimulus identification task cannot. Therefore, the stimulus identification task requires more focused attention.

At first glance, these findings might appear to be in opposition to the predictions of the vigilance-avoidance hypothesis because the participants directed their attention away from neutral facial expressions that might not be considered threatening. However, one might argue that facial expressions, regardless of valence, are threatening to individuals with social anxiety disorder because they essentially fear other people. In fact, at least one functional magnetic resonance imaging (fMRI) study reported differences

between individuals diagnosed with social anxiety disorder and healthy controls with regard to amygdala activation when presented with neutral faces (Cooney, Atlas, Joormann, Eugène, & Gotlib, 2006). Therefore, it might be accurate to conclude that individuals with social anxiety disorder exhibit an attentional bias towards and/or away from (depending on the time course) facial stimuli in general, and that the bias is even greater when the facial stimulus is displaying a threatening expression.

Vassilopoulos (2005), as well as Chen et al. (2002), documented evidence of avoidance of emotional stimuli for individuals with high social anxiety at 500 ms after the onset of the stimuli. In contrast, a number of studies have reported an attentional bias towards threat at 500 ms after the onset of the stimuli. For example, Mogg, Philippot, and Bradley (2004) asked participants with social anxiety disorder and control participants with no history of psychological difficulties to participate in a computerized dot probe task. There were 160 experimental trials and each trial started with the presentation of a central fixation for 500 ms. Then, two facial stimuli were presented simultaneously. The facial stimuli were neutral, angry, or happy and appeared for either 500 or 1,250 ms. The neutral face was always presented with the emotional faces. Next, the stimuli disappeared and an arrow that pointed either up or down replaced one of the stimuli. The participants' task was to indicate, via a response box, in which direction the arrow was pointing. Attentional bias scores were calculated using response times in a way that was similar to Chen et al. (2002). The authors reported that the social anxiety disorder group exhibited an attentional bias towards threat at 500 ms, relative to the other stimuli types, but that there was no bias for the social anxiety disorder participants at 1,250 ms.

As another example, Pishyar, Harris, and Menzies (2004) asked participants with high and low levels of social anxiety to participate in two dot probe tasks. In one task, the stimuli were positive, negative, or neutral words. In the other task, the stimuli were positive, negative, or neutral facial stimuli. Each task consisted of 40 trials that started with the presentation of a fixation point for 500 ms. Next, a positive or a negative stimulus was presented simultaneously with a neutral stimulus for 500 ms. Then, a probe appeared to which the participants had to respond. Threat biases were calculated according to MacLeod and Mathews (1988). Essentially, the formulas provided in MacLeod and Mathews (1988) are based on the comparison of reaction times between trials in which the probe and the emotional face appeared in the same location and the trials in which the probe and the emotional face appeared in opposite locations. Slower reaction times to probes appearing in the location opposite of the emotional stimulus, as opposed to the stimuli appearing the same location as the emotional stimulus, would suggest a bias towards emotional stimuli. The authors reported that the high social anxiety group exhibited an attentional bias towards threat on the task that used the facial stimuli, but that no bias was present for the word task or for other emotional stimuli.

Similarly, Sposari and Rapee (2007) reported evidence of an attentional bias towards facial expressions, regardless of type of emotion displayed. In two studies, participants with social anxiety disorder and control participants engaged in a dot probe task under the threat that they would have to soon deliver a speech. The dot probe task consisted of 96 trials. Each trial started with a 1 second fixation cross. Next, the researchers presented images of household objects and facial expressions (negative, neutral, or positive) simultaneously in diagonal positions. Participants were asked to

identify a probe that replaced the stimuli 500 ms following the onset of the stimuli as either an “E” or an “F”. Bias scores were calculated and results indicated that individuals with social anxiety disorder exhibit an attentional bias towards facial expressions, regardless of the emotion displayed.

Research supporting the idea that individuals with social anxiety are vigilant for threat has been completed using methods with seemingly greater external validity. For example, Perowne and Mansell (2002) asked individuals high and low in social anxiety to give a speech while viewing an audience on a monitor who they believed to be watching them. The audience exhibited positive (e.g., leaning forward) and negative (e.g., yawning) behaviors. Following the speech, participants were shown a picture of the audience and were asked to indicate which behaviors the audience exhibited. The high social anxiety group demonstrated a bias towards noticing the negative behaviors, whereas the low social anxiety group primarily attended to the positive social behaviors. As another example, Veljaca and Rapee (1998) conducted a study in which they asked participants to give a speech in front of an audience and to indicate via a response button when they noticed an audience member engaging in negative or positive social behaviors. They found that highly socially anxious individuals detected more negative and less positive social behaviors.

In contrast to the aforementioned studies, other studies have provided evidence that some stimuli produce similar reactions across individuals, regardless of anxiety. In a visual search task, Esteves (1999) asked individuals with both high and low levels of social anxiety to examine an display containing facial stimuli to determine if a face that was not consistent with the other faces was present (e.g., an angry face among happy

faces). In general, participants more quickly identified inconsistent angry faces than inconsistent neutral or happy faces, however, no response time differences between the groups were found. Using a very similar visual search task, Fox et al. (2000) also found that individuals tend to identify inconsistent angry faces more quickly than inconsistent happy faces. Findings suggested that detection of threat is a process that receives processing priority in many individuals, including individuals with low levels of anxiety.

A number of studies have documented the existence of a vigilance for or an avoidance of threat associated with social anxiety (e.g., Vassilopoulos, 2005), but there are several inconsistencies among the studies. First, some authors reported vigilance for threat 500 ms following the onset of the threatening stimulus (Mogg, Philippot et al., 2004), whereas others reported avoidance of threat at that time for individuals with high levels of social anxiety (e.g., Vassilopoulos, 2005). Second, some authors reported that the attentional biases associated with social anxiety were specific to threatening stimuli (Pishyar et al., 2004), while some authors reported that the attentional bias associated with social anxiety was not specific to threat (Chen et al., 2002). It is important to discover the factors responsible for the variation in findings across the studies as it might influence the way in which we conceptualize the role of attention in the etiology and/or maintenance of social anxiety and have treatment implications.

### 1.3. Attention Modification-Based Treatment

As a reaction to the finding that individuals with high levels of social anxiety exhibit different patterns of attention to threat than individuals with low levels of social anxiety, and to findings that the modification of attentional patterns can affect anxiety (MacLeod, Rutherford, Campbell, Ebsworthy, & Holker, 2002; for an exception see

Harris & Menzies, 1998), a number of researchers have developed treatments for social anxiety based on the modification of attention to threat. For example, Amir et al. (2008) reported evidence of the efficacy of a treatment based on attention modification. The researchers recruited undergraduates who reported both difficulty giving speeches and a high score on a measure of social anxiety. After completing a number of questionnaires, including a measure of state anxiety, participants engaged in a computerized task designed to measure the individual's attention to threat.

The task was a modified version of the Posner paradigm (Posner, 1980) that contained 192 trials. Specifically, participants were asked to focus their attention on a cross located between two rectangles presented on a computer screen. Then, a cue word that was either neutral or threatening was presented in one of the rectangles for 600 milliseconds (ms). Next, the cue disappeared and a probe appeared in one of the two rectangles. The participant's task was to identify the location of the probe by clicking the side of the computer mouse that matched the location of the probe (e.g., the participant would click on the right side of the mouse if the probe were on the right side of the screen). In some of the trials the cue and the probe appeared in the same location (valid trials), in some of the trials the cue and the probe appeared in opposite locations (invalid trials), and in some trials, there was no cue. Previous research suggested that individuals with high levels of social anxiety disorder have slower reaction times to invalid trials following social threat cues than non-anxious control participants (e.g., Vassilopoulos, 2005). This pattern of responding has led some researchers to believe that individuals with social anxiety have difficulty disengaging their attention from threatening stimuli (e.g., Fox, Russo, & Dutton, 2002).

Following the baseline assessment of attention to threat, participants completed a computerized task that was a variation of the dot probe paradigm (MacLeod et al., 1986). During each trial of the task, participants were instructed to focus on the fixation cross that appeared in the center of the computer screen for 500 ms. Following the disappearance of the cross, two facial images were presented immediately and simultaneously. One of the stimuli appeared on the top portion of the screen, while the other appeared on the bottom portion of the screen. Stimuli were displayed on the computer screen for 500 ms. The images were replaced by either an "E" or an "F" and the task of the participants was to indentify the letter via a response on the computer mouse. For participants who were randomly assigned to the attention modification program condition, the probe always replaced the neutral face during trials in which both a neutral and a disgusted face appeared. For participants who were randomly assigned to the attention control condition, the probe replaced the neutral and disgusted facial stimuli with equal frequency during trials in which both a neutral and a disgusted face were simultaneously presented. Following the attention manipulation, the participants again completed the task designed to measure their attention to threat, as well as a measure of state social anxiety. Participants then delivered an impromptu speech that lasted up to five minutes and, finally, completed a measure of state social anxiety. The speeches were videotaped and rated for quality by judges who were blind to condition.

Evidence from this study is consistent with the idea that attention modification affects anxiety symptoms. The participants in the attention modification program condition exhibited less attention to threat in the second assessment of attention to threat,

reported less anxiety concerning the speech, and gave better speeches than the individuals in the attention control condition.

Similarly, Li et al. (2008) reported a greater reduction in some self-reported social anxiety symptoms and a reduction in the attentional bias towards threat for individuals who completed attention training over the course of seven days, as opposed to individuals who completed a control task. All participants reported high levels of social anxiety prior to the study. The attention training modified the attention of participants using a version of the dot probe paradigm by creating a contingency between the location of the cues and the probe. In particular, the probe always appeared in the location formerly occupied by the happy face, as opposed to the threatening face, during trials in which both types of facial stimuli were presented. There was no contingency between type of facial stimuli and the location of the probe in the attention task completed by the control group.

Finally, Schmidt et al. (2009) reported results similar to Amir et al. (2008) and Li et al. (2008) using participants with a social anxiety disorder diagnosis. Furthermore, their follow-up reports indicated that the benefits of the attention training were still present four months after the attention manipulation. The effectiveness of the treatments based on attention modification supports the assertion that individuals with high levels of social anxiety exhibit attention to threat patterns that differ from the patterns those individuals with low levels of social anxiety exhibit.

Based on the aforementioned studies, it appears as though treatments for social anxiety based on attention modification are efficacious. Evidence for the efficacy of attention modification based treatments for social anxiety underscores the need to better understand which variables influence attention to threat in social anxiety. This type of

knowledge is necessary for the refinement of therapeutic techniques. Toward that end, the relative influence of state and trait anxiety on attentional patterns should be better understood. As will be discussed below, there is some suggestion that state and trait social anxiety differentially influence attention to threat (Rutherford et al., 2004).

### 1.4. State versus Trait Anxiety

Although most studies of attention to threat are primarily interested in patterns of attention exhibited by individuals with high and low trait anxiety, state anxiety appears to be an important variable with the potential to influence the nature of attentional processes. This is consistent with the model of anxiety proposed by Mathews and Mackintosh (1998). There are a number of studies that attempt to increase state social anxiety to explore patterns of attention to threat. The methods and conclusions of some of these studies are presented below, with an emphasis on those studies that manipulate state social anxiety to create high and low state anxiety groups.

One common method of inducing state social anxiety is by informing the participant that they will be asked to give a speech. At least six studies of social anxiety and attention to threat have examined patterns of attention in the presence and the absence of a speech threat. For example, Mansell, Ehlers, Clark, and Chen (2002) presented individuals with varying levels of social anxiety with positive and negative social-evaluative words in a dot probe task either under conditions of a speech threat or in the absence of a speech threat. Each trial started with the presentation of a fixation cross for 500 ms. Next, an emotional word was presented simultaneously with a neutral word for 500 ms. Following the disappearance of the stimuli, either an “E” or an “F” replaced one of the stimuli and the participants’ task was to identify the letter. Bias scores were

calculated according to MacLeod et al. (1986). Participants in the speech threat condition exhibited less avoidance of emotional stimuli than individuals in the no speech condition. The high trait social anxiety showed a bias towards attention to negative stimuli. No such bias was exhibited by the low trait social anxiety group.

Similarly, Pineles and Mineka (2005) asked individuals with high and low levels of social anxiety in the presence or absence of a social threat to view pairs of facial stimuli in a dot probe task.[1] At the start of each of the trials, a fixation cross was presented for 500 ms. Then, two faces were presented simultaneously for 500 ms. The face pairs were either neutral-happy, neutral-threat, or happy-threat. Following the disappearance of the facial stimuli, a probe appeared and the task of the participant was to indicate the location of the probe via pressing one of two buttons on a response box. There was no significant evidence of group differences with respect to attentional biases, but there was a trend for a bias towards threat in the high social anxiety and social threat condition only.

Using a somewhat different methodology, Lee and Telch (2008) produced results consistent with Pineles and Mineka (2005), as well as Mansell at al. (2002). Researchers asked individuals with high and low levels of social anxiety to participate in an attention task either in the presence or absence of a social threat. On some trials of the task, unexpected stimuli were presented, including happy and frowning facial expressions. Participants were probed following the task concerning these stimuli. Under conditions of social threat, highly socially anxious individuals were more likely to report seeing

[1] Note: Some trials included the presentation of a visual representation of either a sound wave or false heart-rate feedback. The conclusions regarding those trials are beyond the scope of the paper and will not be discussed

frowning faces than happy faces, while the opposite was true for individuals with low levels of social anxiety.

Similarly, Ononaiye, Turpin, and Reidy (2007) found evidence of attention to threat under the threat of a speech task. In their study, participants with high and low trait social anxiety completed a dot probe task. In addition, half of the participants were informed that they would be giving a speech that would be evaluated later by professionals. Each of the 96 trials of the dot probe task began with a fixation cross presented for 500 ms. Next, a neutral and a threatening word were presented simultaneously for 14 ms. A mask (e.g., XXXX) appeared for the subsequent 486 ms. Results indicate that highly socially anxious individuals exhibited an attentional bias towards masked threat (i.e., words relevant to physical threat) when threatened with a speech task. Low socially anxious individuals did not exhibit this bias.

The results of this study are somewhat puzzling considering evidence that attention to threat should be specific to the nature of one's anxiety (Hope, Rapee, Heimberg, & Dombeck, 1990; Mogg, Mathews, & Eysenck, 1992). In other words, individuals with high social anxiety should differ from low socially anxiety individuals with respect to their attention to stimuli associated with the potential for negative evaluation (e.g., facial stimuli, social-evaluative words) only. There is a possibility that the exaggerated attention to physical threat words was only apparent because the participants were all students obtaining health-related degrees and, therefore, the physical threat words were extremely salient to them.

As an another example of the importance of state social anxiety, Mansell et al. (2002) found evidence of a greater bias towards threat for people who were anticipating

giving a speech than for people who were not. Individuals with high and low trait anxiety were recruited for their study of attention to threat. Prior to the completion of a dot probe task, half of the participants were informed that they would have to give a speech that would be recorded and evaluated by psychologists. Each participant completed 64 trials of a dot probe task. On each trial of the dot probe task, a fixation cross was presented for 500 ms. Next, a neutral word paired with either a positive or a negative social-evaluative word was presented for 500 ms. Then, an "E" or an "F" was presented and the participants' task was to identify the letter as quickly as possible without sacrificing accuracy. Bias scores were calculated according to MacLeod et al. (1986). There was no evidence of an attentional bias in the high social anxiety group. However, participants who were expecting to give a speech exhibited a greater bias towards threat than the participants who did not expect to give a speech.

Mansell, Clark, Ehlers, and Chen (1999) reported contradictory results. They asked participants with high and low levels of trait social anxiety to complete the same task with the same stimuli as Chen et al. (2002), however, they manipulated state anxiety by informing half of the participants that they would have to make a speech that would be evaluated by the research assistant as well as a professional. Their results are partially consistent with Chen et al. (2002) because they found an attentional bias away from emotional faces for the high trait social anxiety group, however, the attentional bias away from emotional faces was only present in the speech condition.

Some studies have reported that individuals with high social anxiety exhibit a specific vigilance for threat, while others have reported evidence for vigilance for emotional stimuli in general. There is some evidence that trait social anxiety influences

attention to threat, whereas state social anxiety influences attention to emotional stimuli (e.g., Mansell et al., 2002). Rutherford et al. (2004) provided a direct test of this hypothesis.

Participants in the Rutherford et al. (2004) study engaged in an emotional Stroop task. During the emotional Stroop task, participants were presented with emotional (positive or negative) or neutral words written in varying colors of ink over 384 trials. The participant's task was to name the ink color. The task works on the assumption that word naming, but not color naming, is an automatic process (Chajut & Algom, 2003). Emotional Stroop interference occurs when the individual's response time is greater when asked to report an emotional word than when asked to indicate the neutral word, presumably due to interference created from the emotional word.

Participants were grouped into high and low trait anxiety and were tested twice. Testing occurred in both a time period far away from an examination and a time period close to an examination. Results supported the hypothesis that high trait anxiety individuals would show greater Stroop interference when naming negative, as opposed to positive words, in comparison to low trait anxiety individuals. Also in support of the study's hypothesis, individuals exhibited a greater Stroop interference for emotional words, as compared to control words, when examinations were close. Results suggested that trait social anxiety influences attention to threat, whereas state social anxiety influences attention to emotional stimuli.

Some researchers have suggested that both trait and state anxiety contribute to the development of patterns of attention to threat. According to Mathews and Mackintosh (1998), increases in state anxiety should improve an individual's ability to detect threat.

Consistent with that assertion, an attentional bias towards threat appears to be more reliably present in studies in which efforts have been made to increase the state anxiety of the participants (e.g., Lee & Telch, 2008), although avoidance of threat under conditions of elevated social anxiety have also been reported (Mansell et al., 1999).

