TIME-COURSE OF ATTENTIONAL BIASES FOR THREATENING FACES IN YOUTH WITH ANXIETY DISORDERS AND NONCLINICAL CONTROLS

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ABSTRACT OF THE DISSERTATION

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Cognitive-behavioral theories of youth anxiety (e.g., Kendall, 1985; Kendall & Ronan, 1990) posit that distortions in the way youth process information may play a role in the etiology and maintenance of these disorders. Research measuring attention allocation for emotional stimuli can test sophisticated models of cognitive processes in youth anxiety disorders, such as the vigilance-avoidance model. The vigilance-avoidance model of anxiety suggests that anxious individuals may demonstrate an attentional bias toward threatening stimuli at the involuntary stages of information processing but then avoid further processing of that stimuli (see Mogg, Bradley, de Bono, & Painter, 1997). The current study used a dot-probe task to assess attentional biases for angry, happy, and sad faces at both 500 and 1250 ms in youth diagnosed with an anxiety disorder and nonclinical control youth in order to test the time-course of attentional biases for threatening cues in youth anxiety. Participants were forty-two youth between the ages of 8-17, with half meeting criteria for a principal anxiety disorder and half serving as a nonclinical control group. All youth completed a structured interview, dot-probe task and

paper and pencil questionnaires. When using our full sample of subjects, results from our study did not support the vigilance-avoidance model of anxiety in youth. Additionally, there was no difference between clinically anxious youth and nonclinical control youth on bias scores for angry, happy or sad faces. However, we found partial support for the vigilance-avoidance model when testing only the Caucasian subjects.

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CHAPTER I

Time-Course of Attentional Biases for Threatening Faces in Youth with Anxiety Disorders and Nonclinical Controls

Anxiety disorders are among the most prevalent disorders in youth (Albano, Chorpita, & Barlow, 1996) with point prevalence rates of up to 20% (Costello, Egger, & Angold, 2005). Cognitive-behavioral theories of youth anxiety (e.g., Kendall, 1985; Kendall & Ronan, 1990) posit that distortions in the way youth process information may play a role in the etiology and maintenance of these disorders. Kendall & Ronan (1990) propose that, similar to anxious adults, anxious youth have threat-focused schemas that when activated, influence cognitions and behavior. Research on distortions in attention for threat-related information in youth has gained considerable popularity. In particular, researchers are interested in measuring attentional biases toward threatening information, or the tendency to selectively attend to threatening stimuli. Daleiden and Vasey (1997) interpret Kendall's theory (e.g., Kendall & Ronan, 1990) to suggest that, due to threat-focused schemas that influence how threatening information is processed, anxious youth will demonstrate an attention bias toward threatening cues in their environment.

A well-established measure of attentional biases, the dot-probe task (MacLeod, Mathews, & Tata, 1986) has been tested extensively with anxious youth and adults. As described in Puliafico and Kendall (2006), the dot-probe task includes multiple trials where two words or images (typically an affective stimulus and a neutral stimulus) are quickly displayed on a computer screen (generally 250-1500 ms). After the presentation of the stimuli, a probe (dot, arrow, asterisk) appears and replaces one of the stimuli, and

participants respond as quickly as possible (by button or key press) to specify the location of the probe or a characteristic of the probe (e.g., one versus two dots; up or down arrow). The dot-probe task measures reaction time, or the time that it takes to respond to the dot-probe, on threat congruent trials (i.e., the probe is in the same location as the threatening stimulus) and threat incongruent trials (i.e., the probe occurs in the opposite location of the threatening stimulus). Most researchers hypothesize that anxious individuals, compared to non-anxious controls, will have quicker response times when the probe replaces the threatening stimulus because they are initially drawn to threatening stimuli (see Puliafico & Kendall, 2006). In contrast, longer response times will occur when the dot-probe replaces the non-threatening stimulus. Attention bias scores are calculated for each subject by subtracting their mean response time (RT) for congruent trials (the probe replaces the threatening stimulus) from their mean response time for incongruent trials (the probe replaces the neutral stimulus; Bradley, Mogg, Falla, & Hamilton, 1998).

Positive bias scores indicate an attention bias toward the threatening stimulus (vigilance) and negative scores indicate an attention bias away from the threatening stimulus (avoidance; Bradley et al., 1998). In the dot-probe literature, "vigilance" can also refer to the significant, positive difference between the sample's mean attention bias score and zero (tested with a one-sample t-test; e.g., Mogg & Bradley, 1999). Similarly, "avoidance" can be defined as the significant, negative difference between the sample's mean attention bias score and zero. For clarification, I will refer to these latter definitions of vigilance and avoidance as "significant vigilance" and "significant avoidance" (Mogg & Bradley, 1999). Oftentimes, it is important to know whether subjects demonstrated vigilance (i.e., mean bias score is positive) toward threat and/or significant vigilance (i.e.,

mean bias score is significantly greater than zero) toward threat. For example, it is possible for an anxious group to be significantly more vigilant toward threat cues when compared to a nonclinical control sample (i.e., the anxious group's bias scores are positive and significantly greater than the control group's bias scores), but also for that anxious group not to have significant vigilance toward those threat cues (i.e., the anxious group's mean threat bias score is not significantly greater than zero). Additionally, the term "bias" has multiple operational definitions, such as 1) a between-subjects difference in attention bias scores for two groups (e.g., clinically anxious and nonclinical control), 2) "significant vigilance or avoidance" as described above (a difference between the sample's mean attention bias score and zero), and 3) a within-subjects difference in attention bias scores between two conditions (e.g., threat-related compared to neutral conditions; see Bar-Haim et al., 2007 for a review). Henceforth, unless specific findings are included, the reader can assume that any description of attention bias findings from previous research could include one or more of these operational definitions.

Researchers have consistently found an attentional bias toward threat words and faces using the dot-probe task in adults with generalized anxiety disorder (see Mogg & Bradely, 2005 for a review) and other anxiety disorders (e.g. social phobia, Mogg, Philippot, & Bradley, 2004). There have been relatively fewer dot-probe studies conducted with anxious youth as compared to adults, but a recent meta-analysis suggests that anxious youth demonstrate a similar bias toward threat-cues across multiple experimental paradigms (i.e., emotional Stroop and dot-probe; Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & IJzendoorn, 2007).

Studies using the dot-probe task have provided support for a bias toward threat-related words (e.g., Taghavi, Neshat-Doost, Moradi, Yule, & Dalgleish, 1999) and pictures (e.g., Hankin, Gibb, Abela, & Flory, 2010; Roy et al., 2008; Waters, Mogg, Bradley, & Pine, 2008; Waters, Wharton, Zimmer-Gembeck, & Craske, 2008) in youth diagnosed with anxiety disorders. Additional studies that tested samples of nonselected youth (i.e., a sample of youth not selected based on clinical or nonclinical status or symptom severity) with dot-probe tasks found that anxiety severity was positively associated with attention bias scores for threatening faces (Heim-Dreger, Kohlmann, Eschenbeck, & Burkhardt, 2006; Telzer et al., 2008; Waters, Kokkoris, Mogg, Bradley, & Pine, 2010; Watts & Weems, 2006). A few of the studies found support for attentional biases toward threatening stimuli in samples of youth with a range of anxiety disorders (e.g., social phobia, generalized anxiety disorder, separation anxiety; Roy et al., 2008; Waters, Wharton et al., 2008), and a select number of studies have examined and found support for attentional biases toward threatening stimuli in samples of youth with specific types of anxiety such as social anxiety (Stirling, Eley, & Clark, 2006), PTSD (Pine et al., 2005), or generalized anxiety (Waters, Mogg et al., 2008).

Time-Course of Attentional Biases in Adult Anxiety Disorders

As reviewed by Bar-Haim et al. (2007), theorists have proposed that differences in attentional processes in individuals with anxiety may be present across one or more stages of information processing. Williams, Watts, MacLeod, and Mathews (1988) suggest that anxious individuals demonstrate an automatic attention bias toward threatening information (i.e., at the involuntary stages of information processing). This

account is consistent with the *vigilance* (MacLeod et al., 1986) theory of anxiety, which describes anxious individuals as hypervigilant toward threat in their environment.

In comparison, other theorists have suggested that anxious individuals demonstrate a propensity to avoid or disengage attention from threatening stimuli and therefore halt the emotional processing of that information (e.g., Foa & Kozak, 1986). Indeed, disengagement of attention in anxiety is supported by theories describing the role of *avoidance* in anxiety disorder etiology and maintenance (Borkovec, Alcaine, & Behar, 2004). Given this theory, one might expect an anxious individual to avert attention away from threatening stimuli. Additionally, other researchers have proposed a merging of the hypervigilance and avoidance models by suggesting that both play a significant role in the attentional biases found in anxious individuals. For example, some theorists have proposed a vigilance-avoidance pattern of attention, suggesting that anxious individuals may demonstrate an attentional bias toward threatening stimuli at the involuntary stages of information processing but then avoid further processing of that stimuli (e.g., disengagement or redirection of attention; see Mogg, Bradley, de Bono, & Painter, 1997; Williams et al., 1988).

As reviewed by Waters et al. (2010), researchers studying adult anxiety have begun to test attentional patterns of vigilance and avoidance by including short and/or long stimulus durations in a dot-probe task. Dot-probe research has consistently demonstrated a greater attentional bias toward threatening words or pictures presented at short stimulus durations (e.g., 500 ms) in anxious compared to nonanxious adults (Bar-Haim et al., 2007). Studies testing attentional biases for threat cues in adults using both short and long stimulus durations (e.g., 1000 ms or greater) within the same dot-probe

task have generated inconclusive findings. Some studies suggest a dissipation of attentional bias toward threat over time in anxious individuals (Frewen, Dozois, Joanisse, & Neufeld, 2008). Specifically, Bradley et al. (1998) found that high trait anxious adults were significantly more vigilant for threat than low trait anxious adults at 500 ms, but there was only a trend toward a significant difference between groups at 1250 ms. Moreover, a study conducted by Mogg, Philippot, et al., 2004 found that a sample of adults with social phobia showed significant vigilance (i.e., mean bias score was significantly greater than zero) toward threatening faces at the 500 ms stimulus duration, but no significant attentional bias was found at 1250 ms. However, some research with adults suggests that anxiety is associated with an attentional bias toward threatening stimuli (words or faces) presented at both short (100, 500 ms) and long (1250, 1500 ms) stimulus durations (GAD: Bradley, Mogg, White, Groom, & de Bono, 1999; state anxiety: Mogg et al., 1997).

Finally, a few studies in the adult literature have shown support for a pattern of vigilance and avoidance for threatening stimuli using the dot-probe task. Mogg, Bradley, Miles, and Dixon (2004) used a dot-probe paradigm to test the vigilance-avoidance model of attention with a sample of adults high (n = 15) or low (n = 15) in trait anxiety. This dot-probe task used high threat and mild threat scenes paired with nonthreat scenes from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 1995). They found that the high trait anxious adults were significantly more vigilant (mean bias score = 33 ms) toward high threat scenes presented at the short stimulus duration (500 ms) when compared to the low trait anxious adults (mean bias score = 4 ms), with no difference in attentional bias between the two groups at the longer stimulus

duration (1500 ms). However, there was an effect of stimulus duration for adults high in blood injury fear (n = 11), as they demonstrated significant vigilance (i.e., mean bias score was significantly greater than zero) for high threat scenes at 500 ms and subsequent significant avoidance (i.e., mean bias score was significantly less than zero) of high threat scenes at 1500 ms. Additionally, there was an effect of stimulus duration for those adults in the medium blood injury fear group (n = 16), who also demonstrated significant vigilance for high threat scenes at 500 ms, with no significant bias at 1500 ms. Finally, there was no effect of stimulus duration for those adults low in blood injury fear (n = 13), with no significant biases at either stimulus duration.

