EXAMINING ATTENTION CONTROL AS A MODERATOR OF THREAT-RELATED ATTENTION BIAS AMONG ANXIETY DISORDERED YOUTH

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ABSTRACT

Research from the information processing and temperament literatures has proposed dysfunction within systems of attention, including early attentional orientation (bottom-up) and later executive control of attention (top-down), in contribution toward the development of anxiety disorders. This study investigated the moderating role of attentional control on the relationship between threat-related attention bias and youth anxiety severity. Participants were 107 treatment-seeking youth (7-17 years, M_{age} = 11.17 years, SD = 3.06; 41.4% male) who met diagnostic criteria for an anxiety disorder. Multimodal assessment (behavioral, youth-, and parent-report) of attention control, threat-related attention bias, and anxiety severity was conducted. Hierarchical regression analyses provided little support for attention control as a moderator of the relationship between threat-related attention bias and anxiety severity. However, attention control was identified as a more salient predictor of anxiety severity than threat-related attention bias. Measures of attention were identified as distinct from parent-reported symptoms of attention-deficit/hyperactivity disorder (ADHD) and depression for youth. Similarly, measures of attention and anxiety severity for youth were not related to parenting behavior or parental attention control but were influenced by parents' self-reported symptoms of anxiety and depression. Implications for future research and clinical work are discussed.

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CHAPTER 1

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Examining Attention Control as a Moderator of Threat-Related Attention Bias Among Anxiety Disordered Youth

Anxiety disorders are among the most prevalent mental health problems for youth (Benjet, Borges, Medina-Mora, Zambrano, Aguilar-Gaxiola, 2009; Costello, Egger, Copeland, Erkanli, & Angold, 2011). Left untreated, anxious youth experience negative outcomes in several domains, including impaired social functioning (Shanahan, Copeland, Costello, & Angold, 2007), academic achievement (van Ameringen, Mancini, & Favolden, 2003), and school functioning (Mychailyszyn, Mendez, & Kendall, 2010). These experiences place individuals at risk for the development of subsequent psychopathology, such as depression, suicidality, and substance use disorders (Angold, Costello, & Erkanli, 1999; Lopez, Turner, & Saavedra, 2005; Wolk, Kendall, & Beidas, 2015). As such, understanding the mechanisms responsible for the development and maintenance of problematic anxiety remains an important area of research.

A number of differences in information processing, particularly early attentional processes, have been identified both in youth reporting high levels of trait anxiety (e.g., Telzer et al., 2008), as well as those diagnosed with anxiety disorders (e.g., Roy et al., 2008). Differences in attention to threat are considered to be mechanisms of risk by which anxiety disorders develop and are maintained (e.g., Watts & Weems, 2006). These attentional processes include an initial, automatic attention orientation, as well as subsequent, volitional attention control. A dual system of disordered attention has been proposed as a risk factor for anxiety (Derryberry & Reed, 1998; 2002). This system includes initial attention biases toward threat in conjunction with low levels of attentional control. However, no studies have examined the interaction of these attentional processes among samples of treatment-seeking youth who meet criteria for anxiety disorders. Given that stages of attention have been identified as cognitive risk factors for anxiety among youth with high self-reported trait anxiety in the absence of a diagnosis (Muris, Meesters, Rompelberg, 2006; Muris, van der Pennen, Sigmond, & Mayer, 2008), the interaction of these predictors within anxiety-disordered youth remains an important area of study.

As one of the earliest stages of information processing (e.g., Fu, Greenwood, & Parasuraman, 2005), attention orientation toward threat has been particularly linked to the development and maintenance of anxiety disorders: both individuals that self-reported high levels of trait anxiety on questionnaires and individuals diagnosed with anxiety disorders attend more quickly to threat, more frequently identify threat, and allocate greater attentional resources toward threat information in the environment (Bar-Haim et al., 2007; Cisler et al., 2009; Mogg & Bradley, 1998). Additionally, threat-related attention biases have been identified across all anxiety disorders (Bar-Haim et al., 2007; Roy et al., 2008), indicating similarly disordered attention orientation across anxiety disorder categories. However, research findings are mixed regarding the relationship between anxiety and threat-related attention biases, with some studies failing to identify attention biases (Waters, Lipp, & Spence, 2004) and others indicating different biases both toward and away from threat (e.g., Cisler et al., 2009) among samples of youth with anxiety disorders (see Cisler & Koster, 2010 for a review). Many of these discrepancies may be due to methodological differences between studies (e.g., small sample sizes, Dalgleish et al., 2003; timing of stimuli, Bar-Haim et al., 2007) that could notably impact attention processes or the ability to identify significant patterns of attention.

Research has sought to reconcile discrepancies in the anxiety-attention literature by proposing that deficits occur at multiple level of processing, specifically focusing on executive attentional control capacities (Posner & Rothbart, 2000). In this view, individuals with high self- and clinician-rated levels of anxiety symptoms show enhanced attentional vigilance toward threat and subsequent difficulty exerting voluntary control of attention, reducing the efficiency of response to non-threat information (Eysenck et al., 2007; Friedman & Miyake, 2004). Voluntary attentional control, occurring subsequent to initial facilitated attention to threat, is recruited as a proposed coping mechanism used to regulate anxiety by allowing one to ignore environmental threat and shift of attention to other, less emotionally-salient sources of information in the environment (Derryberry & Reed, 2002; Derryberry & Rothbart, 1997). Attentional control consists of the ability to inhibit dominant attentional responses, shift attention, and update working memory (Bardeen & Orcutt, 2011). As such, strong attentional control capacities could protect an individual from distracting environmental threat in order to continue task-relevant behavior and further learn from the environment (Ochsner & Gross, 2005; Posner & Rothbart, 1998). Thus, initial experience of anxiety has been proposed to lead to increased threat-related attention bias and deficits in attentional control that lead to difficulty disengaging from threat, inability to take advantage of safety cues, and subsequent escalation of anxiety symptoms (Derryberry, Reed, & Pilkenton-Taylor, 2003).

The role of attentional control in anxiety was initially evaluated among adults with high self-reported trait anxiety (Derryberry & Reed, 2002). Results indicated that high trait anxious participants with good attentional control were better able to shift away from threat at a 500ms stimulus presentation and those with low attentional control evidenced difficulty disengaging from threat at longer delays (Derryberry & Reed, 2002). Studies of attentional control with youth have largely employed community samples with elevated trait anxiety (Muris, de Jong, & Engelen, 2004; Muris, van der Pennen, Sigmond, & Mayer, 2008). Results of these studies suggest that individual differences in attentional control are linked to anxiety symptom severity. However, no studies to date have explored the role of attention control, measured behaviorally and by self- and parent- report, for youth with anxiety disorders.

Although attention biases have been reliably identified among samples of youth endorsing elevated anxiety symptoms (Bar-Haim et al., 2007), and anxiety disorders (e.g., Roy et al., 2008), anxious youth often present with comorbid disorders (Kendall et al., 2010). Consideration of comorbid disorders is important given that many report dysregulated attention as either a central (i.e., ADHD) or associated (i.e., depression) component of their presentation. Studies examining the role of threat-related attention biases within samples of youth with other mental health symptoms are mixed. Some research implicates the presence of attention biases for individuals with depression (Mogg & Bradley, 2005) whereas other studies find no evidence of attention bias among depressed individuals (Grant & Beck, 2006; Mathews, Ridgeway, Williamson, 1996; Mogg & Bradley, 2005). The roles of these comorbidities with anxiety have been infrequently studied among youth. Muris and colleagues (2006) found strong associations between self- and parent-reported attentional control and symptoms of anxiety, depression, and ADHD for a community sample of youth. However, examination of the interaction of attention bias and control among youth with anxiety disorders and these comorbid conditions remains an area of future study.

In addition to the internal selective processes that motivate youth to attend to specific environmental stimuli (Cicchetti & Tucker, 1994; Derryberry & Reed, 1994), it remains important to understand how external stimuli reciprocally impact early information processing systems. Information processing systems are impacted by experience and learning (Mathews & MacLeod, 2005), which shape cognitive biases in anxiety (Eley et al., 2008). Specifically, research has implicated the role of parents and their psychopathology as having a role in the development and maintenance of anxiety for youth (Ollendick & Horsch, 2007; Settipani, O'Neil, Podell, Beidas, & Kendall, 2013). Parental psychopathology often confers risk for youth anxiety symptoms and disorders, even after controlling for genetic influence (Bogels & Brechman-Toussaint, 2006). Parents also play an important role in regulating attention early in development to assist in early emotion regulation for infants (Degnan & Fox, 2007; Fox et al., 2005; Gottman, Katz, & Hooven, 1997). Therefore, given evidence that parents exhibit attentional biases regarding their own and their children's environments (Lester et al., 2009), they likely model dysregulated, reactive attention, anxious behavior, and maladaptive coping to their children (Creswell et al., 2010; Muris, Steerneman, Merckelbach, & Meesters, 1996).

Additionally, anxious parents often act in ways that serve to perpetuate anxiety (e.g., overcontrol of youth; Ollendick & Horsch, 2007). As one of these influential actions, parents may make fear-based parenting decisions (e.g., keep child home from school; Fox, Henderson, Marshall, Nichols, & Ghera, 2005) or encourage their anxious youth to avoid feared objects, which would reinforce or amplify their fear (Degnan & Fox, 2007). Anxious parents often provide explicit negative information about the events and lack of control or ability to cope (Field & Lester, 2010). Parental anxiety (i.e., panic disorder) has also been shown to confer risk in the development of attentional biases among anxiety-disordered youth, although results were confounded by a significant association between youth anxiety disorder and attentional biases toward threat (Pine, Klein et al., 2005). However, other studies have found that attentional biases and familial risk confer independent risk for anxiety disorders among youth (Brown, McAdams, Lester, Goodman, Clark, Elay, 2012). Thus, parental factors, including attention processes and psychopathology, warrant investigation as predictors of attention dysregulation and anxiety symptomatology among anxiety-disordered youth.

The present study examined the moderating role of attentional control in the relationship between threat-related attentional biases and anxiety severity among treatment-seeking, anxiety-disordered youth. This study tested the presence of multiple systems of dysregulated attention among treatment-seeking youth who met criteria for an anxiety disorder within a multi-modal, multi-informant framework. It was hypothesized that anxiety disordered youth would show a threat-related attention bias. Further, it was hypothesized that behavioral and self- and parent-report measures of attentional control would significantly moderate the relationship between threat-related attention bias and anxiety severity. Specifically, it was hypothesized that youth with higher levels of attentional control would evidence less threat-related attention bias and, subsequently, diminished severity of anxiety symptomatology

This study also examined the relationship between attention biases and attentional control and co-occurring symptoms of ADHD and depression among the current sample of anxious youth. It was hypothesized that youth with co-occurring symptoms of ADHD would evidence lower levels of attentional control and no specific differences in attention bias. Per previous research, regarding symptoms of depression, it was hypothesized that higher depressive symptoms would predict less threat-related attention bias (i.e., closer to 0) and lower levels of attentional control. Similarly, symptoms of ADHD were hypothesized to predict lower levels of attentional control, although no previous studies have examined the role of attention bias among samples of youth with comorbid symptoms of anxiety and ADHD. As such, no a priori hypotheses were made regarding the differences in attention bias for youth with anxiety and ADHD symptoms. This study also examined parental factors related to predictors of severity within anxiety-disordered youth. Lower levels of parents' self-reported attentional control, as well as high parental anxiety and depression, were proposed to predict lower levels of youths' attentional control, as well as greater attention bias. Low parental attentional control was proposed to predict severity of youths' anxiety severity. Low levels of child-rated parental psychological autonomy granting and parental involvement were hypothesized to predict lower attentional control and higher threat-related attention bias among anxious youth.

Method

Participants

Participants were 107 youth, ages 7-17 years (*M* = 11.17 years; *SD* = 3.06), with a principal diagnosis of an anxiety disorder. Youth were referred to the Child and Adolescent Anxiety Disorders Clinic (CAADC) of Temple University for outpatient treatment from multiple sources (e.g., school personnel, pediatricians). Youth and their parents participated in the current study during their initial assessment, prior to the initiation of treatment. Families were included in the study if youth (a) were been between 7 and 17 years of age at the time of the initial assessment, (b) met DSM-IV diagnostic criteria for an anxiety disorder (SAD, GAD, SoP, SP, OCD, PTSD, or Anxiety Disorder- Not Otherwise Specified), and (c) read and spoke English and had at least one English-speaking parent. Youth were excluded from the present study if they (a) were diagnosed with a principal disorder other than an anxiety disorder, (b) had an IQ < 80 as determined by psychoeducational records, or (c) had vision problems (i.e., blindness in one or more eyes). Based on these criteria, 6 youth were excluded from data analyses due to the presence of a principal disorder other than an anxiety disorder. Youth were not excluded due to the presence of non-principal comorbidities to increase external validity of the study (i.e., anxiety disordered youth often have multiple comorbid disorders; Kendall et al., 2010). Youth were not excluded on the basis of sex or ethnicity.

Of the 107 participating youth, 41.1% were male; 77.6% self-identified as Caucasian, 7.5% identified as black, 3.7% identified as Asian, 2.8% identified as Hispanic, and 6.5% identified their race/ethnicity as "Other." Parents reported that their families' total household income as $0-19,999 (2.80%), $20,000-39,000 (7.48%), $40,000-59,000 (10%), $60,000-79,000 (5.88%), and over $80,000 (54.2%); 10.3% did not report an estimate of household income.

Youth in the present sample met criteria for principal diagnoses of GAD (32.7%), SoP (18.7%), SP (14.0%), SAD (7.5%), OCD (3.7%), and Anxiety Disorder, Not Otherwise Specified (NOS; 2.8%). Additionally, many youth met criteria for co-principal anxiety disorders, including GAD and SoP (8.4%), GAD and SAD (3.7%), SoP and SAD (1.9%), GAD and SP (2.8%), SAD and SP (1.9%), SoP and SP (0.9%), and GAD, SoP, and SAD (0.9%). Diagnoses were determined during the interviews based on Clinical Severity Ratings (CSR) as given by the interviewing clinician. A minimum CSR of 4 on the 9-point scale (0-8) is required for a diagnosis; ratings below 4 denote subclinical difficulties. The parent-child composite diagnosis, which represents the principal diagnosis for this study, was generated based on CSRs of the symptoms endorsed during each interview according to the "or" rule (a diagnosis is given if the child *or* the parent interview endorses criteria sufficient to warrant a clinical diagnosis; Silverman & Albano, 1996). Of the 107 youth with a principal anxiety disorder, 87 (81.3%) met criteria for a comorbid anxiety disorder, 18 (16.8%) met criteria for a current or past depressive disorder (MDD or dysthymic disorder), 20 (18.7%) met criteria for attention-deficit/hyperactivity disorder (ADHD) of any presentation subtype, and 5 (4.7%) met criteria for oppositional-defiant disorder (ODD).

Measures

Assessment instruments included a semi-structured diagnostic interview, self- and parent-report, and behavioral computer tasks.

Clinician-Administered Measures

Anxiety Disorders Interview Schedule for Children (ADIS-IV-C/P; Silverman & Albano, 1996). The ADIS-IV-C/P are semistructured diagnostic interviews to assess anxiety, mood disorders, and other psychopathology in accordance with the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed., text revision; *DSM-IV*, American Psychiatric Association, 2000), as reported by children aged 7-17 years, and their parents. The ADIS-IV-C/P demonstrates excellent interrater and retest reliability for diagnostic ratings and clinician severity ratings (CSRs), based on both child and parent interviews (Silverman, Saavedra, & Pina, 2001), as well as good to excellent inter-rater reliability (Lyneham, Abbott, & Rapee, 2007). Concurrent validity of ADIS-IV-C/P ratings has been demonstrated with parent-rated scores from the Multidimensional Anxiety Scale for Children (MASC; Villabo, Gere, Torgersen, March, & Kendall, 2012; Wood, Piacentini, Bergman, McCracken, & Barrios, 2002). ADIS-IV-C/P training requires the attainment and maintenance of interrater reliability levels of .85 and above (Cohen's K). Parent and child interviews were conducted separately by two reliable diagnosticians, which consisted of advanced graduate students and postdoctoral fellows.

Youth-Related Measures

Attentional Control Scale for Children (ACS-C/ACS-C-P; Muris, de Jong, & Engelen, 2004). The ACS-C (child report) and ACS-C-P (parent report) is a 20-item self-report measure of youth's self-perceived abilities to focus and shift attention according to environmental demands (e.g., "My/My child's concentration is good, even when someone turns the music on"). The ACS-C and ACS-C-P are adaptations of the adult Attentional Control Scale (Derryberry & Reed, 2002) for use with children. Ratings are made on a 4-point Likert-style scale (0 = *almost never*, 3 = *always*). Nine questions are reverse coded. Total scores are computed by summing all items, with higher scores indicating higher levels of attentional control. The ACS-C and ACS-C-P are comprised of two subscales: attentional shifting and attentional focusing. Little psychometric information is available for the ACS-C. Initial evaluations of the ACS-C identified good internal consistency (α = .72; Muris, De Jong, & Engelen, 2004) and reliability (α = .75; Muris, Meesters, & Rompelberg, 2007) for this scale. Although some studies have found no significant correlations between ACS-C scores and age in samples as young as nine years (Muris, Meesters, & Rompelberg, 2007), others have found increases in ACS-C scores with age (Muris, van der Pennen, Sigmond, & Mayer, 2008). Previous evaluations have found negative associations between ASC-C scores and measures of psychopathology, particularly anxiety (r = -0.38; Muris, De Jong, & Engelen, 2004; r = -0.42; Muris, Meesters, & Rompelberg, 2007; r = -0.51; Muris, van der Pennen, Sigmond, & Mayer, 2008) and cognitive biases (e.g., interpretive threat biases; r = -0.26; Muris, Meesters, & Rompelberg, 2007), as well as positive associations with perceived control (r = 0.22; Muris, De Jong, & Engelen, 2004) and school performance (*r*s between .23 and .42; Muris, 2006a). Although little psychometric information is available for the ACS-C-P, an initial evaluation revealed that the ACS-C-P evidenced good reliability (α = 0.87) and agreement with the child-report version (ICC = 0.72; Muris, Meesters, & Rompelberg, 2007). For the present study, the internal consistency scores were .76 (youth report) and .87 (parent report; both Cronbach's α).

Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001). The CBCL is a 112-item parent-reported measure of child behavioral problems and adaptive skills. Items are rated on a scale of 0 to 2 (0= *not true*, 1= *sometimes true*, 2= *very true or often true*). Validity, internal consistency, and retest reliability have been reported for the CBCL (Achenbach & Rescorla, 2001). The raw scores of the DSM-oriented ADHD problems (7 items; Cronbach's α =.81)and Affective Problems (13 items; Cronbach's α =.77) subscales were used for the present study.