Furthermore, recent evidence suggests that attentional patterns of individuals do not predict anxiety levels, unless there is a threat present. For example, in a recent study (Klumpp & Amir, 2010), socially anxious participants were randomly assigned to engage in one of three attention training tasks to manipulate attention a) towards threat, b) away from threat, or c) towards threat and neutral with equal frequency (control). Following attention training, anxiety levels did not differ between training groups. However, following training, participants completed a speech task. Participants who were trained to attend to threat or away from threat reported less anxiety than participants in the control condition at post-speech. In other words, attentional patterns predicted anxiety in the presence of, but not in the absence of, a threat. Finally, there is evidence that trait social anxiety influenced attention to threat, whereas state social anxiety influenced attention to emotional stimuli.

### 1.5. Negative Affect

Although anxiety is often believed to cause patterns of attention to threat, it is important to determine whether the effects concerning attention to threat are specific to anxiety or if they can be caused by another factor related to anxiety. One potential alternative explanation for the attention to threat patterns observed in high anxiety individuals is that negative affect, and not anxiety per se, causes biased attention to threat. Although there is evidence that negative affect influences patterns of attention to

emotional stimuli, generally, research supports the notion that anxiety affects attention to threat specifically, even after controlling for negative affect.

Some studies show a relationship between negative affect and attention to dysphoric, but not threatening, stimuli. To demonstrate the relationship between negative affect and attention to emotional stimuli, Kellough, Beevers, Ellis, and Wells (2008) recruited young adults who were either experiencing a major depressive episode, or reported no history of a major depressive episode to participate in an eye tracking task. The task involved viewing the simultaneous presentation of a dysphoric, a threatening, a neutral, and a positive stimulus for 30 seconds. The location of the participant's gaze was tracked continuously using the eye tracking equipment. Depressed participants spent more time examining the dysphoric, and less time examining the positive, stimuli than the non-depressed participants. There were no differences between the groups regarding time spent examining threatening stimuli.

Gotlib, Krasnoperova, Neubauer Yue, and Joormann (2004) provided evidence that depressed individuals exhibit an attentional bias towards dysphoric, but not threatening, stimuli. The researchers recruited participants who were diagnosed as having major depressive disorder or generalized anxiety disorder (GAD), or who were healthy controls. In a variation of the dot probe task, researchers presented participants with a fixation cross for 500 ms followed by pairs of faces for 1,000 ms. One face was always neutral, while the other face was sad, happy, or angry. Next, a target stimulus appeared on either the left or right side of the computer screen (replacing one of the facial stimuli). The participants' task was to indicate via a keyboard response the location of the dot.

Depressed participants exhibited a bias towards sadness, but no other biases were found either within the depressed group or the GAD group.

In contrast to the aforementioned studies, Mathews, Ridgeway, and Williamson (1996) provided evidence that depressed individuals exhibit an attentional bias towards threat. Depressed and anxious individuals (with either a generalized anxiety disorder or panic disorder with or without agoraphobia) participated in a modified version of the dot probe task. During the task, participants were presented simultaneously with two words. One of the words was always neutral and the other was always threatening (physically or socially). Depressed individuals exhibited a bias towards the socially threatening words, whereas anxious individuals only exhibited a bias for physically threatening words. Although the results might seem surprising, it is important to note that the study did not control for the high co-morbidity between anxious and depressive symptoms (Chartier et al., 2003). Therefore, it is difficult to know whether the attention towards threat exhibited by the depressed participants was due to depressive symptoms per se, or to concurrent anxious symptoms.

As evidence that attention to threat is associated with anxiety per se, and not negative affect, a number of studies have controlled for negative affect either statistically or by not allowing individuals with high levels of negative affect to participate in their study. For example, Bradley et al. (1998) asked participants with high and low levels of trait anxiety to complete a dot probe task with 128 trials. Each trials started with a fixation cross for 500 ms, followed by the simultaneous presentation of a neutral and either a happy or a threatening facial expression for 500 ms or 1250 ms. Next, a probe appeared in a location formerly occupied by one of the stimuli and the participants' task

was to indicate which type of probe appeared (i.e., : or ..). Bias scores were calculated by finding the difference between the reaction times when the emotional cue and probe were in opposite locations and the reaction times when the cue and the probe were in the same location. Results revealed that, when the effects of depression are accounted for, the high trait anxious group exhibited a bias towards threatening, but not emotional, faces in the 500 ms condition. In addition, it appeared that people with high levels of depression avoided happy faces, whereas individuals with low levels of depression attended to happy faces.

Although there are some inconsistencies in the literature concerning negative affect and attention to threat, most research supports the notion that negative affect influences attention to dysphoric, but not threatening, stimuli. Evidence for this assertion derives from studies using populations that differ with regards to anxiety and depressive symptoms, as well as from studies that control statistically for negative affect.

1.6. Facilitated Detection or Difficulty with Disengagement?

There has been debate concerning whether the patterns of attention to threat associated with social anxiety are attributable to facilitated detection of threat or with difficulty disengaging from that threat. Some theoretical conceptualizations of the association between anxiety and attention to threat suggest that anxiety should facilitate attention to threat, but the empirical evidence is mixed with regard to this question. Relevant studies are presented below.

All of the previously reviewed models of attention and anxiety suggest that anxiety should facilitate the detection of threat. Evidence from visual search tasks in which participants must find a target stimulus among non-target stimuli provide evidence

that there is a facilitated detection of threat associated with anxiety. If a participant is quicker to find a threatening target than a non-threatening target, then facilitated attention to threat is assumed. For example, Juth et al. (2005) found that participants were the most effective at detecting threatening facial stimuli among other facial stimuli if they were high in social anxiety and under conditions of social threat. As another example, Veljaca and Rapee (1998) conducted a study in which they asked participants to give a speech in front of an audience and to indicate via a response button when they noticed an audience member engaging in negative (e.g., yawning) or positive (e.g., leaning forward) social behaviors. They found that highly socially anxious individuals detected more negative and less positive social behaviors. Despite the evidence for an association between threat detection abilities and anxiety, a number of researchers using visual search tasks have reported that facilitated detection of threat is not specific to individuals with high levels of anxiety (e.g., Esteves, 1999).

Evidence from emotional cuing tasks suggests that individuals with high trait social anxiety have difficulty disengaging from threatening stimuli. Typically, in an emotional cueing task, which is a variation of the Posner paradigm (Posner, 1980), an emotional (e.g., a social threat word) or a neutral cue (e.g., a neutral word) appears. Then, the cue disappears and a probe that the participant must identify appears either in the same area as (valid) or in a different area than (invalid) the cue. Responses to invalid trials require attentional disengagement followed by a subsequent attentional shift, whereas valid trials do not. Many studies have found that, when presented with an invalid probe following a threatening stimulus, participants with high levels of anxiety were slower to respond to the probe than controls (Amir, et al., 2003) and that this slowing was

not present on valid trials during which threatening stimuli were presented (Fox et al., 2002). This information suggests that the anxious individual experiences difficulty shifting their attention away from the threatening stimulus.

In an eye tracking task, Buckner, Maner, and Schmidt (2010) concluded that individuals with high social anxiety have difficulty disengaging their visual attention from negative, but not positive, facial expressions. A non-clinical sample of participants with varying levels of trait social anxiety (oversampled for high levels of trait social anxiety) participated in an eye tracking task. Each trial of the task had a duration of 2,000 ms and contained four stimuli. On critical trials, one of the stimuli was a happy or disgusted facial photograph along with three non-social stimuli matched for valence, threat, and arousal. Filler trials contained four non-social stimuli. Eye movements were tracked throughout the trials. Participants with high trait social anxiety were slower than low trait social anxiety participants to disengage from negative facial stimuli, but not positive facial expressions.

There is evidence that both facilitated detection to threat and difficulty with disengagement might be involved in the creation of attention to threat patterns associated with social anxiety. It is possible that both processes are important, but that one process is more salient than the other, depending on the nature of the task.

### 1.7. Methodological Considerations

As can be seen in the empirical findings section of the current literature review, the exact nature of the patterns of attention to threat exhibited by individuals with high levels of anxiety is unclear. Gaps in the extant literature on anxiety and attention to threat might be partially the result of deficiencies in commonly used methods to study attention

to threat. A variety of methodologies have been used to assess attention to threat, however, the majority of studies have used indirect measures of attention such as the emotional Stroop task, or a variation of the dot-probe task (Bögels & Mansell, 2004). Both of these methods rely on reaction times to make inferences about attention. Undoubtedly, the use of more direct measures of oculomotor behavior will improve our knowledge of attention to threat.

During the emotional Stroop task, participants are presented with emotional or neutral words written in varying colors of ink. The participants' task typically is to name the ink color. The task operates on the assumption that word naming, but not color naming, is an automatic process (Chajut & Algom, 2003). Emotional Stroop interference occurs when the individual's response time is greater when asked to report an emotional word than when asked to indicate the neutral word. Although the emotional Stroop task has increased our knowledge of attention to threat in social anxiety (e.g., Amir, Freshman, & Foa, 2002), it is unclear whether the emotional Stroop effect is assessing attention to threat, or other processes, such as cognitive avoidance (Bögels & Mansell, 2004). Therefore, conclusions drawn from studies using an emotional Stroop task should be questioned with these limitations in mind.

MacLeod et al. (1986) developed the dot probe task as a measure of attention to threat. There are many variations of this task, but, in general, participants are asked to focus their attention in the center of a computer screen until two stimuli appear (typically one is threatening and the other is neutral). Next, the stimuli disappear and a probe appears in place of one of the stimuli. Typically, the participant indicates either on which side of the screen the probe is or to identify the probe in some way (e.g., is it an "E" or an

"F?"). Theoretically, individuals should be quicker to respond to probes replacing the pictures to which they were attending than probes replacing the non-attended stimuli. Therefore, reaction times are used as indicators of location of attention. Undoubtedly, the dot probe task has been useful for the study of attention to threat in social anxiety (e.g., Amir et al., 2003), however, the dot probe task is an indirect measure of attention and does not allow the researcher to assess the location of attention moment to moment.

As a result of the indirect nature of the emotional Stroop task and the dot probe task, as well as the necessity for these assessments to occur in a laboratory setting, external and ecological validity are limited by the use of these methods. Eye tracking technology can circumvent these limitations in at least two ways. First, eye tracking allows for a more direct assessment of visual attention patterns as it allows researchers to determine the focus of visual attention from moment to moment. Second, ambulatory eye tracking allows the researcher to monitor attentional patterns of participants in "real-world" settings. Therefore, the information gained from eye tracking methods would be an important addition to the knowledge of the vigilance-avoidance pattern of attention associated with social anxiety because of the improvement in both external and ecological validity.

Currently, there are only a handful of published studies that utilize eye tracking technology in the study of visual attention to threat and anxiety (e.g., Armstrong, Olatunji, Sarawgi, & Simmons, 2010; Buckner et al., 2010; Kimble, Fleming, Bandy, Kim, & Zambetti, 2010; Mogg, Garner, & Bradley, 2007; Rinck & Becker, 2006; Rohner, 2002). A recent study highlighted an advantage of eye tracker technology not previously mentioned. Wieser, Pauli, Alpers, and Muhlberger (2009) monitored the eye

movements of women with high, medium, and low levels of social anxiety in response to an animated video of faces providing either direct or averted gazes. Results suggested that women with high levels of social anxiety fixate longer on the eye region of other individuals than women with low or medium levels of anxiety. Eye tracker technology allows for researchers to assess attention to pre-determined points of interest, such as particular areas of the facial stimuli, as opposed to less specific areas.

Eye tracking has the potential to greatly improve research in the area as it provides the opportunity to assess directly the location of visual attention and its time course. Indirect measures of attention (e.g., the dot-probe task or the Stroop task) have been useful for answering questions concerning attention to threat. However, due to the indirect nature of these assessments, construct validity is limited. Eye tracking allows for a more direct assessment of oculomotor behavior (i.e., eye movements including avoidance) as it permits the determination of the focus of visual attention from moment to moment.

## CHAPTER 2: PURPOSE OF DISSERTATION STUDY

Social anxiety causes significant impairment (Katzelnick et al., 2001; Schneier et al., 1994) for a large number of individuals (Kessler et al., 2005). There is some evidence that treatments based on the modification of attention to threat can reduce symptoms of social anxiety (e.g., Amir et al., 2008), however, the efficacy of those treatments would likely be improved if some of the inconsistencies in the literature were resolved. There are a number of inconsistencies. For example, the nature of the attentional patterns associated with social anxiety in the presence of threat is not clear. In other words, some studies presented evidence of vigilance (Chen et al., 2002); whereas others reported

evidence of avoidance of emotional stimuli (Mansell et al., 1999) and others reported the absence of any patterns associated with anxiety (Esteves, 1999). Also, there is some evidence that trait social anxiety influences attention to threat, whereas state social anxiety influences attention to emotional stimuli more generally (e.g., Mansell et al., 2002; Rutherford et al., 2004), but there are not many studies that directly test this hypothesis. Also, research should be conducted to clarify the differential effects of state and trait anxiety on patterns of attention to threat and emotional stimuli. Similarly, more research should be conducted to clarify the unique influences of negative affect and anxiety on patterns of attention to threat. Finally, the cognitive processes responsible for the observed attention patterns are unclear, partially because commonly used methods of assessing attention indirectly assess attention and confound other attentional processes with attention. It is possible that anxiety facilitates attention to threat, or it is possible that it impedes attentional disengagement. The purpose of the current study was to address some of the limitations of the attention to threat literature using a method that allows for the direct assessment of attention.

## CHAPTER 3: HYPOTHESES

Consistent with both conceptual models of anxiety (e.g., Barlow, 2000; Mathews & Mackintosh, 1998), as well as a number of empirical investigations (e.g., Mogg, Bradley, et al., 2004; Vassilopoulos, 2005), it was hypothesized that the current empirical investigation would find evidence of biased processing of threat in individuals with elevated levels of social anxiety. The specific hypotheses are presented below.

### 3.1. Testing the Vigilance-Avoidance Hypothesis

#### 3.1a. Fixation Time

In light of the evidence supporting the vigilance-avoidance hypothesis (e.g., Vassilopoulos, 2005) and the theoretical importance of anxiety for the facilitated detection of threat (e.g., Barlow, 2000), it was hypothesized that individuals in the high trait social anxiety group would fixate more quickly on threatening stimuli than individuals in the low trait social anxiety group, after controlling for the effects of negative affect, and regardless of the presence or absence of a social-evaluative threat.

#### 3.1b. Run Count

It was hypothesized that individuals in the high trait social anxiety group would return their attention more frequently to threatening stimuli than individuals in the low trait social anxiety group when first presented with threat, but that they would subsequently return their attention less frequently after controlling for the effects of negative affect and regardless of the presence or absence of a social-evaluative threat.

#### 1c. First Run Dwell Time

It was hypothesized that individuals in the high trait social anxiety group would spend more time examining threatening stimuli when initially presented with threatening stimuli than individuals in the low trait social anxiety group, but that they would subsequently spend less time examining the threatening stimuli, after controlling for the effects of negative affect and regardless of the presence or absence of a social-evaluative threat.

### 3.2. State Anxiety and Emotional Stimuli

There is some evidence that trait social anxiety influences attention to threat, whereas state social anxiety influences attention to emotional stimuli (e.g., Rutherford et al., 2004). Multiple studies have documented the existence of an attentional bias towards emotional stimuli for individuals with high levels of state anxiety when they are first presented with the stimuli (e.g., Mansell et al., 2002). Therefore, it was hypothesized that individuals in the high state anxiety group would fixate more quickly than individuals in the low state anxiety group on emotional stimuli (i.e., threatening or happy), after controlling for the effects of negative affect and regardless of their trait social anxiety.

### 3.3. Difficulty with Disengagement

Research indicates that the observed attentional biases towards threat observed on dot probe tasks for individuals with high levels of trait social anxiety might be a result of difficulty disengaging attention from threatening stimuli (e.g., Fox et al., 2002). It was hypothesized that individuals with high trait social anxiety would spend more time attending to threatening stimuli following their first fixation on the threatening stimuli before viewing the other stimuli than individuals in the low trait social anxiety group, after controlling for negative affect and regardless of the presence or absence of social-evaluative threat.

## CHAPTER 4: METHOD

### 4.1 Participants

Eight hundred and thirty-five participants were recruited from the University of Nebraska's (UNL) undergraduate psychology pool to participate in a mass testing that included the Brief Fear of Negative Evaluation (BFNE; described in the Measures

section). The UNL undergraduate psychology pool primarily consisted of students in the Introduction to Psychology classes, although other undergraduate psychology classes were represented as well.

Participants completed the BFNE in either the spring (n = 764) or summer (n = 71) semester. Approximately half of the participants in the spring (49.48%) and 66.70% of the participants in the summer were women. Table 4.1 includes descriptive statistics for the BFNE completed during mass testing for each gender by semester.

Participants with high and low social anxiety, as measured by the BFNE, were recruited for participation in the second phase of the study. High social anxiety men and women scored at or above 42 and 45, respectively, whereas low social anxiety men and women scored at or below 31 and 34, respectively. The cut-off scores were determined by the highest and lowest quartiles of scores in the spring mass testing for each gender. In cases in which the gender of the mass testing participant was unknown, the participant was invited to participate in the second phase of the study given that their score on the BFNE met criteria for inclusion in the second phase of the study, regardless of gender. The decision to use a non-clinical sample was made for pragmatic reasons. The use of a non-clinical sample does not appear to be problematic as non-clinical samples have been used in the past to study attention to threat (e.g., Bradley et al., 1998), facilitating the comparison between the results of the proposed studies and prior studies.