Koster, Verschuere, Crombez, and Van Damme (2005) also found support for avoidance at a longer stimulus duration time using a dot-probe task with high (n = 21) and low trait (n = 22) anxious adults. This dot-probe task also used high threat and mild threat scenes paired with nonthreat scenes (IAPS; Lang, Bradley, & Cuthbert, 1999), and used both 500 and 1250 ms stimulus durations. Findings were supportive of the vigilance-avoidance model such that the high trait anxious adults were significantly more vigilant (mean bias score = 13) toward threatening scenes (high and mild threat) presented at 500 ms when compared to the low trait anxious adults (mean bias score = 0 ms), and the mean bias score for the high trait anxious adults was significantly greater than zero (i.e., significant vigilance). However, the high trait anxious adults were significantly more avoidant (mean bias score = -21) of threatening scenes (high and mild threat) presented at 1250 ms when compared to the low trait anxious adults (mean bias score = -3), and the mean bias score for the high trait anxious adults was significantly less than zero (i.e., significant avoidance).

Time-Course of Attentional Biases in Youth Anxiety Disorders

As reviewed by Waters et al. (2010), a small body of dot-probe research has examined attentional biases for threatening stimuli at short or long stimulus durations in anxious youth. The majority of extant dot-probe research demonstrates evidence for an attention bias toward angry faces at short stimulus durations (i.e., 500 ms) in youth anxiety (e.g., Roy et al., 2008; Telzer et al., 2008; Waters, Mogg et al., 2008; Watts & Weems, 2006). However, two youth dot-probe studies found evidence of avoidance of angry faces presented for 500 ms (Monk et al., 2006; Pine et al., 2005). Both Monk et al. (2006) and Pine et al. (2005) discuss methodological factors that may have contributed to their unusual findings.

Additional dot-probe research has utilized longer stimulus durations (i.e., greater than or equal to 1000 ms) with both clinically anxious youth and nonselected schoolchildren (i.e., a sample of youth not selected based on clinical or nonclinical status or symptom severity), yielding mixed results. Some studies using longer stimulus durations have provided evidence for an attentional bias toward threatening pictures (e.g., faces or scenes) in clinically anxious youth (1000 ms: Hankin et al., 2010; 1250 ms: Waters, Lipp, & Spence, 2004; Waters, Wharton et al., 2008), and a positive relationship between trait anxiety and biases toward threatening faces in schoolchildren (1000 ms: Heim-Dreger et al., 2006). However, one study using a sample of nonselected schoolchildren found the reverse, such that higher levels of social anxiety symptoms were related to greater avoidance of negative faces (when paired with neutral faces) presented for 1000 ms (angry, sad, fearful, disgusted; Stirling et al., 2006). Several other dot-probe studies found an attentional bias toward threatening stimuli at long stimulus durations in

clinically anxious youth (1250 ms: Vasey, Daleiden, Williams, & Brown, 1995; 1500 ms: Dalgleish et al., 2003; Taghavi et al., 1999), but these studies used word stimuli, which may make them inappropriate comparisons to experimental paradigms using pictorial stimuli. Overall, there are few youth dot-probe studies that have tested attentional biases toward threatening pictorial stimuli at long stimulus durations, and those existing studies have yielded mixed results.

When considering dot-probe research conducted with either adult or youth samples, the evidence suggests that the attentional bias toward threatening stimuli in anxious individuals dissipates as the stimulus duration increases. A meta-analysis conducted by Bar-Haim et al. (2007) examined adult and youth studies of threat-related attentional biases in anxiety. In dot-probe studies, when calculating effect sizes for threat-related attentional biases within the anxious groups only, Bar-Haim et al. (2007) found that the anxious participants demonstrated a significant bias toward threat-related stimuli (relative to neutral) at all stimulus duration times (i.e., subliminal exposures under 500 ms, 500 ms exposures, and exposures ≥ 1000 ms). There were no significant differences when comparing these three stimulus duration conditions. However, longer exposure times were associated with an attenuation of attentional bias toward threatening stimuli within the anxious groups, as evidenced by the decreasing effect sizes with the increase of exposure duration (i.e., $d = .65$ for subliminal exposures, $d = .31$ for 500 ms exposures, $d = .29$ for exposures ≥ 1000 ms).

Additionally, when Bar-Haim et al. (2007) re-grouped the data from these dot-probe studies into 2 types of exposure times, < 500 ms (subliminal) and ≥ 500 ms (supraliminal), a *Q*-test revealed a significant difference between these two types of

exposure times, such that subliminal exposures ($k = 5$, $d = .65$) resulted in a significantly larger effect size than supraliminal exposures ($k = 25$, $d = .31$; $Q = 4.12$, $p < .05$). The results from this test can be interpreted to represent a medium effect size for the difference between attentional biases toward threat at subliminal compared to supraliminal stimulus exposure times within anxious groups. This suggests that the attentional bias toward threatening stimuli in anxious samples attenuates at stimulus durations greater than or equal to 500 ms in dot-probe studies.

Finally, when calculating between-groups effects, or the difference in threat-related attentional biases between anxious and nonclinical control groups in dot-probe studies, Bar-Haim et al. (2007) found that the anxious groups were significantly more vigilant toward threatening stimuli compared to the nonclinical control groups at subliminal and 500 ms stimulus durations, but the difference was non-significant for longer durations (i.e., ≥ 1000 ms). This finding suggests that, for anxious groups relative to nonclinical control groups, attentional bias toward threatening stimuli decreases as the stimulus duration time increases in dot-probe studies. Moreover, this finding suggests that this pattern of attentional bias dissipation over time may be more apparent when comparing threat biases in clinically anxious compared to nonclinical control groups. Further, this finding suggests that the effect size measuring the attenuation of attentional bias toward threat should be larger in clinically anxious samples compared to nonselected samples.

A second meta-analysis conducted by Frewen et al. (2008) found that high anxious adults demonstrated an attentional bias toward threatening stimuli relative to neutral stimuli when stimuli were presented subliminally or at 500 ms, but that high

anxious adults have not consistently demonstrated this threat bias when stimuli were presented for a longer duration (i.e., ≥ 1000 ms). This provides further support that, in anxious samples, attentional bias toward threatening stimuli decreases as the stimulus duration time increases.

It is difficult to make conclusions about the time-course of attentional bias in youth anxiety because only one dot-probe study has directly tested multiple stimulus durations within a single experiment. Waters et al. (2010) tested the time-course of attentional biases for emotional faces in a nonselected sample of fifty primary school youth using both 500 ms and 1250 ms stimulus durations in one dot-probe task. The task included photographs of 64 actors presenting a neutral and either a happy or angry facial expression. Each pair of faces was presented twice, one time at each duration, in a random order. They included 16 pairs of neutral-neutral faces as filler trials. Investigators divided the sample into two groups, youth scoring above the median on an anxiety symptom measure and those scoring below the median, and then used two linear mixed model regression analyses to explore the relationship between anxiety severity (high vs. low) and stimulus duration time (500 ms vs. 1250 ms) on attention bias scores for angry and happy faces. Waters et al. (2010) found no support for an interaction between anxiety severity and stimulus durations, but found a main effect for anxiety severity, such that the youth scoring higher on the anxiety measure showed significantly more vigilance toward threatening faces across both time durations when compared to youth scoring lower on the anxiety measure. However, Waters et al.'s (2010) study was completed with a sample of nonselected primary school children. Symptoms of anxiety in this sample may not have been severe enough to elicit a vigilance-avoidance pattern of attentional bias.

Moreover, Waters et al.'s (2010) findings did suggest that attentional bias scores toward the angry faces in the high anxiety group were slightly higher at the 500 ms (short) stimulus duration (M = 20.1, SD = 46.4) than at the 1250 ms (long) stimulus duration (M = 18.4, SD = 27.9). This suggests that future research that includes clinically anxious and nonclinical control samples of youth may find an increased effect size of attentional bias difference at both short and long stimulus durations.

In sum, one youth study (Stirling et al., 2006) found that higher levels of social anxiety symptoms were related to greater avoidance of negative faces presented for a long stimulus duration (1000 ms), whereas another youth study (Waters et al., 2010) found no support for varying attentional biases across short (500 ms) and long (1250 ms) stimulus durations, such that a greater bias toward threatening faces was associated with higher anxiety symptoms across both stimulus durations. The next step in this line of research is to test the time-course of attentional biases for threat-related stimuli in youth anxiety by measuring attentional biases across multiple stimulus durations within one dot-probe task in both clinically anxious and nonclinical control youth samples, which should conceptually increase the vigilance toward threat at shorter durations (500 ms) and increase any avoidance responses at longer stimulus durations (> 1000 ms) in the clinically anxious group when compared to the nonclinical control group.

The Specificity of Attentional Biases in Anxious Youth

Additional dot-probe research has explored the specificity of attentional biases in anxious youth toward threatening cues vs. sad or happy cues. Some investigators (Bradley et al., 1999; Waters et al., 2004) have chosen to include happy or pleasant stimuli (in addition to threat stimuli) in their dot-probe tasks in order to test the

hypothesis that anxious individuals will selectively attend to both positive and negative emotional material (e.g., angry and happy faces) as opposed to threat material specifically, in line with the emotionality hypothesis (Martin, Williams, & Clark, 1991). Current evidence for a bias toward happy stimuli in anxious youth samples is mixed. Hankin et al.'s (2010) findings supported the specificity of attention biases toward threatening stimuli in youth anxiety, with "pure" anxious youth (youth with one or more lifetime anxiety disorders) demonstrating significant vigilance (i.e., mean bias score significantly greater than zero) toward angry faces but not sad or happy faces. Additionally, Roy et al. (2008) failed to find a difference in attentional bias scores for happy faces in clinically anxious compared to nonclinical control youth and Waters et al. (2010) found no effect of youth anxiety severity on bias scores for happy faces. But, a study conducted by Waters et al. (2004) found that clinically anxious youth were significantly more vigilant toward all emotional pictures (threatening and pleasant) presented at 1250 ms when compared to a sample of nonselected youth, whereas the clinically anxious youth did not demonstrate a significantly greater bias toward threatening pictures alone when compared to the nonselected youth. Similarly, Waters, Mogg, et al. (2008) found that there was no effect of anxiety severity (nonclinical controls, GAD and low clinical anxiety, GAD and high clinical anxiety) on attention bias scores as a function of facial type (angry or happy) in youth, but that youth with GAD and high levels of anxiety demonstrated significant vigilance to both angry and happy faces combined at a short stimulus duration (500 ms). Moreover, Waters and colleagues found a near significant trend for the positive relationship between biases toward happy faces and the presence of social phobia. Findings are mixed, and therefore, a dot-probe

study that includes threatening stimuli in addition to other types of emotional stimuli (i.e., happy, sad) would help to further test the specificity of attention biases in anxious youth.

The Current Investigation

In order to further test the time-course of attentional biases for threatening stimuli in youth anxiety, additional studies that test both short and long (e.g., 500 ms, 1250 ms) stimulus durations within the same dot-probe experiment are needed. Comparing findings across studies that have used either a short or long stimulus duration leaves room for confounds associated with study sample, experimental paradigm, and stimuli. As described by Waters et al. (2010), we cannot determine the appropriateness of the vigilance-avoidance model for youth anxiety when existing research has employed a wide range of exposure durations, sample characteristics (e.g., age, clinical vs. nonselected, type of diagnosis), and stimulus types (e.g., faces, pictures, words). Moreover, no studies to date have included multiple stimulus durations within the same dot-probe task with a clinically anxious sample of youth, which Waters et al. (2010) suggests as a next step. Waters et al. (2010) recruited a nonselected sample, which may greatly reduce the likelihood of detecting avoidance patterns even at long durations. Therefore, the primary aim of the current study was to test the time-course of attentional biases for threat-related stimuli in youth anxiety by measuring attentional biases for threatening faces across multiple stimulus durations (500 ms and 1250 ms) within one dot-probe task in both clinically anxious and nonclinical control youth samples.