Multidimensional Anxiety Scale for Children (MASC-C; March, Parker, Sullivan, Stallings, & Conners, 1997). The MASC is a 39-item child- and parent-report of the presence and severity of anxiety symptoms among youth. Specific symptoms assessed include somatic symptoms, social anxiety, harm avoidance, and separation/panic symptoms. The MASC has been reported to have strong psychometric properties (March et al., 1997, 1999). In the present sample, internal consistency for the child-report was .91(Cronbach's α). Internal consistency for the parent-report of the MASC was .83 (Cronbach's α).

Parenting Style Index (PSI; Steinberg, Lamborn, Dornbusch, & Darling, 1992). The PSI is a 22-item self-report measure of youth's perceptions of parenting behaviors. This questionnaire is based on Youth rated their agreement with statements about parents' behaviors in three dimensions on a 4-point Likert scale. These dimensions included (1) strictness/supervision, which describes parents' demandingness (e.g., "How much do your parents really know when you go to bed at night?"); (2) acceptance/involvement, which describes parents' responsiveness (e.g., "When my parents want me to do something, they explain why") ; and (3) granting of psychological autonomy (e.g., "My parents let me make my own plans for things I want to do"). Good reliability and validity have been reported for the PSI (Chao, 2001; Milevsky et al., 2007; Steinberg et al., 1994). The internal consistency of the PSI for the current study was .54 (Cronbach's α); the internal consistency for the parental involvement subscale was .68

(10 items), for the strictness/supervision scale was .58 (9 items), and for the autonomy subscale was .55 (9 items, all Cronbach's α).

Positive and Negative Affectivity Scale for Children (PANAS-C; Laurent et al., 1999). The current study used the 10-item version of the PANAS-C (e.g., Daughters et al., 2009; the original had 27-items; Laurent et al., 1999) to measure the degree to which youth report currently feeling excited, mad, interested, frustrated, happy, upset, energetic, embarrassed, proud, and nervous. Ratings are made on a 10-point Likert-style scale (1= *very slightly or not at all* and 10= *extremely*). Importantly, youth completed the PANAS before and after completing the computer tasks to assess initial state levels of anxiety (e.g., "How nervous are you right now?"), as well as changes in state anxiety across completion of the computer tasks. The PANAS-C has demonstrated strong reliability and convergent validity, as evidenced by positive associations between the negative affectivity subscale of the PANAS and measures of anxiety and depression (Laurent et al., 1999).

Parent-Report Measures

Attentional Control Scale for Adults (ACS-A; Derryberry & Reed, 2002). The ACS-A is a 20-item self-report scale assessing one's ability to focus attention (e.g., "When concentrating, I can focus my attention so that I become unaware of what's going on in the room around me"), shift attention (e.g., "I can quickly switch from one task to another"), and flexibly control thoughts (e.g., "It is hard for me to break from one way of thinking about something and look at it from another point of view"; Derryberry & Reed, 2002). Items are rated on a four-point Likert-type scale (0 = *almost never* to 3 = *always*). Similar to the ACS-C, this questionnaire is comprised of attentional shifting and attentional focusing subscales. The ACS-A evidences good internal consistency (α = .88, Derryberry & Reed, 2002; α = .82, Bardeen & Orcutt, 2011), positive associations with positive emotions (Derryberry & Reed, 2002) and emotional control (Matthews, Yiend, & Lawrence, 2004), and negative associations with measures of psychopathology (e.g., anxiety; Derryberry & Reed, 2002). For the present study, the internal consistency for the total score was .87, for the shift subscale was .79, and for the focus subscale was .82 (all Cronbach's α).

Beck Depression Inventory (BDI; Beck, Rush, Shaw, & Emery, 1979). The BDI is a 21-item self-report measure of depressive symptoms for adults. Items are rated on a three-point scale, 0 to 2. The BDI has evidenced strong retest reliability over a 1-week period, as well as convergent validity with other self- and clinician-rated measures of depressive symptomatology (Beck, Epstein, Brown, & Steer, 1988; Beck, Steer, & Carbin, 1988; Richter, Werner, Heerlein, Kraus, & Sauer, 1998). Internal consistency for the present study was .89 (Cronbach's α).

State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). The STAI State and Trait Inventory scales consist of two 20-item self-report scales assessing one's current (state) and general (trait) symptoms of anxiety. Items are rated on a four-point Likert-style scale (1 = *almost never* to 4 = *almost always*). Research suggests that the STAI Trait scale likely included representation of depression and negative affect in addition to anxiety (Bieling, Antony, & Swinson, 1998). As such, the current study used the revised STAI-A (Bieling et al., 1998) as a measure of self-reported parental anxiety. The internal consistency for the STAI-A for the present sample was .53 (seven items; Cronbach's α).

Computer Tasks

Dot-Probe Task (DPT; adapted from MacLeod et al., 1986; Mogg & Bradley, 1998; Eldar & Bar-Haim, 2010). The dot probe task is a modification of the task by Mogg and Bradley (1998), which has been used to evaluate attention biases among anxious samples (e.g., Pine et al., 2005; Roy et al., 2008). In an effort to remain consistent with previous research regarding attention biases among anxious samples, the current dot-probe task is a modified version of the Mogg and Bradley (1999) protocol that included alternative standardized stimuli from the Eldar and Bar-Haim (2010) protocol. These stimuli, as opposed to those in Mogg and Bradley (1999), allow for a standardized presentation of other features of pictures (e.g., clothing) in addition to facial expression. These stimuli included photographs (47mm x 70mm) of equal luminance and contrast of 12 actors (50% female) from the NimStim Set of Facial Expressions stimulus set (Tottenham et al., 2009; www.macbrain.org/faces/), which were presented against a black background. Each photograph displayed actors making neutral, happy, or angry (threat) faces; as such, there were three potential face pairs for each trial, occurring with equal probability: neutral-neutral, angry-neutral, and happy-neutral. The task consisted of 120 trials presented in random order for each participant. Each trial began with the presentation of a 2cm x 2cm fixation cue (“+”) in the center of the screen for 500ms. As the fixation cue ended, a face pair appeared on the screen, horizontally centered, for 500ms. Immediately after the termination of the face pair presentation, an asterisk probe (*) appeared in the location previously occupied by one of the face photographs. Youth were instructed to indicate on which side of the screen the probe appeared as quickly and accurately as possible, by clicking the left or right arrow button on the laptop keyboard to correspond to the location of the asterisk probe (left or right side of the screen). The probe remained on the screen for approximately 1100ms. The inter-trial interval varied randomly between 750ms and 1250ms. Youth were instructed to focus their gaze on the fixation cue when it reappeared. Stimulus affect and asterisk probe presentation were counterbalanced by the side of the screen on which they were presented.

Latency and accuracy of response to the asterisk probe were recorded; only trials in which a correct response is recorded were included in attention bias scores. Critical trials included those in which neutral faces were paired with emotion (angry vs. happy) faces. Attention bias scores were calculated by subtracting response latencies for trials in which the asterisk probe appeared behind the angry/threat face from those in which the asterisk probe appeared behind the neutral face during critical trials (Bardeen & Orcutt, 2011; MacLeod, Mathews, & Tata, 1986). Thus, positive latency values denote presence of attentional bias toward the respective emotion, whereas negative latency values represent attentional bias away from the respective emotion (Bradley et al., 1998).

Attention Network Test, Child Version (ANT-C; Fan, McCandliss, Sommer, Raz, & Posner, 2002; Rueda et al., 2004). The ANT is a computerized task that assesses multiple networks of attention, including alerting, orienting, and executive control. Rueda and colleagues (2004) adapted the original ANT task (Fan et al., 2002) for use with youth four years of age and older. Although attentional control capabilities are proposed to develop throughout childhood, the test developers of the ANT-C have noted a stability of scores after age seven (Rueda, Posner, & Rothbart, 2005). The child version of the ANT includes use of developmentally appropriate stimuli (i.e., fish), given the importance of considering stimuli choice in the assessment of attention processes for younger participants (McDermott, Perez-Edgar, & Fox, 2007). Fish stimuli were yellow line drawings presented against a blue backdrop. The ANT-C consists a 24-trial practice block, followed by three blocks of 48 trials, resulting in a total of 144 trials. Each ANT trail began with the presentation of a fixation cross for varying durations (between 400 and 1600ms) followed by one of four potential warning cues, displayed for 150ms: no asterisk (i.e., no warning), a central asterisk cue (i.e., over the fixation cross), a spatial asterisk cue (i.e., one asterisk presented above or below central fixation cross that cues the location of upcoming targets), or a double asterisk cue (i.e., presented above and below central fixation cross). Initial cues were followed by a 450ms fixation period. Then, a central target fish, which was sometimes flanked by two distractor fish on either side in a horizontal row, was displayed for 1700ms or until a response was made. Youth were directed to "feed the middle fish" by responding quickly and accurately to the direction that the central fish was pointing by pressing the left or right arrow key. Youth were provided visual feedback following response to each trial (1000ms); correct responses were followed with a display of the target fish blowing bubbles and incorrect responses were followed by no animation of the fish. Flanking fish pointed either in the same direction (congruent trials) or opposite direction (incongruent trials) as the central fish. No flanking fish were present for neutral trials (Fan et al., 2002). The behavioral measure of attentional control was calculated by subtracting mean response latency for congruent trials from incongruent trials, such that higher scores indicated greater attentional conflict and lower (negative) scores indicated diminished conflict, or greater attentional control capacity (Fan et al., 2002; Reinholdt-Dunne, Mogg, & Bradley, 2009).

Procedure

Families seeking treatment at the CAADC were invited to participate during their initial visit; no families declined to participate. Anxious youth and their parents consented to study procedures before separately completing the ADIS-IV-C/P, self-report measures, and computer tasks. The ADIS-IV-C/P was conducted by trained and reliable diagnosticians. Youth self-report forms were completed following the youth ADIS-IV-C and took approximately 30 minutes. Following these self-report forms, youth completed the computer tasks while their parents(s) finished completing their self-report measures. Youth completed the PANAS-C both prior to and directly after the computer tasks. Presentation of all computer tasks was conducted in a quiet room on a Dell Latitude E5500 laptop. Participants were seated approximately 50cm from the computer screen. Both computer tasks were programmed and presented using E-Prime® 2.0 (Psychology Software Tools, Pittsburgh, PA; www.pstnet.com). The Principal Investigator (PI) or a research assistant supervised by the PI ran all computer tasks; while some study personnel were not blind to study hypotheses, they were blind to anxiety severity and presenting concerns for youth. Instructions were read aloud to participating youth, who were asked to repeat the directions to ensure their understanding. Participant response for both computer tasks required pressing the right and left arrow keys; youth were instructed to keep the pointer finger from each hand on the respective arrow keys. Computer tasks took approximately 30 minutes to complete. Participants received a short break (< 5 minutes) before completing the PANAS-C and beginning the computer tasks.

Data Analysis Plan

Preliminary Analyses. A Missing Value Analysis was conducted to examine the pattern of missing data and determine if data were missing at random or not at random. Hierarchical linear regression and analysis of variance (ANOVA) examined the initial relationships between sociodemographic factors (age, race/ethnicity, family SES) and measures of attention and anxiety severity for continuous and categorical variables, respectively. Factors found to be significantly associated with these variables were included as covariates in subsequent analyses.

Primary Analyses. Each study aim was investigated using hierarchical multiple regression analyses. Each measure of attentional control (i.e., ANT conflict scores, ACS-C, and ACS-C-P) was examined in a separate model. Anxiety severity was examined through the construction of a latent variable that included the composite CSR for principal anxiety disorder, MASC-C total score, and MASC-P total score. Moderation was examined though inclusion of interaction terms (e.g., attention bias and attention control; attention control and ADHD symptoms). Study variables were z-standardized for all moderation analyses to reduce multicollinearity. All significant interactions were probed using recommendations described by Aiken and West (1991) and Holmbeck (2002), such that the relationship between attention bias and anxiety severity was examined at both high (+1 SD from mean) and low (-1 SD from mean) levels of the moderator variable. Regarding the attention control moderation aim, all analyses were conducted both with and without the inclusion of state anxiety scores at the time of assessment from the PANAS to control for state anxiety experienced at the time of the assessment and behavioral task completion.

Results

Preliminary Analyses

In line with previous research (Bar-Haim et al., 2010; Bardeen & Orcutt, 2011), data trials from the dot probe task were excluded if participant response was less than 200ms or greater than two standard deviations above their personal mean response rate ($M_{dptrialsexcluded}$ = 11.04%). Additionally, two participants' dot probe data were excluded as extreme outliers (e.g., more than 2 standard deviations from the overall mean). Per the design of the ANT task, trials were excluded if response time was greater than three standard deviations above the median response time (Reinholdt-Dunne et al., 2009; $M_{anttrialexcluded}$ = 5.42%). Additionally, youths' performance on both computer measures was excluded if more than 75% of their responses were incorrect (2 dot probe cases, 0 ANT cases), indicating potential difficulty understanding task rules. None of the demographic factors or child characteristics examined were significantly associated with youth attention or anxiety variables (Table 1); thus, none of these variables was included as covariates. Study variables were examined for skewness and kurtosis; these analyses indicated that variables were approximately normally distributed. Means and standard deviations of study variables are presented in Table 2. Bivariate correlations between study variables are presented in Table 3.

Missing Data

A Missing Value Analysis examined the pattern of missing data and determine if data were missing in a random or a non-random fashion. Most variables were missing less than 5% of cases, with the exception of scores for the dot-probe task, ANT task, the ACS-C-P scale, and CBCL variables (Table 2). Missing data resulted from participant and technological error. Little's MCAR Chi-Square statistic was found to be non-significant ($\chi2$ (27)= 28.74, p= .37), indicating that there were no significant differences on study variables for participants who were missing data versus those that were not. As such, we proceeded under the assumption that data were missing at random (MAR), which does not assume listwise deletion for SEM-based calculations in Mplus. Given the presence of missing data greater than 5% for some variables, full information maximum likelihood (FIML) estimation was used in this study to analyze the full and incomplete data set. This method does not impute any data, but rather utilizes all data present in the sample to estimate parameter values; thus, the FIML estimate of a parameter is the value of the parameter that is most likely to have resulted in the observed data. This method provides unbiased parameter estimates and standard errors (Allison, 2000), whereas listwise deletion, mean imputation, and other strategies potentially bias analyses (e.g., Bodner, 2008; Little & Rubin, 2002).

Aim 1: The Moderating Role of Attentional Control on the Relationship Between Attention Bias to Threat and Anxiety Severity.

The ability of attention variables to predict anxiety severity individually was examined. ANT conflict scores ($\beta_{ANT} = 0.35$, $t = 2.63$, $p = 0.01$) significantly predicted anxiety severity, such that greater attentional conflict was associated with increased youth anxiety severity. Attention bias scores ($\beta_{BIAS} = -0.001$, $t = -0.01$, $p = 0.99$), ACS-C total scores ($\beta_{ACSC} = 0.38$, $t = 1.94$, $p = 0.053$), and ACS-C-P total scores ($\beta_{ACSCP} = 0.05$, $t = 0.35$, $p = 0.73$) did not significantly predict anxiety severity.

ANT Task: ANT conflict scores did not moderate the relationship between attention bias and anxiety severity ($\beta_{ANTXBIAS} = -0.17$, $t = -1.26$, $p = 0.21$). The conditional effect of ANT score was significant ($\beta_{ANT} = 0.34$, $t = 2.65$, $p = 0.008$), such that, when youth displayed an average attention bias, increased attention conflict was associated with increased anxiety severity (see Table 3). When controlling for state anxiety (PANAS anxiety rating), the relationships between attention variables did not change; the conditional effect of ANT scores ($\beta_{ANT} = 0.35$, $t = 2.93$, $p = 0.003$) remained a significant predictor. State anxiety did significantly predict anxiety severity ($\beta_{PANAS} = 0.31$, $t = 2.67$, $p = 0.008$), such that higher state anxiety immediately prior to computer task administration was associated with increased anxiety severity overall (see Table 4).

ACS-C: ACS-C total scores did not moderate the relationship between threat-related bias and anxiety severity ($\beta_{ACSCXBIAS} = -0.04$, $t = -0.43$, $p = 0.66$). The conditional effect of ACS-C scores did predict anxiety severity ($\beta_{ACSC} = 0.41$, $t = 2.43$, $p = 0.015$), such that increased youth-reported attention control was associated with increased anxiety severity when an average threat-related attention bias was displayed. When analyses controlled for state anxiety (PANAS state anxiety $\beta_{PANAS} = 0.15$, $t = 1.62$, $p = 0.11$), no change in the moderation relationship was found ($\beta_{ACSCXBIAS} = -0.03$, $t = -0.33$, $p = 0.74$) and the conditional effect of ACS-C ($\beta_{ACSC} = 0.42$, $t = 2.98$, $p = 0.003$) remained a significant predictor.

ACS-C-P: ACS-C-P scores were found to moderate the relationship between attention bias and anxiety severity ($\beta_{ACSCPXBIAS} = -0.31$, $t = -1.96$, $p = 0.05$). This moderation effect was probed using recommendations described by Aiken and West (1991) and Holmbeck (2002), such that the relationship between attention bias and anxiety severity was examined at both high (+1 SD from mean) and low (-1 SD from mean) levels of attention control by the ACS-C-P. Results of this analyses indicated that both the slopes for high ACS-C-P scores ($\beta_{HIACSCPXBIAS} = -0.65$, $t = -2.43$, $p = 0.02$) and low ACS-C-P scores ($\beta_{LOACSCPXBIAS}$ = -0.45, t = -2.43, p = 0.02; see Figure 1) were significant. These results suggest that high threat-related attention bias with low parent-reported attention control and low threat-related attention bias with high parent-reported attention control are associated with greater anxiety severity. When analyses controlled for state anxiety (β_{PANAS} = 0.25, t = 1.80, p = 0.07), ACS-C-P total scores no longer moderated the relationship between attention bias and anxiety severity ($\beta_{ACSCPXBIAS}$ = -0.22, t = -1.35, p = 0.18; see Table 4).

Aim 2: Comorbid Symptoms and Measures of Attention

ADHD. The relationship between attention variables and parent-reported symptoms of ADHD in the prediction of anxiety severity was examined (all variables standardized for moderation analyses). Examined individually, ADHD symptoms did not significantly predict anxiety severity (β_{ADHD} = 0.21, t = 1.14, p = 0.25). Parent-reported ADHD symptoms did not moderate the relationship between anxiety severity and attention bias ($\beta_{ADHDXBIAS}$ = -0.05, t = -0.31, p = 0.76); ANT conflict scores ($\beta_{ADHDXANT}$ = 0.26, t = 1.61, p = 0.11); ACS-C total scores ($\beta_{ADHDXACSC}$ = -0.12, t = -1.05, p = 0.29); or ACS-C-P total scores ($\beta_{ADHDXACSCP}$ = -0.01, t = -0.05, p = 0.96). See Table 5.