In addition, preliminary data analysis of a recent study of attention to threat at UNL suggests that the variability in social anxiety in our undergraduate samples is sufficient and predicts attention to threat. Furthermore, the Rapee and Heimberg (1997) model suggests that the experience of transient anxiety and social anxiety disorder differ

Table 4.1: Descriptive statistics for the mass testing BFNE scores for each gender by semester

| Semester | Gender | M | SD | Range | N |
|---|---|---|---|---|---|
| Spring | Men | 36.66 | 9.15 | 16-60 | 364 |
| | Women | 38.76 | 8.99 | 16-60 | 378 |
| | Unknown Gender | 37.14 | 8.48 | 24-51 | 22 |
| | Total | 37.72 | 9.10 | 16-60 | 764 |
| Summer | Men | 37.17 | 8.18 | 21-53 | 23 |
| | Women | 32.54 | 8.90 | 15-52 | 48 |
| | Unknown Gender | NA | NA | NA | 0 |
| | Total | 34.04 | 8.89 | 15-53 | 71 |
| Combined | Men | 36.69 | 9.09 | 16-60 | 387 |
| | Women | 38.06 | 9.19 | 15-60 | 426 |
| | Unknown Gender | 37.14 | 8.48 | 24-51 | 22 |
| | Total | 37.4 | 9.14 | 15-60 | 835 |

Note: BFNE = Brief Fear of Negative Evaluation

quantitatively, not qualitatively, making it possible that the results of the proposed research would be relevant for individuals who suffer from social anxiety disorder. Finally, meta-analytic evidence suggests that the effect size associated with threat-related attentional biases does not differ significantly between participants diagnosed with an

anxiety disorder and high anxiety, non-clinical participants (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007).

Ninety-one individuals participated in the second phase of the study. Approximately half of the participants in the second phase of the study were women (52.70%). The majority of participants (84.62%) identified as "White," seven participants (7.69%) identified as "Hispanic," one participant (1.10%) identified as "Asian," one participant (1.10%) identified as "African-American," and five participants (5.49%) identified themselves as "Other." The average age of participants was 20.40 (*SD* = 3.27). Table 4.2 provides univariate statistics for the mass testing BFNE scores of the participants by anxiety group and gender.

4.2. Measures

4.2a. The Brief Fear of Negative Evaluation Scale

The Brief Fear of Negative Evaluation Scale (BFNE; Leary, 1983) served as the primary measure of trait social anxiety. The BFNE is a 12-item measure of the extent to which the participant worries that others have an unfavorable view of the participant. Respondents are asked to rate how characteristic of them each item is on a scale ranging from 1 (Not at all characteristic of me) to 5 (Extremely characteristic of me).

The scale demonstrates good internal consistency and is correlated in expected ways with measures of loneliness and depression (Duke, Krishnan, Faith, & Storch, 2006), though some analyses suggest that the reversed scored items are not as related to theoretically similar constructs as the non-reversed scored items (Rodebaugh et al., 2004; Weeks et al., 2005). Internal consistency was high in the current study (coefficient $\alpha$ = .95).

Table 4.2: Descriptive statistics for the mass testing BFNE scores for each anxiety group in phase two by gender

| Social Anxiety | Gender | BFNE | | | |
|---|---|---|---|---|---|
| | | M | SD | Range | N |
| High | Men | 49.05 | 5.06 | 43-60 | 20 |
| | Women | 51.30 | 4.82 | 45-60 | 20 |
| | Total | 50.18 | 5.01 | 43-60 | 40 |
| Low | Men | 23.87 | 3.82 | 17-31 | 23 |
| | Women | 27.46 | 3.49 | 20-33 | 28 |
| | Total | 25.84 | 4.03 | 17-33 | 51 |
| Total | Men | 35.58 | 13.44 | 17-60 | 43 |
| | Women | 37.40 | 12.55 | 20-60 | 48 |
| | Total | 36.54 | 12.94 | 17-60 | 91 |

Note: BFNE = Brief Fear of Negative Evaluation

Although not explicitly designed as a measure of social anxiety, per se, the BFNE was chosen as the trait social anxiety for the current studies for two reasons. First, fear of negative evaluation appears to be a core feature of social anxiety. Second, the BFNE does not tap into fear of specific social situations, which is important given that the task in Study 1 has no social context. In a psychometric assessment of the BFNE when used with a clinical population, Collins, Westra, Dozois, and Stewart (2005) reported evidence of the measure's construct, convergent, and discriminant validity. Specifically, they

indicated that the measure could differentiate between individuals diagnosed with social phobia and panic disorder and that changes in social anxiety symptoms tended to parallel changes in the individual's score on the measure. Furthermore, they reported that the measure correlated with measures of social avoidance and depression, but not with agoraphobic avoidance and demographic variables, in a sample of individuals with either social phobia or panic disorder. Finally, results of their study suggested that the measure has good inter-item reliability as well as two week test-retest reliability.

4.2b. Personal Report of Confidence as a Speaker

The Personal Report of Confidence as a Speaker (PRCS; Paul, 1966) is a commonly used measure of public speaking anxiety. The measure consists of 30 items pertaining to thoughts, feelings, and perceptions before, during, and after a speech. Respondents indicate whether each item is "true" or "false" and higher scores reflect greater anxiety. Although the scale was published over 40 years ago, more recently published normative data are available (Phillips, Jones, Rieger, & Snell, 1997). In addition, there is evidence that the scale is internally consistent (Klorman, Weerts, Hastings, Melamed, & Lang, 1974) and valid (Lombardo, 1988). Internal consistency was high in the current study (coefficient $\alpha = .93$).

4.2c. Positive and Negative Affect Schedule

The Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) is a commonly used measure of affect that consists of a 10-question scale that measures positive affect (PA) and another 10-question scale that measures negative affect (NA). Each item consists of an adjective and the participant must rate how much they typically feel this way, on a scale from 1 (very slightly or not at all) to 5 (extremely). The

scales of the PANAS have demonstrated good internal consistency and appropriate correlations with measures of anxiety and depression (Crawford & Henry, 2004). The current study used the PANAS-NA only as a measure of negative affect. Internal consistency was high in the current study (coefficient α = .86).

4.2d. State-Trait Anxiety Inventory

The State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1970) is a self-report measure of anxiety symptoms. It contains two scales: the trait scale and the state scale. The trait scale was not used in the proposed study. The state scale measures the current intensity of anxiety symptoms. It contains 20 statements describing anxious or non-anxious feelings such as, "I am tense." Examinees rate on a scale ranging from 1 to 4 the degree to which they agree with the statement at the moment, with 1 being "not at all" and 4 being "very much so."

Barnes, Harp, and Jung (2002) examined the reported internal consistency reliability coefficients for over 50 research articles that used the STAI. They determined that, on average, the state anxiety scale had an internal consistency reliability coefficient of .91. Internal consistency was high in the current study (coefficient α = .92 and .96 for the first and second administrations, respectively). Also, using seven research articles that reported test-retest reliabilities for the trait and state anxiety scales, Barnes et al. (2002) determined that the average test-retest reliability of the state scale is .70. In addition, Metzger (1976) reported evidence of the validity of the scales, as well as appropriate test-retest reliabilities for both the state (.45) and trait (.97) when there were 21 days between tests. Similarly, Rule and Traver (1983) reported a two-week test-retest reliability coefficient of .40 for the state scale. Also, Rule and Traver (1983) provided evidence of

the validity of the state scale that is relevant in the current study. They reported that the state scores increased significantly from baseline when the participants were presented with a social anxiety provoking situation.

4.3. Equipment

The SR Research EyeLink II, a second-generation, video based eye tracking system that allows researchers to assess visual attention from moment to moment, was utilized in the proposed studies. The system includes three small cameras that are mounted on a headband that the participant wears. One camera is directed at each eye and the third collects information about the environment. Essentially, after an initial calibration, the system can determine the location of an individual's gaze either on a computer screen, or outside of the laboratory (through the utilization of one of the head-mounted cameras).

The system collects eye movement data at a sampling rate of 500 Hz (500 samples per second) with a 3 ms lag time and has an average gaze position error of less than 0.5°. The system is light weight, has a relatively easy set-up, and can be used when participants wear most eye glasses and contacts. The system has the capability to track both the left and right eye. It should be noted that the EyeLink II occasionally is unable to track both eyes, in which case one eye is chosen for tracking. Consistent with prior research in our lab, the EyeLink II was unable to track the eye movements in a small percentage of the participants in the current study (i.e., less that 10%).

The EyeLink II provided information on a variety of variables, including the frequency and duration of fixations in predetermined locations, and eye movement kinematics (e.g., how quickly a given eye movement occurred). For the purposes of this

study, a fixation occurs when the eye is relatively stationary (i.e., is moving less than 30º per second) for at least 100 ms.

Eye tracking has an advantage over many other measures of attention, such as dot probe tasks, as it can more directly assess the pattern of oculomotor behavior in the presence of threat, including avoidance behavior. In addition, the portability of video based eye tracking systems allows researchers to collect data about attentional processes outside of the laboratory environment. Finally, the EyeLink II can ensure that the participant's gaze is directly centered between the stimuli prior to each trial so as to decrease the likelihood that either of the stimuli is more likely to be viewed on each trial.

4.4. Stimuli

The facial stimuli came from the NimStim face stimulus set. The NimStim stimulus set was provided by the Research Network on Early Experience and Brain Development. The stimulus set contains facial stimuli from men and women from a variety of ethnic backgrounds displaying expressions of fear, happiness, sadness, anger, surprise, calm, neutrality, and disgust that were derived by asking drama students to express the aforementioned emotions and photographing the results. Research results indicated that, in general, untrained individuals can reliably identify the intended emotions in the stimulus set and that there is high agreement among participants concerning the identification of the emotional expressions (Tottenham et al., 2009). Each trial of the experimental task involved the presentation of two facial stimuli. Each trial contained one of the following pairs: neutral-angry, neutral-happy, or angry-happy.

Many studies of attention to threat simultaneously present a threatening and a neutral stimulus (e.g., Fox, 1996), however, in order to determine the specificity of the

information processing bias, a number of researchers have included trials that contain threatening, neutral, happy, or sad stimuli (e.g., Bradley et al., 1998, 1997; Buckner et al., 2010; Georgiou et al. 2005). It appears as though trait social anxiety predicts attention to threat, whereas state social anxiety predicts attention to emotions (Rutherford et al., 2004). Given the evidence that even non-threatening emotional stimuli differentially affect attentional patterns of high and low anxious individuals, the current study included neutral-angry, neutral-happy, and angry-happy stimuli pairs. This procedure helped to distinguish between the effects of emotional valence and threat per se on attentional patterns.

4.5. Procedure

Participants were recruited based on their scores on the BFNE administered during a mass testing session. Specifically, the BFNE scores of all mass testing participants were calculated and participants whose scores fell in the highest and lowest quartiles of their gender were invited to participate via an email.

4.5a. Informed Consent

Prior to engaging in the procedures of the proposed study, participants were provided with an informed consent form to read. Participants were instructed not to sign the form until the researcher or the research assistant reviewed the procedures with them, and any questions they had were addressed. Then, they were asked to sign the form if they wished to participate. Participants were assured that their participation would remain confidential, and that they were free to withdraw their participation at any point without penalty. In addition, participants were informed that there was a possibility that they would be asked to deliver a speech. The signing of the informed consent form occurred in

a room with a podium facing a set of chairs and a video camera with the intention of increasing the likelihood that the participants believed that they would have to deliver a speech if assigned to the speech condition.

4.5b. Data Collection Procedures

Participants were scheduled up to two at a time. Following the informed consent procedures, participants completed the state version of the STAI.

Next, participants were randomly assigned to either the speech or the no speech condition using a block randomization procedure. Specifically, for each pair of participants (A and B), a coin flip determined the condition assignment of Participant A and Participant B was assigned to the other condition.

Participants assigned to the speech condition and were told the following:

> *You have been assigned to the speech condition. Following a computer task, we will assess "your social skills and public speaking ability. In a while I am going to ask you to make a speech on a controversial topic. This video camera is going to record you so that later some expert psychologists can make ratings of your ability. Now, I won't be giving you the topic of the speech until thirty seconds before I start the camera and you begin the speech."*(Mansell et al., 1999, p. 678).

Participants assigned to the no speech condition were told the following:

> *You have been assigned to the no speech condition. However, following a computer task, we will ask you to watch a video of another individual delivering a speech. You will be asked to provide a number of ratings concerning the quality of their speech.*

Next, half of the participants completed the questionnaire packet (including the BFNE and the PANAS), followed by the eye tracking task, whereas the other half of the participants completed the procedures in the opposite order. The procedure was meant to minimize carry-over effects. More importantly, this procedure was designed to exclude priming effects as a potential explanation for attention patterns. Participation required approximately one hour's worth of time on behalf of the participant.

4.5c. The Eye Tracking Task

Participants were seated in front of a computer screen and the eye tracking equipment was fitted. Then, for calibration and validation purposes, the participant was asked to visually track a dot that appeared on the computer screen. The participants were asked to track the stimuli on the screen until the computer accurately determined the location of the individual's gaze. Next, participants were provided with the following verbal instructions:

> *In this study, you will be presented with pictures of faces so that we can study the way that individuals look at faces. There are no rules concerning where you look, so do not feel obligated to examine all parts of the pictures. However, you are welcome to do so if you want. All we ask is that you look at the screen. Remember, there are no particular areas of the screen to which you need to attend. This study contains over 30 trials. To start each trial you will have to look directly at the fixation point in the middle of the screen while pressing the spacebar. Once the trial finishes the fixation point will appear again and you will again look at that point and press the spacebar, and so on. Because of this requirement, it might*

*take a few tries before the trial starts sometimes. Please try to not move your head or body during this study.*

The participants were presented with 36 trials of the experimental task presented in random order. Each trial had a three-second duration and involved the simultaneous presentation of two facial stimuli (neutral-angry, neutral-happy, and happy-angry). Each type of stimulus (i.e., neutral, angry, and happy) appeared on the right side of the screen during half of the trials and on the left side of the screen on the other half of the trials. Each pairing appeared with equal frequency. Direction of gaze was monitored continuously.

After the completion of the eye tracking task, participants were reminded of whether they were in the speech or the no speech condition and again completed the state version of the STAI. Participants in the no speech condition were asked to watch a video of another individual delivering a speech and to answer questions regarding their feelings about the speech. Participants in the speech condition were asked to give a three-minute speech on a controversial topic (i.e., the death penalty or abortion) and provide a number of ratings concerning their feelings about the speech and the audience members.

Participants were thanked for their participation, debriefed, and given the opportunity to ask questions regarding the task.

4.6. Design Overview

Trait social anxiety, speech condition, and gender served as between subject independent variables. Facial stimulus type (neutral-angry, neutral-happy, or angry-happy) served as a within subject independent variable. Negative affect served as a between subject covariate.

### 4.7. A Priori Power Analyses

Prior to conducting the current study, analyses were conducted to determine the sample size needed to have at least an 80% chance of finding the proposed effects, if they existed. Based on prior studies of social anxiety and attention to emotional faces (i.e., Mogg et al., 2007; Vassilopoulos, 2005), the vigilance-avoidance pattern is associated with a medium effect size (Cohen's d = .60, r = .30). In order to find differences between the high and low social anxiety groups with respect to gaze bias, assuming a Cohen's d of .60, power tables recommended a sample size of 82, resulting in 41 people per anxiety group. There were no good studies to look to for recommendations concerning sample size given how infrequent eye tracking had been used to study attention to threat in anxiety. Most studies on anxiety and attention to threat use about 20 participants per condition, which is less than the sample size that was suggested by the aforementioned power analysis. Initially, the study hoped to include ninety participants because data from the author's lab suggested that the eye tracker is unable to collect data from less than 10% of participants. Post-hoc power analyses are presented throughout the following section.

## CHAPTER 5: RESULTS

### 5.1. Preliminary Data Procedures

Following the initial entry, data that were manually entered into SPSS were checked for accuracy by research assistants by comparing the entered data to the original data recorded by the research participants.

Consistent with prior research in our lab, the EyeLink II was unable to track the eye movements in a small percentage of the participants in the current study. Specifically, five participants (5.49%) were not calibrated on the EyeLink II in the current study.

Therefore, their data was not included in the tests of the primary hypotheses involving eye tracking variables. Four of those participants were in the low trait social anxiety group and three were women.

5.2. Significance Testing

Consistent with current research guidelines (Wilkinson & Task Force, 1999), significance tests (p) and effect sizes (d) with 95% confidence intervals were calculated for each of the following analyses.

5.3. State anxiety manipulation check

In order to test whether the state STAI scores of the individuals in the speech condition increased significantly more from the 1st STAI administration to the 2nd administration than the scores of the individuals in the no speech condition, a 2 (speech vs. no speech) X 2 (1st vs. 2nd STAI administration) mixed factor ANOVA was conducted. Table 5.1 contains the means for the STAI both pre and post speech condition assignment.

There was a main effect of speech condition, $F(1, 83) = 11.07$, $p = .001$, such that participants in the speech condition had higher STAI scores than participants in the no speech condition, regardless of time of administration. There was a significant main effect of time of administration, $F(1, 83) = 24.71$, $p < .001$, such that STAI scores at the 2nd administration were higher than those at the first administration, regardless of speech condition. In addition, there was a significant interaction between time and speech condition, $F(1, 83) = 44.38$, $p < .001$. HSD follow-up analyses of the cell means (LSD minimum mean difference = 3.86) indicated that there was not a significant difference

Table 5.1: Means (standard deviations) for the state form of the State-Trait Anxiety Inventory (STAI) pre and post speech condition assignment by social anxiety group and speech condition

| Social Anxiety Group | Speech Condition | STAI-1 | STAI-2 | Combined |
|---|---|---|---|---|
| High | Speech | 37.56 (10.73) | 53.68 (9.26) | 46.14 (7.48) |
| | No Speech | 35.37 (9.23) | 33.42 (10.39) | 34.33 (9.52) |
| | Combined | 36.43 (9.91) | 43.55 (14.13) | 40.24 (10.35) |
| Low | Speech | 27.83 (7.83) | 35.96 (11.93) | 31.90 (9.02) |
| | No Speech | 30.04 (7.52) | 28.04 (6.20) | 28.82 (5.62) |
| | Combined | 28.98 (7.67) | 31.84 (10.12) | 30.33 (7.56) |
| Combined | Speech | 32.00 (10.29) | 43.79 (13.93) | 38.00 (12.16) |
| | No Speech | 32.29 (8.60) | 30.31 (8.56) | 31.13 (8.72) |
| | Combined | 32.15 (9.40) | 36.90 (13.29) | 34.52 (10.08) |

between the STAI scores obtained during the 1st and 2nd administrations of the STAI for the participants in the no speech condition. As hypothesized, there was a significant difference between the STAI scores obtained during the 1st and 2nd administrations of the STAI for the participants in the speech condition, such that STAI scores were greater during the second administration. Figure 5.1 depicts this interaction.