A secondary aim of the current study was to test the specificity of attention biases toward emotional stimuli in anxious youth. We would expect that anxious youth would demonstrate an attention bias toward threatening stimuli only, in support of cognitive

theories that describe the content specificity of cognitions across different psychological disorders (e.g., Beck, 1976; Beck, Brown, Steer, Eidelson, & Riskind, 1987), and in support of theories that suggest that the content of information processing biases is also specific to disorder types (see Hankin et al., 2010 for a review). Findings from the majority of dot-probe studies support the specificity of attentional bias toward threatening stimuli in anxious youth (Hankin et al., 2010; Roy et al., 2008; Waters et al., 2010). However, additional research suggests that anxious youth may demonstrate a significant bias toward threatening stimuli combined with other types of emotional stimuli (i.e., happy; Waters et al., 2004; Waters, Mogg, et al., 2008). Therefore, the current study included happy and sad faces in addition to angry faces in order to further test the specificity of attention biases in anxious youth.

The stimulus duration of 500 ms has been used extensively in dot-probe studies to measure initial attentional biases toward threat cues in both youth and adults (see Bar Haim et al., 2007 for a review). In addition to the traditional short duration of 500 ms, we chose to include the long stimulus duration of 1250 ms in our dot-probe task for many reasons. First, there is evidence suggesting that attentional biases toward threatening stimuli in anxious groups decreases at durations equal to or longer than 1000 ms when measured by the dot-probe task (Bar-Haim et al., 2007; Frewen et al., 2008). Additionally, Stirling et al.'s (2006) dot-probe study with youth found evidence that higher levels of social anxiety symptoms were related to greater avoidance of negative faces presented for 1000 ms. Also, using a 1250 ms stimulus duration in our dot-probe task allowed us to compare our findings directly to the Waters et al. (2010) study, which is the only study using a youth sample to have directly tested multiple stimulus durations

within a single dot-probe experiment. Further, it allowed us to compare our findings to previous youth dot-probe studies that utilized similarly long durations (e.g., Hankin et al., 2010; Waters, Wharton et al., 2008). These studies did not test for differences across multiple exposure durations, but having similar methods facilitated comparisons of findings from our secondary hypotheses (e.g., comparison of attentional bias across diagnostic class and valence) to findings from these relevant studies. Moreover, a stimulus duration of 1250 ms has also been associated with avoidance of threat cues in dot-probe studies with adults (i.e., Koster et al., 2005). Finally, using the stimulus duration of 1250 ms may have helped to ensure that we were capturing an early stage of information processing. We chose not to include a stimulus duration > 1250 ms because doing so may have increased our chances of measuring a later stage of the information processing sequence, such as the interpretation stage, instead of measuring the earlier encoding stage and the attentional processes therein (Crick & Dodge, 1994). Taken together, this suggests that including the stimulus durations of 500 ms and 1250 ms within one dot-probe task is appropriate for testing the time-course of attentional biases for threatening cues in youth anxiety.

The current study used a dot-probe task to assess attentional biases for angry, happy, and sad faces at both 500 and 1250 ms in youth diagnosed with a principal anxiety disorder (i.e., GAD, Separation Anxiety, Social Phobia and/or Panic Disorder) and nonclinical control youth. Angry faces have consistently been used in dot-probe studies with adults and youth to represent “threatening” cues intended to resonate with anxious individuals (e.g., Mogg, Philippot et al., 2004; Roy et al., 2008; Waters et al. 2010). Parent and child reported paper-and-pencil measures of current anxiety and depression

symptoms were also collected to test for significant differences on these measures between the clinically anxious and nonclinical control groups.

Primary hypothesis. When reviewing dot-probe research conducted with either adult or youth samples, the evidence suggests that attentional biases toward threat stimuli in anxious individuals dissipate as the stimulus duration increases (Bar-Haim et al., 2007; Frewen et al., 2008). Therefore, we hypothesized a significant diagnostic group x stimulus duration interaction for angry face attention bias scores, such that the clinically anxious group would have greater attention bias scores for angry faces than nonclinical controls at the 500 ms duration, but the nonclinical controls would have greater attention bias scores for angry faces than the clinically anxious group at the 1250 ms duration. We hypothesized that the clinically anxious group's angry face attention bias scores would be positive (suggesting vigilance) for the 500 ms duration and negative (suggesting avoidance) for the 1250 ms duration. We tested this hypothesis with a 2 Diagnostic Group (anxious, control; between subjects) x 2 Stimulus Duration (500 ms, 1250 ms; within subjects) mixed ANOVA with attention bias score for angry faces as the dependent variable.

An a priori power analysis using GPower for a mixed within-between ANOVA interaction (estimated effect size of $f = .25$, $\alpha = .05$, total sample size = 40, number of groups = 2, number of measurements = 2, estimated correlation among repeated measures = .7, nonsphericity correction = 1) resulted in power of .98 to detect a significant finding for our primary hypothesis. Therefore, we determined that there was sufficient power ($\geq$ .80) to detect a significant finding for our primary hypothesis. There was little guidance in the literature for estimating an exact effect size for this interaction, because 1) no

studies have compared clinically anxious youth to nonclinical control youth using multiple stimulus durations in the same dot-probe study, and 2) results sections in adult dot-probe studies with similar experimental paradigms provided insufficient information to calculate effect sizes for this specific interaction effect. Therefore, an estimated medium effect size (f = .25) was used to calculate a priori power for this interaction because Bar-Haim et al. (2007) detected a medium effect size for the difference between attentional biases toward threat at subliminal (< 500 ms) compared to supraliminal (≥ 500 ms) stimulus exposure times within anxious groups (see earlier description for more detail). Our medium effect size estimate was also supported by our inclusion of clinically anxious and nonclinical control groups (as opposed to a nonselected sample), which should have produced larger differences in the effects of exposure time, as described earlier.

Secondary hypothesis #1. While there are mixed findings regarding anxious youth and an attention bias toward happy stimuli (e.g., Hankin et al., 2010; Roy et al., 2008; Waters et al., 2004; Waters et al., 2010; Waters, Mogg, et al., 2008), cognitive models of anxiety and depression suggest that the subject of an attention bias is specific to the disorder (e.g., Beck et al., 1987; Kendall, 1985; Kendall & Ronan, 1990). As supported by previous dot-probe studies that found specificity of attention biases toward angry faces (with no significant bias toward happy or sad faces) in anxious youth (Hankin et al., 2010; Roy et al., 2008; Waters et al., 2010), we hypothesized that there would be a significant diagnostic group x stimulus valence interaction for attention bias scores, such that the clinically anxious youth, as compared to nonclinical control youth, would have greater attention bias scores for angry faces only, and not for happy or sad faces. We

hypothesized that the clinically anxious group's angry face attention bias scores would be positive (suggesting vigilance). We tested this hypothesis with a 2 Diagnostic Group (anxious, control; between subjects) x 3 Stimulus Valence (angry, happy, sad; within subjects) mixed ANOVA with attention bias score as the dependent variable.

An a priori power analysis using GPower for a mixed within-between ANOVA interaction (estimated effect size of $f = .25$, $\alpha = .05$, total sample size = 40, number of groups = 2, number of measurements = 3, estimated correlation among repeated measures = .7, nonsphericity correction = .5) resulted in power of .93 to detect a significant finding for this secondary hypothesis. Therefore, we determined that there was sufficient power ($\geq .80$) to detect a significant finding for this secondary hypothesis. An estimated medium effect size ($f = .25$) was used to calculate a priori power for this interaction because Hankin et al.'s (2010) youth dot-probe study revealed a significant Diagnostic Group (clinically anxious, clinically depressed, comorbid anxious/depressed, nonclinical control) x Stimulus Valence (angry, happy, sad) interaction with a medium effect size ($f = .25$). Follow-up analyses revealed that the anxious group demonstrated a significantly greater attention bias toward angry faces when compared to the nonclinical control group and the depressed group. No such differences were found for the anxious group when testing attention biases toward happy or sad faces.

Secondary hypothesis #2. Additionally, we hypothesized that due to the dissipation of attention bias toward threatening cues in anxious individuals as the stimulus duration increases (Bar-Haim et al., 2007; Frewen et al., 2008), there would be a significant stimulus valence x stimulus duration interaction for attention bias scores when testing the clinically anxious group only, such that the clinically anxious youth would

have greater attention bias scores for angry faces when compared to sad and happy faces at the 500 ms duration, but would have greater attention bias scores for sad and happy faces when compared to angry faces at the 1250 ms duration. We hypothesized that the clinically anxious group's angry face attention bias scores would be positive (suggesting vigilance) for the 500 ms duration and negative (suggesting avoidance) for the 1250 ms duration. We tested this hypothesis with a 3 Stimulus Valence (angry, happy, sad; within subjects) x 2 Stimulus Duration (500 ms., 1250 ms; within subjects) ANOVA with attention bias score as the dependent variable and with the anxious group only.

An a priori power analysis for this interaction hypothesis was not calculated because formulas for calculating exact power for within-within interactions are unavailable. However, we similarly estimated a medium effect size for this interaction due to the dissipation of attention bias toward threat cues in anxious individuals as stimulus duration increases (Bar-Haim et al., 2007; as described above). This interaction only used half of our sample (i.e., the clinically anxious group), which may have reduced power to detect a significant finding, but since this interaction included two within-subjects variables (which increases power), we estimated that it would have similar power to detect a significant finding as the previously described hypotheses.

CHAPTER II

Method

Participants

Participants were forty-two youth between the ages of 8-17 (*M* = 12.77 years, *SD* = 1.88), with twenty-one youth meeting criteria for a principal anxiety disorder diagnosis (i.e., Generalized Anxiety Disorder [GAD], Social Phobia [SP], Separation Anxiety Disorder [SAD] and/or Panic Disorder [PD]) and twenty-one youth serving as a nonclinical control group (see Table 1 for demographic description). There were originally twenty-five youth that met criteria for the clinically anxious group, but three subjects were removed from all analyses due to invalid attention bias scores (see description of dot-probe task below for more detail), and one subject was removed because they were an outlier when considering the combination of their mean angry bias score, mean happy bias score, and mean sad bias score (using Mahalanobis distance outlier detection). Additionally, there were originally twenty-two youth that met criteria for the nonclinical control group, but one subject was removed from all analyses because of the Mahalanobis distance outlier detection. The following descriptives and the demographic table (see Table 1) do not include the three excluded clinically anxious subjects or the excluded nonclinical control subject.

Eleven youth met criteria for a principal GAD diagnosis (52.4%), eleven youth met criteria for principal SP (52.4%), and five met criteria for a principal SAD diagnosis (23.8%), where five youth met criteria for multiple principal anxiety disorder diagnoses (23.8%). In terms of comorbidity, six youth were diagnosed with comorbid Specific Phobia (28.6%), six with Major or Minor Depressive Disorder (28.6%), five with GAD

(23.8%), five with Social Phobia (23.8%), two with SAD (9.5%), two with Obsessive Compulsive Disorder-Compulsion subtype (9.5%), one with Dysthymia (4.8%), one with Oppositional Defiant Disorder (4.8%), one with Selective Mutism (4.8%), and zero youth were diagnosed with Attention Deficit Hyperactivity Disorder (0%). Parents reported an average educational attainment of "some college, but did not graduate" for both mothers and fathers, and an average yearly household income of $60,001 to $80,000. Twelve youth were diagnosed with "pure anxiety" (i.e., only clinical anxiety disorders; 57.1%), and nine youth (42.9%) were diagnosed with clinical anxiety and a comorbid depressive disorder, ODD, or Selective Mutism.