Depression. The relationship between attention variables and parent-reported symptoms of youth depression in the prediction of anxiety severity was examined. Examined individually, depression symptoms significantly predicted anxiety severity (β_{DEP} = 0.46, t = 4.00, p < 0.001). Parent-reported symptoms of youth depression did not moderate the relationship between anxiety severity and attention bias ($\beta_{DEPXBIAS}$ = 0.29, t = 1.93, p = 0.053); ANT scores ($\beta_{DEPXANT}$ = 0.19, t = 1.17, p = 0.24); ACS-C total scores ($\beta_{DEPXACSC}$ = -0.18, t = -1.58, p = 0.12); and ACS-C-P total scores ($\beta_{DEPXACSCP}$ = 0.24, t =

1.34, $p = 0.18$). The conditional effects of ANT conflict scores ($\beta_{ANT} = 0.37$, $t = 2.81$, $p = 0.005$) and depression ($\beta_{DEP} = 0.41$, $t = 2.80$, $p = 0.005$) were significant in this interaction, such that when youth displayed average attentional conflict, increased depression was associated with increased anxiety severity. Similarly with average parent-reported depression, increases in youth attention conflict were associated with increases in youth anxiety severity. The conditional effect of ACS-C was significant ($\beta_{ACSC} = 0.45$, $t = 2.51$, $p = 0.012$). Additionally, when included in the model with ACS-C-P total scores, the conditional effect of depression was significant ($\beta_{DEP} = 0.42$, $t = 2.54$, $p = 0.011$), such that increases in depression were associated with increased anxiety severity when parents reported an average level of attention control abilities for youth. See Table 6.

Aim 3: Parental Factors

Parental Behaviors. Parental autonomy granting did not significantly predict youth anxiety severity ($\beta_{AUT} = -0.01$, $t = -0.05$, $p = 0.96$); attention bias ($\beta_{AUT} = -0.07$, $t = -0.66$, $p = 0.51$); ANT scores ($\beta_{AUT} = -0.16$, $t = -1.56$, $p = 0.12$); ACS-C total scores ($\beta_{AUT} = 0.03$, $t = 0.31$, $p = 0.75$); or ACS-C-P total scores ($\beta_{AUT} = -0.07$, $t = -0.58$, $p = 0.56$). Parental involvement did not significantly predict youth anxiety severity ($\beta_{INV} = -0.02$, $t = -0.13$, $p = 0.90$), attention bias ($\beta_{INV} = -0.01$, $t = -0.13$, $p = 0.89$), ANT scores ($\beta_{INV} = -0.11$, $t = -1.03$, $p = 0.30$), ACS-C total scores ($\beta_{INV} = 0.11$, $t = 1.09$, $p = 0.28$), or ACS-C-P total scores ($\beta_{INV} = -0.11$, $t = -1.04$, $p = 0.30$). See Table 7.

Parental Psychological Factors. Parent attention control did not significantly predict youth anxiety severity ($\beta_{ATTN} = 0.19$, $t = 1.38$, $p = 0.17$); attention bias ($\beta_{ATTN} = 0.16$, $t = 1.60$, $p = 0.11$); ANT scores ($\beta_{ATTN} = 0.15$, $t = 1.47$, $p = 0.14$); ACS-C total scores (β_{ATTN} = 0.13, t = 1.28, p = 0.20); or ACS-C-P total scores (β_{ATTN} = 0.18, t = 1.82, p = 0.07).

Parental anxiety did not significantly predict youth anxiety severity (β_{ANX} = -0.08, t = -0.54, p = 0.59); threat-related attention bias (β_{ANX} = 0.17, t = 1.65, p = 0.10); ANT conflict scores (β_{ANX} = -0.06, t = -0.61, p = 0.54); or ACS-C total scores (β_{ANX} = 0.17, t = 1.77, p = 0.08). Parental anxiety did significantly predict ACS-C-P total scores (β_{ANX} = 0.24, t = 2.35, p = 0.02), such that increases in parental anxiety were associated with increased parent-reported youth attention control.

Parental depression significantly predicted youth anxiety severity (β_{DEP} = 0.29, t = 2.41, p = 0.016), such that higher parental depression was associated with greater youth anxiety severity. Parental depression also significantly predicted ACS-C-P total scores (β_{DEP} = 0.22, t = 2.32, p = 0.02), such that higher levels of parental depression were associated with increased parent-reported attention control for youth. Parental depression did not predict attention bias (β_{DEP} = 0.02, t = 0.20, p = 0.84); ANT conflict scores (β_{DEP} = 0.19, t = 1.87, p = 0.06); or ACS-C total scores (β_{DEP} = 0.11, t = 1.76, p = 0.28). All results are presented in Table 7.

Discussion

This study examined the relationship between early automatic and subsequent controlled attentional processes in the prediction of anxiety severity among anxiety-disordered youth through the use of multimodal (behavioral, parent-, and self-report) assessment of these factors. Despite evidence that supports the importance of attention control in regulating other early attentional and temperamental processes in the development and maintenance of youth anxiety (Lonigan et al., 2004), results from the present study indicated little support for the interplay of initial attention bias and subsequent attention control in the prediction of anxiety severity. Parent-reported attention control for youth was found to moderate the relationship between threat-related attention bias and anxiety severity, although this relationship did not hold once analyses controlled for state anxiety. Although little interaction between attention processes was identified, attention control was identified as a salient predictor of youth anxiety severity.

The lack of moderation identified in the current study falls counter to proposed study hypotheses. It may be that the cognitive processes of attention bias and control, albeit simultaneously present in for anxious youth as identified by previous research (Reinholdt-Dunne, Mogg, & Bradley, 2009), do not interact as much as initially thought. Alternatively, it is possible that the dot-probe task used in the present study was not a sensitive assessment of attention bias, as may be implied given the lack of an identified threat-related bias among anxious youth in the present study. Indeed previous research has found substantial variability in the identification of an attention bias to threat, particularly when stimuli (i.e., emotion faces) were presented for 500ms or longer (Derryberry & Reed, 2002; Mogg et al., 2004). Including measurement of attention bias with presentations shorter than 500ms may allow for more sensitive measurement of attention bias and subsequent interplay of cognitive factors involved in the development and maintenance of anxiety disorders.

However, attention control was identified to be a salient predictor of youth anxiety. The behavioral measure of attention control, ANT conflict scores, was associated with elevated youth anxiety, such that higher attentional conflict was associated with elevated youth anxiety. This relationship aligns with current study hypotheses and past research which indicates that poorer control of attention increases risk for anxiety development and maintenance (e.g., Muris, deJong, & Engelen, 2004); research proposes that these youth are then less able to garner safety cues from the environment in order to better regulate their emotions and respond adaptively (Rueda, Posner, & Rothbart, 2005). The relationship between attention conflict and anxiety severity was present in relation to a behavioral measure of attention bias (i.e., dot probe threat bias scores). Here, increased attentional conflict was associated with increased anxiety severity when youth displayed an average threat-related attention bias for our study participants. Of note, average attention bias in the present study was not statistically different from 0 ($M = 5.57$, $SD = 32.26$), indicating that the conditional effect of attention control can be interpreted as occurring when youth are not displaying a threat-related attention bias in either direction (i.e., toward or away from threat).

However, when displaying average threat-related attention bias (i.e., no bias), youth self-reported significantly increased attention control with increased anxiety severity. As such, although youth experience more attention conflict, or more impaired attention control as measured behaviorally by the ANT task, they actually report increased attention control abilities associated with higher anxiety severity. This distinction is notable, although the underlying explanation remains unclear. It may be that youth have difficulty reporting about attention control, as it represents an abstract, metacognitive construct that may be more difficult for some youth to identify. Difficulties with attention control may be particularly difficult for youth to report if they are situationally bound to times when youth experience increased state anxiety, rather than a global executive dysfunction distinct from emotional arousal. Alternatively, youth may have diminished their report of impairment on questionnaire measures in order to present their abilities in a more favorable light or due to cognitive fatigue at the end of a long assessment procedure.

Although attention control was not identified as a reliable moderator of threat-related attention bias in the prediction of youth anxiety for the current study, it was found to be a salient predictor of anxiety severity. This relationship between attention control and anxiety severity has important clinical implications. Recently, much research has focused on attention bias modification, which purports to re-train threat-related attention bias to more balanced attention orientation toward environmental stimuli (e.g., Bar-Haim, 2010). Given the relatively stronger relationship between anxiety severity and attention control relative to attention bias, it is important to consider the treatment implications of attention control. Attention control represents a later, volitional state of attentional processing, rather than threat-related attention bias, which is a faster, more automatic attention orientation process (Bishop et al., 2004; Posner & Rothbart, 1998). Thus, attention control may represent a more accessible and malleable aspect of cognitive processing at play in the development and maintenance of pathological anxiety. Thus, change in attention control should be explored as a mechanism of anxiety reduction (Heeren, Mogoase, McNally, Schmitz, & Philippot, 2015; Heeren, Raedt, Koster, & Philippot, 2013). Indeed, improvements in attention control have been identified via traditional cognitive-behavioral therapy (Johnco, Wuthrich, & Rapee, 2013; Klumpp, Fitzgerald, Angstadt, Post, & Phan, 2014) and other third-wave treatment approaches (e.g., acceptance and commitment therapy; Arch et al., 2012).

Although these cognitive components are proposed to be involved in the development of elevated trait anxiety, it remained unclear whether they represented persistent cognitive difficulty or whether impairment in these areas was present only when youth experienced elevated anxiety in the moment. These cognitive impairments have been proposed both as a risk factor for the development of pathological anxiety (e.g., Lonigan et al., 2004) and as a product of elevated anxiety (e.g., Eysenck et al., 2007). As such, all moderation analyses were also conducted controlling for state anxiety. Indeed, youth-reported state anxiety immediately prior to completing computer tasks often predicted overall anxiety severity, which was represented by a latent variable that included clinician, parent, and youth ratings of youth anxiety. State anxiety was not found to change the relationship between attention bias and behavioral or youth-reported measures of attention control in the prediction of anxiety severity. However, controlling for state anxiety did attenuate the moderation of attention bias by parent-reported youth attention control, indicating that these parent report of attention control may be conflated by youths' anxiety presentation.

Attention control represents a facet of executive functioning that is conceptualized to be impaired in multiple psychological disorders (e.g., ADHD; Castellanos & Proal, 2012). Symptoms of ADHD, based on DSM-IV-TR criteria (APA, 2000), were not found to be associated with anxiety severity and did not moderate the relationship between attention variables and anxiety severity. Such a finding may indicate that ADHD symptoms are conceptually distinct from the attention variables measured herein as cognitive components of anxiety. This pattern may be accounted for by the importance of state anxiety in the relationship between attention variables and anxiety severity. It may be that attention difficulties for anxious youth are state dependent, such that youth experience an increase in attentional conflict or difficulties with attention control when experiencing elevated anxiety in the moment. Thus, they may not demonstrate sufficient global impairment for parents to report on questionnaire measures. However, it should be noted that youth with principal ADHD were excluded from this study, and the symptom measurement of ADHD was missing data.

Although symptoms of ADHD were not related to youth anxiety, youth symptoms of depression, as reported by their parents, were associated with anxiety severity. Such a finding is not surprising, given that internalizing symptoms frequently overlap and co-occur (Cummings, Caporino, & Kendall, 2014; Garber & Weersing, 2010). Parent-reported depression symptoms for youth did not moderate the relationship between attention variables and anxiety severity. Although anxiety and depression frequently co-occur and both are proposed to include cognitive dysfunction (Brooks et al., 2010), it may be that threat-related attention bias and attention control represent cognitive components that are specific to anxiety. However, this study does not include youth presenting with principal depression or mood disorders. Future research should examine relative cognitive features of attention among youth with both principal anxiety and depressive disorders.

This study examined the relationship between parenting behaviors and psychological factors and youth attention and anxiety. Research has shown that parenting behaviors have a strong impact on youth anxiety (Settipani et al., 2013). However, neither of the youth-reported parenting behaviors examined in this study, autonomy granting and involvement, were associated with youth anxiety severity or attention variables. Given that parenting behaviors are known to have a strong influence on the expression of anxiety among youth (McLeod, Wood, & Weisz, 2007), it may be that the behaviors assessed in this study do not tap the salient and subtle parenting behaviors that are more likely to influence the development of temporally inceptive attention processes for youth. Future research should examine multimodal assessment (e.g., behavioral observation) of multiple parenting behaviors in order to fully assess the relationship between parenting behaviors and youth attention in the context of anxiety.

Parent psychopathology is known to impact the presentation of youth symptoms (Bogels & Brechman-Toussaint, 2006). In the present study, parent anxiety was found to be associated with parent report of youths' attention control, such that higher parental anxiety was associated with increased attention control for youth. A similar finding was identified with parental depression, indicating that parents likewise endorsed more psychopathological symptoms for themselves and increased attention control abilities for their children. It may be that parent psychological problems are protective for the development of stronger attention control for youth. However, it should be noted that these findings may be inflated due to shared-method variance (i.e., parent report). It is possible that parents with more symptoms of anxiety or depression are motivated to present their youths' abilities in a favorable light given their experience of personal distress. Parental depression was also associated with higher anxiety severity for youth. Such a finding is not surprising given that parents' symptoms of internalizing disorders are often associated with similar symptoms among youth (Van der Bruggen, Stams, & Bögels, 2008).

Parental attention control was not found to be associated with youth attention or anxiety severity. It is possible that parental attention control does not have a direct influence on the manifestation of youth anxiety or attentional processes. However, given the differences between behavioral and questionnaire measures of attention control found in this study, future research should examine behavioral measures of parental attention control and bias and their relationship to youths' attention and executive function factors.

This study is not without limitations. First, this study contained a notable amount of missing data for certain variables. However, data were determined to be missing at random and full-information maximum likelihood was employed as an unbiased method of handling missing data (Little & Rubin, 2014). Second, youth completed all study measures and tasks following completion of the ADIS-IV-C; while youth were encouraged to take a break before completing tasks, it is possible that cognitive fatigue may have influenced their performance on behavioral measures and completion of questionnaires. Third, the dot-probe task for the present study was altered from previous studies, such that it included empirically validated programming (Mogg & Bradley, 1998) with more standardized pictures (Eldar & Bar-Haim 2010). Although this task was modified to increase standardization and subsequent validity of the attention bias assessment, it is possible that this change inherently modified the assessment of attention bias.

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Table 1

Descriptive Information for Study Participants (N = 107)

Variable	n	(%)
Youth age in years	*M* = 11.17	
Gender		
Males	44	41.1
Race		
Caucasian	83	77.57
African-American	8	7.47
Asian-American	4	3.74
Hispanic	3	2.80
Other	7	6.54
Not reported	2	1.87
Principal Anxiety Diagnosis		
GAD	35	32.71
SoP	20	18.70
SAD	8	7.47
SP	15	14.02
OCD	4	3.74
AD-NOS	3	2.80
Co-Principal Anxiety	22	20.56
Total Household Income		
$0-19,999	3	2.80
$20,000-39,999	8	7.48
$40,000-59,999	17	10.00
$60,000-79,999	10	5.88
Over $80,000	58	54.21
Not reported	11	10.28

Note. Total *N* = 107. GAD = Generalized Anxiety Disorder, SAD = Separation Anxiety Disorder, OCD = Obsessive Compulsive Disorder, AD-NOS = Anxiety Disorder, Not Otherwise Specified.

Table 2

Descriptive Information for Study Variables

Measures	*M*	*SD*	*Missing n (%)*
Youth Anxiety Variables			
Max CSR	5.69	.79	0 (0.00)
MASC-C	49.50	19.04	1 (0.9)
MASC-P	59.30	18.15	0 (0.00)
PANAS-C Pre	1.90	2.56	1 (0.9)
Attention Variables			
Threat Bias	5.57	32.26	8 (7.5)
ANT	80.68	49.49	14 (13.1)
ACS-C	48.06	8.68	1 (0.9)
ACS-C-P	49.51	9.76	15 (14.0)
Other Youth Variables			
CBCL-ADHD	4.65	3.46	28 (26.2)
CBCL-Depression	5.40	4.20	28 (26.2)
Parent Variables			
STAI-A	11.87	3.90	2 (1.9)
BDI	6.23	5.82	1 (0.9)
ACS-A	40.98	9.14	3 (2.8)
PSI-Autonomy	25.39	3.86	1 (0.9)
PSI- Involvement	29.52	4.25	1 (0.9)

Note: Max CSR = maximum clinician severity rating of composite diagnoses, MASC-C = Multidimensional Anxiety Scale for Children, child report, MASC-P = Multidimensional Anxiety Scale for Children, parent report, PANAS Anxiety Pre = Positive and Negative Affectivity Scale for Children anxiety rating pre computer tasks, Threat Bias = Dot-probe threat-related attention bias scores, ANT = Attention Network Task Conflict Scores, ACS-C = Attention Control Scale- child report total scores, ACS-C-P = Attention Control Scale- parent report of child total scores, CBCL-ADHD = CBCL DSM-Oriented ADHD scale raw score, CBCL-Depression = CBCL DSM-Oreinted Affective Problems scale raw score, STAI-A = State/Trait Anxiety Index- Anxiety scale, BDI = Beck Depression Inventory, ACS-A = Attention Control Scale- adult report, PSI-Autonomy = Parenting Styles Inventory, autonomy granting subscale, PSI Involvement = Parenting Styles, involvement subscale.

Table 3

Bivariate Correlations for Study Variables

Measures	Max CSR	MASC -C	MASC -P	PANA S-Pre	Threat Bias	ANT Conflict	ASC-C	ACS-C-P
Max CSR	-							
MASC-C	.24*	-						
MASC-P	.26**	0.25**	-					
PANAS-C Pre	0.14	0.23*	0.03	-				
Threat Bias	-0.01	-0.10	0.09	0.06	-			
ANT	0.05	0.27**	0.18	-0.04	0.07	-		
ACS-C	0.21*	0.13	0.16	0.08	-0.04	0.05	-	
ACS-C-P	-0.02	-0.07	0.03	-0.04	0.06	-0.03	-0.05	-

Note: All variables represent Pearson's *r* bivariate correlations. Max CSR = maximum clinician severity rating of composite diagnoses, MASC-C = Multidimensional Anxiety Scale for Children, child report, MASC-P = Multidimensional Anxiety Scale for Children, parent report, PANAS Anxiety Pre = Positive and Negative Affectivity Scale for Children anxiety rating pre computer tasks, Threat Bias = Dot-probe threat-related attention bias scores, ANT = Attention Network Task Conflict Scores, ACS-C = Attention Control Scale- child report total scores, ACS-C-P = Attention Control Scale- parent report of child total scores. * p <.05; ** p < .01.