5.4. Random Assignment Checks

Independent samples t-tests comparing PRCS and BFNE scores obtained during phase two of the study between the speech and no speech groups were conducted to

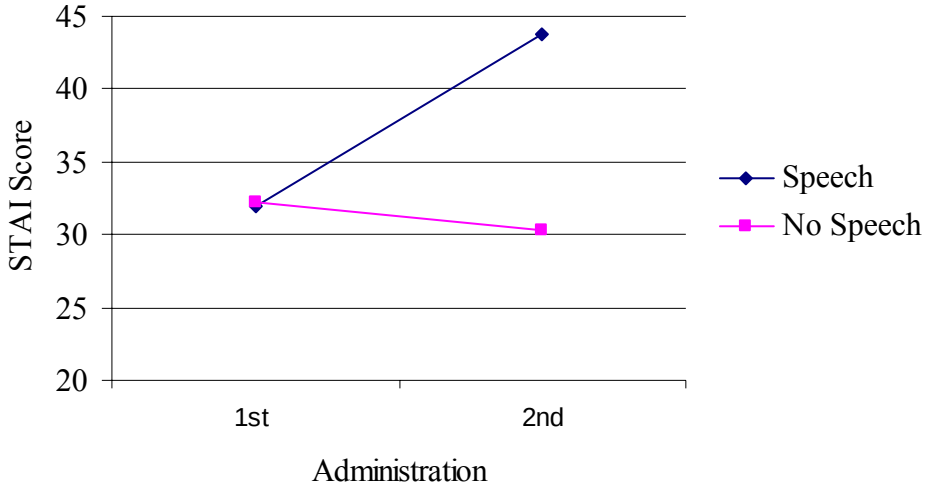



Figure 5.1: State-Trait Anxiety Inventory (STAI) scores by speech condition and administration.

examine the effectiveness of random assignment. Table 5.2 contains the group means and standard deviations for the PRCS and the BFNE by speech condition and trait social anxiety group.

Unexpectedly, results indicated that participants in the no speech condition had lower PRCS scores than individuals in the speech condition, $t(89) = -2.18$, $p = .03$. Participants were aware of their speech condition assignments prior to the completion of the PRCS. Therefore, it is possible that individuals in the speech condition felt less confident about their public speaking abilities because of the threat of the impending speech. A t-test comparing mass testing BFNE scores between the speech and no speech groups was conducted to examine the effectiveness of random assignment. As expected, results indicated that there was no difference between BFNE scores for participants in the no speech condition and participants in the speech condition, $t(89) = 0.08$, $p = .78$

Table 5.2: Means (standard deviations) for the Personal Report of Confidence as a Speaker (PRCS) and Brief Fear of Negative Evaluation (BFNE) collected in phase two of the study by trait social anxiety condition and speech condition

| Social Anxiety Group | Speech Condition | PRCS | BFNE |
|---|---|---|---|
| High | Speech | 22.55 (5.94) | 48.79 (4.55) |
| | No Speech | 16.60 (7.98) | 46.00 (7.00) |
| | Combined | 19.58 (7.57) | 47.36 (6.02) |
| Low | Speech | 11.58 (6.41) | 26.83 (6.68) |
| | No Speech | 10.19 (5.49) | 26.41 (6.02) |
| | Combined | 10.86 (5.93) | 26.61 (6.28) |
| Combined | Speech | 16.57 (8.25) | 36.53 (12.45) |
| | No Speech | 12.98 (7.35) | 34.74 (11.69) |
| | Combined | 14.73 (7.97) | 35.60 (12.02) |

Note. BFNE = Brief Fear of Negative Evaluation; PRCS = Personal Report of Confidence as a Speaker

5.5. Trait Anxiety Check

Participants' scores on the BFNE completed during the experiment were calculated and compared to mass testing BFNE scores. If a participant's score were to deviate more than one standard deviation (9.14; based on mass testing data) from the original cut-off score for their pre-determined trait social anxiety group, then the

participant would have been excluded from further analysis. No participants were excluded based on this criterion.

5.6. Dependent Variables

Analyses focused on four critical variables in the current study:

1) First Fixation Time: First fixation is defined as the amount of time that elapses following the start of each trial until the first fixation on each type of stimulus.
2) Run Count: Run count is defined as the number of times the participants returned their attention to each type of stimulus. Run count was calculated for the first 1000 ms of each trial, the last 2000 ms of the trial, and for each trial as a whole.
3) Dwell Time: Dwell time is defined as the amount of time participants spent attending to each type of stimulus. Dwell time was calculated for the first 1000 ms of each trial, the last 2000 ms of the trial, and for each trial as a whole.
4) First Run Dwell Time: First run dwell time is defined as the amount of dwell time spent on each type of stimulus the first time they direct their gaze towards it during each trial.

5.7. Gender-Related Analyses

It is important to include an analysis of gender-related effects in studies of anxiety as there is evidence that there are anxiety-related differences between men and women. For example, more women meet diagnostic criteria for social anxiety disorder than men (Weinstock, 1999). Furthermore, there is evidence that the timing of the processing of emotional information (a very important variable in the current study) differs between men and women (Sass, Heller, Stewart, Silton, Edgar, Fisher et al., 2010). Therefore,

prior to conducting the analyses presented below, a multivariate analysis of variance (MANOVA) test was conducted to determine whether there were important effects of gender that need to be considered. There were no hypotheses regarding gender effects.

A 2 X 2 X 2 X 6 MANOVA was conducted. Gender, trait social anxiety (high or low), and speech condition (speech or no speech) served as between subject independent variables. Facial stimulus type (neutral paired with angry; neutral paired with happy; angry paired with neutral; angry paired with happy; happy paired with neutral; or happy paired with angry) served as a within subject independent variable. Each dependent variable involved in the hypotheses was included in the MANOVA: first fixation time, run count, dwell time, and first run dwell time. Table 5.3 contains the univariate statistics for each dependent variable by gender and facial stimulus type.

The MANOVA did not result in any significant effects involving gender. The main effects of gender, $F(24, 54) = 1.40$, $p = .15$, speech condition, $F(24, 54) = 1.44$, $p = .14$, and trait social anxiety group, $F(24, 54) = 1.08$, $p = .39$, were not significant. There was not an interaction between gender and speech condition, $F(24, 54) = .89$, $p = .61$, or between gender and trait social anxiety group, $F(24, 54) = 1.22$, $p = .27$, or between speech condition and trait social anxiety group, $F(24, 54) = 1.46$, $p = .13$. Finally, the interaction between gender, speech condition, and trait social anxiety group was not significant, $F(24, 54) = 1.61$, $p = .08$. Therefore, the remaining analyses collapse across gender.

Table 5.3: Means (standard deviations) for dependent variables by gender and facial stimulus type

| Facial Stimulus | Gender | Dependent Variable: 1st Fixation Time | Run Count | Dwell Time | 1st Run Dwell Time |
|---|---|---|---|---|---|
| Angry (with Happy) | Men | 795.38 (212.10) | 1.42 (.36) | 1240.37 (*173.11*) | 998.45 (291.85) |
| | Women | 711.20 (185.92) | 1.49 (.28) | 1179.07 (*136.00*) | 896.42 (189.78) |
| | Total | 750.81 (201.94) | 1.46 (.32) | 1207.92 (*156.68*) | 944.43 (247.06) |
| Angry (with Neutral) | Men | 726.61 (219.31) | 1.46 (.31) | 1329.48 (*175.70*) | 1080.65 (273.34) |
| | Women | 664.58 (195.11) | 1.47 (.30) | 1252.58 (*132.57*) | 999.64 (253.63) |
| | Total | 694.15 (208.12) | 1.46 (.30) | 1289.24 (*158.49*) | 1038.26 (264.80) |
| Happy (with Angry) | Men | 776.20 (238.55) | 1.46 (.37) | 1205.88 (*157.00*) | 938.62 (248.02) |
| | Women | 714.87 (193.22) | 1.52 (.31) | 1204.38 (*133.84*) | 902.73 (241.46) |
| | Total | 744.11 (216.92) | 1.49 (.34) | 1205.10 (*144.47*) | 919.84 (243.83) |

| | | | | | |
|---|---|---|---|---|---|
| Happy (with Neutral) | Men | 763.78 (260.46) | 1.48 (.32) | 1303.91 (178.91*)* | 1018.96 (260.25) |
| | Women | 683.95 (167.39) | 1.52 (.29) | 1248.05 (*111.91*) | 930.50 (229.22) |
| | Total | 722.01 (219.17) | 1.50 (.30) | 1274.68 (*149.44*) | 972.67 (247.07) |
| Neutral (with Angry) | Men | 873.20 (242.72) | 1.41 (.36) | 1106.55 (*166.02*) | 870.43 (245.28) |
| | Women | 806.57 (190.99) | 1.50 (.31) | 1133.37 (*124.16*) | 816.98 (210.61) |
| | Total | 838.34 (218.47) | 1.46 (.34) | 1120.59 (*145.37*) | 842.46 (228.02) |
| Neutral (with Happy) | Men | 839.60 (249.17) | 1.44 (.33) | 1133.42 (*158.61*) | 876.69 (256.49) |
| | Women | 746.04 (172.99) | 1.49 (.31) | 1143.47 (*114.79*) | 870.85 (202.70) |
| | Total | 790.65 (216.51) | 1.47 (.32) | 1138.68 (*136.69*) | 873.64 (228.55) |

## 5.8. Hypothesis-Specific Analyses

Presented below are the analyses relevant to the specific hypotheses of the study. The analyses include significance tests and calculations of effect size (i.e., partial $\eta^2$) and power for each test of a specific research hypothesis.

For each hypothesis, a 2 X 2 X 6 analysis of covariance (ANCOVA) was conducted. Trait social anxiety (high and low) and speech condition (speech or no speech) served as between group independent variables. Facial stimulus type (neutral paired with angry; neutral paired with happy; angry paired with neutral; angry paired with happy; happy paired with neutral; or happy paired with angry) served as a within group independent variable. Negative affect served as a covariate. Each analysis differs only by the dependent variable (unless otherwise specified).

Each analysis used the PANAS-NA, a measure of negative affect, as a covariate. Table 5.4 contains the group means and standard deviations for the PANAS-NA completed during phase 2 of the study. Table 5.5 contains the correlations between PANAS-NA and the dependent variables used in the analyses presented below.

## 5.9. First Fixation Time

Table 5.6 contains the means and standard deviations for first fixation time. Results were contrary to the hypothesis that individuals in the high trait social anxiety group would fixate more quickly on threatening stimuli than individuals in the low trait social anxiety group. There was a significant interaction between facial stimulus type and trait social anxiety, $F(5, 400) = 2.41$, $p = .04$. However, LSD follow-up analyses of cell means (minimum mean difference = 58.06) indicated that high and low trait social

Table 5.4: Means (standard deviations) for Positive and Negative Affect Schedule-Negative Affect (PANAS-NA) by trait social anxiety and speech condition

| Social Anxiety Group | Speech Condition | PANAS-NA |
|---|---|---|
| High | Speech | 21.30 (5.86) |
| | No Speech | 21.45 (6.71) |
| | Combined | 21.38 (6.22) |
| Low | Speech | 16.58 (5.47) |
| | No Speech | 14.74 (3.35) |
| | Combined | 15.61 (4.52) |
| Combined | Speech | 18.73 (6.07) |
| | No Speech | 17.60 (6.01) |
| | Combined | 18.14 (6.03) |

Table 5.5: Correlations between Positive and Negative Affect Schedule-Negative Affect (PANAS-NA) and the dependent variables

| Dependent Variable | Correlation with PANAS-NA | P |
|---|---|---|
| Dwell Time: Angry paired with Happy | -0.003 | .98 |
| Dwell Time: Angry paired with Neutral | -0.03 | .75 |
| Dwell Time: Happy paired with Angry | -0.03 | .82 |
| Dwell Time: Happy paired with Neutral | -0.12 | .26 |

| | | |
|---|---|---|
| Dwell time: Neutral paired with Angry | -0.01 | .90 |
| Dwell time: Neutral paired with Happy | 0.08 | .47 |
| First fixation time: Angry paired with Happy | 0.10 | .36 |
| First fixation time: Angry paired with Neutral | -0.01 | .96 |
| First fixation time: Happy paired with Angry | 0.01 | .92 |
| First fixation time: Happy paired with Neutral | -0.11 | .32 |
| First fixation time: Neutral paired with Angry | -0.02 | .89 |
| First fixation time: Neutral paired with Happy | -0.03 | .76 |
| First run dwell time: Angry paired with Happy | 0.02 | .87 |
| First run dwell time: Angry paired with Neutral | -0.04 | .71 |
| First run dwell time: Happy paired with Angry | -0.05 | .65 |
| First run dwell time: Happy paired with Neutral | -0.02 | .83 |
| First run dwell time: Neutral paired with Angry | -0.01 | .93 |
| First run dwell time: Neutral paired with Happy | -0.06 | .57 |
| Run count Angry paired with Happy | -0.02 | .85 |
| Run count: Angry paired with Neutral | 0.01 | .97 |
| Run count: Happy paired with Angry | -0.01 | .91 |
| Run count: Happy paired with Neutral | -0.05 | .67 |
| Run count: Neutral paired with Angry | -0.03 | .79 |
| Run count: Neutral paired with Happy | 0.03 | .82 |

anxiety groups did not differ with regard to the first fixation time on the angry faces. Partial $\eta^2$ for this effect was .03 and power was 76.04%. Of note, high and low trait social anxiety participants exhibited differences with regard to first fixation time on neutral faces (paired with angry faces) as well as happy faces (paired with angry faces). Specifically, low trait social anxiety participants were slower to fixate on the non-angry faces (in trials than contained angry faces) than high trait social anxiety participants. This pattern is consistent with the idea that the high trait social anxiety participants avoid threatening stimuli. No other differences emerged between the groups. Figure 5.2 depicts the pattern of this interaction (note: Displayed means are not corrected for negative affect).

Although the interaction between speech condition and facial stimulus type was not significant, $F(5, 400) = 1.97$, $p = .08$, planned comparisons were conducted to examine the hypothesis that individuals in the speech condition would fixate more quickly on emotional stimuli than individuals in the no speech condition. LSD follow-up analyses of the cell means (minimum mean difference = 58.06) indicated that the speech groups did not differ with regard to the first fixation time on any facial stimulus type. Partial $\eta^2$ for this effect was .02 and power was 66.40%.

There was not a significant main effect of trait social anxiety, $F(1, 80) = 1.08$, $p = .30$, speech condition, $F(1, 80) = .21$, $p = .65$, facial stimulus type, $F(5, 400) = .99$, $p = .42$, or negative affect, $F(1, 80) = .18$, $p = .68$.

Table 5.6: Means (standard deviations) for first fixation time by trait social anxiety group, speech condition, and facial stimulus type

| Social Anxiety Group | Speech Condition | Trial Type: Angry-Happy | | Angry-Neutral | | Happy-Neutral | |
|---|---|---|---|---|---|---|---|
| | | Angry | Happy | Angry | Neutral | Happy | Neutral |
| High | Speech | 759.00 (234.99) | 673.23 (209.99) | 723.01 (262.92) | 759.50 (210.66) | 699.28 (227.52) | 746.09 (209.63) |
| | No Speech | 764.11 (200.99) | 717.92 (195.17) | 679.57 (200.10) | 862.46 (220.33) | 710.18 (247.61) | 777.96 (185.61) |
| | Combined | 761.42 (216.62) | 694.40 (201.64) | 702.43 (233.19) | 808.27 (218.65) | 704.44 (234.06) | 761.19 (196.61) |
| Low | Speech | 785.36 (202.48) | 850.09 (203.29) | 726.65 (155.09) | 869.47 (164.13) | 788.44 (163.03) | 826.89 (245.09) |
| | No Speech | 700.90 (173.94) | 730.06 (226.93) | 661.80 (209.23) | 866.21 (260.54) | 690.59 (239.86) | 809.62 (221.88) |
| | Combined | 742.23 (191.20) | 788.80 (221.79) | 693.53 (185.65) | 867.80 (216.40) | 738.48 (209.58) | 818.07 (231.13) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Combined | Speech | 773.10 (215.95) | 767.83 (222.63) | 724.96 (209.99) | 818.32 (193.04) | 746.97 (198.41) | 789.31 (230.23) |
| | No Speech | 727.99 (186.35) | 724.83 (211.47) | 669.41 (203.08) | 864.60 (241.27) | 698.99 (240.40) | 796.05 (205.31) |
| | Combined | 750.81 (201.94) | 746.60 (216.97) | 697.511 (206.99) | 841.19 (218.15) | 723.26 (220.17) | 792.64 (217.00) |

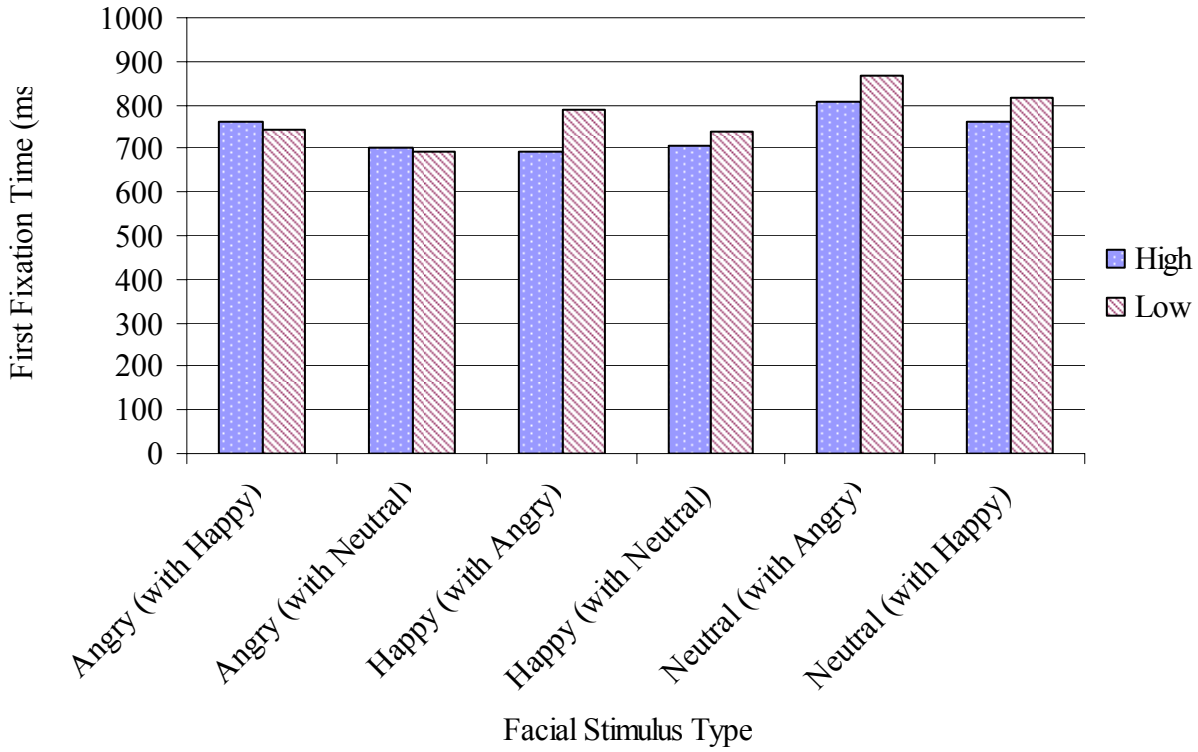



Figure 5.2: First fixation time by trait social anxiety group and facial stimulus type

There were no significant two-way interactions between trait social anxiety and speech condition, $F(1, 80) = 1.36$, $p = .25$, facial stimulus type and negative affect, $F(5, 400) = 1.29$, $p = .27$, facial stimulus type and trait social anxiety, $F(5, 400) = 2.41$, $p = .04$, or facial stimulus type and speech condition, $F(5, 400) = 1.97$, $p = .08$.