Participants in the current study were recruited through clinic and community sources. Nineteen (45.2%) youth were recruited from the Rutgers Youth Anxiety and Depression Clinic (YAD-C), a university-based research clinic that conducts diagnostic interviews with a treatment-seeking population prior to initiating psychotherapy. Participating youth completed procedures for the current study within the context of a standardized intake protocol. Three (6.8%) youth were recruited from the second source of recruitment, which was the sample of youth who participated in a school-based randomized clinical trial at Franklin Township Middle School in Somerset, NJ. Indicated and nonclinical youth were identified through a school-wide multi-gated screening that included both symptom measures and diagnostic interviews. Twenty (47.6%) youth were recruited by circulating flyers at Franklin Township Middle School (FTMS authorization and Rutgers IRB approval received).

Diagnostic Inclusion Criteria

Inclusion criteria for the clinical sample of the current study included a principal DSM-IV-TR anxiety disorder diagnosis (i.e., Generalized Anxiety Disorder, Social Phobia, Separation Anxiety and/or Panic Disorder) based on the Anxiety Disorders Interview Schedule for DSM-IV – Child and Parent Interviews (ADIS-IV; Silverman & Albano, 1996). Youth with comorbid depressive disorder diagnoses (Major Depressive Disorder, Minor Depressive Disorder, Dysthymia) or disruptive behavior disorder diagnoses (Attention Deficit-Hyperactivity Disorder, Oppositional Defiant Disorder, Conduct Disorder) were included in the current study. Exclusion criteria included severe learning or psychiatric problems (i.e., autism spectrum disorder diagnosis, psychosis), or hospitalization within the last year for severe suicidal ideation or a suicide attempt. Similar to many past dot-probe studies (e.g., Hankin et al., 2010), current psychotropic medication use was not an exclusion criterion for the current study. Five participants (23.8%) in the clinically anxious group were taking psychotropic medications during the time of study participation.

Inclusion criteria for the nonclinical control sample included: no current psychiatric diagnoses based on the ADIS-IV Child interview (Silverman & Albano, 1996). Exclusion criteria for the nonclinical control sample were any indication of a psychiatric diagnosis based on the ADIS-IV Child interview (Silverman & Albano, 1996).

Measures

Background and Medical History Form (BMH). The parent(s) completed the BMH prior to in-person diagnostic intake. The BMH recorded demographic

characteristics for the child and family and information regarding the child's medical, developmental, and treatment (psychological and medication) histories.

Anxiety Disorders Interview Schedule for Children (ADIS-IV) Child/Parent Interviews. The ADIS-IV (Silverman & Albano, 1996) is a semi-structured interview that evaluates the presence and severity of DSM-IV-TR diagnoses. Diagnostic interviews can be collected for the parent and child. Impairment (Clinician's Severity Rating; CSR) is rated per disorder on a 0 (not at all) to 8 (debilitating) scale where 4 represents the clinical threshold. Graduate-level independent interviewers who completed formal training to reliability on the ADIS administered the ADIS in the current study. Interviewers were considered reliable when they matched expert ratings of diagnosis and Clinician's Severity Ratings (ratings of impairment; Cohen's $\kappa \geq 0.80$). Actual mean inter-rater reliability was $\kappa = 0.94$ (range = 0.85 – 0.99).

Multidimensional Anxiety Scale for Children—Child and Parent Forms. The MASC—Parent and Child forms (March, 1997) were collected to test for significant differences in anxiety symptoms between the clinically anxious and nonclinical control groups. The MASC long form includes 39 items designed to assess four broad categories of anxiety symptoms: physical symptoms, harm avoidance, social anxiety, and separation/panic. Items are rated on a "0" (Never True) to "3" (Often True about me) scale. Parallel child and parent forms are available and both were used in the current study. The MASC is one of the most commonly used self-report measures of anxiety in youth and it has been normed on large samples. Cronbach's alphas in our sample were .94 for child report and .93 for parent report.

Center for Epidemiological Studies - Depression Scale—Child and Parent Forms. The CES-D—Parent and Child forms (Radloff, 1977) were collected to test for significant differences in depression symptoms between the clinically anxious and nonclinical control groups. The CES-D includes 20 items and is designed to assess depressed mood, feelings of worthlessness/guilt, sense of helplessness/hopelessness, psychomotor retardation, loss of appetite, and sleep disturbance. Parallel child and parent forms are available and both were used in the current study. Respondents rated each item on a 4-point Likert-type scale in order to report the frequency of their symptoms during the last week. Response categories include 0 (rarely; less than one day), 1 (little; 1-2 days), 2 (moderately; 3-4 days), and 3 (most of the time; 5-7 days). Total scores range from 0-60, with four items requiring reverse scoring and total scores calculated by summing the item responses. The CES-D was initially created for use with adults and the child version did not require adaptation to be used with youth samples. Cronbach's alphas in our sample were .83 for child report and .76 for parent report.

Visual Analog Mood Scale. The VAMS consists of two questions to assess how the participant is feeling in the moment. It asks the participant to place a line on a scale indicating their current mood from "Very Happy" to "Very Sad" and a scale indicating their current anxiety from "Very Calm" to "Very Anxious." Each questionnaire item was scored by measuring the distance between the left anchor and the line the subject drew (in mm), with the total length of the line equaling 100 mm. Variations on VAMS have been used extensively to measure mood (see Ahearn, 1997 for a review). If there was a significant relationship between current mood or anxiety (as measured by the VAMS)

and attentional bias scores, current mood and/or anxiety were entered as covariates during data analysis.

Dot-Probe. A dot-probe task adapted from Gibb, Benas, Grassia, & McGeary (2009) was administered on a computer using E-Prime software. The stimuli consisted of pairs of facial expressions that contain one affective face and one neutral face from the same actor taken from a standardized stimulus set (Tottenham et al., 2009). Validity ratings were available for each affective face for each actor by having a group of participants rate the images at two separate points (Tottenham et al., 2009). Actors were chosen for the current dot-probe task if validity ratings reached kappa = .7 or greater for each affective image for a particular actor (all affective faces for each actor were included: sad, happy, angry and neutral). This resulted in a total of 32 separate actors, 16 males and 16 females and a variety of races, displaying a happy, angry, or sad faces paired with a neutral face resulting in 96 pairs of faces. The dot-probe task (Gibb et al., 2009) was modified to include 24 pairs of neutral-neutral trials included as fillers in each block so that the child was not exposed to affective stimuli on every trial. A random selection of 24 of the actors were chosen for the neutral-neutral trials with an even number of each gender and a variety of races. The neutral-neutral trials consisted of an expression described as "calm" and an expression described as "neutral" from each actor in order to be consistent with the different expressions shown during the affective trials.

The size of each photograph was modified from the original task so that the size was approximately 7 cm high and the distance between the inner edges of each photograph is approximately 7 cm. These dimensions were modeled after Mogg and Bradley (1999), a task that has been used in multiple dot-probe studies with youth (e.g.,

Pine et al., 2005; Roy et al., 2008). The task was also modified to include two different stimulus durations (500 ms and 1250 ms; see below for details) instead of one stimulus duration.

Attention bias scores were calculated separately for each stimulus valence type (sad, happy, and angry faces) for each subject by subtracting their mean response time (RT) for congruent trials (the probe replaced the affective face) from their mean response time for incongruent trials (the probe replaced neutral face; Bradley et al., 1998). Positive bias scores indicate an attention bias toward the emotional face (vigilance) and negative scores indicate an attention bias away from the emotional face (avoidance). RTs from trials with errors (i.e., the wrong probe number was indicated) were removed. Additionally, in order to remove outliers from the analyses, previous studies have commonly removed RTs that are <200 ms (Mogg, Bradley et al., 2004; Waters et al., 2010) or >3 SDs above each participant's mean (Waters et al., 2010). These cutoff scores were used to remove outliers before conducting analyses. Three of the twenty-five subjects diagnosed with clinical anxiety were removed from analyses (resulting in a final total of twenty-two youth in the clinically anxious group) due to a large percentage of trials removed due to error or cutoff scores (>38% excluded trails). There was no precedence for excluding subjects due to a large number of invalid trials on the dot-probe task; excluded subjects were each missing more than a quarter of their trials, suggesting that the subjects were not paying attention to large portions of the task. All three excluded subjects were clinically anxious youth recruited from the YAD-C, where study procedures required youth to complete the dot-probe after an extensive diagnostic interview. This ordering of the study procedure likely increased fatigue and decreased

attention during the dot-probe, a limitation in the current study. For the remaining forty-two subjects (twenty-one clinically anxious and twenty-one control), a low percentage of trials were removed due to subject error and the cutoff scores (≤5% per subject on average). Finally, the filler trials (pairs of neutral-neutral faces) were excluded from the analyses.

Procedure

The current study was conducted at both a university (Rutgers; New Brunswick, NJ) and a middle school (Franklin Township Middle School; Somerset, NJ) in an urban setting. All participants that were currently Franklin Middle School (FMS) students at the time of the study were offered the option of completing the current study at FMS or at Rutgers. All other participants completed the current study procedures at Rutgers.

Those youth/families who entered the current study as treatment seekers (i.e., YAD-C and the school-based clinical trial) completed the current study procedures, including informed parent consent and youth assent, as part of a larger clinic-based assessment battery. Youth that were previous participants in the school-based clinical trial were contacted to assess interest in completing the current study. Youth/families that did not currently attend FMS (i.e., previous participants in the school-based clinical trial) completed the informed consent/assent for the current study in person during their study visit at Rutgers. For youth that were currently attending FMS (i.e., responded to the recruitment flyer circulated at FMS), the parent was provided with study information (via verbal summary of consent form) during the initial phone contact and had the opportunity to ask questions about the current study. If the parent/youth continued to be interested, they were mailed written consent forms for participation in the current study, and a study

appointment time was scheduled. Families were asked to send the signed parental consent form along with the youth to school on the day they were scheduled to meet with the PI.

All youth completed the dot-probe task after they complete the ADIS-IV Child interview (Silverman & Albano, 1996). The researcher ensured that each child sat approximately 50 cm away from the computer for the dot-probe task by measuring the distance between the computer screen and the child's face with a tape measure. Immediately prior to completion of the visual probe task, all study participants completed the Visual Analog Mood Scale. The researcher then introduced the dot-probe task. Each youth first completed 8 practice trials of the dot-probe task followed by 240 trials divided into two blocks with a rest in between. Each trial began with a blank display with only a black fixation cross in the center of the screen for 1,000 ms, followed by a pair of pictures of facial expressions from the same actor (500 or 1250 ms). The offset of the pictures was replaced by an asterisk (or pair of asterisks) where one of the prior pictures was located (either emotional or neutral), cuing the participant to indicate the number of asterisks presented as quickly as possible. Participants were instructed to press the "1" key on the keyboard in response to 1 asterisk and to press the "2" key in response to 2 asterisks. The probe remained on the screen until the subject pressed the "1" or "2" key on the keyboard. The inter-trial interval varied randomly between 750 and 1250 ms. Each actor's face pairs (e.g., angry-neutral, sad-neutral, happy-neutral) was presented once in each block for a total of 64 trials with angry-neutral faces, 64 trials with sad-neutral faces, 64 trials with happy-neutral faces, and 48 trials with neutral-neutral faces. There were an equal number of trials in each condition and in each block as a function of stimulus duration (500 or 1250 ms), emotional face location (left or right), probe location

(left or right), and probe type (one or two asterisks). Across both blocks each affective face (angry, sad, happy) for each actor was presented once at 500 and once at 1250 ms. Each participant received a new, fully randomized order of stimuli. The dot-probe task took approximately 16 minutes for each youth to complete.