Table 4

Multiple Regression Examining Moderation of Attention Control Measures in the Relationship between Threat-Related Attention Bias and Anxiety Severity

Model	**Variable**	**B**	**SE B**	**β**	R^2	f^2
ANT					0.15	0.18
	Threat Bias	0.01	0.04	0.02		
	ANT	0.10	0.05	0.34**		
	Bias * ANT	-0.06	0.05	-0.17		
	--				0.25*	0.33
	Threat Bias	0.01	0.03	0.03		
	ANT	0.09	0.05	0.35**		
	PANAS pre	0.03	0.02	0.31**		
	Bias * ANT	-0.05	0.04	-0.17		
					0.17	0.21
ACS-C	Threat Bias	0.01	0.02	0.07		
	ACS-C	0.06	0.07	0.41*		
	Bias * ACS-C	-0.01	0.01	-0.04		
	--				0.22	0.28
	Threat Bias	0.01	0.02	0.07		
	ACS-C	0.06	0.07	0.42**		
	PANAS pre	0.01	0.01	0.15		
	Bias * ACS-C	-0.01	0.02	-0.03		
					0.08	0.09
ACS-C-P	Threat Bias	0.04	0.06	0.11		
	ACS-C-P	0.02	0.06	0.04		
	Bias * ACS-C-P	-0.09	0.06	-0.31*		
	--				0.13	0.15
	Threat Bias	0.03	0.06	0.08		
	ACS-C-P	0.01	0.06	0.03		
	PANAS pre	0.04	0.02	0.25		
	Bias * ACS-C-P	-0.06	0.05	-0.22		

Note: All analyses predicting youth anxiety severity latent variable, which includes maximum clinician severity rating for principal anxiety disorder (Max CSR), Multidimensional Anxiety Scale for Children, child (MASC-C) and parent (MASC-P) total scores; attention variables all z-standardized; ANT = Attention Network Task Conflict Scores, Threat Bias = Dot-probe threat-related attention bias scores, ACS-C = Attention Control Scale- child report total scores, ACS-C-P = Attention Control Scale- parent report of child total scores. f^2 = Cohen's f^2 effect size for multiple regression. * p <.05; ** p < .01.

Table 5

Multiple Regression Examining Moderation of Symptoms of ADHD in the Relationship between Threat Bias or Attention Control and Anxiety Severity

Model	**Variable**	**B**	**SE B**	**β**	R^2	f^2
Threat Bias					0.07	0.08
	Threat Bias	0.004	0.02	0.02		
	ADHD	0.05	0.08	0.28		
	ADHD * Bias	-0.01	0.03	-0.05		
ANT					0.20	0.25
	ANT	0.09	0.06	0.27		
	ADHD	0.07	0.06	0.23		
	ADHD * ANT	0.08	0.06	0.26		
ACS-C					0.16	0.19
	ACS-C	0.04	0.08	0.39		
	ADHD	-0.01	0.01	-0.05		
	ADHD * ACS-C	-0.01	0.03	-0.12		
ACS-C-P					0.02	0.02
	ACS-C-P	0.02	0.07	0.06		
	ADHD	0.03	0.09	0.08		
	ADHD * ACS-C-P	-0.01	0.09	-0.01		

Note: All analyses predicting youth anxiety severity latent variable, which includes maximum clinician severity rating for principal anxiety disorder (Max CSR), Multidimensional Anxiety Scale for Children, child (MASC-C) and parent (MASC-P) total scores; attention variables and ADHD symptoms variable all z-standardized; ANT = Attention Network Task Conflict Scores, Bias = Dot-probe threat-related attention bias scores, ACS-C = Attention Control Scale- child report total scores, ACS-C-P = Attention Control Scale- parent report of child total scores, ADHD = CBCL DSM-Oriented ADHD scale raw score. f^2 = Cohen's f^2 effect size for multiple regression.

Table 6

Multiple Regression Examining Moderation of Symptoms of Depression in the Relationship between Threat Bias or Attention Control and Anxiety Severity

Model	**Variable**	**B**	**SE B**	**β**	R^2	f^2
Threat Bias					0.21	0.27
	Threat Bias	-0.04	0.04	-0.14		
	DEP	0.11	0.07	0.36*		
	DEP * Bias	0.07	0.05	0.29		
ANT					0.29*	0.41
	ANT	0.13	0.06	0.37**		
	DEP	0.14	0.07	0.41**		
	DEP * ANT	0.07	0.07	0.19		
ACS-C					0.20	0.25
	ACS-C	0.06	0.07	0.45*		
	DEP	-0.003	0.01	-0.20		
	DEP * ACS-C	-0.03	0.03	-0.18		
ACS-C-P					0.19	0.23
	ACS-C-P	-0.04	0.07	-0.10		
	DEP	0.16	0.08	0.42*		
	DEP * ACS-C-P	0.000	0.000	0.24		

Note: All analyses predicting youth anxiety severity latent variable, which includes maximum clinician severity rating for principal anxiety disorder (Max CSR), Multidimensional Anxiety Scale for Children, child (MASC-C) and parent (MASC-P) total scores; attention variables and depression symptoms variable all z-standardized; ANT = Attention Network Task Conflict Scores, Bias = Dot-probe threat-related attention bias scores, ACS-C = Attention Control Scale- child report total scores, ACS-C-P = Attention Control Scale- parent report of child total scores, DEP = CBCL DSM-Oriented Affective Disorders scale raw score. f^2 = Cohen's f^2 effect size for multiple regression. * p <.05; ** p < .01.

Table 7

Multiple Regression Examining Relationship between Youth Variables and Parental Behaviors and Psychological Variables

Model	Variable	B	SE B	β	R^2	f^2
PSI-Autonomy	Anxiety Severity	-0.07	1.57	-0.01	0.000	<0.001
	Threat Bias	-0.01	0.01	-0.07	0.004	0.004
	ANT	-0.01	0.01	-0.16	0.03	0.03
	ACS-C	0.01	0.04	0.03	0.001	0.001
	ACS-P	-0.03	0.04	-0.07	0.004	0.004
PSI-Involvement	Anxiety Severity	-0.22	1.69	-0.02	0.000	<0.001
	Threat Bias	-0.002	0.01	-0.01	0.000	<0.001
	ANT	-0.01	0.01	-0.11	0.01	0.01
	ACS-C	0.05	0.05	0.11	0.01	0.01
	ACS-P	-0.05	0.05	-0.11	0.01	0.01
ACS-A	Anxiety Severity	4.46	3.50	0.19	0.04	0.04
	Threat Bias	0.05	0.03	0.16	0.03	0.03
	ANT	0.03	0.02	0.15	0.02	0.02
	ACS-C	0.14	0.11	0.13	0.02	0.02
	ACS-P	0.17	0.10	0.18	0.03	0.03
STAI-A	Anxiety Severity	-0.82	1.54	-0.08	0.01	0.01
	Threat Bias	0.02	0.01	0.17	0.03	0.03
	ANT	-0.01	0.01	-0.06	0.004	0.004
	ACS-C	0.08	0.05	0.17	0.03	0.03
	ACS-P	0.10	0.04	0.24*	0.06	0.06
BDI	Anxiety Severity	6.28	4.49	0.29*	0.08	0.09
	Threat Bias	0.004	0.02	0.02	0.000	<0.001
	ANT	0.02	0.12	0.19	0.04	0.04
	ACS-C	0.07	0.07	0.11	0.01	0.01
	ACS-P	0.13	0.06	0.22*	0.05	0.05

Note: All analyses run as separate models. Anxiety Severity = latent variable including maximum clinician severity rating for principal anxiety disorder (Max CSR), Multidimensional Anxiety Scale for Children, child (MASC-C) and parent (MASC-P) total scores, ANT = Attention Network Task Conflict Scores, Threat Bias = Dot-probe threat-related attention bias scores, ACS-C = Attention Control Scale- child report total scores, ACS-C-P = Attention Control Scale- parent report of child total scores, PSI-Autonomy = Parenting Styles Inventory, autonomy granting subscale, PSI-Involvement = Parenting Styles Inventory- Involvement subscale, ACS-A = Attention Control Scale, adult report, STAI-A = State/Trait Anxiety Index- Anxiety scale, BDI = Beck Depression Inventory. f^2 = Cohen's f^2 effect size for multiple regression. * p <.05.

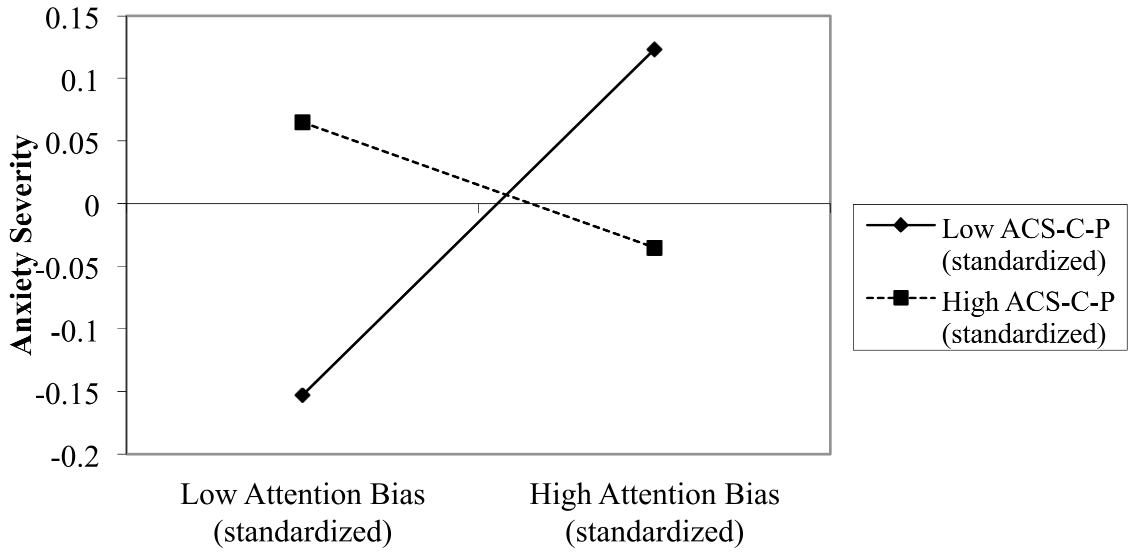

Figure 1. Moderation effect of ACS-C-P scores on the relationship between threat-related attention bias and anxiety severity. Attention bias and control scores z-standardized. Anxiety severity latent variable includes CSR for principal composite anxiety disorder and MASC Total scores by parent and child report. Intercept for latent dependent variable set at 0, per recommendation by Muthen (2012).

CHAPTER 2

LITERATURE REVIEW

Anxiety disorders are among the most prevalent mental health disorders among youth (Benjet, Borges, Medina-Mora, Zambrano, Aguilar-Gaxiola, 2009; Costello, Egger, Copeland, Erkanli, & Angold, 2011). Left untreated, anxiety-disordered youth experience negative outcomes in several domains of life, including impaired social functioning (Shanahan, Copeland, Costello, & Angold, 2008), academic achievement (van Ameringen, Mancini, & Favolden, 2003), and school functioning (Mychailyszyn, Mendez, & Kendall, 2010). Anxiety disorders also place individuals at risk for the development of subsequent psychological difficulty later in life, such as depression and substance use disorders (Angold, Costello, & Erkanli, 1999; Lopez, Turner, & Saavedra, 2005). As such, understanding the mechanisms responsible for the development and maintenance of problematic anxiety remains an important area of research.

A number of cognitive information processing features have been identified as mechanisms by which pathological anxiety begins and continues for anxious individuals (e.g., Watts & Weems, 2006). Specifically, the well-documented link between maladaptive attentional processes and anxiety underscores the need to consider how multiple stages of attention interact with other endogenous and exogenous factors to lead typical psychological development awry. Threat-related attention biases are perhaps one mechanism by which anxiety disorders develop and are maintained (Beck & Clark, 1997). However, anxiety disorders are not likely the result of attentional processes alone; anxiety is linked to a variety of cognitive and environmental factors - including attention- that interact with one another across development. In the study of anxiety during dynamic developmental periods, such as childhood and adolescence, it is important to consider the interface of typical and atypical trajectories of attention and associated risk factors.

The current review of empirical research explores the relative roles of (a) threat-related attentional biases and (b) attentional control as a dual-system of dysregulated attention proposed to confer risk for the development and maintenance of anxiety disorders. These systems are considered in conjunction with associated temperament constructs (i.e., effortful control) and neurobiological pathways (i.e., limbic-prefrontal cortex circuitry). The transactional relationship between the development of attention systems and influential parental factors is considered within a developmental psychopathology framework. Further, given the interface between typical and atypical development of dysregulated attention, clinical implications are considered regarding the role of attention in the treatment of anxiety disorders among youth.

Information Processing Models and Anxiety

Information processing theories include complementary cognitive and neurobiological sequences of cognitive functions that guide the intake and synthesis of information for current and future use (e.g., Posner & Petersen, 1990; Wells & Matthews, 1996). Models of information processing highlight differences between typical and atypical development and cognitive function in the screening, encoding, storing, and retrieval of information (Crick & Dodge, 1994;Vasey & MacLeod, 2001). Although a review of all information processing models is beyond the present scope, the following section details the influential information processing models proposed to account for differences in typical and atypical processing of threat-related information and conferred risk for impairing anxiety.

As they relate specifically to the processing of threat, a number of cognitive theorists have proposed distinct, yet complementary, models of information processing (e.g., Beck et al., 1985; Wells & Matthews, 1996). These theories detail multiple cognitive stages that often include early and automatic recognition of threat-related information, followed by subsequent elaborative processes that interact with previous knowledge and experience. As one of the most influential examples, Beck and Clark's schema-based model (1997) proposed three stages by which threat information is processed cognitively. They posited that threat-related information (a) is initially and rapidly recognized and oriented to by the individual and (b) activates a "primal threat mode, in which thoughts (e.g., hypervigilance for threat) and behaviors (e.g., escape, avoidance) related to safety and survival are initiated. The initial activation of these reflexive safety-related schemas in turn activate (c) secondary elaborative, and meta-cognitive schemas, including those related to the probability of threat and self-efficacy for coping in the face of threat (Beck & Clark, 1997). These proposed cognitive systems highlight the evolutionary importance of threat-related stimuli; individuals are primed to identify and respond to threat in their environment (Kindt & Van Den Hout, 2001; Ohman, 1996; 2005). Problematic anxiety is proposed to arise by the dysfunctional augmentation of those systems designed to identify and respond to risk in the environment (Beck & Clark, 1997; Daleiden & Vasey, 1997).

Within models of information processing, distinctions are drawn between automatic and controlled processing of information. Automatic pathways include stimulus-driven, effortless and fast processing of threat-related information that occurs outside of awareness (bottom-up), whereas controlled pathways are responsible for elaborative, effortful, and slow processing of threat, governed by conscious awareness (top-down; Cisler & Koster, 2010; McNally, 1995; 1996; Moors & DeHouwer, 2006; Shiffrin & Schneider, 1977; Vasey & MacLeod, 2001). Here, threat-related information travels through each cognitive stage, starting with the most basic phase of alert to sensory information (e.g., sight), and is then influenced and controlled by higher-order executive functions that exert effortful control on the initiation and the propagation of lower-order cognitive processes. In an effort to explain the differences in these systems, Metcalfe and Mischel (1999) proposed two opposing cognitive processes: a bottom-up "hot" system involved in immediate response and emotional processing, and a top-down, regulatory "cool" system, involved in emotion regulation and impulse control. Difficulties in both bottom-up, automatic and top-down controlled systems is supported by research regarding individual differences at multiple stages of information processing for individuals with high self-reported trait anxiety (e.g., Wells & Matthews, 1994; Williams et al., 1988), including both automatic orientation toward threat (Mogg & Bradley, 1998; Williams et al., 1988) and controlled processing of information (Wells & Matthews, 1994).

Stages within these information processing models cannot be considered wholly independent from one another; incoming information is modified as it proceeds through subsequent stages of processing based on previous experience and individual differences at earlier stages (Massaro & Cowan, 1993). For example, following a traumatic car accident, an individual may increasingly look for and identify signs of car-related environmental threat (hypervigilance) that then activate later, elaborative stages of threat processing (e.g., overestimation of the threat of car accidents) and subsequent anxious behavior (e.g., avoidance). Although early theories regarding threat processing emphasize particular stages as conferring the most risk for anxiety (e.g., Foa, Steketee, & Rohbaum, 1989), models of information processing have increasingly emphasized the dynamic interaction of their multiple stages, particularly early threat recognition and later threat elaboration. For example, Wells and Matthews (1994, 1996) proposed a Self-Regulatory Executive Function (S-REF) model of dysfunctional information processing of threat-related information. Within this theory, the authors posit the interaction between three levels of cognitive processing, including (a) an automatic, reflexive recognition of threat, (b) voluntary and effortful processing (self-regulation) influenced by attentional demands and (c) involvement of stored information (memory) or self-beliefs (e.g., "I am a failure;" Wells & Matthews, 1994, 1996). This particular model aligns with many others (e.g., Foa & Kozak, 1986; Mogg, Bradley, De Bono, & Painter, 1997; Wells & Matthews, 1994) in its emphasis on the interaction between automatic and controlled processing responsible for the elaboration of or inhibition of responses to threatening stimuli.

Of central importance to the current review, Lonigan and colleagues (2004) elaborated on existing models of interacting bottom-up and top-down systems of threat processing to specify the role of (a) attentional threat-related biases and (b) top-down attentional control processes in the development of pathological anxiety symptoms. The design of this model specifically emphasized the interplay of important temperamental factors typically explored separately, including initial states of negative affectivity/neuroticism and effortful control, an umbrella concept encapsulating executive attentional control capacities (Lonigan, Vasey, Phillips, & Hazen, 2004). In this view, individuals at high risk for developing anxiety disorders evidence high levels of negative affectivity, which increase attentional biases toward threat (i.e., hypervigilance). Further low levels of effortful control over such reflexive behaviors increase threat-related biases at later stages of information processing (e.g., interpretive biases), increasing the likelihood of overestimation of environmental threat and increases in anxiety symptoms. The evidence regarding Lonigan and colleague's proposed model (2004) will be discussed in later sections; however, it is described herein as an important intersection of information processing, temperament, and clinical evidence regarding stages of cognitive factors found to confer risk for the development of anxiety.

Given that the distinctions between facets of these cognitive systems are not well defined as of yet, most interactions include some combination of these processing pathways, rather than exclusive reliance on one system (Bargh, 1989; Cisler & Koster, 2010; Eysenck et al., 2007; MacLeod & Mathews, 1988). Consideration of multiple levels of information processing, including their development and relative influence on each other, remains important in understanding the role of cognitive biases and distortions for anxiety disorders among youth. In general, information processing systems provide useful tools that aid in modeling the various cognitive risk factors found to confer risk for anxiety disorders and other forms of psychopathology among both adults and youth (Daleiden & Vasey, 1997; Gotlib & MacLeod, 1997; Vasey & MacLeod, 2001).

Information Processing and Anxiety: Attention Orientation and Biases toward Threat

As described above, numerous theories exist regarding the processing of threat-related information as it relates to the development of anxiety. Attention refers to a multifaceted system that includes multiple cognitive mechanisms occurring early in information processing systems, which affect the processing of future information (Harvey, Watkins, Mansell, & Shafran, 2004; Posner & Petersen, 1990; Posner & Rothbart, 2007) and which are considered to be integral in emotion regulation processes (Wilson & Gottman, 1996). Attention comprises the acts of (1) alerting the organism to environmental stimuli, (2) selecting and orienting the organism to particular sensory information, and (3) and executive attention, or monitoring and resolving of conflict among cognitions, emotions, and behavioral responses (Posner & Petersen, 1990; Posner & Rothbart, 2007). To organize the influence of these multiple stages of attention over the development of anxiety, theorists differ in their consideration of the multiple levels of attention proposed to confer risk for anxiety (Bar-Haim et al., 2007; White et al., 2009). The following sections detail the extant research and associated implications regarding anxiety-related dysfunction at both early attentional-orientation and later attentional-control stages of information processing.