The three-way interaction between trait social anxiety, speech condition, and facial stimulus type was not significant, $F(5, 400) = .68$, $p = .64$.

5.10. Run Count

Table 5.7 contains the descriptive statistics for run count.

There was a significant interaction between speech condition and facial stimulus type, $F(5, 400) = 3.10$, $p = .01$. Partial $\eta^2$ for this effect was .04 and power was 87.40%.

LSD follow-up analyses of the cell means (minimum mean difference = .06) indicated that the no speech group returned their attention to the happy face in happy-angry trials less often than the speech group. On neutral-happy trials, the no speech group returned their attention more often to the neutral face than the speech group. No other differences emerged between the speech groups. Figure 5.3 depicts the pattern of this interaction (note: Displayed means are not corrected for negative affect).

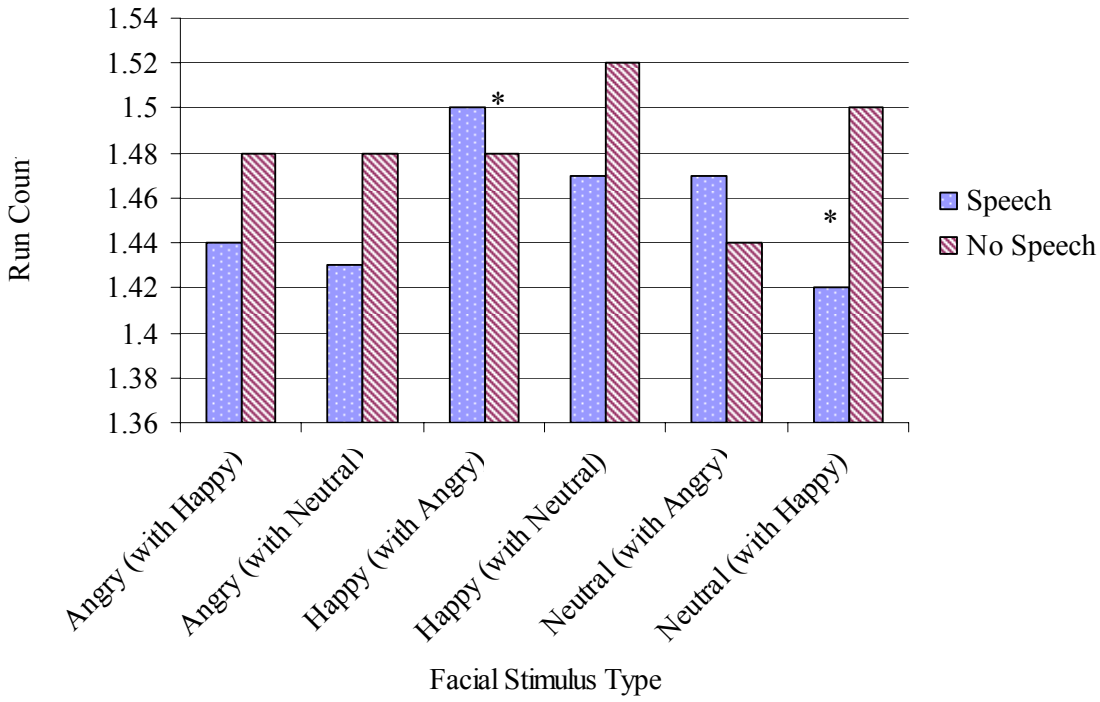



Figure 5.3: Run count by speech condition and facial stimulus type

Table 5.7: Means (standard deviations) for run count by trait social anxiety group, speech condition, and facial stimulus type

| Social Anxiety Group | Speech Condition | Trial Type | | | | | |
|---|---|---|---|---|---|---|---|
| | | Angry-Happy | | Angry-Neutral | | Happy-Neutral | |
| | | Angry | Happy | Angry | Neutral | Happy | Neutral |
| High | Speech | 1.53 (*.34*) | 1.56 (*.37*) | 1.54 (*.35*) | 1.55 (*.36*) | 1.58 (*.32*) | 1.50 (*.34*) |
| | No Speech | 1.37 (*.29*) | 1.43 (*.29*) | 1.44 (*.27*) | 1.40 (*.32*) | 1.47 (*.32*) | 1.47 (*.30*) |
| | Combined | 1.46 (*.33*) | 1.50 (*.34*) | 1.49 (*.31*) | 1.48 (*.34*) | 1.53 (*.32*) | 1.48 (*.32*) |
| Low | Speech | 1.35 (*.24*) | 1.46 (*.29*) | 1.34 (*.23*) | 1.41 (*.30*) | 1.38 (*.21*) | 1.35 (*.29*) |
| | No Speech | 1.56 (*.36*) | 1.49 (*.37*) | 1.50 (*.31*) | 1.46 (*.37*) | 1.55 (*.33*) | 1.53 (*.33*) |
| | Combined | 1.46 (*.32*) | 1.47 (*.33*) | 1.43 (*.29*) | 1.44 (*.33*) | 1.47 (*.29*) | 1.44 (*.32*) |
| Combined | Speech | 1.44 (*.30*) | 1.50 (*.33*) | 1.43 (*.30*) | 1.47 (*.33*) | 1.47 (*.28*) | 1.42 (*.32*) |
| | No Speech | 1.48 (*.34*) | 1.48 (*.33*) | 1.48 (*.30*) | 1.44 (*.35*) | 1.52 (*.33*) | 1.50 (*.31*) |

| | | | | | | |
|---|---|---|---|---|---|---|
| Combined | 1.45 (*.32*) | 1.48 (*.33*) | 1.46 (*.30*) | 1.46 (*.34*) | 1.49 (*.30*) | 1.46 (*.32*) |

There were no other significant effects. The main effects of trait social anxiety, $F(1, 80) = .63$, $p = .43$, speech condition, $F(1, 80) = .01$, $p = .94$, negative affect, $F(1, 80) = .35$, $p = .56$, and facial stimulus type, $F(5, 400) = 1.48$, $p = .20$, were not significant.

The two-way interactions between trait social anxiety and speech condition, $F(1, 80) = 3.47$, $p = .07$, facial stimulus type and negative affect, $F(5, 400) = 1.12$, $p = .35$, and facial stimulus type and trait social anxiety, $F(5, 400) = 1.19$, $p = .31$, were not significant.

The three-way interaction between trait social anxiety, speech condition, and facial stimulus type was not significant, $F(5, 400) = 1.95$, $p = .09$.

5.10a. Run count bias

In order to test the hypothesis that individuals in the high trait social anxiety group would return their attention more often to threatening stimuli than individuals in the low trait social anxiety group during the first 1000 ms of each trial, but that they would fixate a lesser amount of the time during the last 2000 ms of each trial, a new dependent variable was calculated. The standard run count variable for the first 1000 ms and the last 2000 ms of the trial are not comparable because the time in which the behaviors can occur in each time frame differs. In order to adjust for differences in timing between the variables collected in the first 1000 and the last 2000 ms of the trials, run count bias was calculated by dividing the run count for the angry face by the run count for the non-angry face on the trials that contained an angry face. Scores with an absolute value greater than 1 on the run count bias variable indicate a bias towards more fixations on the angry face. Scores were calculated for the first 1000 ms and the last 2000 ms of each trial. Table 5.8 contains the means and standard deviations for run count bias.

Table 5.8: Means (standard deviations) for run count bias by trait social anxiety group, speech condition, trial type, and trial time

| | | Trial Type | | | |
|---|---|---|---|---|---|
| Social Anxiety Group | Speech Condition | Angry-Happy | | Angry-Neutral | |
| | | 1000 | 2000 | 1000 | 2000 |
| High | Speech | .98 (.21) | 1.07 (.26) | 1.06 (.21) | 1.00 (.34) |
| | No Speech | .99 (.22) | 1.01 (.50) | 1.32 (.45) | .89 (.33) |
| | Combined | .98 (.21) | 1.04 (.39) | 1.18 (.37) | .94 (.34) |
| Low | Speech | 1.11 (.29) | .84 (.25) | 1.19 (.19) | .83 (.35) |
| | No Speech | 1.05 (.24) | 1.15 (.43) | 1.28 (.32) | .89 (.25) |
| | Combined | 1.08 (.264) | 1.00 (.38) | 1.23 (.26) | .86 (.30) |
| Combined | Speech | 1.05 (.26) | .94 (.28) | 1.13 (.31) | .90 (.35) |
| | No Speech | 1.03 (.23) | 1.09 (.46) | 1.30 (.37) | .89 (.28) |
| | Combined | 1.04 (.25) | 1.01 (.39) | 1.21 (.31) | .90 (.32) |

A 2 X 2 X 2 X 2 mixed group Analysis of Covariance (ANCOVA) was conducted with trait social anxiety (high or low) and speech condition (speech or no speech) as between group independent variables, with trial type (angry-neutral or angry-happy) and trial time (first 1000 ms or last 2000 ms) as within group independent variables, with negative affect as a covariate, and with run count bias as the dependent variable.

Table 5.9 contains the correlations between run count bias for each trial type and trial time and the PANAS-NA.

Table 5.9: Correlations between the PANAS-NA and run count bias for each trial type and trial time

| Trial Type | Trial Time | R | p |
|---|---|---|---|
| Angry-Happy | 1000 | -0.07 | 0.54 |
| | 2000 | 0.01 | 0.93 |
| Angry-Neutral | 1000 | -0.13 | 0.24 |
| | 2000 | 0.03 | 0.82 |

Contrary to the hypothesis, the interaction between trait social anxiety and trial time was not significant, $F(1, 79) = 2.01$, $p = .16$. Partial $\eta^2$ for this effect was .03 and power was 28.90%. Although the interaction was not significant, planned comparisons were conducted to examine the hypothesis that individuals in the high trait social anxiety group would return their attention more often to threatening stimuli than individuals in the low trait social anxiety group during the first 1000 ms of each trial, but that they would return their attention less often to threatening stimuli during the last 2000 ms of each trial. LSD follow-up analyses of the cell means (minimum mean difference = .16) revealed no group differences.

The main effect of speech condition was significant, $F(1, 79) = 5.43$, $p = .02$, such that the participants in the no speech condition returned their attention to angry faces

more frequently than the speech condition. Partial $\eta^2$ for this effect was .06 and power was 63.40%.

The main effect of speech condition was modified by the interaction between trial time, trait social anxiety, and speech condition, $F(1, 79) = 5.74$, $p = .02$. Partial $\eta^2$ for this effect was .07 and power was 65.80%. LSD follow-up analyses of the cell means (minimum mean difference = .16) revealed that for the no speech condition, the high and low trait social anxiety groups did not differ with regard to run count bias for either trial time. For the speech condition, although the high and low trait social anxiety groups did not differ with regard to run count bias for the 1000 ms trial time, the high trait social anxiety group returned their attention to the angry faces more often than the low trait social anxiety group at 2000 ms. Figure 5.4 depicts the pattern of this interaction (note: Displayed means are corrected for negative affect).

There were no other significant effects. The main effects of trait social anxiety, $F(1, 79) = .004$, $p = .95$, negative affect, $F(1, 79) = .13$, $p = .72$, trial time, $F(1, 79) = 1.33$, $p = .25$, and trial type, $F(1, 79) = 2.09$, $p = .15$ were not significant.

Two-way interactions between trait social anxiety and speech condition, $F(1, 79) = 1.83$, $p = .18$, trial time and negative affect, $F(1, 79) = .01$, $p = .93$, trial time and speech condition, $F(1, 79) = .12$, $p = .73$, trial type and negative affect, $F(1, 79) = 1.19$, $p = .28$, trial type and trait social anxiety, $F(1, 79) = 2.07$, $p = .16$, trial type and speech condition, $F(1, 79) = .14$, $p = .71$, and trial time and trial type, $F(1, 79) = .91$, $p = .34$, were not significant.

The three way interactions between trait social anxiety, trial type, and speech condition, $F(1, 79) = 3.24$, $p = .08$, trial time, trial type, and negative affect, $F(1, 79) =$

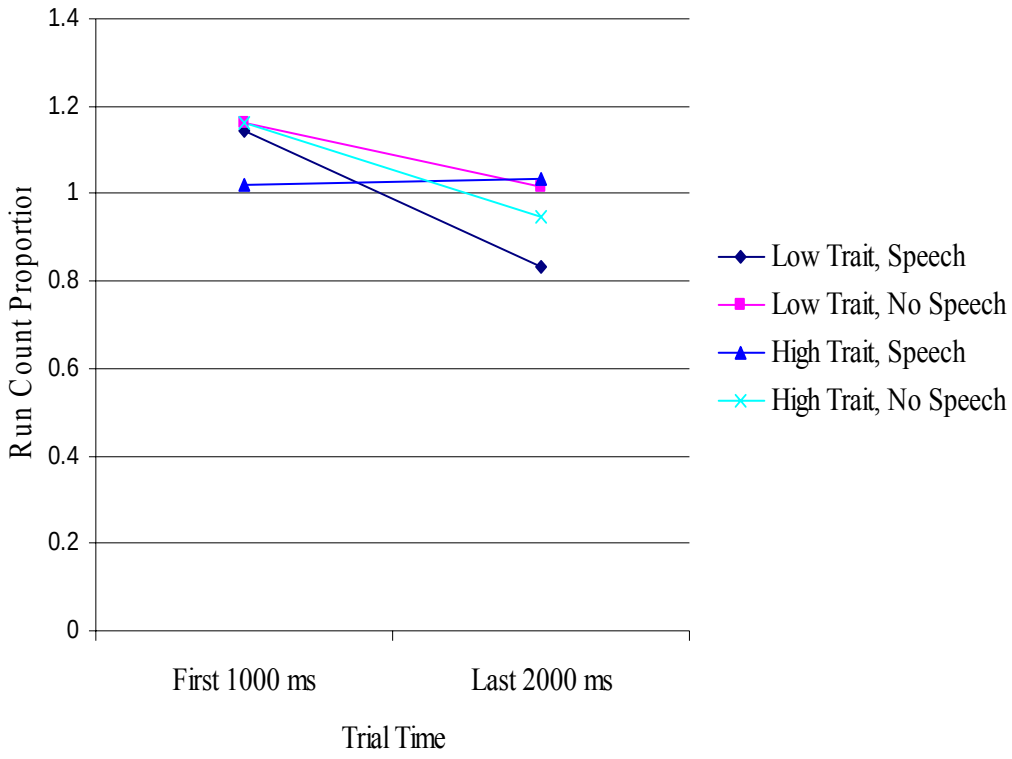



Figure 5.4: Run count bias by trait social anxiety, speech condition, and trial time

.01, p = .94, trait social anxiety, trial time, and trial type, F(1, 79) = .01, p = .94, and speech condition, trial time, and trial type, F(1, 79) = 3.78, p = .06, were not significant.

The four-way interaction between trait social anxiety, speech condition, trial time, and trial type was not significant, F(1, 79) = .08, p = .78.

5.11. Dwell Time

Table 5.10 contains the univariate statistics for dwell time.

There were no significant effects. The main effects of trait social anxiety, $F(1, 80) = .07$, $p = .80$, speech condition, $F(1, 80) = .23$, $p = .63$, negative affect, $F(1, 80) = .53$, $p = .47$, and facial stimulus type, $F(5, 400) = .84$, $p = .52$, were not significant.