All youth recruited from the school-based clinical trial and the school-based recruitment source were compensated $20 in gift certificates for completing the study. Participants at the YAD-C completed the dot-probe task as a part of their intake session for the clinic and therefore, they did not receive compensation.

CHAPTER III

Results

Group Characteristics and Descriptives

Demographic and clinical characteristics of the clinically anxious and nonclinical control groups are presented in Table 1. There were no significant differences in age and sex between the two diagnostic groups. However, when dividing the sample into two ethnicity groups, Caucasian and Non-Caucasian (i.e., African American, Asian, Hispanic, and Multi-Ethnic), a Pearson's Chi-Square test revealed an uneven distribution of ethnicities between the two diagnostic groups ($p < .05$). To further explore the effect of ethnicity on our primary and secondary hypotheses, exploratory post-hoc analyses were conducted with ethnicity as a moderator (see Exploratory Post-Hoc Analyses below). The clinically anxious group scored significantly higher on all symptom measures (child and parent-reported) when compared to the nonclinical control group ($p < .001$). Tests of normality, conducted separately for the clinically anxious group and nonclinical control group, revealed a normal distribution for all symptom questionnaires (both parent and child) for the clinically anxious group as assessed by the Shapiro-Wilk test ($p > .05$; skewness < 1). The nonclinical control group's responses were non-normally distributed on the parent reported CES-D ($p < .05$; skewness > 1; Radloff, 1977), and were normally distributed on the remaining symptom questionnaires. There was a trend toward a positive correlation between attention bias scores for angry faces and the age of the subjects ($r = .30$, $p = .055$); therefore, age was entered as a covariate when testing our primary and secondary hypotheses. There was no correlation between age and attention bias scores for sad faces or happy faces ($ps > .05$). There were no differences between

genders on the attention bias scores for angry faces, sad faces, or happy faces (*p*s > .05). Therefore, gender was not entered as a covariate in any of our analyses. Finally, there were no differences between diagnostic groups on either the mood or anxiety scales of the VAMS (*p*s > .05), which suggests that the VAMS failed to differentiate between clinically anxious and nonclinical control groups.

Attention Bias Scores and Diagnostic Groups

To test our primary hypothesis, a 2 Diagnostic Group (anxious, control; between subjects) x 2 Stimulus Duration (500 ms, 1250 ms; within subjects) mixed Analysis of Covariance (ANCOVA) was conducted with attention bias scores for angry faces entered as the dependent variable (DV) and age entered as a covariate. Results showed that the Diagnostic Group X Stimulus Duration interaction for angry face attention bias scores was nonsignificant, $F(1, 39) = .003$, $p = .96$, $f = .009$ (where *f* of .10, .25, and .40 equals small, medium, and large effect sizes, respectively). There were no significant main effects. No further follow-up tests were conducted due to the nonsignificant findings. A post-hoc power analysis for a mixed within-between ANOVA interaction was calculated using the actual sample size ($N = 42$), which revealed that our study design had sufficient power (.98) to detect a significant finding with the hypothesized medium effect size ($f = .25$) but insufficient power (.05) to detect a significant finding with the effect size actually found ($f = .009$).

To test our secondary hypothesis #1, a 2 Diagnostic Group (anxious, control; between subjects) x 3 Stimulus Valence (angry, happy, sad; within subjects) mixed ANCOVA was conducted with attention bias scores as the dependent variable and with age entered as a covariate. Results showed that the Diagnostic Group X Stimulus Valence

interaction for attention bias scores was nonsignificant, $F(2, 78) = .08$, $p = .92$, $f = .04$. A post-hoc power analysis for a mixed within-between ANOVA interaction was calculated using the actual sample size ($N = 42$), which revealed that our study design had sufficient power (.99) to detect a significant finding with the hypothesized medium effect size ($f = .25$) and insufficient power (.09) to detect a significant finding with the effect size actually found ($f = .04$).

This analysis did reveal a significant Age (covariate) x Stimulus Valence interaction, $F(2, 78) = 3.96$, $p < .05$, $f = .32$. Exploratory post-hoc moderator analyses were conducted (see Exploratory Post-Hoc Analyses below) to further explore this significant effect of age on attention bias scores. This analysis also identified a significant main effect of valence, $F(2, 78) = 3.72$, $p < .05$, $f = .31$. Planned simple contrasts were then conducted to further explore the significant main effect of valence. The planned contrasts revealed that there was a significant difference between attention bias scores for angry faces and bias scores for sad faces, such that youth (across both diagnostic groups) had greater attention bias scores for angry faces than sad faces (See Table 2), $F(1, 39) = 4.65$, $p < .01$, $f = .34$. Additionally, the planned simple contrasts revealed that there was a significant difference between attention bias scores for angry faces and bias scores for happy faces, such that youth (across both diagnostic groups) had greater attention bias scores for angry faces than happy faces, $F(1, 39) = 5.13$, $p < .05$, $f = .36$. The mean attention bias scores for each valence (happy, sad, angry) were all positive values, suggesting vigilance. One-sample t-tests were calculated separately for each valence to determine if there was statistically significant vigilance (i.e., mean bias score significantly greater than zero) toward any of the valence types. One-sample t-tests

revealed that the mean attention bias scores for angry, sad, or happy faces were not significantly greater than zero (*p*s > .05), suggesting that the full sample did not demonstrate significant vigilance or avoidance for any of the valence types.

Finally, to test our secondary hypothesis #2, a 3 Stimulus Valence (angry, happy, sad; within subjects) x 2 Stimulus Duration (500 ms, 1250 ms; within subjects) repeated measures ANCOVA was conducted with attention bias scores as the dependent variable, with the clinically anxious group only, and with age entered as a covariate. Results showed that the Stimulus Valence X Stimulus Duration interaction for attention bias scores was nonsignificant, $F(2, 38) = ..51$, $p = .60$, $f = .16$. There were no significant main effects. No further follow-up tests were conducted due to the nonsignificant findings. A post-hoc power analysis for this hypothesis was not calculated because formulas for calculating exact power for within-within interactions are unavailable.

Exploratory Post-Hoc Analyses

A series of exploratory post-hoc analyses were conducted to further explore nonsignificant results. A 3 Stimulus Valence (angry, happy, sad; within subjects) x 2 Diagnostic Group (anxious, control; between subjects) x 2 Stimulus Duration (500 ms, 1250 ms; within subjects) mixed ANCOVA was conducted with attention bias scores as the dependent variable and with age entered as a covariate. Results showed that the Stimulus Valence x Diagnostic Group x Stimulus Duration interaction for attention bias scores was nonsignificant, $F(2, 78) = .25$, $p = .78$, $f = .08$. Again, a main effect of valence was found (described under 2 Diagnostic Group x 3 Stimulus Valence analysis above). Again, a significant Age (covariate) x Stimulus Valence interaction was found, $F(2, 78) =$

3.96, $p < .05$, $f = .32$. Exploratory moderator analyses were conducted (see below) to further explore this significant effect of age on attention bias scores.

We ran a series of exploratory analyses to test for a moderation effect of age group (dichotomous variable based on median split of age, <13 years and ≥ 13 years), gender, depression severity (dichotomous variable based on median split of child-reported CES-D scores, < 9 and ≥ 9), and ethnicity (dichotomous variable, Caucasian and Non-Caucasian). These moderators were tested with all three of our primary analyses with age included as a covariate: Diagnostic Group x Stimulus Duration, Diagnostic Group x Stimulus Valence, and Stimulus Valence x Stimulus Duration for the anxious group only. Age group, gender, and depression severity were not significant moderators for any of our primary analyses (ps > .05).

However, when including ethnicity as a moderator in the Diagnostic Group x Stimulus Duration ANCOVA, there were two trends ($p < .10$). There was a trend toward significance for the moderation effect of ethnicity with a Diagnostic Group x Stimulus Duration x Ethnicity interaction for angry face attention bias scores, $F(1, 37) = 3.51$, $p = .07$, $f = .31$ (see Table 3). As seen in Figure 1, there was a nonsignificant difference in angry bias scores between the clinical Caucasian ($M = 28.63$, 95% $CI = -9.37 – 66.63$) and clinical Non-Caucasian ($M = 7.16$, 95% $CI = -35.07 – 49.38$) groups at the 500 ms duration. However, at the 1250 ms duration, the clinical Caucasian and Non-Caucasian groups demonstrated significantly different angry bias scores ($M = -23.35$, 95% $CI = -50.22 – 3.53$; $M = 46.59$, 95% $CI = 16.73 – 76.46$; respectively). The clinical Caucasian group showed significantly lower angry bias scores than the Non-Caucasian group at 1250 ms. Visual inspection of Figure 1 suggests that clinical Caucasian youth

demonstrate the expected trend of greater (positive) bias scores at 500 ms and smaller (negative) bias scores at 1250 ms. This trend was in the opposite direction for clinical Non-Caucasian youth. Supporting this trend, nonclinical Caucasian and Non-Caucasian youth showed minimal angry bias score differences between 500 ms and 1250 ms. While there appears to be a difference in angry bias scores between clinical and nonclinical Caucasian youth at 1250 ms, this difference was not significant (M = -23.35, 95% CI = -50.22 – 3.53; M = 11.29, 95% CI = -28.94 – 51.53; respectively). Still, within Caucasian youth, this finding could provide preliminary support of our hypothesis that clinically anxious youth would have lower (and negative) angry face attention bias scores compared to nonclinical youth at the 1250 ms duration. There were no differences in anxiety or depression symptom measures, gender, or study setting (YAD-C vs. middle school) between the clinically anxious Caucasian and non-Caucasian groups (ps > .05; see Table 4).

We also found a trend toward significance for the moderation effect of ethnicity with a Stimulus Duration x Ethnicity interaction for angry face attention bias scores, $F(1, 37) = 3.09$, $p = .09$, $f = .29$. We ran a simple effects analysis to further explore this interaction, and found that at the 500 ms duration, there was no significant difference in angry face attention bias scores between the Caucasian group and the Non-Caucasian group (collapsed across diagnostic groups), $F(1, 40) = .03$, $p = .87$ (See Table 3). However, at the 1250 ms duration, the Non-Caucasian group had greater angry face attention bias scores than did the Caucasian group, $F(1, 40) = 6.28$, $p < .025$ (adjusted alpha for two tests). As seen in Figure 2, the Caucasian group demonstrated the expected

attention bias pattern for angry faces (vigilance at 500 ms and avoidance at 1250 ms), but the Non-Caucasian group demonstrated the opposite pattern at the 1250 ms duration.

When including ethnicity as a moderator in the Stimulus Valence x Stimulus Duration ANCOVA for the anxious group only, there was a trend toward significance for the moderation effect of ethnicity with a Stimulus Duration x Ethnicity interaction for attention bias scores (collapsed across all stimulus valences), $F(1, 36) = 3.34$, $p = .08$, $f = .43$. We ran a simple effects analysis to further explore this interaction, and found that for the Caucasian group, there was a trend toward significant difference in overall attention bias scores, such that they had greater scores at the 500 ms duration ($M = 23.73$, $CI = 4.70 – 42.76$) than at the 1250 ms duration ($M = -5.09$, $CI = -24.69 – 14.51$), $F(1, 19) = 5.00$, $p = .04$ (adjusted alpha of .025 for two tests; See Figure 3). For the Non-Caucasian group, there was no difference in overall attention bias scores between the 500 ms duration ($M = 9.52$, $CI = -12.61 – 31.65$) and the 1250 ms duration ($M = 21.94$, $CI = -.85 – 44.74$), $F(1, 19) = .92$, $p = .35$.