The Role of Attention Orientation

As discussed previously, models of information processing for anxious adults indicate that they show an attention bias in favor of emotionally threatening information (Beck, Emery, & Greenberg, 1985; Daleiden & Vasey, 1997; Williams, Watts, MacLeod, & Matthews, 1988). As one of the earliest stages of information processing (e.g., Fu, Greenwood, & Parasuraman, 2005), attention orientation is often linked to the development and maintenance of anxiety disorders. Attentional orientation or selection is thought to play a crucial role in facilitating the encoding of information from the environment and guidance of subsequent behavior (Cisler & Koster, 2010; Muris & Field, 2013; Wells & Matthews, 1996). Furthermore, attention toward particular environmental information guides concept building at higher levels of information processing (Muris & Field, 2013).

Threat-related attentional biases have been proposed as the specific dysfunction in attention orientation linked to elevated levels of anxiety (e.g., Derryberry & Reed, 1994). This means that individuals with elevated symptoms of anxiety attend more quickly to and more frequently identify threat, thus allocating greater attentional resources toward threat information in the environment (Bar-Haim et al., 2007; Cisler et al., 2009; Mogg & Bradley, 1998). This pattern of attention bias has also been proposed as a mechanism by which anxiety is maintained for youth (e.g., Daleiden & Vasey, 1997), and this theory has been empirically supported (see Puliafico & Kendall, 2006, for a review).

Theoretically, an attention bias toward threat in the environment is an adaptive mechanism that prepares one to respond quickly to potential attacks or threats to existence or survival (Kindt & Van Den Hout, 2001; Ohman, 1996; 2005). However, as human nervous systems evolved over time, individuals have become more sensitive to the detection and learning of more complex threat cues (e.g., social threat; Ohman & Mineka, 2001). Research with adults has repeatedly demonstrated that angry or threatening faces are more quickly identified in a visual search paradigm than neutral, happy, or sad faces (Calvo, Avero, & Lundqvist, 2006; Esteves, 1999; Fox et al., 2000; Mather & Knight, 2006). Supporting these behavioral studies, temporal evidence from ERP studies supports the idea that threatening faces are attended to earlier than positive or neutral faces (Holmes, Bradley, Nielsen, & Mogg, 2009). This evidence supports an adaptive model of information processing that prioritizes threatening information from the environment. A motivational affective state of fear and anxiety mediates this attentional response to motivate behavior and so that responses may be appropriately conditioned or tailored to the contextual demands and subtleties of the environment (Ohman & Mineka, 2001; Rescorla & Solomon, 1967). Indeed, research has found similar attention biases to threat between high- and low- trait anxious groups when in situations that elevate state anxiety (e.g., stress tasks) among both children (Kindt, Brosschot, & Everaerd, 1997) and adults (MacLeod & Rutherford, 1992; Mogg et al., 1990) when anxiety was measured via self-report questionnaires. Thus, biases toward threat can be useful at times when threat is imminent, in order to for individuals to remain on-guard and self-protective. In a modern world, threats are less obvious than an overt attack by a predator. Thus, we must be attuned to more subtle and interpersonal cues (e.g., facial expressions; Ohman et al., 1985). Although all individuals are proposed to show attentional biases to environmental threat, those high in anxiety are distinguished from others in their response to lower, more ambiguous levels of threat (e.g., Mathews & Mackintosh, 1998; Mogg & Bradley, 1998), such that increased identification of threat in the environment perpetuates an anxious state of readiness that leads to difficulties in adaptive functioning.

Attention Biases to Threat and Anxiety Disorders

For individuals who meet diagnostic criteria for anxiety disorders, this once-adaptive bias toward threat information becomes out of proportion with true environmental risk and results in a selective attention toward threatening stimuli (Lang & Sarmiento, 2004). Thus, early attention orientation resources are allocated toward perceived threats that are not limited to those of evolutionary importance and come to encompass others through contingency reinforcement. Anxiety-provoking stimuli do not automatically or consistently elicit the same response in all individuals (Ohman & Mineka, 2001), such that fear responses are programed differently with distinct levels of specificity between people. For example, individuals in chronically high-stress situations would likely find themselves in a constant state of preparedness, which may confer risk for the development of clinically impairing anxiety. In other circumstances, overgeneralization of threat cues increases the frequency with which individuals find threat in the environment, and thus increases their perceived probability of encountering threat in the environment. Not only does learning influence attention, but attention also reciprocally influences what is learned and, thus, the development of cognitive representations (Derryberry & Reed 1996). In the case of anxiety, the "overgrowth" of a once-adaptive attention bias toward threat leads to the development of these more extreme, or distorted, cognitions, which are often hallmarks of clinically impairing anxiety.

Although the specific presentations of particular anxiety disorders necessarily vary, individuals with anxiety disorders have reliably evidenced attentional biases in the presence of threat (e.g., Bar-Haim et al., 2007). Attention bias is characterized by a facilitated allocation of attention toward threat (Bar-Haim et al., 2007; Cisler et al., 2009; Lonigan, Vasey, Phillips, & Hazen, 2004; Mogg & Bradley, 1998); individuals high in anxiety quickly seek out and find threat in their environments. Two methodologies are predominantly used to examine the presence of attention biases among youth and adults with elevated anxiety symptoms: the modified Stroop and dot-probe detection tasks. Although the theories behind these methods are similar, the inferences that can be made from their programmatic distinctions have important implications in the evaluation of the role of attention biases in anxiety. [i]

The modified Stroop task (Stroop, 1935) involves comparing the difference in latency to name the color of printed threat words vs. non-threat words. An attention bias toward threat is represented by increased response time to read threat-related words as compared to non-threat words, with the assumption that processing of threat information produces cognitive interference in basic reading abilities. Results from multiple studies employing the modified Stroop task have found evidence for greater attentional bias toward threatening stimuli for community youth with high fear of spiders (spider-relevant, Martin, Horder, & Jones, 1992), those with high self-reported trait anxiety without anxiety disorder diagnoses (e.g., Williams, Mathews, & MacLeod, 1996), behaviorally inhibited profiles (Schwarts, Snidman, & Kagan, 1996), and post-traumatic stress disorder (PTSD; Moradi, Taghani, Neshat Doost, Yule, & Dalgleish, 1999). Use of the Stroop paradigm has also found that children of adults who suffer from PTSD also evidence attention biases to threat stimuli (words, Moradi, Taghavi, Neshat Doost ,Yule, & Dalgleish, 1999). However, interpretation of results from the modified Stroop task is complicated by the possibility that increased latency to read threat words may be due to delayed response to, as well as increased vigilance for, threat given that semantic

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[i] Evidence from these literature bases includes studies of both community and anxiety-disordered samples of youth and adults. Anxiety is assessed in different ways among these samples; anxiety among community samples of individuals that are not assessed for presence of an anxiety disorder has often been assessed through self-reported levels of state or trait anxiety on questionnaire measures (e.g., State and Trait Anxiety Inventory [STAI/STAI-C]; e.g., MacLeod & Mathews, 1988), whereas anxiety is often assessed through clinical interviews and clinician-reported disorder severity in addition to self-reports of anxiety (e.g. Mathews, May, Mogg, & Eysenck, 1990). Clarification of specific questionnaires and cut scores to assess anxiety is included when possible.

understanding of words requires later stages of information processing (Algom, Chajut, & Lev, 2004; Cisler & Koster, 2010).

The dot-probe detection task is an alternative, and perhaps more sensitive, method of assessing attention bias that has more consistently identified differential information processing at the stage of attention among anxious individuals (MacLeod et al., 1986; Vasey & MacLeod, 2001). In this computer task, participants signal the detection of a probe (e.g., "*") on either side of a screen following brief presentation of a pair of emotionally valenced stimuli (e.g., pictures, faces, words). In critical trials, latency to detect probes following threat stimuli (i.e., congruent trials) are compared to response times to probes following neutral or positive stimuli (i.e., incongruent trials). An attention bias to threat is demonstrated by shorter reaction time to identify probes directly following threat stimuli versus longer latencies to identify probes following neutral stimuli when competing (i.e., displayed simultaneously) with threat stimuli (Posner, Snyder, & Davidson, 1980). Importantly, non-anxious individuals largely do not show differential response latencies across the test conditions, as explored in a recent meta-analysis (Bar-Haim et al., 2007), whereas anxious individuals tend to show faster reaction times for threat congruent trials (Mogg & Bradley, 1999). The short and controlled presentation time for stimuli in the dot-probe paradigm may make it uniquely suited for assessing group differences in early stages of information processing, such as initial attention orientation. Furthermore, the dot probe task allows for assessment of spatial attention (MacLeod, Mathews, & Tata, 1986), making inferences about where individuals are attending more clear. Indeed, research supports the use of this technique as a more sensitive measure over the modified Stroop task (Shechner et al., 2012), during which longer stimulus presentation allows for the involvement of increasingly later stages of information processing (i.e., reading/word recognition; Brosschot, de Ruiter, & Kindt, 1999; Vasey & MacLeod, 2001).

Extending previous work done with adults (e.g., Bradley, Mogg, White, Groom, & de Bono, 1999; Mogg & Bradley, 1999), initial use of the dot probe task provided reliable evidence of an attention bias for self-reported high trait anxious and youth that meet criteria for anxiety disorders when compared to non-anxious counterparts (Roy et al., 2008; Shechner et al., 2012; Taghavi et al., 2003; Telzer et al., 2008; Waters, Mogg, Bradley, Pine, 2008; Watts & Weems, 2006). Following this initial study, many further investigations have supported the presence of an attention bias using the dot-probe technique for youth with anxiety disorders (DSM-IV anxiety diagnoses, Taghavi et al., 1999), elevated self- and parent-reported trait anxiety without an anxiety diagnosis (Child Behavior Checklist, Schippel, Vasey, Cravens-Brown, & Bretveld, 2003; STAI-C, Telzer et al., 2008; Test Anxiety Scale for Children scores > 12 [boys] or 16 [girls], Vasey, El-Hag, & Daleiden, 1996), anxiety disorder severity (clinician severity ratings; Waters, Henry, Mogg, Bradley, & Pine, 2010), comorbid presentation of anxiety disorders with other psychological (e.g., bipolar disorder by DSM-IV diagnostic criteria, Brotman et al., 2006) and developmental disorders (e.g., elevated scores on the Spence Children's Anxiety Scale for youth with Williams syndrome; Dodd & Porter, 2011), and concurrent medical complications (e.g., elevated scores on the Child Behavior Checklist among youth with recurrent abdominal pain; Boyer, Compas, Stanger, et al., 2006). A recent meta-analysis of attention bias identified an aggregate effect size of $d = .50$ for studies involving anxious youth (Bar-Haim et al., 2007), indicating a reliable identification of attention bias to threat for this demographic.

Furthermore, attention biases toward threat have been found across all anxiety disorders, with no statistical differences between them (Bar-Haim et al., 2007). Studies of attention bias have studied the specific relationship between anxiety disorders and anxiety-specific stimuli (e.g., disorder specific words or faces for panic disorder, Reinecke, Cooper, Favaron, Massey-Chase, & Harmer, 2011; social phobia, Ononaiye, Turpin, & Reidy, 2007; post-traumatic stress disorder, Pine et al., 2005), leading some to conclude that threat stimuli must match the disorder in question (e.g., panic-related words for panic disorder; Maidenberg et al., 1996; Reinecke et al., 2011). However, a recent evaluation confirmed the presence of significant attention biases among anxiety-disordered youth across diagnostic categories with the use of a dot-probe task using emotional faces (Roy, Vasa, Bruck, et al., 2008). Subsequent studies have supported the notion that stimuli do not need to match an individual's principal anxiety concern (e.g., pictures of dogs for a specific phobia of dogs) in order to activate an attentional bias toward threat (Wiener, Perloe, Whitton, & Pincus, 2012). The lack of specificity of attention biases supports the idea that this maladaptive pattern of attention contributes to anxiety more generally. Although comorbidity of anxiety disorders within these samples likely confounds the ability to make conclusive statements on this issue.

Mixed results: Attention Bias is not the Whole Story

Discrepancies in the identification of attention bias among youth with elevated symptoms of anxiety can largely be attributed to methodological inconsistencies (Algom, Chjut, & Lev, 2004). First, when attention bias was assessed using both Stroop and dot-probe methodologies concurrently, no relationship was found between their respective attention bias scores, although the dot probe paradigm more successfully identified attention biases (Dalgleish, Taghani, Neshat-Doost, Moradi, Canterbury, & Yule, 2003). Given the differences between the protocols, it has been proposed that these two methods evaluate different stages of attention as they relate to threat perception (Shechner et al., 2012); the dot-probe task allows for very short stimulus presentations (≤ 500ms), often before conscious awareness, and the modified Stroop task measures interference in word reading or picture naming, then occurring within conscious awareness. Inconsistent results are also found within methods. For example, some studies using the modified Stroop found no differences between anxious and non-anxious groups in word-reading latencies (e.g., DSM-IV disorder criteria for panic, de Cort et al., 2007; total score > 9 on parent-reported anxiety on unnamed questionnaire, Kagan, Snidman, Zentner, & Peterson, 1999). Disparate results are often found between the card (i.e., multiple stimuli presented simultaneously) versus single-trial (i.e., one word at a time; McNally, Amir, & Lipke, 1996) and integrated (i.e., identify color of the word) versus non-integrated (e.g., identify color of a shape superimposed on the word; Kindt & Brosschot, 1999) variants of the task. Variations in the presentation of stimuli and other task parameters likely influence how information is processed (e.g., Amir, Freshman, & Foa, 2002). These methodological inconsistencies, which contribute the unreliability of the modified Stroop task as a measure of attention biases to threat (Vasey & MacLeod, 2001), must be considered given that results from these studies are often used to confirm or disconfirm the presence of attention biases to threat associated with symptoms of anxiety.

Use of the dot-probe task as a measure of attention bias is vulnerable to similar inconsistencies. Although considered to be the more sensitive measure of attention bias (e.g., Helfinstein, White, Bar-Haim, & Fox, 2008), some studies have failed find a difference between anxious and non-anxious groups in their latencies to detect threat (e.g., Waters, Lipp, & Spence, 2004). As with the modified Stroop task, however, many of these discrepancies may be due to methodological differences, such as small sample sizes (e.g., Dalgliesh et al., 2003; Vasey, Daleiden, Williams, & Brown, 1995; Waters, Lipp, & Spence, 2004), sample confounds (e.g., medication, Lim & Kim, 2005), threat stimuli used (e.g., faces vs. words; e.g., Mogg, Bradley, de Bono, & Painter, 1997), or position of threat stimuli (i.e., presented vertically vs. horizontally; Vasey, Daleiden, Williams, & Brown, 1995). Additionally, anxiety-provoking experimental conditions appear to alter the likelihood of finding an attention bias to threat, such that anxiety-provoking situations increase state anxiety and suppress attention biases to threat (Garner, Mogg, & Bradley, 2006; Helfinstein, White, Bar-Haim, & Fox, 2008). Perhaps the most important difference between dot probe studies is the presentation time for the emotionally valenced stimuli. Dot-probe studies vary in their presentation of stimuli at time specifications ranging from 100 milliseconds to 1500 milliseconds (e.g., Bradley, Mogg, Falla, & Hamilton, 1998; Broadbent & Broadbent, 1988; Mogg, Bradley, Miles & Dixon, 2004). Given that time is thought to correspond to stages of information processing, it is likely that longer stimulus presentation intervals allow for processing of stimuli at subsequent, more controlled levels of processing. For example, Mogg and colleagues (2004) found that individuals self-reporting high levels of trait anxiety (scores above 6 on the Taylor Manifest Anxiety Scale and median scores on the STAI) displayed an attention bias to threat at 500ms presentation relative to low-anxious individuals, but no evidence of attention bias toward, and even evidence of bias away from threat, at a 1500ms presentation interval for the high-anxious group. Similarly, Derryberry and Reed (2002) found that adults self-rating elevated anxiety (above sample median score on the STAI) reliably displayed an attention bias toward threat when stimuli were presented at 250ms, but that only those with low attentional control were still stuck on threat at a 500ms presentation of stimuli. Thus, later stages of information processing include effortful, controlled capacities that feedback and influence the perseveration and direction of earlier, automatic stages.

Overall, research has often demonstrated the presence of threat-related attention biases for anxious individuals (d = 0.45 for anxious participants vs. d = -.007 for nonanxious controls; Bar-Haim et al., 2007). Following their recent meta-analysis, Bar-Haim and colleagues (2007) concluded that "with over 150 studies that have established the existence and typical magnitude of threat-related bias in anxious individuals from different populations and with a variety of experimental conditions, it appears as if little will be gained from additional studies of threat-related bias unless these are strongly driven by theory" (p. 18). As such, it remains important to focus on an integrative model of attention that includes mechanisms underlying and mediating these initial, automatic attention orientation processes (Bar-Haim et al., 2007; Cisler & Koster, 2010). Next, we consider theory and evidence regarding the role of executive attention as an important moderating force on the presence and maintenance of threat-related attention biases.

Information Processing and Anxiety: Attentional Control

Research has sought to reconcile discrepancies in the attention bias literature by proposing that deficits occur at multiple level of processing, specifically including executive attentional control capacities (Posner & Rothbart, 2000). In this view, individuals with elevated anxiety show increased attentional vigilance toward threat and subsequent difficulty exerting voluntary control of attention, reducing the efficiency of response to non-threat information (Eysenck, et al., 2007; Friedman & Miyake, 2004). Voluntary attentional control, occurring subsequent to initial facilitated attention to threat, is recruited as a coping mechanism used to regulate anxiety by allowing one to shift attention from environmental threat to other, less emotionally-salient sources of information in the environment (Derryberry & Reed, 2002; Derryberry & Rothbart, 1997; Rothbart, Derryberry & Posner, 1994). Such a procedure can be likened to tenets of cognitive change in cognitive-behavioral treatment for anxiety disorders; anxiety disordered individuals are encouraged to examine evidence in the environment regarding (a) the likelihood of threat, (b) the imminence of threat, and (c) one's ability to cope with threat. Attentional control is considered to be a multifaceted attribute, consisting of the ability to inhibit dominant attentional responses, shift attention, and update working memory (Bardeen & Orcutt, 2011). As such, strong attentional control capacities could protect an individual from distracting environmental threat in order to continue task-relevant behavior and further learn from the environment (Oshsner & Gross, 2005; Posner & Rothbart, 1998). This perspective aligns with theories that posit that non-anxious individuals may evidence an attention bias away from threat (Williams et al., 1988); this purported bias away from environmental threat may be more indicative of increased attentional control. Indeed, anxiety has been found to negatively impact functioning in all three areas (Graydon & Eysenck, 1989; Lavie et al., 2004), particularly that anxious children are increasingly distractible and subsequently impaired (Daleiden & Vasey, 1997). Thus, initial experience of anxiety leads to increased attention bias to threat and deficits in attentional control that lead to difficulty disengaging from threat, inability to take advantage of safety cues, and subsequent escalation of anxiety symptoms (Derryberry, Reed, & Pilkenton-Taylor, 2003). Low attentional control has also been linked to threat perception from ambiguous vignettes (Muris, Meestes, & Rompelberg, 2006), indicating links to later, more elaborative stages of information processing.