The two-way interactions between trait social anxiety and speech condition, $F(1, 80) = .08$, $p = .78$, facial stimulus type and negative affect, $F(5, 400) = .32$, $p = .90$,

Table 5.10: Means (standard deviations) for dwell time by trait social anxiety group, speech condition, and facial stimulus type

| | | Trial Type | | | | | |
|---|---|---|---|---|---|---|---|
| Social Anxiety Group | Speech Condition | Angry-Happy | | Angry-Neutral | | Happy-Neutral | |
| | | Angry | Happy | Angry | Neutral | Happy | Neutral |
| High | Speech | 1220.32 *(119.90)* | 1183.45 *(100.36)* | 1291.63 *(117.27)* | 1182.62 *(121.79)* | 1269.57 *(128.73)* | 1134.22 *(127.47)* |
| | No Speech | 1207.07 *(119.10)* | 1206.13 *(98.52)* | 1302.81 *(135.71)* | 1104.28 *(111.26)* | 1243.24 *(138.38)* | 1159.67 *(153.15)* |
| | Combined | 1214.04 *(118.09)* | 1194.19 *(98.81)* | 1259.03 *(131.51)* | 1145.51 *(121.97)* | 1257.10 *(132.23)* | 1146.27 *(138.88)* |
| Low | Speech | 1168.48 *(153.90)* | 1242.04 *(145.07)* | 1278.80 *(124.87)* | 1127.46 *(116.70)* | 1262.80 *(116.04)* | 1146.30 *(106.25)* |
| | No Speech | 1236.03 *(205.25)* | 1182.72 *(196.90)* | 1343.19 *(212.28)* | 1074.21 *(194.30)* | 1319.25 *(195.16)* | 1113.57 *(159.93)* |
| | Combined | 1202.97 *(183.18)* | 1211.75 *(174.21)* | 1311.68 *(176.20)* | 1100.27 *(161.70)* | 1291.62 *(162.17)* | 1129.59 *(135.87)* |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Combined | Speech | 1192.59 | 1214.79 | 1251.28 | 1153.12 | 1265.95 | 1140.68 |
| | | *(139.98)* | *(128.28)* | *(123.61)* | *(121.05)* | *(120.67)* | *(115.33)* |
| | No Speech | 1223.62 | 1192.75 | 1325.89 | 1087.10 | 1286.67 | 1133.33 |
| | | *(172.41)* | *(160.97)* | *(182.55)* | *(162.91)* | *(175.37)* | *(156.86)* |
| | Combined | 1207.92 | 1203.90 | 1288.14 | 1120.49 | 1276.19 | 1137.05 |
| | | *(156.68)* | *(144.90)* | *(159.10)* | *(146.23)* | *(149.67)* | *(136.66)* |

facial stimulus type and trait social anxiety, $F(5, 400) = 1.13$, $p = .34$, and facial stimulus type and speech condition, $F(5, 400) = 1.99$, $p = .08$, were not significant.

The three-way interaction between trait social anxiety, speech condition, and facial stimulus type was not significant, $F(5, 400) = 1.01$, $p = .41$.

5.11a. Dwell time bias

In order to test the hypothesis that individuals in the high trait social anxiety group would spend more time examining threatening stimuli for the first 1000 ms of each trial than individuals in the low trait social anxiety group, but that they would spend less time examining the threatening stimuli during the last 2000 ms of each trial, a new dependent variable was calculated. The standard dwell time variable for the first 1000 ms and the last 2000 ms of the trial are not comparable because the time in which the behaviors can occur in each time frame differs. In order to adjust for differences in timing between the variables collected in the first 1000 and the last 2000 ms of the trials, dwell time bias was calculated by dividing the dwell time for the angry face by the dwell time for the non-angry face on the trials that contained an angry face. Scores with an absolute value greater than 1 on the dwell time bias variable indicate a bias towards greater dwell time on the angry face. Scores were calculated for the first 1000 ms and the last 2000 ms of each trial. Table 5.11 contains the means and standard deviations for dwell time bias.

A 2 X 2 X 2 X 2 mixed group Analysis of Covariance (ANCOVA) was conducted with trait social anxiety (high or low) and speech condition (speech or no speech) as between group independent variables, with trial type (angry-neutral or angry-happy) and trial time (first 1000 ms or last 2000 ms) as within group independent variables, with negative affect as a covariate, and with dwell time bias as the dependent variable.

Table 5.11: Means (standard deviations) for dwell time bias by trait social anxiety group, speech condition, trial type, and trial time

| Social Anxiety Group | Speech Condition | Trial Type: Angry-Happy 1000 ms | Angry-Happy 2000 ms | Angry-Neutral 1000 ms | Angry-Neutral 2000 ms |
|---|---|---|---|---|---|
| High | Speech | .97 (.28) | 1.14 (.36) | 1.28 (.37) | .98 (.25) |
| | No Speech | 1.08 (.42) | 1.03 (.27) | 1.68 (.78) | 1.08 (.29) |
| | Combined | 1.02 (.35) | 1.09 (.32) | 1.47 (.63) | 1.03 (.27) |
| Low | Speech | 1.24 (.53) | .89 (.28) | 1.49 (.46) | 1.06 (.34) |
| | No Speech | 1.08 (.37) | 1.17 (.55) | 1.61 (.67) | 1.32 (.88) |
| | Combined | 1.16 (.45) | 1.03 (.45) | 1.54 (.57) | 1.19 (.67) |
| Combined | Speech | 1.11 (.45) | 1.01 (.34) | 1.39 (.43) | 1.02 (.30) |
| | No Speech | 1.08 (.39) | 1.11 (.45) | 1.64 (.71) | 1.22 (.69) |
| | Combined | 1.10 (.42) | 1.06 (.40) | 1.52 (.60) | 1.12 (.54) |

Contrary to the hypothesis that there would be an interaction between trial time and trait social anxiety group, the interaction was not significant, $F(1, 79) = .03$, $p = .87$. Partial $\eta^2$ for this effect was less than .01 and power was 5.30%. Despite the non-significant interaction, planned comparisons were conducted. LSD follow-up analyses of the cell means (minimum mean difference = .22) revealed no differences.

Table 5.12 contains the correlations between run count bias for each trial type and trial time and the PANAS-NA.

Table 5.12: Correlations between the PANAS-NA and dwell time bias for each trial type and trial time

| Trial Type | Trial Time | r | p |
|---|---|---|---|
| Angry-Happy | 1000 | -0.14 | 0.20 |
| | 2000 | 0.03 | 0.79 |
| Angry-Neutral | 1000 | -0.05 | 0.63 |
| | 2000 | -0.03 | 0.77 |

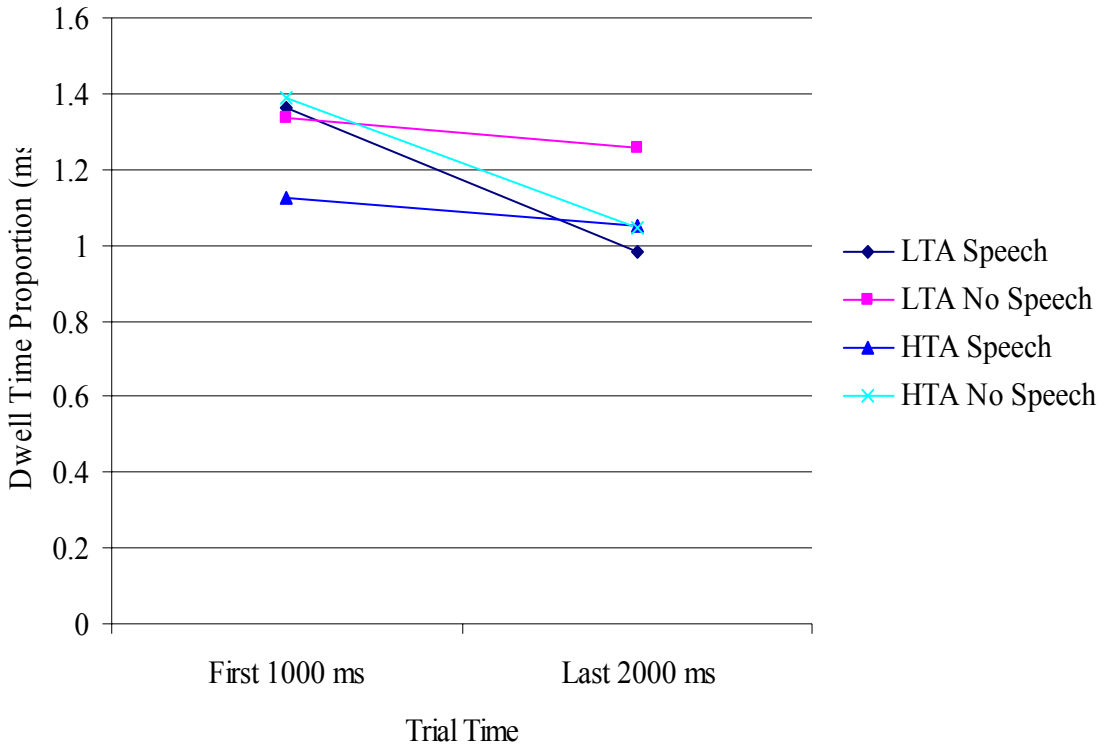
There was a significant main effect of speech condition, $F(1, 79) = 2.74$, $p = .04$, on dwell time bias such that participants in the no speech condition spent more time examining angry faces than individuals in the speech condition. Partial $\eta^2$ for this effect was .05 and power was 52.60%.

There was a significant interaction between trial type and speech condition, $F(1, 79) = 4.79$, $p = .03$. Partial $\eta^2$ for this effect was .06 and power was 58.00%. LSD follow-up analyses of the cell means (minimum mean difference = .19) indicated that for angry-happy trials, there was no difference between participants in the speech and no speech condition with regard to dwell time bias on the angry faces. However, on the angry-neutral trials, participants in the no speech condition had a greater dwell time bias on the angry faces than participants in the speech condition.

There was a significant interaction between trial time, trait social anxiety group, and speech condition, $F(1, 79) = 6.77$, $p = .01$. Partial $\eta^2$ for this effect was .08 and power was 72.60%. LSD follow-up analyses of the cell means (minimum mean difference = .31) indicated that for high trait social anxiety participants in the speech condition, there was no difference between the dwell time bias on the angry face in the first 1000 ms of the trials and the last 2000 ms of the trials. In addition, high trait social anxiety participants in the no speech condition spent a greater amount of time examining angry faces in the first 1000 ms of the trials than the last 2000 ms of the trials. The pattern is reversed for participants in the low trait social anxiety condition such that low trait social anxiety participants in the no speech condition spent an equivalent amount of time examining the angry faces in the first 1000 ms of the trials and the last 2000 ms of the trials. However, low trait social anxiety participants in the speech condition spent a greater amount of time examining the angry face during the first 1000 ms of the trials than the last 2000 ms of the trials. Figure 5.5 depicts the pattern of this interaction for high and low trait social anxiety participants (note: depicted means are raw means and are not adjusted for negative affect).

There was not a significant main effect for trial type, $F(1, 79) = .39$, $p = .53$, trial time, $F(1, 79) = 3.00$, $p = .09$, negative affect, $F(1, 79) = .01$, $p = .91$, or trait social anxiety group, $F(1, 79) = 1.38$, $p = .24$ on dwell time bias.

There were no significant two-way interactions between trial type and negative affect, $F(1, 79) = .57$, $p = .45$, trial type and trait social anxiety, $F(1, 79) = 1.10$, $p = .30$, trait social anxiety and speech condition, $F(1, 79) = .00$, $p = .99$, trial time and negative




Note: HTA = High Trait Social Anxiety; LTA = Low Trait Social Anxiety

Figure 5.5: Dwell time bias for angry faces by trait social anxiety, speech condition, and trial time

affect, F(1, 79) = .50, p = .48, trial time and speech condition, F(1, 79) = .03, p = .88, or trial type and trial time, F(1, 79) = .89, p = .35.

There were no three way interactions between trial type, trait social anxiety group, and speech condition, F(1, 79) = .36, p = .55, trial type, trial time, and negative affect, F(1, 79) = .00, p = .98, trial type, trial time, and speech condition, F(1, 79) = .75, p = .39 or trial type, trial time, and trait social anxiety group, F(1, 79) = 1.67, p = .20.

The four-way interaction between trial time, trial type, trait social anxiety group, and speech condition was not significant, F(1, 79) = .35, p = .56.

5.12. First Run Dwell Time

Table 5.13 contains descriptive statistics for first run dwell time.

Contrary to the hypothesis that individuals with high trait social anxiety would spend more time attending to threatening stimuli following their first fixation on the threatening stimuli before viewing the other stimuli than individuals in the low trait social anxiety group, the interaction between trait social anxiety and facial stimulus type was not significant, $F(5, 400) = 1.86$, $p = .10$. Partial $\eta^2$ for this effect was .02 and power was 63.20%. Although the interaction was not significant, planned comparisons were conducted. LSD follow-up analyses of the cell means (minimum mean difference = 67.264) revealed that the low trait social anxiety participants exhibited greater first run dwell times than the high trait social anxiety participants with regard to the angry face (paired with neutral) and the happy face (paired with neutral). Therefore, the hypothesis was not supported. Figure 5.6 depicts the interaction between trait social anxiety and facial stimulus type (note: Displayed means are not corrected for negative affect).

There were no other significant effects. The main effects of trait social anxiety, $F(1, 80) = .66$, $p = .42$, speech condition, $F(1, 80) = .03$, $p = .86$, negative affect, $F(1, 80) = .01$, $p = .91$, and facial stimulus type, $F(5, 400) = .39$, $p = .86$, were not significant.

The two-way interactions between trait social anxiety and speech condition, $F(1, 80) = 2.58$, $p = .11$, facial stimulus type and negative affect, $F(5, 400) = .52$, $p = .76$, facial stimulus type and trait social anxiety, $F(5, 400) = 1.86$, $p = .10$, and facial stimulus type and speech condition, $F(5, 400) = .90$, $p = .48$, were not significant.

The three-way interaction between trait social anxiety, speech condition, and facial stimulus type was not significant, $F(5, 400) = .68$, $p = .64$.

Table 5.13: Means (standard deviations) for first run dwell time by trait social anxiety group, speech condition, trial type, and trial time

| Social Anxiety Group | Speech Condition | Angry-Happy | | Angry-Neutral | | Happy-Neutral | |
|---|---|---|---|---|---|---|---|
| | | Angry | Happy | Angry | Neutral | Happy | Neutral |
| High | Speech | 910.99 (262.63) | 871.53 (249.27) | 920.13 (256.49) | 847.19 (282.11) | 923.43 (284.22) | 830.39 (218.69) |
| | No Speech | 998.36 (216.84) | 928.70 (263.62) | 1062.54 (235.63) | 842.83 (232.07) | 946.11 (241.97) | 893.20 (251.38) |
| | Combined | 952.37 (242.85) | 898.61 (254.31) | 987.59 (253.94) | 845.13 (256.16) | 934.18 (261.75) | 860.14 (233.67) |
| Low | Speech | 981.72 (237.38) | 982.63 (236.75) | 1112.07 (210.63) | 884.96 (201.24) | 1030.68 (181.02) | 949.64 (219.25) |
| | No Speech | 896.13 (264.98) | 897.40 (237.54) | 1059.40 (315.29) | 805.19 (207.62) | 987.62 (275.12) | 826.52 (224.40) |
| | Combined | 938.02 (252.84) | 939.11 238.48 | 1085.18 (267.64) | 844.23 (206.27) | 1008.69 (232.36) | 886.77 (228.12) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Combined | Speech | 948.82 (248.98) | 930.95 (246.19) | 1022.79 (249.77) | 867.39 (239.96) | 980.80 (237.98) | 894.17 (224.58) |
| | No Speech | 939.94 (248.00) | 910.82 (246.40) | 1060.75 (280.69) | 821.32 (216.49) | 969.83 (259.17) | 855.10 (235.72) |
| | Combined | 944.43 (247.06) | 921.00 (245.04) | 1041.55 (264.60) | 844.63 (228.48) | 975.38 (247.25) | 874.86 229.62 |

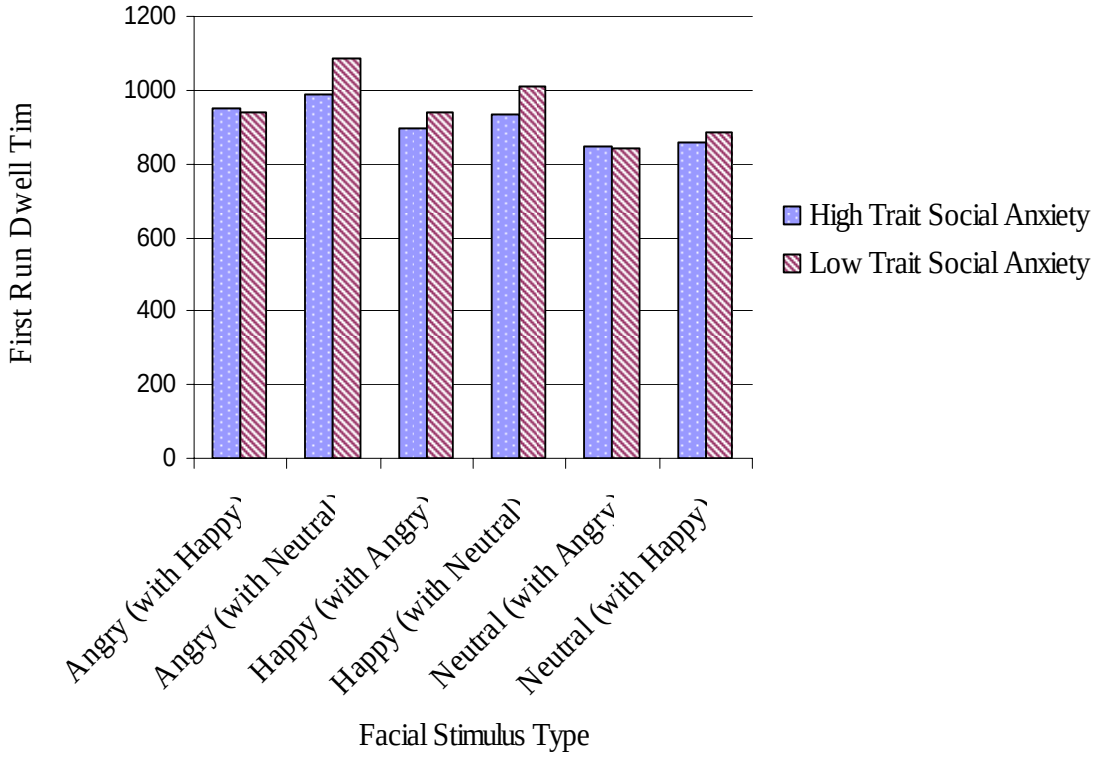



Figure 5.6: First run dwell time by trait social anxiety and facial stimulus type

## CHAPTER 6: DISCUSSION

The purpose of the current study was to address some inconsistencies and gaps in the attention to threat and social anxiety literature using a methodology that allowed for a qualitatively different assessment of the location of visual attention and its time course than was used in prior studies. Specific research hypotheses were designed to: a) test the vigilance-avoidance hypothesis of anxiety and attention to threat, b) examine the effect of state anxiety on attention to emotional stimuli, and c) examine whether facilitated detection of threat or delayed disengagement from threat better account for the attentional patterns of individuals with high levels of anxiety in the presence of threatening stimuli. In addition to the specific hypotheses, data analysis addressed questions about whether a)

the observed effects of anxiety on attention to threatening and other emotional stimuli are specific to anxiety; or, rather, are associated with negative affect as defined more broadly, b) the emotional valence of the stimulus paired with the threatening stimulus affects attentional patterns, and c) state social anxiety, trait social anxiety, and time interact to predict the timing of attention to threatening stimuli. Results of the study as they related to each of the aforementioned areas of interest will be discussed below. Treatment implications, limitations of the study, and suggestions for future research will also be discussed.