CHAPTER IV

Discussion

We did not find support for the vigilance-avoidance model of anxiety in youth, as there was no difference in threat-related attentional biases in the clinically anxious compared to the nonclinical control group at either the 500 ms or 1250 ms stimulus durations. However, we found a trend toward significance for the moderation effect of ethnicity, suggesting that we must be cautious in interpreting our findings as unsupportive of the vigilance-avoidance model (see discussion below in Exploratory Post-Hoc Analyses). Additionally, we did not find an interaction between diagnostic group and stimulus valence, contrary to our hypothesis that the clinically anxious youth, as compared to nonclinical control youth, would have greater attention bias scores for angry faces only (and not for happy or sad faces). Finally, the clinically anxious youth did not demonstrate a difference in attention bias scores for angry, happy, or sad faces as a function of stimulus duration. Results did reveal a significant effect of stimulus valence on attention bias scores across both the clinically anxious and nonclinical control groups, such that the combined sample had greater attention bias scores for the angry faces when compared to the sad faces and for the angry faces when compared to the happy faces.

Our inability to detect a difference in threat-related attentional biases in the clinically anxious compared to the nonclinical control group at either the 500 ms or 1250 ms stimulus durations was unexpected and inconsistent with some previous research in youth (e.g., Stirling et al., 2006) and adults (Koster et al., 2005; Mogg, Bradley et al., 2004). This nonsignificant diagnostic group x stimulus duration interaction for angry face attention bias scores (our primary hypothesis) is not likely due to a lack of power (as

determined by the post-hoc power analysis, see results section), but it is likely due to a smaller effect size than that found in previous studies and also due to the moderating effect of ethnicity (see Exploratory Post-Hoc Analyses discussion below). This is supported by the fact that previous studies in the adult literature that found support for a difference in threat-related bias between anxious and nonclinical control groups at short and long durations used similar sample sizes to ours (Koster et al., 2005; Mogg, Bradley et al., 2004). We were sufficiently powered to detect a medium effect size for this interaction, but instead we found a very small effect size.

This null result is similar to the Waters et al.'s (2010) findings, such that they did not find support for an interactive effect of anxiety severity and stimulus duration on attention bias for angry faces in youth. While Waters et al. (2010) used a nonselected sample of youth, the current study recruited both clinically anxious and nonclinical control samples of youth in hopes of increasing the effect size for the attenuation of attentional bias toward threat with the increase in exposure duration (Bar-Haim et al., 2007; Frewen et al., 2008). Despite recruitment of clinically anxious and nonclinical control samples, results were unsupportive of the vigilance-avoidance model. However, since we did not find support for a greater attention bias toward angry faces in clinically anxious compared to nonclinical control youth (secondary hypothesis #1, see below), it is unlikely that we would have found support for the vigilance-avoidance model. Additionally, we found a trend toward significance for the moderating effect of ethnicity. Therefore, we must be cautious in interpreting our findings as unsupportive of the vigilance-avoidance model, and instead consider methodological factors and potential moderating variables that may have contributed to our unusual findings.

A number of methodological factors may have contributed to the very small effect for our primary interaction hypothesis. The vigilance-avoidance model proposes that anxious individuals will demonstrate this bias pattern when faced with stimuli perceived as threatening (Mogg et al., 1997). As suggested by Bradley et al. (1999), images of angry faces may be perceived as only mildly threatening, and therefore may fail to elicit an attention bias pattern of vigilance-avoidance. Therefore, different stimuli that may elicit more anxiety, such as emotional pictures of threatening scenes (e.g., images from the International Affective Picture System; Lang, Bradley, & Cuthbert, 2005), may be needed. Additionally, as discussed by Waters et al. (2010), it is possible that active avoidance of anxiety provoking stimuli does not occur within the initial stages of attention, and therefore, would not be detected by a dot-probe task with relatively short stimulus duration times (e.g., <1500 ms). Therefore, an inability to detect a pattern of vigilance-avoidance using the dot-probe task would not necessarily dispel this theory, but rather, suggests that different methods of testing this theory may be necessary. Alternatively, our inability to detect a vigilance-avoidance pattern, similar to additional research with youth populations (e.g., Waters et al., 2010), might simply suggest that the vigilance-avoidance model is inappropriate for understanding youth anxiety.

Since we did not find support for a difference in threat-related attentional biases in the clinically anxious compared to the nonclinical control group at either the 500 ms or 1250 ms stimulus durations, it is unsurprising that the clinically anxious youth did not demonstrate a difference in attention bias scores for angry, happy, or sad faces as a function of stimulus duration (our secondary hypothesis #2: stimulus duration x stimulus

valence interaction with attention bias as the dependent variable and with clinically anxious youth, only).

Finally, we did not find an interaction between diagnostic group and stimulus valence for attention biases (secondary hypothesis #1), which is inconsistent with previous research testing a similar interaction (Hankin et al., 2010), and is inconsistent with previous findings of a greater attention bias toward angry faces in clinically anxious compared to nonclinical control youth (Roy et al., 2008; Waters, Mogg et al., 2008). Further, we found no difference between the clinically anxious youth as compared to the nonclinical controls on bias scores for happy faces, which supported our hypothesis and some previous research (Hankin et al., 2010; Waters et al., 2010). However, because we also did not find a specific bias toward angry faces in the clinically anxious compared to the nonclinical control group, we cannot comment on the specificity of attention bias for different types of emotional cues in anxious youth.

Our nonsignificant diagnostic group x stimulus valence interaction for attention biases was likely due to a smaller than expected effect size. The small effect size for this finding was unexpected because a greater bias toward threatening cues in anxious compared to nonclinical control youth has been supported across multiple studies (e.g., Roy et al., 2008; Hankin et al., 2010), and Hankin et al. (2010) detected a medium effect size for a similar diagnostic group x stimulus valence interaction for attention biases. Again, we were sufficiently powered to detect a medium effect size for this interaction, but instead we found a very small effect size. This unexpected finding may be explained by characteristics of our study methodology, as described below.

Finally, our findings suggest that across both the clinically anxious and nonclinical control groups, youth demonstrated significantly greater attention bias scores for the angry faces when compared to the sad faces and for the angry faces when compared to the happy faces. These findings were surprising, and might suggest that the pictorial stimuli used in the current study did not successfully differentiate between emotions; youth may have had greater attentional biases for the angry faces because they appeared notably different than the neutral faces they were paired with, yet, youth may have been unable to differentiate between the sad or happy and the neutral faces. While stimuli for the current study's dot-probe task (adapted from Gibb et al., 2009) were chosen based on validity ratings available for each type of affective face (Tottenham et al., 2009), these validity ratings were determined by participants observing and rating each stimulus at leisure (see Tottenham et al., 2009), which may differ from ratings assigned when the stimuli are quickly flashed (as in the dot-probe task). Similarly, the validity ratings for these stimuli were obtained by a sample of adults, and therefore, these validity ratings may not generalize to youth populations.

Factors related to our study design may have contributed to our inability to find support for our hypotheses. For example, high levels of diagnostic comorbidity in the current study's clinically anxious sample may have contributed to the null findings. While high levels of comorbidity are expected in youth psychopathology (Angold, Costello, & Erkanli, 1999), the diagnostic complexity of the current sample is notable. Only two youth within the clinically anxious sample were diagnosed with a solitary anxiety disorder diagnosis, and the remaining youth were diagnosed with additional internalizing (i.e., anxiety or depression) and/or externalizing disorders. However,

previous studies that found support for an attentional bias toward angry faces in anxious youth included youth with multiple anxiety disorder diagnoses (i.e., Hankin et al., 2010; Roy et al., 2008; Waters, Mogg et al., 2008). Additionally, the current study included youth with a comorbid (but not principal) depression diagnosis, which may have contributed to null findings by increasing variance in reaction times to the dot-probe stimuli. Youth with depression often exhibit slower movements, which may disrupt reaction times in a task such as the dot-probe. Previous dot-probe studies that have found an attentional bias toward threatening stimuli in anxious youth vary in their inclusion criteria, with some studies including youth with comorbid depression (e.g., Waters, Mogg et al., 2008) and others excluding youth with a depression diagnosis (e.g., Roy et al., 2008).

Follow-up analyses revealed that the clinically anxious youth without comorbid depression (n = 14) had similar scores on the child reported MASC (MASC-C; March, 1997) anxiety symptom measure (M = 46.57, SD = 25.64) as anxious youth with comorbid depression (n = 7; M = 57.00, SD = 14.22), $t(20) = -.99$, $p = .33$. This suggests that the anxiety disorder diagnosis was truly primary for those youth with comorbid anxiety and depression. Follow-up analyses also revealed that the anxious youth without comorbid depression had similar scores on the child reported CES-D (Radloff, 1977) depression symptom measure (M = 17.50, SD = 12.02) as the anxious youth with comorbid depression (M = 21.14, SD = 9.69), $t(20) = -.69$, $p = .50$. The child reported CES-D scores in our anxious group without comorbid depression may seem elevated. A cutoff score of 16 (out of 60) on the CES-D has been suggested as a cutoff score for detecting depression in adults (Radloff, 1977), but a cutoff of 24 has been suggested for

adolescents in order to better predict depression in this population (Roberts, Lewinsohn, & Seeley, 1991). Therefore, the mean child reported CES-D scores for the anxious youth without comorbid depression in the current study are not higher than expected. Finally, when excluding youth with comorbid anxiety and depression from analyses, all tests of primary and secondary hypotheses continue to be nonsignficant (*p*s > .05). It is unclear whether the current study's inclusion of youth with complex diagnostic profiles contributed to its null findings, but future dot-probe research may benefit from excluding youth with comorbidity in order to reduce any possible effects of multiple disorders on reaction times.

Additional methodological factors should be considered in light of our nonsignificant findings. As discussed in Waters et al. (2010), it's possible that the "long" stimulus duration of 1250 ms was not long enough to elicit avoidance of the threatening cues, as predicted by the vigilance-avoidance model. Waters et al. (2010) suggest that future dot-probe research could utilize a longer stimulus duration (e.g., ≥ 1500 ms) paired with a short stimulus duration, and ideally, would incorporate an eye-tracking measure in the study design in order to measure any shifting patterns of attention that might occur with longer durations (e.g., Gamble & Rapee, 2009). As compared to reaction time, eye-tracking provides a more sensitive measure of engagement and avoidance, which may reveal more complex patterns of attentional processes (Gamble & Rapee, 2009). Moreover, it's possible that the type of probe used in the current study's dot-probe task may have increased variance in youth's reaction times. Mogg and Bradley (1999) suggest that probe classification tasks where the participant is asked to identify the type of probe, as used in the current study (i.e., identifying the number of asterisks), can be

advantageous in that it results in equal monitoring of both sides of the computer screen, but may result in higher error rates and increase reaction time variance. This may be particularly true for youth populations. Therefore, future studies may consider comparing the effects of probe type on attention bias in a clinically anxious sample of youth.