Voluntary attentional control systems are thought to exert their influence temporally later in stages of information processing (e.g., Beck & Clark, 1997; Mogg & Bradley, 1998; Posner & Petersen, 1990) than initial attention biases to threat, reflecting secondary appraisals of information and initiation of possible coping mechanisms (Derryberry & Reed, 2002). The chronological differences in initiation of these two systems likely account for the discrepancies in attentional bias identification throughout the anxiety information processing literature. For example, stimulus presentation variation the dot probe task allows for a temporal evaluation of attention allocation (Bardeen & Orcutt, 2011). Watts and Weems (2006) found a significant link between parent-reported anxiety symptoms (on the Revised Child Anxiety and Depression Scale) and selective attention (i.e., bias toward threat) for a picture-based dot-probe task with a 500ms stimulus presentation interval, but no link between anxiety symptoms and threat-related response latency for a word-based dot-probe task with a 1500ms stimulus presentation interval. Although the conclusions from this study are complicated by the different types of stimuli used, many other studies of attentional processing among youth with elevated symptoms of anxiety found attention biases toward threat at 500ms presentation intervals (see Puliafico & Kendall, 2006, for a review), whereas others found no biases toward threat or, instead, at later intervals (see Bar-Haim et al., 2007, for a review). Furthermore, some studies have found biases away from threat at 500ms interval (Monk et al., 2006; Pine et al., 2005; Stirling et al., 2006). However, none of these studies accurately accounted for attentional control as a factor that may contribute to the pattern of attention direction found. Across attention bias tasks, presentation of threat cues varies from masked, subliminal presentation to supraliminal presentation intervals (Carlson, Reinke, & Habib, 2009; Morris et al., 1998; Vuilleumier, Armony, Driver, & Dolan, 2001; Whalen et al., 2004), raging from 17ms to 1500ms (Bar-Haim et al., 2007). Longer presentation times (greater than 500ms; Neely, 1991) likely allow for the recruitment and influence of voluntary attentional systems, and subsequent individual differences in these capacities (Posner & Rothbart, 1998). For individuals with good attentional control, initial biases toward threat are overridden to consider an increasingly wider array of environmental stimuli, whereas individuals with poorer attentional control are less able to shift away from an initial vigilance for threat.

In their initial study regarding adult attentional control, Derryberry and Reed (2002) used a Stroop-like spatial cueing to demonstrate the relationship between attentional control and self-reported anxiety in information processing delays among a sample of healthy volunteers. Participants were required to respond to the location of targets based on negative or positive spatial cues. Results indicated that the relationship between anxiety and attendance to threat was moderated by individual differences in attentional control; high trait anxious participants (i.e., those above the median score

[52.5] on the STAI) with good attentional control showed more orientation to threat (negative spatial cues) at short delays (250ms), but were better able to shift away from threat at longer delays (500ms). High trait anxious individuals with low attentional control evidenced difficulty disengaging from threat at longer delays. No influence of attentional control was evident at short delays (250ms). Overall, the results of this study provide a strong case for the role of attentional control in mitigating the threat-orienting effect seen in high anxious individuals (Derryberry & Reed, 2002).

A number of subsequent studies, particularly those that allow a longer stimulus presentation period, have supported the role of voluntary attentional control as a later stage of information processing that moderates an initial bias to threat (e.g., Peers & Lawrence, 2009; Lonigan et al., 2004). A recent study with adults using the emotional Stroop task found greater task interference by emotional faces for high self-reported trait anxiety individuals only if they also evidenced low attentional control (Reinholdt-Dunn, Mogg, & Bradley, 2009). These findings are congruent with research that has demonstrated no attentional biases toward or away from threat at longer stimulus presentation intervals (1500ms; Bradley et al., 1998; Mogg et al., 1997). These results are further bolstered by the relationship between anxiety symptoms and self-reported difficulties with attentional control for both adults (Derryberry & Reed, 2002) and children (Muris, de Jong, & Engelen, 2004; Muris, Meesters, & Rompelberg, 2006; Muris, van der Pennen, Sigmond, & Mayer, 2008). Although studies of attentional control with youth largely employ community samples that are not assessed for presence of an anxiety disorder (e.g., Muris, van der Pennen, Sigmond, & Mayer, 2008) and correlational research designs (e.g., Simonds, Kieras, Rueda, & Rothbart, 2007), it appears that individual differences in attentional control continue to be linked consistently to anxiety symptoms, and may moderate initial attentional biases to threat among these samples. However, the specific role of attentional control has yet to be evaluated within an anxiety-disordered sample of youth. Furthermore, difficulties in attentional control may manifest in delayed disengagement from, as well as attentional avoidance of, threat. The role of attentional control in these differences has yet to be studied.

In addition to inference from longer presentation times during dot-probe tasks, attentional-control specific measures have been developed. Given that attentional control represents a later stage of information processing that includes voluntary and conscious behavior, adult (Derryberry & Reed, 2002) and child (Muris, de Jong, & Engelen, 2004) self-report measures have been developed. Results from studies evaluating these questionnaires have reliably tied self- and parent- report scores of attentional control to symptoms of psychopathology, particularly internalizing ($r = -0.51$ for self-reported anxiety and attentional control; Muris et al., 2008) and externalizing symptomatology ($r = -0.42$ for parent-reported symptoms of inattention and child-reported attentional control; Muris, Meesters, & Rompelberg, 2006), as well as to temperamental traits (i.e. neuroticism, $r = -0.45$; Meesters, Muris, & van Rooijen, 2007) considered to be instrumental risk factors in the development of anxiety (Lonigan et al., 2004). However, the role of self- and parent- reported attentional control has not been evaluated within a sample of anxiety-disordered youth.

In addition to self-report measures, which are often open to subjective bias, objective laboratory tasks have been designed to probe conflict-resolution networks of attention (Rueda, Posner, & Rothbart, 2004). One computer task, called the Attention Network Task (ANT), was designed to isolate attentional control networks from other neural systems for alertness and spatial orienting (Fan, Fossella, & Posner, 2001; Fan, McCandliss, Sommer, Raz, & Posner, 2002). Within this task, individuals are prompted to respond to a central target, flanked by congruent (facing same direction) or incongruent (facing opposite direction) distractors. Attentional control capacity is inferred by one's ability to ignore distractor stimuli in order to respond quickly and efficiently to the central target. The ANT also measures spatial orienting by providing spatial cues regarding the location of the next target for some trials, and measures general alertness by providing cues that provide no information about spatial location of future cues (Fan et al., 2002; Johnson et al., 2008). The ANT was adapted for use with children as young as four years of age, and results from initial evaluations indicate consistent responding among typically developing youth age 7 and up (Rueda, Fan et al., 2004). Initial studies using this task with children identify distinct deficits within these separable networks; scores on the ANT successfully differentiated youth with attention-deficit/hyperactivity disorder (ADHD) from control participants without ADHD, as ADHD youth evidenced deficits in attentional control and alerting to cues (Johnson et al., 2008). Performance of anxiety-disordered youth on the ANT has yet to be examined.

Although no studies have examined the performance of youth with elevated symptoms of anxiety or anxiety disorders with the ANT task, attentional control has also been measured by other "conflict" tasks, including similarly structured flanker tasks (Eriksen & Eriksen, 1974). Again, participants are required to respond to central non-word targets while ignoring flanking distractor stimuli. Although frontal control abilities are considered to mature over the first few years of life (e.g., McDermott et al., 2007; see developmental consideration section), youth often perform similarly to adults in these tasks when they are given a central fixation point (Brodeur, 2004; Enns & Akhtar, 1989), even for youth as young as five years of age (Tipper Bourque, Anderson, & Brehaut, 1989; Tipper & McLaren, 1990). Evaluations of variations of the flanker paradigm (i.e., different stimuli; fish, shapes, colors) among a preschool-aged community sample indicated the presence of individual differences among youth's ability to control attention and self-monitor responses (McDermott et al., 2007), which are likely affected by temperamental traits (e.g., Henderson, 2003) rather than age. Wilson and colleague's Children's Attentional Shifting Task (CAST; 2006), which prompts youth to shift between two computer monitors in order to respond to angry and happy faces, provided evidence for individual differences in attentional shifting for a sample of kindergarten and first-grade youth nominated by peers as being either socially preferred or aggressive. However, this computer paradigm have not been used to evaluate cognitive biases among youth with psychological disorders.

Attention-Maintenance Hypothesis: Difficulty Disengaging from Threat

In addition to facilitated attention toward threat, attentional biases also have been described as a pattern of difficulty disengaging from threat in the environment (e.g., Derryberry & Reed, 1998). However, subsequent research has identified this pattern of response as indicative of difficulty with attentional control, given that disengagement from stimuli represents later stage in information processing from initial attention shift/orientation (Posner & Petersen, 1990). Posner and Cohen (1984) include the concept of Inhibition of Return (IOR) in their theory of information processing in anxiety as a mechanism that briefly enhances detection of threat (100-300ms) and then impairs detection at later intervals (500-3000ms). Anxiety interacts with IOR to increase attention focus or dwell and decrease one's ability to disengage from threat-related stimuli at later presentation intervals. Difficulty disengaging from threat aligns with Posner and Raichle's model of attention and anxiety (1994), which stipulated disengagement as an important early function of attentional shifting.

Experimentally, difficulty disengaging from threat is seen as a longer latency to respond to targets in an uncued location, opposite of a threat cue (e.g., Georgiou et al., 2005). This can be contrasted with identification of facilitated attention to threat, which is seen as a faster response to cues that directly follow threat information, relative to happy or neutral information. Numerous studies have supported the idea that anxious individuals display delayed disengagement from threat at longer threat presentation intervals (e.g., ≥500ms) using the dot probe task (Amir, Elias, Klumpp, & Przeworski, 2003; Bardeen & Orcutt, 2011; Fox, Russo, Bowles, & Dutton, 2001; Fox, Russo, & Dutton, 2002; Koster et al., 2004). Furthermore, influence of top-down attentional control capacities can also be seen in results of the modified Stroop task that utilizes blocked presentation (i.e., presentation of multiple like-valenced stimuli in succession, effectively lengthening the presentation time of threat stimuli). Slow latencies to read threat words in this condition may indicate deficiencies in top-down attentional control capacities that would regulate an attentional bias response (Bardeen & Orcutt, 2011; Bar-Haim et al., 2007), rather than providing contradictory evidence of attentional bias for anxious individuals using the modified Stroop paradigm (e.g., PTSD; Kimble et al., 2009). Although the exact speed of higher-order executive control processes is unknown, these findings support the view of disengagement from threat as a deficit at later stages of information processing (i.e., attentional control; Bardeem & Orcutt, 2011), indicating a state of continued hypervigilance for threat with difficulty shifting or disengaging attention away from threat (Bar-Haim et al., 2007; Fox, Russo, & Dutton, 2002; Peers & Lawrence, 2009).

Vigilance-Avoidance Hypothesis: Attention bias away from threat

Although much empirical evidence supports theories of attention bias toward, and delayed disengagement from, threat among anxious individuals, some findings have suggested that anxious individuals display attentional avoidance of threat (Cisler et al., 2009; Fox et al., 2001; 2002; Koster et al., 2004, 2005, 2006; Mogg et al., 2004). Researchers have argued that these studies provide evidence for a lack of maladaptive attention patterns among anxious individuals (e.g., Waters, Lipp, & Spence, 2004), although it is likely that, in their extreme form, biases away from threat may represent another type of vigilance for threat that manifests itself in at later states of information processing. Vigilant-avoidant models of attention are consistent with findings that find that anxious individuals are initially vigilant to threat and subsequently avoid it (Amir, Foa, & Coles, 1998; Weirich et al., 2008). Weirich and colleagues (2008) proposed that although anxious individuals appear to be overtly avoid attending to threat, there is evidence that they covertly maintain allocation of attentional resources to threat, indicating presence of a type of vigilance toward threat. The behavioral corollary for this attentional system is seen in the ways that anxious individuals characteristically avoid threat in their environment; one is necessarily aware of threat in order to systematically avoid it. Just as initial attentional biases to threat prevent anxious individuals from gaining more information from the environment in order to effectively cope, attentional avoidance likewise prevents them from more fully and appropriately appraising the situation, preventing them from habituating to the situation or learning new information that could reduce the level of perceived threat and subsequent anxiety perception (Lonigan et al., 2004; Marks, 1987).

Some findings indicate biases away from threat particularly in studies that utilize particularly distressing or salient stimuli (e.g., pictures of threat for individuals with PTSD; Pine, Mogg, Bradley et al., 2005) or when experimental conditions induce elevated state anxiety in participants (e.g. frightening neuroimaging scanners; Monk, Nelson, McClure, et al., 2006). Thus, it may be that increased immediate threat or fear in particular experimental paradigms, which may be salient even to non-anxious individuals, may promote avoidance reactions over continuous attention to threat (Mogg, Bradley, Miles, &, Dixon, 2004). However, the vigilant-avoidant profile for some anxious individuals has been seen more consistently at longer stimulus presentation intervals (1250ms), even when state anxiety was not particularly elevated by the conditions of the experiment (Koster et al., 2005, 2006; Mogg et al, 2004). Studies involving eye-movement procedures indicate that anxious individuals initially indicated rapid eye movement toward threat, but avoided it at later intervals (Calvo & Avero, 2005; Garner et al., 2006; Rohner, 2002; Pfugshaupt et al., 2005).

Few studies have examined different profiles of attentional avoidance among anxiety-disordered youth or those with elevated self-reported symptoms of anxiety (e.g., Monk et al., 2006; Pine et al., 2005; Stirling, Eley, & Clark, 2006). Gamble and Rapee (2009) found evidence for attentional bias away from threat at shorter presentation intervals (i.e., 500ms) among anxiety-disordered children and adolescents. However, they found no attention bias relative to a non-anxious control group at later presentation intervals (e.g., 3000ms), suggesting the influence of attentional control capacities at later stages. More specifically, this study found avoidance of threat at the 3000ms presentation for both anxiety-disordered youth and non-anxious controls. It may be that 500ms represents a time frame susceptible to higher-order executive control processes for youth. Furthermore, it is important to note that this study utilized an eye movement measurement procedure, which may be sensitive to different features of attentional biases than the dot probe task.

Attentional avoidance can be viewed as an attempted coping mechanism, serving to distract individuals and allow them to regulate their emotions, however briefly. Derryberry and Reed (2002) drew a distinction between active avoidance and passive avoidance, wherein active avoidance allows individuals to purposefully and adaptively shift to safety cues and gain more information to facilitate coping. In support of this distinction, Waters and colleagues (2012) found that youth with greater anxiety symptom improvement (clinician severity ratings and self-report symptoms [Spence Children's Anxiety Scale]) following a 10-week cognitive-behavioral treatment program for anxiety disorders evidenced a pretreatment attention bias toward threat. Thus, individuals evidencing attentional biases away from threat may be engaging in passive avoidance, indicative of escape and restriction in further information (Derryberry & Reed, 2002). Such extreme avoidance of threat is likely to be an ineffective coping strategy, given that it does not allow one to gather information about the threat-related contextual information in order to habituate to the feelings of the anxiety within the situation (Rachman, 1998).

As such, avoidance, whether attentional or behavioral, perpetuates anxiety in the absence of further information processing.

Difficulty disengaging vs. Avoidance of threat

Overall, research has demonstrated that anxious individuals strongly orient toward both safe and threat cues at long delays, indicating the influence of voluntary attentional control accounting for both a bias away from threat and difficulty disengaging from threat, respectively (Derryberry & Reed, 1995, 1996, 2002). Attentional avoidance and difficulty disengaging from threat appear to be competing processes. It may be that differences between these two attentional patterns reflect individual differences in monitoring the environment and distinct coping styles (Waters et al., 2012). Alternatively, attentional control is not considered a singular construct, and instead is comprised of a few executive attention-related functions. Miyake and colleagues (2000) and Eysenck (2007) and their colleagues proposed a model linking anxiety and disruption in three separate but related executive functions that comprise the umbrella of attentional control: inhibition of dominant responses, shifting between stimuli and tasks, and updating information held in working memory. Here, inhibition indicates one's ability to regulate dominant automatic responses (e.g., attentional bias toward threat) to sustain attention toward task-relevant stimuli (Muris, 2006), whereas shifting describes one's ability to shift attention between tasks in order to respond to environmental demand. The third component regarding working memory is less directly concerned with attentional control, and is thus proposed to be less impacted by anxiety (Eysenck et al., 2007). Deficits in top-down attentional regulation related to anxiety thus indicates difficulties in inhibiting the initial attentional bias or vigilance of threat and difficulty shifting away from threat to focus on less emotionally salient environmental information or tasks at hand, increasing the influence of bottom-up systems (Eysenck et al., 2007). As such, anxious individuals may become more distracted by external or internal (i.e., worrying) threat cues. It may be that the differences in difficulty disengaging from threat and attentional avoidance of threat may represent different patterns of dysfunction between these systems.

Questions remain about the conditions under which attentional control mechanisms may be disrupted. Theorists have proposed that greater deficits are observed in higher-order functions under high and low perceptual load conditions, and the evidence regarding the influences of these possibilities remains mixed. Under the first condition, the limited, finite nature of attentional resources is highlighted. Studies have shown that when the system is overwhelmed with a high degree of perceptual information, greater deficits in ability to control attention are observed (Bardeen & Orcutt, 2011; Lavie et al., 2004; Williams et al., 1996). As such, anxious individuals may show relatively good attentional control under low levels of stress, and increasing difficulty as the system becomes overwhelmed. They, then, require greater levels of effort to perform comparably to non-anxious counterparts, effectively exhausting available attentional resources (Eysenck et al., 2007). Alternative cognitive load theories of attention posit that interference in recruiting control mechanisms is seen primarily under situations of low perceptual load. In this view, the high-load tasks would fully occupy attentional resources, such that the influence of distractors are excluded at early levels of processing (Lavie, 2000; Lavie, 2005). Thus, with low load tasks, attention resources are only partially occupied, allowing for distractors to compete for resources unless control resources are actively and effortfully recruited to support task-related behavior (Bishop, 2009; Forster, & Lavie, 2007; Huang-Pollock, Carr, & Nigg, 2002; Kerns et al., 2004; Maylor & Lavie, 1998;).

Furthermore, some debate remains as to whether deficits of higher-order attentional control capacities, whether at low or high perceptual loads, are specific to emotionally laden information. Generally, poor attentional control is considered a trait characteristic, one that plays a role in early information processing (attention) even when not processing threat-related information (Bishop, 2009). As such, poor attentional control is considered to be a pervasive trait, accounting for deficits in controlled information processing among anxious individuals more broadly during neutrally valenced tasks (Mandler & Sarason, 1952; Fox, 1993; Eysenck & Calvo, 1992). This might explain the increased endorsement of difficulty concentrating and sustaining attention for anxious individuals. However, deficits in regulatory attentional control appear to interact with state anxiety at subcortical threat-detection systems within the limbic system (Bishop, Duncan et al., 2004; Bishop, Jenkins et al., 2007) leading to the pervasive cognitive biases seen in individuals with anxiety disorders (Eysenck & Byrne, 1992; Eysenck et al., 2007). This finding may be why distinctive profiles of attentional avoidance or disengagement toward safety cues are only seen within the context of threat cues (Derryberry & Reed, 2002).