### 6.1. Testing the Vigilance-Avoidance Hypothesis

The vigilance-avoidance hypothesis states that anxious individuals initially orient towards, but subsequently avoid, highly threatening, anxiety-provoking stimuli (Mogg, Bradley et al., 2004). Evidence regarding the assertions of the vigilance-avoidance hypothesis appears to be mixed (e.g., Fox et al., 2000; Mogg, Bradley et al., 2004). Therefore, the current study was designed to test the assertions of the vigilance-avoidance hypothesis. Three hypotheses related to the vigilance-avoidance hypothesis were tested. The results of the tests of the hypotheses are summarized and discussed below.

It was hypothesized that individuals in the high trait social anxiety group would fixate more quickly on threatening stimuli than individuals in the low trait social anxiety group. The data did not support this hypothesis. Interestingly, although the groups did not differ with regard to timing of the first fixation on angry faces, the high trait social anxiety group was faster to fixate on happy and neutral faces when they were paired with angry faces than the low trait social anxiety group. Although unexpected, the finding is

not necessarily inconsistent with theories of anxiety as having a threat detection function or the tenets of the vigilance-avoidance hypothesis.

In the current study, the dependent variables measured did not assess the timing of threat detection; rather, the study assessed the timing of fixations. On average, trait socially anxious participants made their first fixations on the angry images in the angry-neutral trials around 700 ms after the onset of the stimuli. Detection typically occurs within 100 ms (Utama, Takemoto, Koike, & Nakamura, 2009). Therefore, it is likely that the participants detected the threatening stimuli prior to fixation and that high trait social anxiety participants actively avoided the angry stimuli by fixating more quickly to non-threatening stimuli. This is consistent with the idea that high trait social anxiety participants are avoiding angry faces.

It was hypothesized that individuals in the high trait social anxiety group would return their attention to threatening stimuli more frequently than individuals in the low trait social anxiety group when first presented with threat, but that they would subsequently fixate less frequently. Results did not support this hypothesis. Instead, the frequency with which participants returned their attention to angry faces did not differ by trait social anxiety.

Similarly, it was hypothesized that individuals in the high trait social anxiety group would spend more time examining threatening stimuli when initially presented with it than individuals in the low trait social anxiety group, but that they would subsequently spend less time examining the threatening stimuli. Results did not support this hypothesis. In fact, no differences between high and low trait social anxiety

participants emerged with regard to the amount of time they spent examining facial stimuli.

There were no differences between the high and low trait social anxiety groups in terms of how often participants returned their attention to threatening stimuli and the duration of the examination of the angry stimuli. The null results are not surprising considering the lack of consensus on the topic in the literature. For example, some studies have found evidence for avoidance of threatening stimuli at 500 ms following the onset of the stimuli (e.g., Chen et al., 2002; Vassipoulos, 2005), while some studies have found evidence of an attentional bias towards threat at that time point (e.g., Mogg, Philippot, et al., 2004, Sposari & Rapee, 2007). Furthermore, these findings are consistent with studies that demonstrate that anxiety does not always moderate patterns of attention to threat (e.g., Esteves, 1999; Fox et al., 2000).

In general, patterns of visual attention can be influenced by a number of variables including the affective intensity of the stimuli. Therefore, it is possible that differences among the studies might be a result of seemingly minor variations in methodology. For example, building upon the idea that trait anxiety does not always affect attention to threat and the inconsistencies that exist in the literature, Wilson and MacLeod (2003) explored the effect of stimulus intensity on attention to threat. Participants with high or low trait anxiety engaged in a dot probe task during which mildly, moderately, and highly threatening facial stimuli were presented. The authors conclude that, consistent with Mathews and Mackintosh (1998) model of attention to threat, all people orient attention away from mildly threatening stimuli and toward highly threatening stimuli. However, whether or not someone orients attention away from moderate threat depends on the

person's anxiety level; high anxious individuals orient toward it while low anxious individuals orient away from it. In a similar study, Mogg et al. (2007) monitored the gaze of participants with high and low levels of trait anxiety when presented with angry, fearful, and neutral facial stimuli. The angry and fearful faces varied in intensity of expressed emotion. Although the groups did not differ in terms of proportion of trials in which the initial orientation was to a mildly negative (as opposed to a neutral) facial stimulus, participants in the high trait anxiety group exhibited a greater vigilance for the more intense negative facial stimuli than participants in the low trait anxiety group. Given the Wilson and MacLeod (2003) and Mogg et al. (2007) studies, it is possible that results of the current study would have been different if the stimulus intensity were different.

Unexpected findings concerning the vigilance-avoidance hypothesis might be accounted for by methodological differences between the current study and past studies of the vigilance-avoidance hypothesis. Specifically, the majority of the research on the vigilance-avoidance hypothesis has been conducted using the dot probe task. The task of the participant in the dot probe task is to indicate the location of a probe. In contrast, the current study utilized a free view task in which participants were asked to examine the visual stimuli, but the manner in which they were to do so was not specified. Task differences appear to be important as task requirements have been found to have a great influence on visual attention (e.g., Dodd, Van der Stigchel, & Hollingworth, 2009). Furthermore, the dependent variables derived from the dot probe task are different from the dependent variables derived from the free view task of the current study. In a dot probe task, the location of visual attention is inferred for a specific point in time (e.g., 500 ms following the onset of the stimulus). In contrast, eye tracking allows for the

determination of a variety of variables such as timing of first fixation and dwell time. The location of visual attention at a particular time point is not typically assessed. Therefore, studies that use the differing methodologies are not directly comparable.

Currently, there are few published studies that have utilized eye tracking in the study of visual attention to threat and anxiety. Not surprisingly, the results of these studies appear to be mixed. Although the current study found that participants exhibited an initial avoidance followed by no attentional bias, some studies report a vigilance-avoidance pattern. For example, results from a study of spider phobics provide evidence for a vigilance-avoidance pattern of visual attention (Rinck & Becker, 2006). The authors found that participants with a significant spider phobia spent more time examining images of spiders than the control participants during the first 500 ms of the trials, but that the groups did not differ during the next 1 second of the stimulus presentations. Furthermore, the spider phobia group spent less time examining the spider images than the control group during the remainder of the 1-minute trial. Rohner (2002) made slightly different conclusions. Rohner (2002) reported that both high and low trait anxiety participants spent more time on average examining angry faces than happy faces in the first second of the trial, but that during the last second of the trials, the high trait anxiety participants avoided the angry faces more than they did from the happy faces. The low trait anxiety group did not exhibit a bias in the last second of the trial. Similarly, Hermans, Vansteenwegen, and Eelen (1999) monitored the attention of participants with both high and low levels of spider phobia during a task in which they were asked to view pictures of spider and flower stimuli simultaneously. Results suggest that both groups exhibited a vigilance towards the spiders initially, but that the high spider phobia group

avoided the spiders as trial time progressed. The low spider phobia group maintained their vigilance towards spiders throughout the trials.

In contrast to Rinck and Becker (2006) and Rohner (2002), some studies report evidence for a vigilance-vigilance pattern of visual attention to threat. For example, Armstrong et al. (2010) reported that participants with high fears of contamination orient their attention more quickly to fearful faces and maintain their gaze on facial stimuli with fearful and disgusted facial expressions for longer than participants with low contamination fear in a free view task. Similarly, in a study examining the visual attention of Iraq war veterans to generally negative stimuli and Iraq-relevant negative stimuli in a free view task, Kimble et al. (2010) reported that veterans with greater PTSD symptoms spent more time examining the generally negative stimuli than veterans with lower levels of PTSD symptoms. Also, they reported a trend for the high PTSD group to fixate first on the Iraq-relevant stimuli. Consistent with evidence that participants with high levels of anxiety will fixate more quickly on threatening stimuli, as described above, Mogg et al. (2007) found that high trait anxiety participants tend to fixate first on images of people with negative emotional facial expressions more often than participants with low trait anxiety.

There are few, if any, studies of social anxiety and the vigilance-avoidance hypothesis that utilize eye trackers. Although there has been some research on visual attention to threat and other anxiety disorders, more research specific to social anxiety is necessary because there are differences among the anxiety disorders that could influence visual attention to threat. As a basic example, the definition of threat, and therefore the operationalization of “threat,” differs among the anxiety disorders. Knowing what

constitutes a threat is crucial for designing studies of visual attention to it as research suggests that threat is disorder-specific (Hope et al., 1990). Conversely, determining oculomotor behavior in the presence of a given stimulus might inform our knowledge of what is and is not "threatening" for both the individual and people with high levels social anxiety. As another example, studies of visual attention to threat that use participants with high levels of social anxiety might be different from studies of attention to threat in other anxiety disorders populations because experimental procedures themselves (e.g., arriving for a laboratory study, performing a task in front of the researchers) can trigger social anxiety and possibly influence visual attention.

In sum, the current study did not support the vigilance-avoidance hypothesis. Instead, it appears as though participants in the high trait social anxiety group initially avoided threatening stimuli, as compared to the low trait social anxiety group, but subsequently did not differ from the low trait social anxiety group in terms of attentional bias. The current study tested the tenets of the vigilance-avoidance hypothesis using a methodology that had not been used before with a sample selected for levels of trait social anxiety. Methodological differences between the current study and prior studies of the vigilance-avoidance hypothesis (i.e., dot probe studies) might account for some of the unexpected results of the current study, although more empirical research is necessary to determine which variables affect visual attention to threat for individuals with high levels of social anxiety.

### 6.2. The Effect of State Anxiety on Attention to Emotional Stimuli

Given the evidence that state social anxiety is associated with biased attention towards emotional stimuli in general (as opposed to a threat specific bias; e.g., Rutherford

et al., 2004), it was hypothesized that individuals in the high state anxiety group would fixate more quickly than individuals in the low state anxiety group on emotional stimuli (i.e., threatening or happy). Determining the effects of state social anxiety on patterns of attention to threat in particular across time is important because it has theoretical implications. Specifically, a number of theoretical models that explain patterns of attention to threat associated with anxiety posit that elevations in state social anxiety enhance the detection of threatening stimuli, resulting in vigilance for threat (e.g., Barlow, 2000; Mathews & Mackintosh, 1998; Rapee & Heimberg, 1997).

Contrary to the aforementioned predictions, state social anxiety did not affect the speed with which participants fixated on emotional stimuli. The results are not entirely surprising given the inconsistencies in the literature. Specifically, some studies report no predictive ability of state anxiety (e.g., Pineles & Mineka, 2005), while other studies report that state anxiety predicts attention to emotional stimuli (e.g., MacLeod et al., 1986). Furthermore, some studies report that state anxiety interacts with trait social anxiety to predict attention to emotional stimuli, although it does not predict attention to threat alone (e.g., Mansell et al., 1999).

Research suggests that the results of the current study with regard to the effects of state social anxiety might have been different if verbal stimuli were used instead of the facial stimuli. An examination of the aforementioned studies that address state anxiety and attention to emotional stimuli suggests that the studies that include facial stimuli produce results that differ from studies that use verbal stimuli. Specifically, studies that used facial stimuli concluded that elevations in state anxiety lead individuals to avoid

emotional stimuli, whereas studies that used verbal stimuli concluded that elevations in state anxiety lead individuals to attend to emotional stimuli.

As evidence for the importance of stimulus choice, Mansell et al. (2002) conducted two dot probe tasks with identical specifications except that in one task words were used and in the other task facial images were used as stimuli. Trait social anxiety predicted the avoidance of threatening stimuli when the facial stimuli were used, but not when words were used as stimuli. Similarly, Reinholdt-Dunne, Mogg, and Bradley (2009) asked participants with high and low trait anxiety to engage in Stroop tasks in which participants were asked to identify the color of emotional facial stimuli or words. Participants with high trait anxiety exhibited a greater Stroop interference than low trait anxiety participants in the emotional faces were used as stimuli, but not when emotional words were used as stimuli. Therefore, it is possible the type of stimulus used in the current study influenced attentional patterns within the study.

Stimulus intensity and saliency are two factors that could provide clarification concerning the causes of the attentional differences that exist between studies that use facial stimuli and studies that use verbal stimuli. As discussed above in the vigilance-avoidance hypothesis section, stimulus intensity appears to be an important variable to consider when assessing patterns of attention to threat (Wilson & MacLeod, 2003). It is possible that emotional facial stimuli are perceived as more intense than emotional words, especially within a socially anxious population, and that this difference produces seemingly inconsistent results across studies that use different types of stimuli. Furthermore, empirical evidence suggests that emotional facial information is more

salient and easily processed than emotional words (Beall & Herbert, 2008), which may lead to larger differences between studies that use different stimuli.

In conclusion, participants with high and low state social anxiety participants did not differ with regard to how quickly they fixated on emotional stimuli. The results of the current study appear consistent with at least one prior examination of the association between state anxiety and attention to emotional stimuli (Pineles & Mineka, 2005), but inconsistent with a number of other studies (e.g., MacLeod et al., 1986). Analysis of the pertinent research suggests that the type of stimulus used as emotional stimuli (e.g., facial or verbal) matters. Specifically, it appears as though when a person experiences inflated state anxiety, they avoid emotional facial stimuli and attend to emotional words. These patterns might be explained by intensity and saliency differences between the types of stimuli.

### 6.3. Difficulty with Disengagement

Research using dot probe tasks suggests that difficulty disengaging attention from threatening stimuli is associated with high trait social anxiety (e.g., Fox et al., 2002). Therefore, it was hypothesized that individuals with high trait social anxiety would spend more time attending to threatening stimuli following their first fixation on the threatening stimuli before viewing the other stimuli than individuals in the low trait social anxiety group. Results did not support the hypothesis. Instead, the data indicate that there is no difference between the trait social anxiety groups with regard to the amount of initial dwell time on angry faces for angry-happy trials, but that for angry-neutral trials, individuals in the low trait social anxiety group had longer initial dwell times on the angry face than individuals in the high trait social anxiety group.

Results are inconsistent with many prior studies investigating the possibility that individuals with high trait anxiety experience a delayed disengagement from threat. In particular, evidence from studies using emotional cuing paradigms (Amir et al., 2003; Fox et al., 2002) and at least one eye tracking study using a free-view task (i.e., Buckner et al., 2010) provide support for the idea that participants with high trait anxiety experience a delay in disengaging from threatening stimuli. As discussed previously, methodological differences between the current study and studies using emotional cuing paradigms might account for some of the inconsistencies. Although the current study and Buckner et al. (2010) used similar methodologies, the studies differed in the way in which they measured delayed disengagement from threat. In the current study, delayed disengagement from threat was operationalized as longer initial dwell times on the threatening stimuli. In contrast, Buckner et al. (2010) divided the 2,000 ms trial duration into four 500 ms segments. For each segment, they calculated the proportion of fixation time on the threatening stimulus. Then, they calculated a proportion of fixation time change score by subtracting the proportion of fixation time in the last 500 ms from the proportion of fixation time in the second 500 ms. An analysis of the differences between the groups in terms of change score revealed that participants with high social anxiety reduced their proportion of fixation scores more slowly than participants with low social anxiety. Therefore, the Buckner et al. (2010) conceptualization of delayed disengagement is not directly comparable to the conceptualization of delayed disengagement in the current study. Buckner et al. (2010) emphasizes longer term changes in attention than the current study.

## 6.4. Facilitated Detection versus Delayed Disengagement: Explained by Attentional Control?

There has been debate about whether the vigilance to threat pattern associated with anxiety is better accounted for by facilitated detection of threat or delayed disengagement from threat. On the one hand, visual search tasks tend to demonstrate that high social anxiety participants detect threat more quickly than low social anxiety participants (e.g., Juth et al., 2005; Veljaca & Rapee, 1998; for exceptions see Esteves, 1999 and Fox et al., 2000). On the other hand, emotional cuing tasks (Amir et al., 2003; Fox et al., 2002) and at least one eye tracking study (Buckner et al., 2010) provide evidence for delayed disengagement from threat. The results from the current study provide evidence that high anxiety participants do not experience difficulty disengaging from threat. Given the mixed empirical evidence involved in the debate, it is unlikely that the field will come to a consensus soon. Fortunately, some researchers have conducted studies aimed at better understanding the causes of the observed patterns of attention associated with anxiety.