Exploratory Post-Hoc Analyses: Moderation Effect of Ethnicity

In light of our unexpected null findings for our primary and secondary hypotheses (i.e., primary analyses), a series of exploratory analyses were conducted to test for a moderation effect of age group, gender, depression severity, and ethnicity. Age group, gender, and depression severity were not significant moderators for any of our primary analyses. However, there was a trend toward significance with ethnicity as a moderator for the diagnostic group x stimulus duration interaction for angry face attention bias scores (our primary hypothesis; Diagnostic Group x Stimulus Duration x Ethnicity). Our clinically anxious sample was highly diverse, with 42.8% of the subjects identifying as a Non-Caucasian ethnicity (see Tables 1 and 4). A visual inspection of Figure 1 suggests that while the clinically anxious Caucasian group demonstrated the hypothesized effect of vigilance at the shorter stimulus duration (500 ms) and avoidance at the longer stimulus duration (1250 ms), the clinically anxious Non-Caucasian group demonstrated vigilance at 500 ms (similar to clinically anxious Caucasian group) and *increased* vigilance at 1250 ms (opposite of the clinically anxious Caucasian group). The Caucasian and Non-Caucasian nonclinical control groups demonstrated little change in their angry face attention bias scores across the two stimulus durations.

There was no difference in angry bias scores between the clinically anxious Caucasian and Non-Caucasian groups at the 500 ms duration, but the clinically anxious

Caucasian group had significantly lower angry bias scores than the Non-Caucasian group at 1250 ms. This suggests that ethnicity affected the angry face attention bias pattern of our clinically anxious subjects. Additionally, while not a significant difference, a visual inspection of Figure 1 suggests a difference in angry bias scores between the clinically anxious Caucasian and nonclinical control Caucasian groups at the 1250 ms duration, such that the clinically anxious Caucasian group had lower angry bias scores than the nonclinical control Caucasian group. At least within Caucasian youth, this finding may provide preliminary support of our hypothesis that clinically anxious youth would have lower (and negative) angry face attention bias scores compared to nonclinical youth at the 1250 ms duration. The moderation effect of ethnicity was a trend and therefore, further replication of this study is needed with larger samples of diverse ethnic groups in order to test the validity of this finding. Moreover, when including ethnicity as a moderator in our diagnostic group x stimulus duration analysis, there was a trend toward significance for the moderation effect of ethnicity with a stimulus duration x ethnicity interaction for angry face attention bias scores (see Figure 2). This finding is reflected in the three-way interaction as described above.

Finally, when including ethnicity as a moderator in our stimulus valence x stimulus duration analysis for the anxious group only, there was a trend toward significance for the moderation effect of ethnicity with a stimulus duration x ethnicity interaction for attention bias scores (collapsed across all stimulus valences). This finding suggests that the Caucasian and Non-Caucasian clinically anxious groups demonstrate a similar attention bias pattern for all affective faces in addition to angry faces only. However, the vigilance-avoidance pattern in the clinically anxious Caucasian group is

more pronounced when only considering attention bias scores for angry faces (see Figure 1) as compared to all valences combined (see Figure 3). This finding suggests that ethnicity moderated the effect of duration for all emotional stimuli and for the angry faces in particular.

One hundred percent of the clinically anxious Caucasian youth completed the study at the YAD-C within a clinical setting as compared to 77.8% of the clinically anxious Non-Caucasian youth (see Table 4). Only 22.2% of the clinically anxious Non-Caucasian youth completed the study at the middle school, a non-clinical setting. This suggests that study setting was not likely a contributing factor in our ethnicity moderation findings. Therefore, we might conclude that differences in ethnicity contributed to the unexpected results of our primary analyses. It is possible that youth with a Non-Caucasian ethnic background (i.e., African American, Hispanic, Asian American, or Multi-Ethnic) responded differently to the facial stimuli used in our dot-probe task. While the facial stimuli used in our task included a variety of ethnicities (i.e., Caucasian, African American, Asian American, and Hispanic), 51.7% of the total trials used facial stimuli from Caucasian actors (30% African American, 11.7% Asian American, 6.7% Hispanic). Our study's clinically anxious sample consisted of 42.8% Non-Caucasian subjects, suggesting that the ethnicity of a large number of our clinically anxious subjects did not match the ethnicity of the largest proportion of facial stimuli in our dot-probe task (i.e., Caucasian). A meta-analysis conducted by Elfenbein and Ambady (2002) explored the effect of cultural background on emotion recognition in studies using a variety of stimuli (e.g., photographs, voice, video) and found that recognition of emotions was more accurate when both the subject interpreting the emotion and the subject expressing the

emotion were members of the same nationality or ethnicity. Elfenbein and Ambady (2002) discuss a number of possible explanations for this "in-group advantage," (p. 204) including culture-specific patterns of emotional expression that are learned, and a greater efficiency in the cognitive processing of stimuli when subject and stimuli ethnicity match. These findings suggest the importance of matching the cultural background of both the study subjects and study facial stimuli in a task such as the dot-probe. Therefore, the current study's highly diverse clinically anxious sample may have been less accurate overall in interpreting the emotions of the facial stimuli used in our dot-probe task.

Moreover, the facial stimuli used in the current study were not validated with an ethnically diverse sample, with 81% of the participants recruited to validate the stimuli identifying as Caucasian (Tottenham et al., 2009). For Gibb et al.'s (2009) dot-probe task (adapted for the current study), they chose to include actors from the Tottenham et al. (2009) stimulus set based on a validity rating threshold for each affective face for a particular actor. However, since the validity ratings were generated with a mostly Caucasian sample of subjects, these ratings may not generalize to a more ethnically diverse sample. As described above, Non-Caucasian youth may not respond to each face valence in the same way as Caucasian youth, and may not rate each face valence as the same emotion as Caucasian youth. Overall, these findings suggest the importance of considering ethnicity in the design and interpretation of future dot-probe studies. Future dot-probe research should explore the vigilance-avoidance model with samples of youth that ethnically match the facial stimuli used in the task. Additionally, future research would benefit from new facial stimulus sets that are validated by more diverse samples of youth.

Limitations and Conclusion

There were limitations to the current study. Firstly, the majority of youth in the clinically anxious group completed the dot-probe task as the final portion of an extended clinic intake procedure that can take up to three hours, and typically takes place in the evening after the youth's school day. Therefore, youth in the clinically anxious group may have had a more difficult time concentrating due to fatigue, and distraction may have increased reaction time variance. This is evidenced by our need to exclude three subjects from analyses that were otherwise eligible for the clinically anxious group due to their unusually high rate of errors on the dot-probe, suggesting that these subjects may not have been paying attention to large portions of the task. Future research would benefit from conducting the dot-probe task alone or prior to an intense diagnostic intake, if possible. Additionally, researchers could include a questionnaire at the end of the dot-probe task assessing each participant's subjective experience of the task, their understanding of the procedure, their ability to attend to the task, and their level of distractedness. This questionnaire may provide further guidance in excluding subjects based on fatigue or attention difficulties.

A second limitation of the current study may have been the large age range of the participants. In the current study, there was a trend toward significant positive relationship between age and attention bias scores for angry faces. Therefore, due to our inclusion of youth across a large age range, changes in cognitive abilities associated with age may have contributed to differences in reaction times and could have increased noise in our data. Moreover, youth in the nonclinical control group were recruited almost exclusively from a middle school setting, and therefore, youth in the nonclinical control

group (*M* age = 13.14 years), while not significantly older, were on average almost a year older than youth in the clinically anxious group (*M* age = 12.40 years). Since a significant, positive correlation was found between age and attention bias scores for angry faces, the difference in ages between the two groups may have been a confound in the current study. Future dot-probe research may benefit from testing the vigilance-avoidance with a narrower age range.

In light of a discussion on limitations, it is helpful to consider methodological changes that would strengthen this study in the future. If we were to re-design this study, we would likely narrow the inclusion age range so as to limit the potential confounding effects of cognitive development on attention bias scores. Additionally, in order to prevent the potential effects of comorbid depression diagnoses on attention bias scores for angry faces, we would not include youth with comorbid depressive disorder diagnoses, but instead only include youth with "pure anxiety" (i.e. only anxiety disorders).

Moreover, the threat facial stimuli used in the current study were angry faces as opposed to fearful faces. We chose to include angry faces due to the use of angry faces in past dot-probe research with youth (e.g., Hankin et al., 2010; Roy et al. 2008). However, if we were to re-design this study, we may consider using fearful faces rather than angry faces due to the issue of self vs. other-referent cues. A body of literature has focused on the processing of self-referent information (i.e., information that describes you) and other-referent information (i.e., information that describes others; e.g., Kuiper and Rogers, 1979). Findings from a study conducted by Kuiper and Rogers (1979) suggest that it was easier for subjects to recall words that they had rated as self-referent when

compared to words they had rated as not self-referent. Kuiper and Rogers (1979) interpreted this finding to suggest that words rated as self-relevant were better stored in memory. Therefore, it seems possible that the use of self vs. other-referent cues would affect information processing in tasks such as the dot-probe. The angry faces used in the current study may have been other-referent in that an anxious child may have been vigilant toward the angry face as a threatening cue, but they may not have personally identified with the angry face. Instead, images of fearful faces might elicit a self-referent response in that an anxious child may identify the emotion on the face as self-relevant. This may increase the salience of the threatening faces used in our dot-probe task, which may facilitate the information processing of the threatening faces and potentially decrease reaction times for anxious youth. Finally, if we re-designed the current study we would consider using a facial stimulus set that uses youth faces as opposed to adult faces. Youth faces may also be more salient stimuli for youth samples, again possibly by generating a self-referent response as opposed to an other-referent response. The National Institute of Mental Health Child Emotional Faces Picture Set (Egger et al., 2011) is an available option that we would consider using for future dot-probe research with youth.

To conclude, results from our primary analyses did not provide evidence in support of the vigilance-avoidance model of anxiety in youth. However, there was a trend found for ethnicity moderating the interaction effect of diagnostic group and stimulus duration, with no difference in angry bias scores between the clinically anxious Caucasian and Non-Caucasian groups at the 500 ms duration, but a difference between the two groups at 1250 ms. Therefore, the inclusion of a highly ethnically diverse clinically anxious sample likely contributed to our initial null findings and suggests that

further research is necessary in order to test the validity of the vigilance-avoidance model in youth.

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Table 1

Demographic and Clinical Data for Anxious Youth and Nonclinical Controls (NC)

Characteristic	Anxious (n = 21)	NC (n = 21)	Full Sample (N = 42)
	N (%)	*N* (%)	*N* (%)
Gender			
Female	11 (52.4%)	9 (42.9%)	20 (47.6%)
Race/ethnicity			
Caucasian	12 (57.1%)	5 (23.8%)	17 (40.5%)
African American	3 (14.3%)	6 (28.6%)	9 (21.4%)
Asian American	2 (9.5%)	3 (14.3%)	5 (11.9%)
Hispanic	4 (19.0%)	4 (19.0%)	8 (19.0%)
Multi-Ethnic	0 (0%)	3 (14.3%)	3 (7.1%)
	M (*SD*)	*M* (*SD*)	*M* (*SD*)
Age (years)	12.40 (2.34)	13.14 (1.23)	12.77 (1.88)
VAMS-Mood (mm)	26.95 (20.29)	21.45 (18.33)	24.13 (19.26)
VAMS-Anxiety (mm)	16.32 (19.83)	21.35 (23.11)	18.90 (21.44)
Symptom Measures			
CES-D-C	18.71 (11.19)***	6.38 (3.88)	12.55 (10.36)
CES-D-P	18.00 (10.04)***	3.57 (3.12)	10.79 (10.36)
MASC-C	50.05 (22.66)***	28.14 (14.43)	39.10 (21.80)
MASC-P	57.10 (16.15)***	30.76 (8.10)	43.93 (18.35)
CGI	4.71 (.78)***	1.38 (.74)	3.05 (1.85)

Note. CES-D = Center for Epidemiological Studies - Depression Scale; MASC = Multidimensional Anxiety Scale for Children.
*** significant group differences between Anxious and NC of $p < .001$