Overall, attentional control has been identified as a significant cognitive vulnerability for individuals with anxiety disorders, as they serve to modulate negative affectivity (Compton, 2003; Eisenberg et al., 2000). Deficits in attentional control for anxious individuals are consistent with reports that anxiety is particularly associated with poor concentration and increased distractibility (Eysenck, 1997; Mathews & Mackintosh, 1998; Williams, Mathews, & MacLeod, 1996). However, given that other psychological difficulties (e.g., attention-deficit/hyperactivity disorder and brain injury) are characterized by poor attentional control, and that self-reported measures of attentional control among youth have been linked to other psychological symptoms in addition to anxiety (e.g., aggression, depression; Muris, Meesters, & Rompelberg, 2006; Muris et al., 2008), attentional control is not sufficient to result in anxiety disorders (Bishop, 2009). Alternatively, individual differences in attentional control capacities are proposed to interact with temperamental traits (i.e., negative affectivity, effortful control) and environmental experiences to maintain clinically impairing levels of anxiety (Bishop, 2009; Muris, Meesters, & Rompelberg, 2006).

Dysfunctional Attentional Systems and Anxiety: Neurological Evidence

In addition to observable behaviors and inferred cognitive patterns, results from neuroimaging studies provide evidence for the role of automatic attention biases and later dysfunction in attentional control in anxiety disorders (Bishop 2009; White et al., 2009), indicating anxiety-related differences in structure and function of brain regions implicated in detection and processing of threatening stimuli. Many neuroanatomical, neurochemical, and genetic processes have been tied to attentional systems and attentional biases toward threat for anxious individuals. Of this extensive literature, the limbic-prefrontal cortical circuitry has been identified as a prominent neural mechanism that represents both bottom-up emotional response and top-down control capacities (Bishop, 2007).

Specifically, the evolutionarily based fear responses discussed earlier have been linked to subcortical and hypothalamic areas, which are mediated by more superior cortical processes (Lang, Davis, & Ohman, 2001; LeDoux, 1995; 1996; Rosen & Schulkin, 1998). These neural processes directly mirror the empirical cognitive models that show that early automatic attention is regulated by later executive control processes (Mathews & Mackintosh, 1998). As one of the primary mediating components of hypervigilance to threat (Anderson & Phelps, 2001; Davis & Whalen, 2001; Ohman, 2005; Ohman & Weins, 2004), the amygdala represents a subcortical neural structure and component of the limbic system that is strongly tied to the processing of threat-related and other emotionally-valenced stimuli (LeDoux, 2000; Myers & Davis, 2007; White et al., 2009) transmitted from lower visual nuclei in the brainstem (Carlson, Reinke, & Habib, 2009; Liddell et al., 2005; Usunoff et al., 2006). Evidence from neuroimaging studies indicates that the amygdala plays an integral role in early stages of fear acquisition (e.g., LaBar & Phelps, 2005) even in the absence of awareness (Liddell et al., 2005; Whalen et al., 2005). The amygdala also integrates input from higher-order, self-regulatory neural systems (LeDoux, 1995; Milad et al., 2007), in complement with Posner's theories of the processing of threat-related material from both involuntary (posterior) and voluntary (anterior) pathways (Posner & Raichle, 1994; Rothbart, Derryberry, & Posner, 1994). Along this anterior pathway, the amygdala has projective connections into the ventro-lateral prefrontal cortex, which is responsible for initiation and inhibition of voluntary attentional resources. It is here that the amygdala has been proposed to influence the direction of attention (Mathews, Mackintosh, & Fulcher, 1997); elevated activity in the amygdala has been associated with facilitated attention toward threat (e.g., Anderson & Phelps, 2001). Carlson et al., 2009; Monk et al., 2004, 2008; van den Heuvel et al., 2005; For youth with anxiety disorders, these neural reactions to threat appear exaggerated or uncontrolled (White et al., 2009), such that anxiety increases the amydalar response to threat (Bishop, 2007; Bishop et al., 2004). Evidence of the role of the amygdala in early fear processing has been demonstrated by both fMRI (Guyer et al., 2008; Monk et al., 2008; van den Heuvel et al., 2005) and amygdala lesion (Anderson & Phelps, 2001) studies. Furthermore, imaging studies have linked amygdala functioning with both masked and unmasked emotional stimuli in dot probe studies (Carlson, Reinke, & Habib, 2009; Morris et al., 1998; Vuilleumier, Armony, Driver, & Dolan, 2001; Whalen et al., 2004), mirroring behavioral studies (Bar-Haim et al., 2007), and emphasizing the automaticity of amygdala influence in the earliest stages of attentional processing outside of the role of effortful processes (Cisler & Koster, 2010; Dolan & Vuilleumier, 2003). The amygdala has been identified as a critical mechanism that serves to mediate the input of its subcortical fear responses to areas of the prefrontal cortex responsible for executive control and decision-making (Lang, Davis, & Ohman, 2001; LeDoux, 1996; Rosen & Schulkin, 1998).

Contrasting the automatic attentional bias for threat perpetuated by initial amygdala activation from the posterior pathway, slower and more effortful anterior systems work to inhibit and control attention at later stages of processing (Bishop et al., 2004; LeDoux, 1995), mediating anxiety. Brain imaging studies with animals have shown that prefrontal control systems inhibit amygdala output during extinction phases of learning (Milad et al., 2006). Indeed, when anxiety is elevated in humans, the circuitry between the amygdala and executive control areas, such as the dorsolateral and ventrolateral prefrontal cortex (DLPFC and VLPFC) and anterior cingulate cortex (ACC), is down-regulated, indicating that executive regulatory abilities are not as engaged as in non-anxious individuals (Bishop et al., 2004; Carter, et al., 2000; MacDonald, Cohen, Stenger, & Carter, 2000; Posner & DiGiralomo, 1998; White et al., 2009). Each of these control areas is involved in distinct aspects of attentional control. The PFC is involved in maintaining task-specific information about rules or goals (Greicius et al., 2003; MacDonald et al., 2000), particularly in the face of conflicting information (Pessoa 2008). For example, the DLPFC is thought to be involved in sustaining mental representation of current goals and task rules, with regard to maintenance of attention, in order to promote on-task performance (MacDonald, Cohen, Stenger, & Carter, 2000; Miller & Cohen, 2001). Furthermore, the DLPFC is also involved in altering patterns of attention allocation according to unexpected environmental changes in processing demand, which are signaled by the ACC (Botvinick, Braver, Barch, Carter, & Cohen, 2001; Botvinick, Nystrom, Fissell, Carter, & Cohen, 2002). Generally, neural executive control centers serve to down-regulate subcortical limbic centers (i.e., amygdala; Myers & Davis, 2007; Quirk, Garcia, & Gonzalez-Lima, 2006; Sotres-Bayon, Cain, & LeDoux, 2006) in order to work toward other goals or gather additional information outside of the influence of initial fear responses (Telzer et al., 2008). Neuroimaging studies show decreased amygdala activity along with increased PFC activity during stimulus re-interpretation, indicating that these control mechanisms serve to allow individuals to reevaluate threatening or ambiguous environmental stimuli in order to self-regulate affect (Ochsner et al., 2004; Phan et al., 2006). Such a pattern provides neurological backing for behavioral observations of top-down information processing abilities that regulate initial fear-based amygdala response (Cisler & Koster, 2010; Miller & Cohen, 2001; Shechner et al., 2012).

Given this evidence, one would expect that decreased attentional control abilities are associated with decreased recruitment of prefrontal cortical areas, and this is supported in some studies. Telzer and colleagues (2008) found an increase in PFC areas for high trait anxious children and adolescents when required to shift away from threat. Such a pattern may indicate reduced processing efficiency at work in anxiety disorders, such that anxious individuals require more activity in order to appropriately control attention and maintain on-task behavior (Eysenck & Calvo, 1992). Bishop (2009) found that diminished dorsolateral PFC recruitment was linked to trait anxiety during low perceptual-load tasks (i.e., letter string comprised of one target letter) in the presence of incongruent distractors (i.e., the *other* target letter), indicating impoverished PFC control abilities in the absence of threat or competing stimuli (i.e., low situation demands). The authors proposed that increased recruitment of attentional control networks is required when demands are low in order to maintain on-task behavior; when demands are low, individuals with poor attentional control are more susceptible to the influence of environmental distractors, possibly explaining the endorsement of concentration difficulties and occupational impairment even outside the immediate experience of anxiety (Bishop, 2009). Although these results implicate similar neural areas of interest regarding the interaction of information processing and anxiety, they provide neurological support for the cognitive load models of selective attention that identify attentional control as a general cognitive vulnerability in anxiety (Lavie, 2000, 2005). These findings would appear to contradict attentional control theories (Eysenck & Calvo,

1992) that posit the existence of attentional control deficits only during times of increased situational demands (i.e., in the face of threat; Bishop, 2009; Eysenck, Derakshan, Santos & Calvo, 2007). As, such the extent of the influence of attentional control deficits for anxious individuals is not entirely clear given current behavioral and neurological evidence.

Additionally, the role of these control centers provides support for observed difficulty controlling attention and disengaging from threat seen in anxious individuals. As previously discussed, attentional control capacities moderate initial patterns of attentional bias, all at relatively early stages of information processing (i.e., ~ <500ms; Derryberry & Reed, 2002; Eysenck et al., 2007). As such, poor behaviorally observed attentional control capacities, coupled with high trait anxiety, have been linked to decreased ACC and PFC activity as individuals attempt to disengage from unexpected threat stimuli (i.e., control attention toward threat; Armony & Dolan, 2002; Bishop, 2009; Bishop, Duncan, Brett, Lawrence, 2004; Dolcos & McCarthy, 2006; Posner & Rothbart, 1998). Notably, these theories advance previous suppositions that threat and neutral stimuli compete for finite cognitive processing (Bishop, 2009). Such a pattern is evidence that anxiety may develop not only from enhanced bottom-up, automatic, fear responses, but from diminished top-down, voluntary, regulatory processes (Ochsner, Ray, Cooper, Robertson, Chopra, Gabrieli , & Gross, 2004; Schaefer, Jackson, Davidson, Aguirre, Kimberg, & Thompson-Schill, 2002). Research from genetic studies further links behavioral observations with these neural irregularities; the short-allele polymorphism of the serotonin transporter gene (5-HTT) is associated with facilitated attention to threat (Beevers et al., 2007) and enhanced amygdala activity in threat situations (Hariri et al., 2002; Munafo et al., 2008), as well as difficulty disengaging from threat (Beevers et al., 2009) and decreased function of the regulatory pathway between the amygdala and ACC (Pezawas et al., 2005). Similar patterns have also been found with short-allele-carrier youth (Gibb et al., 2009; Perez-Edgar et al., 2010; Thomason, Henry, Hamilton, et al., 2010). Furthermore, diminished activation in the ventrolateral PFC is associated with compensatory avoidance of threat at later stages of information processing among anxious individuals (Monk et al., 2006). Later studies have found diminished PFC activity among anxious individuals in the presence of distractor items during a cognitive load task, outside of the context of environmental threat or state anxiety (Bishop, 2009), suggesting generally impoverished regulatory abilities for anxious individuals, which likely play a role in anxiety sensitivity (Telzer, Mogg, Bradley, et al., 2008). Overall, neurological evidence supports the involvement of overactive amygdala activity and impoverished prefrontal executive recruitment in a double-impact cognitive vulnerability toward anxiety (Bishop, 2009).

Temperament: Effortful Control and Information Processing in Anxiety

Despite the evidence for multiple disruptions in information processing systems for problematic anxiety, these difficulties represent an incomplete model. How do these systems come to be disrupted? The early attentional processes described above (i.e., attentional orienting and control), are thought to play a central role in mediating the influence of child factors, such as temperament, in the development of anxiety disorders (Vasey & MacLeod, 2001). The multifaceted construct of temperament is theorized to encapsulate the initial reactivity of the individual to the environment, as well as involvement of subsequent self-regulatory systems (Muris & Ollendick 2005; Rothbart &

Bates, 1998). Just as increased facilitated attention to threat and deficits in attentional control are proposed to lead to the maintenance of anxious states, dysregulation of reactive and self-regulatory temperamental systems have been shown to influence the persistent presentation of dysregulated emotion and play an integral role in the subsequent development of psychopathology (Derryberry, Reed, & Pilkenton-Taylor, 2003; Lonigan, Vasey, Phillips, & Hazen; 2004). Longitudinal studies have linked temperamental traits to risk for psychopathology, in that children evidencing particular behavioral profiles (i.e., behavioral inhibition; e.g., Hirshfeld et al., 1992; McDermott et al., 2009; Turner et al, 1996) evidence common reactive and regulatory difficulties and are likely to follow particular developmental, physiological, and psychopathological trajectories across childhood (Caspi, Henry, McGee, Moffitt, & Silva, 1995; Perez-Edgar, Bar-Haim, McDermott, Chronis-Tuscano, Pine, & Fox, 2010).

Temperamental reactivity factors are comprised of negative affectivity, or neuroticism, and positive affectivity, or extraversion (Muris & Ollendick, 2005; Rothbart & Bates, 1998). High levels of negative affectivity/neuroticism, even from very early in infancy, has been most reliably linked to high trait anxiety (e.g., $r = 0.58$ [panic] and $r = 0.61$ [generalized anxiety], Chorpita & Daleiden, 2002), identifying high negative reactivity as an early risk factor for the development of later anxiety disorders (Anthony, Lonigan, Hooe, & Phillips, 2002; Clark et al., 1994). Indeed, empirical evidence demonstrates that children who display heightened fearful reactivity to novelty, also known as behavioral inhibition (Gray, 1982; 1991; Kagan, Reznick, Snidman, Gibbons, & Johnson, 1988), as infants are at risk for developing anxiety disorders later in childhood or adolescence (Fox, Henderson, Marshall, Nichols, & Ghera, 2005;

Gladstone, Parker, Mitchell, Wilhelm, & Malhi, 2005; Perez-Edgar & Fox, 2005 Schwartz, Snidman, & Kagan, 1999).

Temperamental Self-Regulation and Anxiety: Effortful Control

In addition to individual differences in reactivity to the environment, variations in self-regulatory abilities contribute to developmental profiles and subsequent risk for psychopathology. Trait negative affect and early attentional processes are thought to be governed by more effortful temperamental processes, such as effortful control (e.g., Lonigan et al., 2004; Posner & Rothbart, 2000). In typical development, effortful control allows individuals to override dominant responses in order to self-soothe, consider subdominant responses, engage more flexibly with the environment, and work toward less immediate objectives (Posner & Rothbart, 2000; Rothbart and Bates,1998; Rothbart & Rueda, 2005). Comprised of inhibitory control, activation control, and attentional control (Posner & Rothbart, 2000), individual differences in effortful control imply variable ability to engage executive control abilities over emotions, resulting from heredity, maturation, and environmental experience (Rothbart & Rueda, 2005). One of the predominant goals of the first years of life is to develop increased control over emotional reactions and behaviors in the form of self-regulatory capacities like effortful control (Rueda, Posner, & Rothbart, 2005). Effortful control is conceptualized as a multifaceted concept, comprised of multiple emotion regulation strategies, including the ability to delay gratification, empathize with others, and follow social rules and mores (Derryberry & Reed, 1997; Eisenberg, Smith, Sadovsky, & Spinrad, 2004).

The concept of effortful control comprises multiple temperamentally based factors, including sensitivity to sensory sensitivity, and the ability to inhibit dominant responses, shift and focus attention (Rueda, Posner, & Rothbart, 2005). These capacities allow individuals to regulate impulse reactivity to the environment in order to work toward current and future goals, identifying them as protective factors against psychopathology (Kochanska & Knaack, 2004). High levels of effortful control have been linked to high levels of empathy (r = .48; Rothbart, Ahadi, & Hershey, 1994), the development of conscience and moral beliefs (Kochanska, Murray, & Coy, 1997), high attentional control (r = 0.67; Muris et al., 2008), and lower levels of internalizing (anxiety) and externalizing (impulsivity; Eisenberg, Sadovsky, et al., 2005) among typically developing children. On the other hand, low levels of effortful control have been identified as a characteristic of children with symptoms of internalizing disorders (r = -0.25; Oldehinkel et al., 2004), or those who exhibit behaviorally inhibited temperamental profiles, suggesting that they utilize more reactive coping mechanisms characteristic of anxiety disorders (e.g., avoidance; Derrberry, Reed, & Plinkenton-Taylor, 2003; Lonigan et al., 2004). Thus, individual differences in the ability to control reactivity to the environment is one way that sets youth with elevated symptoms of anxiety apart from their non-anxious counterparts early in development (Rothbart, Posner, & Rosicky, 1994). As with difficulties in the attentional system, it is most useful to consider the presentation of effortful control along a continuum, as a dimension that interacts with other endogenous and exogenous factors, conferring risk for subsequent psychopathology.

Research within the temperament and information processing literatures regarding risk factors for anxiety largely evolved separately. As such, there exists important overlap between constructs. In merging these ideas, theorists propose that attentional control comprises one important aspect underlying effortful control, one that allows individuals to organize incoming information and maintain a calm state of mind in order to organize and select potential behavioral responses to the environment (Derryberry & Rothbart, 1997; Rothbart & Bates, 1998). Furthermore, evidence from the temperament literature on effortful control supports research regarding attentional control as an early mechanism of self-regulation of emotion (Cisler & Koster, 2012; Gross 1998, 2001, 2007; Koole 2009; Posner & Rothbart, 1992, 1998; Rothbart, Posner, & Kieras, 2006). The attentional aspects of effortful control are proposed to comprise attentional focusing and attentional shifting (Derryberry & Rothbart, 1998). Among these factors, attentional focusing was linked most specifically to symptoms of anxiety (r = -0.38; Verstraeten et al., 2010), particularly over broader measures of effortful control (Eisenberg et al., 2001). Developmentally, self-regulation of emotion via attentional control is observed when infants shift their gaze away from stimuli to regulate distress (Harman, Rothbart, & Posner, 1997). The use of attentional control to modulate emotional reaction necessarily increases as the dynamics of situations and the meaning of stimuli increase in complexity (Rothbart, Posner, & Boylan, 1990). For instance, attentional control is used to think flexibly about the context of situations, factor in previous knowledge of one's self, and consider potential actions (Rothbart & Rueda, 2005). As such, the development of these adaptive attentional capacities is theorized to serve as a protective factor, mediating trajectories of reactive, behaviorally inhibited youth toward lower levels of subsequent psychopathology (Degnan & Fox, 2007). Evidence of for the inclusion of attentional control as a component of effortful control includes evidence that adults high in effortful control are able to better shift attention away from threatening stimuli similar to low-anxious individuals (Derryberry & Reed, 2002). The link between these concepts is supported by significant correlations between effortful and attentional control measures (*r* = 0.67; Muris et al., 2008).