Although many researchers contributing to the debate about facilitated detection of threat and delayed disengagement from threat have traditionally designed their studies to discover which mechanism better accounts for attentional patterns in an all-or-nothing manner, it is possible that both processes contribute to the patterns observed within a high social anxiety population. Furthermore, it is possible that a common mechanism is responsible for occurrence of both patterns, and, therefore, the maintenance of social anxiety. Empirical evidence suggests that differences in attentional control processes

between anxious and non-anxious individuals might lead to both of the observed differences in visual attention patterns.

In a recent study (Klumpp & Amir, 2010), socially anxious participants were randomly assigned to engage in one of three attention training tasks to manipulate attention a) towards threat, b) away from threat, or c) towards threat and neutral with equal frequency (control). Following attention training, participants completed a speech task. Participants who were trained to attend to threat or away from threat reported less anxiety than participants in the control condition. Results suggest that cognitive control difficulties in general might play a causal mechanism in the maintenance of anxiety.

A number of studies of attention are consistent with the Klumpp and Amir (2010) findings. For example, research on basic attentional processes suggests that individuals with high social anxiety exhibit a greater vigilance for salient stimuli (including non-emotional stimuli) than individuals with lower social anxiety (Moriya & Tanno, 2009). This research suggests that, consistent with Klumpp and Amir (2010), anxiety is associated with cognitive control difficulties. Furthermore, attentional control abilities appear to mediate the relationship between attention to threat and anxiety. As a demonstration of this idea, Derryberry and Reed (2002) found that, in general, high trait anxiety participants exhibit an early bias towards threat (assessed at 250 ms after the onset of the threatening stimulus), but that whether the participant exhibits a bias towards threat later (500 ms after the onset of the threatening stimulus) depends on attentional control. High anxiety participants with high attentional control avoid threatening stimuli at 500 ms, but high anxiety participants with low attentional control attend to threatening stimuli at 500 ms. Similarly, Reinholdt-Dunne et al. (2009) used an emotional Stroop task

with emotional faces tinted with varying colors as stimuli to assess interference from emotional non-relevant stimuli. They reported a greater emotional Stroop interference for participants with high trait anxiety and low attentional control than other participants. Participants with low trait anxiety (regardless of attentional control) and participants with high trait anxiety and high attentional control exhibited a smaller interference than the high trait anxiety and low attentional control group.

In sum, anxiety might be associated with both facilitated detection of and delayed disengagement from threat. It is possible that both patterns of attention are the result of a common mechanism. Specifically, it is possible that attentional control differences between high and low trait social anxiety individuals produce both patterns and are important for the maintenance of social anxiety.

### 6.5. Are Attention Patterns Unique to Anxiety?

There is strong research support for the idea that anxiety is associated with attention to threatening stimuli, whereas depressive symptoms are more strongly associated with attention to dysphoric imagery. Evidence for this assertion comes from studies using both eye tracking (Kellough et al., 2008) and dot probe (Gotlib et al., 2004; Bradley et al., 1998) methodologies. In the current study, trait and state anxiety groups were used as the independent variables in statistical analyses that controlled for the effects of negative affect on attention to emotional stimuli. None of the main effects of negative affect were significant in the analyses reported in the current paper. These results are not surprising given that the majority of the hypotheses concerned attention to threat and that prior research suggests that general negative affect does not predict

attention to threat. Results of the current study appear to support the idea that anxiety specifically, and not negative affect in general, affects patterns of attention to threat.

### 6.6. The Emotional Valence of the Stimulus Paired with Threat

The majority of studies of anxiety and attention to threat present threatening and neutral stimuli simultaneously in order to measure attentional bias (e.g., Mogg & Bradley, 2002; Vassilopoulos, 2005). As a result, little is known about attentional patterns of anxious individuals when threatening stimuli are paired with other emotional stimuli. In general, results of the current study suggest that the emotional valence of the stimulus paired with threat affects attentional patterns towards threat.

Trait social anxiety appears to interact with the emotional valence of the stimulus paired with threat to produce variations in the duration of the first fixation on angry faces. When an angry face is paired with a neutral face, the low trait social anxiety participants exhibit longer dwell times the first time they fixate on the angry face than high trait social anxiety participants. In contrast, on angry-happy trials, there is no difference between the trait social anxiety groups with regard to the duration of their first fixation on the angry face.

State social anxiety interacts with the emotional valence of the stimulus paired with threat to produce variations in dwell time on threatening stimuli and the number of times participants returned their attention to threatening stimuli. On angry-neutral trials, the low state social anxiety participants exhibited greater dwell times on the angry face than the high state social anxiety participants. Differences between the groups did not emerge with regard to dwell time on angry-happy trials. On angry-happy trials, low state social anxiety participants returned their attention to the happy faces less than the high

state social anxiety participants. There were no differences between the groups with regard to this variable on angry-neutral trials.

In general, the way in which trait and state social anxiety interact with the type of stimulus paired with threat to produce attentional patterns is mostly consistent with evidence that anxiety affects attention to threatening stimuli when paired with neutral stimuli (e.g., Vassilopoulos, 2005) and that individuals, regardless of state or trait anxiety, are more vigilant for emotional faces than neutral faces (Holmes, Bradley, Nielsen, & Mogg, 2009). As discussed previously, high trait and state social anxiety participants exhibited avoidance of threatening stimuli when the threatening stimuli were paired with neutral stimuli (as evidenced by first run dwell time and dwell time, respectively). However, when the threatening stimuli were paired with positive stimuli, the tendency for emotional faces in general to capture attention likely counteracted the tendency for low trait and state social anxiety participants to attend to the threatening stimuli because both the positive and threatening stimuli are emotional.

These results are consistent with Becker (2010) who reported that attention (regardless of a participant's anxiety) does not reliably follow a particular stimulus when threatening and positive stimuli are paired. Furthermore, Becker (2010) explained that attention does not reliably follow either positive or neutral stimuli when these types of stimuli are paired either, although attention follows threatening stimuli when paired with a neutral stimulus. As a result, Becker (2010) proposes that attentional patterns in the presence of paired threatening and positive stimuli are not predictable based on knowledge of how they affect attention in the presence of neutral stimuli alone.

The current study suggests that the emotional valence of the stimulus paired with the threatening stimulus affects attentional patterns towards threat in terms of first run dwell time and total dwell time. In general, the pattern of results is consistent with empirical data suggesting that anxiety determines patterns of attention to threatening stimuli when the threatening stimuli are paired with neutral stimuli (e.g., Vassilopoulos, 2005) and that individuals, regardless of state or trait anxiety, are more vigilant for emotional faces than neutral faces (Holmes et al., 2009). As an exception to these trends, differences between high and low state social anxiety groups with regard to run count emerged on happy-angry trials, but not on the neutral-angry trials. Given the paucity of research in the area of anxiety and attention to positive stimuli, more research is needed to validate the results of the current study.

### 6.7. Do Trait Social Anxiety, State Social Anxiety, and Time Interact to Predict Attention to Threat?

A number of studies suggest that trait social anxiety differentially affects patterns of attention to threat across time (e.g., Mogg, Bradley et al., 2004; Vassilopoulos, 2005). Although there are some studies that examine the influence of a socially threatening situation on patterns of attention to threat (e.g., Mansell et al., 2002), few studies (if any) have examined the effects of state social anxiety across time or how it interacts with trait social anxiety across time to predict patterns of attention to threat. It is important to determine how anxiety-provoking situations can influence the effect of trait social anxiety on attention to threat across time to further refine our theories of the relationship between anxiety and attention to threat.

The interaction between trait social anxiety, state social anxiety, and time was a significant predictor of both dwell time and run count (the number of times attention returned to a particular stimulus). Timing did not influence either variable with regard to angry faces for high trait social anxiety participants in the speech condition. In contrast, high trait social anxiety participants in the no speech condition exhibited a vigilance-avoidance pattern such that they spent a greater amount of time examining the angry face and returning their attention to the angry during the first 1000 ms than in the last 2000 ms of each trial. The pattern is reversed for participants in the low trait social anxiety condition. Specifically, timing did not influence either variable with regard to the angry faces for low trait social anxiety participants in the no speech condition; however, for low trait social anxiety participants in the speech condition, timing was important. Low trait social anxiety participants in the speech condition spent a greater amount of time examining the angry faces and returning their attention to the angry faces during the first 1000 ms of the trials than the last 2000 ms of the trials.

More concisely, timing was not important for participants in either of the extreme conditions (i.e., high or low state and trait anxiety) as their vigilance towards threat (or lack thereof) remained constant. Relative to each other, the high state and trait social anxiety group remained avoidant across time whereas the low state and trait social anxiety group remained vigilant across time. For participants in the other two groups, timing was important. In fact, both of the non-extreme conditions showed a similar vigilance-avoidance pattern. Analyzed differently, there appears to be one group during each time point that deviates from the other three groups. In the first 1000 ms, the high trait social anxiety participants in the speech condition exhibit less of a bias towards

threat than the other groups. In the last 2000 ms, the low trait social anxiety participants in the no speech condition exhibit a greater bias towards threat than the other groups.

Theoretically, individuals with high trait and state social anxiety should exhibit vigilance for threatening information (e.g., Barlow, 2000; Mathews & Mackintosh, 1998; Rapee & Heimberg, 1997). This was not the case. It is possible that the combination of a high baseline trait anxiety and an impending threat might have caused participants in the high trait and state social anxiety condition to reach an intensity of anxiety at which avoidance is a more adaptive mechanism. Alternatively, consistent with Clark and Wells (1995), it is possible that when social anxiety is elevated, the individual experiencing the anxiety focuses more on internal, as opposed to external, threat cues. Although the mechanism that produced these patterns is unknown, the current study implies that trait and state social anxiety as well as timing are important variables to assess when studying the effect of anxiety on attention to threat.

### 6.8. Treatment Implications

There are effective interventions for social anxiety disorder (Chambless & Hope, 1996; Fedoroff & Taylor, 2001; Feske & Chambless, 1995; Hofmann & Smits, 2008; Norton & Price, 2007; Powers et al., 2008; Taylor, 1996); however, both psychosocial and psychopharmacological treatments result in significant numbers of treatment non-responders (Heimberg et al., 1998). The results of the current study have implications for improving treatments for social anxiety disorder in terms of timing of attentional manipulations and the types of stimuli used.

The current study most directly informs the attention modification based treatments for social anxiety disorder. A number of studies (e.g., Amir et al., 2008;

Klumpp & Amir, 2010; Li et al., 2008; Schmidt et al., 2009) have demonstrated the utility of attention modification programs in decreasing social anxiety. Many of these attention training programs are based on the idea that individuals with social anxiety attend to threatening stimuli (when paired with neutral or positive stimuli) approximately 500 ms following the onset of the threatening stimulus.

Based on the idea that it might be beneficial for individuals with high trait social anxiety to attend to threat in a way that is more similar to the way in which individuals with low social anxiety attend to threat, the current study would suggest two enhancements of attention modification programs. First, the study suggests that attention modification programs should attend to the manipulation of first fixation on neutral stimuli. Specifically, the speed with which high trait social anxiety participants fixate on a neutral stimulus when that stimulus is paired with a threatening stimulus, should be slower. However, this suggestion seems to conflict with the findings that the existing programs that direct attention towards neutral stimuli at 500 ms are effective . Second, the study suggests that attention modification programs should manipulate the duration of the first fixation on the threatening stimulus such that the duration is greater.

Although the development of attention modification programs have traditionally focused on the manipulation of attention away from threat, at least one study (Klumpp & Amir, 2010) suggests that it is attentional control, and not attention towards or away from threat per se, that affects anxiety. This study is consistent with research suggesting that attentional control moderates the relationship between anxiety and attention to threat (Derryberry & Reed, 2002; Reinholdt-Dunne et al., 2009). Furthermore, attention to emotional stimuli appears to be a “top-down” (i.e., not automatic) process (Pessoa,

Kastner, & Ungerleider, 2002) under the control of the lateral prefrontal cortex (Browning, Holmes, Murphy, Goodwin, & Harmer, 2010). The lack of automaticity involved in attention to emotional stimuli might render resulting patterns more susceptible to change. Given this evidence, trainings designed to improve attentional control might be a useful adjunct to (if not a replacement for) existing attention modification programs.

It is possible that existing attention modification programs would be improved if the programs included efforts at increasing the duration of the initial fixations on angry stimuli. Additionally, attempts to modify basic attentional control capabilities might result in greater anxiety reductions. The most effective ways to manipulate attention as described above have yet to be determined. In fact, recent research suggests that attention modification training programs that use modified dot probe tasks affect subsequent attentional bias towards threat only when attention is manipulated later than 100 ms following the onset of the threatening stimuli (Koster, Baert, Bockstaele, & De Raedt, 2010). Therefore, it is unclear how early attention can be manipulated to produce subsequent changes in attention towards threat. Ultimately, more empirical research is necessary to determine the characteristics of the most efficacious attentional modification training programs.

### 6.9. Limitations

The results of the current study should be interpreted in light of the study's limitations. Potential limitations of the current study include the use of a non-clinical sample,the use of angry faces as threatening stimuli, the short trial duration, and the

possibility that state anxiety was elevated in the sample. These potential limitations are discussed below.

In general, the use of a non-clinical sample in social anxiety research does not appear to be problematic given that primarily non-clinical samples have been used in the past to study attention to threat (e.g., Bradley et al., 1998), thus facilitating the comparison between the results of the proposed studies and prior studies. Furthermore, the experience of transient social anxiety is thought to differ quantitatively, not qualitatively, from the experience of individuals with social anxiety disorder (Rapee & Heimberg, 1997). Finally, the effect size associated with threat-related attentional biases does not differ significantly between participants diagnosed with an anxiety disorder and high anxiety, non-clinical participants (Bar-Haim et al., 2007). Of course, replication of the current study with a social anxiety disorder sample would provide better evidence of the similarities between the clinical and non-clinical social anxiety samples.

Although many studies of attention to threat and social anxiety have used angry faces as threatening stimuli, recent evidence suggests that disgust faces might be more threatening to individuals with high social anxiety. Amir, Najmi, Bomyea, and Burns (2010) asked participants to rate the negativity of both angry and disgust faces. Although participants with high general anxiety and non-anxious controls did not rate the stimulus types differently, participants with high social anxiety rated the disgust faces as more negative than the angry faces. Despite the differences in severity, the use of disgust faces as threatening stimuli appears to have produced results consistent with similar studies that used angry faces as threatening stimuli (e.g., Buckner et al., 2010). Future research

should investigate whether the use of disgust faces produces any results that are important and different than the results produced using angry faces.

The three-second duration of the trials might have limited the results of this dissertation, especially as the results relate to the dwell time and run count variables. The three-second duration of the trials provided a small time frame within which the assessed behaviors could occur. This limitation is especially salient for the run count variable. On average, participants were only able to return their attention to each stimuli less than two times. If given more time to examine the stimuli, it is possible that greater differences would have emerged between the conditions.

Finally, it is possible that the sample, regardless of speech condition, was experiencing elevated state anxiety during the experiment. Prior to the manipulation of state anxiety (i.e., the speech manipulation), all participants completed the informed consent form. The informed consent indicated that the participants might be asked to engage in a speech task. Many participants reported their desire to be assigned to the no speech condition, suggesting that they were worrying about the possibility of being assigned to the speech condition. It is possible that the anxiety of participants in the no speech condition did not completely return to baseline following their assignment, thus reducing the difference between the speech and no speech conditions with regard to state anxiety. Future research might benefit from a manipulation of state anxiety that limits the potential for participants in the low state anxiety condition to experience elevated state anxiety.

## 6.10. Future Research

The current dissertation highlights the need for future research in the area of social anxiety and attentional patterns in the presence of threatening stimuli. It is difficult to make comparisons between the current study and studies in the area using other methodologies (e.g., dot probe, emotional Stroop) due to differences in assessed dependent variables and tasks. Conducting more studies using eye tracking would result in a greater understanding of the relationship between social anxiety and attention to threat as eye tracking allows researchers to examine attention in a way that is different, albeit complementary, to methods of attentional assessment. Also, the recent literature exploring attentional control and social anxiety (e.g., Klumpp & Amir, 2010) should be expanded. This emerging body of literature highlights the importance of assessing basic attentional capacities in the process of studying anxiety and attention. Furthermore, future research is necessary to determine how to best improve attentional control to result in decreases in anxiety.

Most importantly, researchers should continue to adapt attentional modification training programs based on both the empirical and theoretical literature and to test empirically the efficacy of these programs. Differences among training programs in terms of affective type and intensity of the stimuli used, timing of the attentional modifications, the way in which attention is modified, and whether the programs are conducted while the patient is experiencing high or low state anxiety might produce efficacy differences among the programs.

## 6.11. Conclusion

The current dissertation explored many questions arising from the social anxiety and attention to threat literature. The study did not support the vigilance-avoidance hypothesis in the expected manner. Instead, it appears as though high trait social anxiety participants were faster to fixate on neutral stimuli paired with threatening stimuli. No differences between high and low trait social anxiety participants with regard to speed of first fixation on threatening stimuli emerged. Similarly, there no differences between the trait social anxiety groups with regard to the number of times their attention returned to, the initial dwell time on, or the total dwell time on the threatening stimuli. Results are consistent with a pattern in which high social anxiety participants are initially aware of, but actively avoid, threatening stimuli. State social anxiety did not predict how quickly fixations on emotional stimuli occurred. Furthermore, the study did not support the idea that participants with high trait social anxiety experience a delay in disengagement from threat. In fact, results suggest that low trait social anxiety participants exhibited longer initial dwell times on threatening stimuli.

Inconsistencies between the current study and prior studies in the area can be (at least partially) explained by methodological differences between the studies. Future research in the area is important for a better understanding of the intricacies of the way in which individuals with high social anxiety attend to threat and for the development of more effective treatments for social anxiety disorder.

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