Table 2

Mean (SD) Attention Bias (milliseconds; ms) for Anxious Youth and Nonclinical Controls (NC)

	Anxious (n = 21)		NC (n = 21)		Full Sample (N = 42)	
Attention Bias Measure	*M*	*SD*	*M*	*SD*	*M*	*SD*
Angry Bias						
500 ms	16.26	71.59	16.30	49.64	16.28	60.85
1250 ms	5.50	61.23	6.38	35.95	5.94	49.59
Overall	10.88	49.54	11.34	21.20	11.11	40.89
Happy Bias						
500 ms	21.49	80.07	-6.01	29.83	7.74	61.28
1250 ms	7.60	53.41	9.85	34.27	8.72	44.33
Overall	14.54	44.90	1.92	27.56	8.23	37.35
Sad Bias						
500 ms	15.17	45.51	4.38	48.35	9.78	46.69
1250 ms	6.38	42.20	6.89	39.40	6.63	40.31
Overall	10.78	28.81	5.63	31.91	8.20	30.14

Table 3

Attention Bias Data for Ethnicity Moderation of Diagnostic Group x Stimulus Duration Effect for Angry Bias Scores

	Anx Cauc (*n* = 12)		Anx NonCauc (*n* = 9)		NC Cauc (*n* = 5)		NC NonCauc (*n* = 16)		Full Sample Cauc (*n* = 17)		Full Sample NonCauc (*n* = 25)	
Attention Bias	*M*	*SE*	*M*	*SE*	*M*	*SE*	*M*	*SE*	*M*	*SE*	*M*	*SE*
Angry												
500 ms	28.6	18.8	7.2	20.8	19.5	28.1	11.2	16.0	24.0	17.2	9.2	13.3
1250 ms	-23.4	13.3	46.6	14.7	11.3	19.9	3.4	11.4	-6.0	12.2	25.0	9.4

Note. Means and standard errors in this table are adjusted according to the covariate of age used in this model. Means and standard errors are presented in milliseconds.

Table 4

Demographic and Clinical Data for Anxious Caucasian and Anxious Non-Caucasian Subjects

	Anxious Cauc (n = 12)	Anxious NonCauc (n = 9)
	M (*SD*)	*M* (*SD*)
Age (years)	11.78 (2.16)	13.21 (2.45)
CES-D child report	16.17 (12.74)	22.11 (8.19)
MASC child report	45.58 (25.95)	56.00 (16.99)
Angry Bias	-3.04 (57.61)	29.45 (29.89)
Happy Bias	22.16 (51.82)	4.39 (33.82)
Sad Bias	11.71 (28.29)	9.53 (31.18)
	N (%)	*N* (%)
Gender		
Female	5 (41.7%)	6 (66.7%)
Setting		
Middle School	0 (0%)	2 (22.2%)
YAD-C Intake	12 (100%)	5 (55.6%)
YAD-C	0 (0%)	2 (22.2%)
Child's Home	0 (0%)	0 (0%)

Note. CES-D = Center for Epidemiological Studies - Depression Scale; MASC = Multidimensional Anxiety Scale for Children.

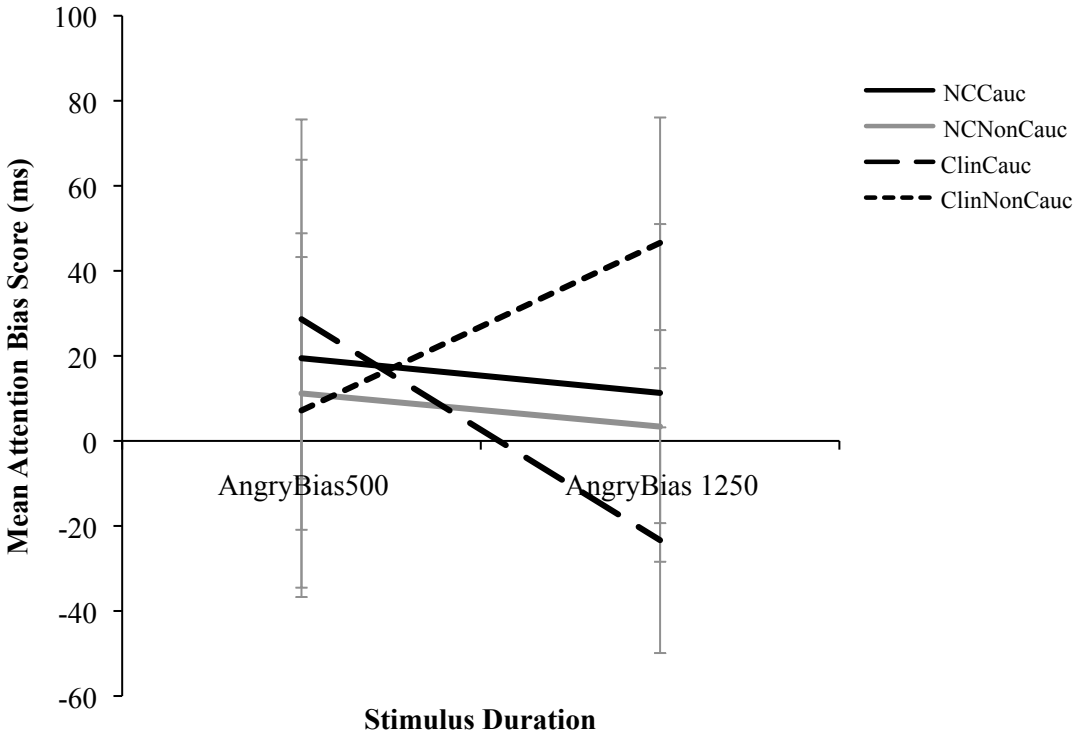

Figure 1. Ethnicity as a Moderator of Diagnostic Group x Stimulus Duration Analysis of Covariance: Diagnostic Group x Stimulus Duration x Ethnicity Interaction. Means and standard errors in this figure are adjusted according to the covariate of age used in this model. Error bars are +/- 2 SE from the mean.

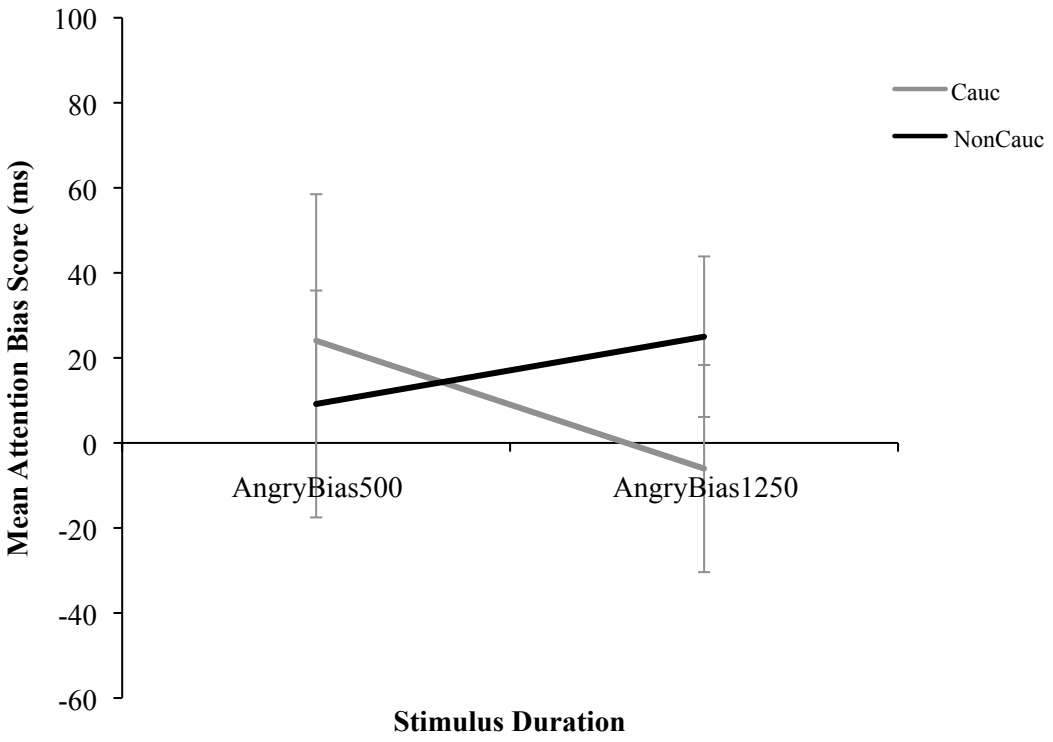

Figure 2. Ethnicity as a Moderator of Diagnostic Group x Stimulus Duration Analysis of Covariance: Stimulus Duration x Ethnicity Interaction. Means and standard errors in this figure are adjusted according to the covariate of age used in this model. Error bars are +/- 2 SE from the mean.

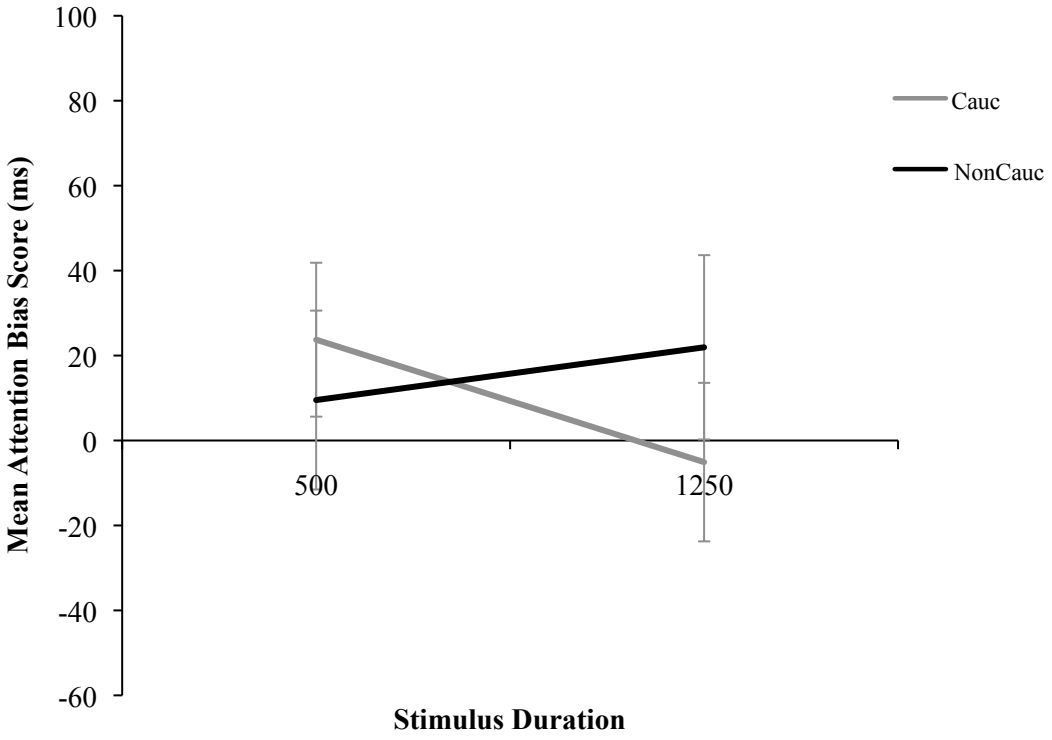

Figure 3. Ethnicity as a Moderator of Stimulus Valence x Stimulus Duration Analysis of Covariance: Stimulus Duration x Ethnicity Interaction. This analysis was conducted with the clinically anxious group only. Means and standard errors in this figure are adjusted according to the covariate of age used in this model. Error bars are +/- 2 SE from the mean.