Interaction between effortful control and negative affectivity

Just as individual differences in bias toward threat and control confer risk for anxiety, the interaction of negative affectivity and effortful control directly mirror this system and have also been linked to anxiety disorders. Lonigan and colleagues (2004) proposed an integrative model of these systems, such that negative affectivity and effortful control influence the development of attentional biases to threat in the etiology of anxiety disorders. Vulnerability toward anxiety disorders arises from inefficiencies among these coping systems, including early reactivity/attention biases and deficient effortful/attentional control abilities. The failure of effortful attentional control to inhibit an early, reactive attention bias toward threat could be the result of a number of factors. In one theory, a low capacity for situation demands could deplete the cognitive and emotional resources available, especially during times of high stress (Lonigan et al., 2004).

The interactions between these systems have been frequently, although incompletely, tested through the extant empirical literature. Attentional control was found to moderate the effects of negative emotionality or fear reactivity on social competence (Eisenberg et al., 1997), shyness (Eisenberg, Shepard, Fabes, Murphy, & Guthrie, 1998), general problem behavior (Eisenberg et al., 2000), interpretive biases (Muris, Meesters, & Rompelberg, 2006), attentional biases (Lonigan & Vasey, 2009), and anxiety (Lonigan et al., 2004; Oldenhinkel et al., 2007). Individuals high in negative affectivity and low in effortful control were found to exhibit attentional biases to threat at a stimulus presentation time of 1250ms among a group of community youth without anxiety diagnoses (Lonigan & Vasey, 2009), aligning with evidence of difficulty disengaging from threat with low levels of attentional control. Youth less distracted by spatial conflict in laboratory tasks also evidenced higher ratings on parent-report of effortful control and scores on inhibitory control (Rothbart, Ellis, Rueda, & Posner, 2003). These systems are further tied together with evidence that similar neural systems are activated between the attentional systems discussed earlier and the temperamental traits discussed herein (Derryberry, Reed, & Pilkenton-Taylor, 2003; Perez-Edgar et al., 2007). The increased sympathetic activity associated with high negative reactivity and behavioral inhibition (Kagan, Reznick, & Snidman, 1987) activates similar limbic and prefrontal cortical areas as attentional biases to threat and attentional control (Derryberry, Reed, & Pilkenton-Taylor, 2003; Rueda, Posner, & Rothbart, 2004). Use of emotion regulation strategies and reappraisal, effortful control strategies results in increased PFC and decreased amygdala activity (Eippert et al., 2007, Kim & Hamann, 2007; Urry et al., 2006). In sum, evidence from these converging lines of research support the supposition that cognitive responses to threat are determined by emotional reactivity and the attention network; individuals with low effortful/attentional control capacity are less able to regulate initial, impulsive, reactive responses to the environment, including attentional biases (Cisler & Koster, 2012; Lonigan et al., 2004).

Environmental Influence: The role of parents

Although early information processing and temperamental traits appear to interact and confer risk for anxiety disorders (e.g., Lonigan et al., 2004), it is important to consider that youth exist within a context that likely influences the stability and trajectory of these processes (e.g., Thomas & Chess, 1977). It is likely that anxiety-disordered youth are not born with the extent of the deficits that unfold over development, such that these malleable systems are impacted by experience and learning (Mathews & MacLeod, 2005). Interaction with the environment is thought to help shape cognitive biases in anxiety (Eley et al., 2008), including threat-related biases and the development of attentional control (Posner & Rothbart, 1998). Although internal selective processes motivate youth to attend to specific environmental stimuli, effectively constraining the impact of the environment (Ciccheti & Tucker, 1994; Derryberry & Reed, 1994), it remains important to understand how environmental stimuli reciprocally impact early information processing systems. The influence of the environment takes multiple forms, including the role of parents and the frequency of true or perceived threat.

Research implicates parents and their psychopathology as having an important role in the development and maintenance of anxiety for youth (Ollendick & Horsch, 2007; Settipani, O'Neil, Podell, Beidans, & Kendall, 2012), although the impact of parents on information processing biases is not conclusive. Parental psychopathology often confers risk for youth anxiety, even after controlling for genetic influence (Bogels & Brechman-Toussaint, 2006). Kujawa and colleagues (2011) found a threat-related attentional bias for youth (ages 5-7 years) with mothers diagnosed with major depressive disorder. However, the mechanism by which parental internalizing psychopathology (i.e., depression, anxiety) results in child attentional bias for threat is not clear from these results. We know that parents play a role in regulating attention early in development to assist in early emotion regulation for infants (Degnan & Fox, 2007; Fox et al., 2005;

Gottman, Katz, & Hooven, 1997). Therefore, given evidence that parents exhibit attentional biases regarding their own and their children's environments (Lester et al., 2009), they likely model dysregulated, reactive attention to their children. Additionally, anxious parents often provide explicit negative information about the events and lack of control or ability to cope (Field & Lester, 2010). McFarlane (1987a; 1987b) found that parental expression of anxious behavior following involvement in a natural disaster accounted for approximately 12% of the variance in youth's post-traumatic symptomatology. Not only do parents provide information about the environment, but they also model anxious behavior and maladaptive coping (Creswell et al., 2010; Muris, Steerneman, Merckelbach, & Meesters, 1996). However, the specific influence of parents on attentional biases remains mixed. Muris and Field (2010) found that youth developed an attentional bias for novel stimuli after hearing threat-related information from their parents. There has been some evidence that parental anxiety (i.e., panic disorder) played a larger role in conferring risk for attentional biases toward threat among youth than youth anxiety, although youth anxiety disorder was also associated with significant attentional biases toward threat (Pine, Klein et al., 2005). These findings would suggest that attention biases may be passed intergenerationally, as youth either experience increased anxiety (Vasey & MacLeod, 2001) or develop ways of interpreting threat similar to parents (Moradi et al., 1999; Muris & Field, 2013). However, Lester and colleagues (2012) found no relationship between maternal anxiety and attentional biases. Differences between study conclusions in this area may be a factor of how parents share information with youth (i.e., verbally, behaviorally), the frequency with which information was displayed, or the degree of elaboration that events or anxious cognitions were relayed.

Findings regarding parental anxiety influence on youth anxiety are clearer for later stages of information processing. Creswell and colleagues (2011) found that parental expectancies regarding children's threat perceptions predicted similar threat-related, anxious cognitions within their children over time. In another evaluation, maternal anxiety was associated with biases in later stages of information processing (i.e., interpretive biases), rather than initial threat-related attention biases (Lester, Field, & Cartwright-Hatton, 2012). It was also found that youth evidenced higher interpretation of threat in ambiguous information when threat-related interpretive biases were induced in parents (Muris, van Zwol, Huijding, Mayer, 2010). Furthermore, parents often act in ways that serve to perpetuate anxiety (e.g., overcontrol of youth; Ollendick & Horsch, 2007). As one of these influential actions, parents may make fear-based parenting decisions (e.g., keep child home from school; Fox, Henderson, Marshall, Nichols, & Ghera, 2005) or encourage their children to avoid feared objects, particularly when youth display elevated symptoms of anxiety, which would reinforce or amplify youths' fear (Degnan & Fox, 2007). It is suggested that inception of youths' anxious cognitions mediates the relationship between parenting processes and development of anxiety for youth (Ollendick & Benoit, 2012), such that parenting behaviors influence youths' anxious cognitions and, subsequently, levels of anxiety. This finding implicates the role of later conscious stages of information processing in anxiety inception. These findings highlight the possibility that initial reactions to the environment, linked to reactive temperamental factors, may be less malleable; however, later self-regulative skills and later stages of information processing may be more impacted by parental influence. This finding is corroborated by evidence of the malleability of attentional control from attention bias modification studies (e.g., Bar-Haim, 2010, discussed below).

Youth are impacted by environmental factors, but they similarly impact their environment (Moffitt, Caspi, & Rutter, 2006). It may be that the relationship between parents and perceived environmental threat maintains anxiety in anxiety-disordered youth via a transactional relationship, such that the youth also selects and shapes their environment. Future research should examine parents and offspring longitudinally in order to elucidate the temporal trajectory of these multiple risk factors for anxiety. Information about the interplay of parental psychopathology and information processing biases in similar difficulties among youth provide important implications for treatment. It may be important to address parental information processing biases among parents of treatment-seeking youth, especially for more treatment-resistant cases. This finding is particularly important in light of evidence that transmission of parental anxious cognitions regarding ambiguous scenarios to children resulted in enhancement of avoidance behaviors for anxiety-disordered youth and those with elevated symptoms of anxiety (Barrett, Rapee, Dadds, & Ryan, 1996; Chorpita et al., 1996).

Developmental considerations

Although cognitive biases have been found to be similar across adults and children (Bar-Haim et al., 2007) and seen even among youth as young as 4 years of age (Muris & Field, 2013), there are a number of developmental points to consider regarding dysregulated attentional networks among anxiety-disordered youth. Given the discrepancies in attention bias findings addressed previously, early theories proposed that attention biases developed equally in all children over time, such that anxious individuals were those that failed to develop inhibitory mechanisms aimed to negate a naturally occurring attention bias (Kindt, Bierman, & Brosschot, 1997; Kindt, Bogels, & Moren, 2003; Kindt & van den Hout, 2001). For example, among their sample of typically developing 8- to 11-year-old youth reporting high fear of spiders, Kindt and colleagues (2000) found limited evidence for attentional bias toward spider-related words among the younger children in their sample. Differences in presence of attentional biases among typically developing, non-anxious children remain important points of consideration. Two recent studies (LoBue, 2009; LoBue & Larson, 2010) demonstrated the same patterns of response toward threatening faces among 5-year olds, and toward a geometric corollary of angry faces (i.e., a downward-pointing "V"; Larson, Arnoff, & Stearns, 2007) among 3-year olds, respectively. Indeed, investigation of attentional biases among anxious youth is complicated by limited, inconsistent results (e.g., Fox, 1994; Kindt, Bierman, & Brosschot, 1997; Kindt & Van Den Hout, 2001; MacLeod & Rutherford, 1992; Martin & Jones, 1995). As such, some of the evidence of attentional biases with youth remains inconclusive.

Studies of attentional biases among youth are complicated by methodological variations (as discussed previously). Accounting for these differences across studies, there is considered to be substantial evidence of anxiety-related individual differences in attentional biases for youth (Muris & Field, 2013). A recent meta-analysis (Bar-Haim et al., 2007), found a significant effect of threat-related attentional bias for anxious youth (d = .50) that was not statistically different from that of anxious adult samples. Empirical evidence has proposed a dynamic relationship between attention biases and anxiety since early in life (Martin, Horder, & Jones, 1992), as the posterior, reactive attentional orientation system is established early in the first year of life (Luria, 1973). However, it is unclear if presence of attentional bias and anxiety changes over time when present. Early studies of attention bias among anxious youth failed to find support for younger children (ages 7-12) and found similar patterns as adults for older children (ages 9-17 years; Vasey & MacLeod, 2001). In many studies of attentional biases, age is often not found to moderate the attentional effects elicited by computer tasks (e.g., Martin et al., 1992), indicating that attentional biases do not worsen or improve with age in childhood. However, others find increased biases toward threat with increased age (Kindt, Bierman, & Brosschot, 1997), highlighting plasticity within the biased attentional system and a potential transactional relationship between attention systems and symptoms of anxiety (Shechner et al., 2012). Although evidence for attention bias even among young children has been found, the conclusions about the relationship between bias, age, and severity of anxiety remains complicated by the cross-sectional nature of the majority of these studies.

Investigating early temperamental markers for anxiety (e.g., high reactivity among behaviorally inhibited temperament profile; Chronis-Tuscano, Degnan, Pine, et al., 2009; Schwartz, Wright, Shin et al., 2003) allows for longitudinal investigation of the relationship between attention and anxiety, leading to the development of anxiety disorders (White, Helfinstein, & Fox, 2010). Although temperamental traits are thought to change with early experience (Zahn-Wexler, Klimes-Dougan, & Slattery, 2000), including initial visual reactivity to the environment (Calkins, Fox, & Marshall, 1996), differences in attention may interact with high levels of negative reactivity to novelty

(Fox et al., 2007) and maintain early patterns of behavioral inhibition. Given that youth identified as behaviorally inhibited are more likely to be socially withdrawn later in life (e.g., Caspi et al., 2003), early attentional biases toward threat and/or difficulty controlling attention may promote these avoidance and withdrawal behaviors. To address limitations of cross-sectional studies, a series of investigations have examined the longitudinal associations between attention orienting, temperamental traits, and anxiety. The degree and stability of behavioral inhibition in infancy early childhood (i.e., two and three years of age) for a sample of community youth significantly predicted social withdrawal at five years of age (Perez-Edgar, Reeb-Sutherland et al., 2011) and in adolescence (Perez-Edgar, Bar-Haim et al., 2010; Perez-Edgar, McDermott et al., 2010), but only for those youth who evidenced a concurrent attention bias toward threat. However, given that attention biases were not measured at an earlier age, the temporal precedence of attentional biases or temperamental factors like behavioral inhibition remains unclear. This is particularly important in light of the fact that temperamental profiles have been found to change over time (Shechner et al., 20102), with the stability of behavioral inhibition linked most to anxiety (Perez-Edgar et al., 2011).

Development of Attentional Control

Given that self-regulatory abilities are believed to develop later in the first year of life (Posner & Rothbart, 2000), it may be particularly important to consider developmental differences in the role of attentional control. Evidence from typical development emphasizes the role of developing attentional control, mirroring the maturation of requisite neural areas (Kochanska, 2000; Posner & Rothbart, 2000). Developmentally, infants learn to overcome a “sticky” gaze toward threat or overwhelming stimuli early in their first year of life as, and are increasingly able to voluntarily redirect gaze away from distressing stimuli as a developing self-regulation skill (Colombo, 2001; Harman et al., 1997; Posner & Rothbart, 1998; Ruff & Rothbart, 1996). This pattern is also modeled by caregivers who increasingly help the child shift away from distress via distraction to neutral or positive stimuli; individuals without disorders move toward neutral distractors during stressful events in order to assist in emotion regulation (van Dillen & Koole, 2007; Sheppes & Meiran, 2008). By their preschool years (about three years of age), children are able to control attention between competing stimuli with increasing dexterity, albeit with great individual variability (Posner & Rothbart, 1998; Sroufe, 1996). Development in attentional control is thought to occur primarily between the ages of three and seven years of age (Rueda, Rothbart, McCandliss, Saccomann, & Posner, 2005), with variability stemming from interaction from early reactivity, or motivational systems (e.g., positive vs. negative affectivity/reactivity; Derryberry & Rothbart, 1997; Rothbart, Derryberry, et al., 1994). Thus, typical youth are able to make use of such attentional control in the face of some environmental threat, redirecting their attention, elaborating on information about the environment, and employing adaptive coping strategies instead of becoming mired in increasing levels of anxiety through avoidance. Although attentional control capacities continue to mature, they remain open to influence by temperamental traits, physical development (e.g., hormonal changes), and environmental experience (e.g., parental influence). Indeed, continued difficulty in gaze shifting across development is predictive of later internalizing problems across the lifespan (infants, Rothbart, Ziaie, & O'Boyle, 2006; children, Eisenberg, Fabes et al., 1994; Rothbart, Posner, & Rosicky, 1994; adults, Derryberry & Reed, 2002). Although self-regulation capacities, including attentional control have been shown to develop with age (Muris et al., 2008), empirical evidence repeatedly shows solidification of attentional control capacities beginning around seven years of age by both self-report (Muris, Meesters, Rompelberg, 2006) and objective computer measures (ANT task, Rueda et al., 2004; flanker tasks, McDermott et al., 2007), such that youth show no difference from typical adult samples. Furthermore, attention training among four-year-old children without anxiety disorders evidenced improved executive attention similar to adults (Rueda, Rothbart, McCandliss, Saccamono, & Posner, 2005). Attentional control capacities develop during early childhood and, during that early time period, are impressionable to early experience.

Children who display low levels of developed effortful control of attention processes are likely to become attentionally "stuck" on looking for and attending to threat cues. In the absence of sufficient self-regulatory abilities, such a pattern would further maintain a high and persistent level of anxiety and negative affectivity stemming from temperamental reactivity, and these children would be less able to control their feelings of anxiety, which confers risk for the development of psychopathology. Support for the interaction between attentional biases and attentional control across early development is supported by the finding that individuals that self-report high levels of trait anxiety without receiving a clinical diagnosis are at risk for later developing an anxiety disorder (Vasey & MacLeod, 2001). As such, such attentional differences may predate the development of anxiety disorder.

In sum, although there remains mixed evidence for the exact temporal role of early information processing differences across in risk for psychopathology, these attentional biases are believed to progressively shape youth's cognitive representations of the world, reflecting underlying temperamental traits (Derryberry & Reed, 1996), and interacting with the development of effortful processes and perceptions of self-efficacy in the face of threat (Derryberry & Rothbart, 1997). As these intricate interactions are further studied, the use of developmentally sensitive methods of measurement remains critical (Davis, Bruce, & Gunnar, 2002). This consideration is important not only in accounting for developmental differences in attentional capacities, but also for differences in dexterity and interest (i.e., for computer tasks) and verbal abilities (i.e., for self-report measures; McDermott et al., 2007). Given the expected development of attentional control and other skills, tasks that may elicit individual differences at one age may be too easy and insensitive to such discrepancies for later age groups. Overall, studies of attentional processes across development and in the face of intervention (discussed below) emphasize the plasticity of neural and behavioral systems underlying important factors that confer risk for anxiety.

Clinical Implications

The role of reactive attentional biases to threat and self-regulatory attentional control in the trajectory of anxiety disorders provide important implications for intervention. Attention has shown to play an integral role in explicit learning (Derryberry & Rothbart, 1997; Ruff & Rothbart, 1996). Current empirically supported treatments for anxiety address attention in treatment by encouraging anxious individuals to attend to and stay within anxious situations long enough to establish new associative learning patterns.

As an emotional regulation strategy, the role of attentional control has particular importance in treatment of anxiety disorders. Individuals with higher capacity for this protective factor have been shown to experience lower levels of anxiety among community samples (e.g., Lonigan et al., 2004). As such, it makes sense that higher levels of attentional control result in better treatment response, particularly during exposure (Bardeen & Read, 2010). Here, it may be that individuals were better able to shift attention between the specific aspects of the narrative and the immediate situation in order to help mitigate anxiety and encourage new, learned patterns of response. Such a view is in line with the findings that mild distraction, in the absence of overt/active avoidance, expedite fear reduction during exposure therapy (Johnstone & Page, 2004). Poor treatment response was indicated by relatively diminished attentional control capacities pre-treatment (Price, Tone, & Anderson, 2011). Attentional control may even improve individual's willingness to attend and continue to engage in treatment, as their ability to shift attention makes it more tolerable (Bardeen & Read, 2010).

Although dysregulated attentional systems have been identified s reliable risk factors in the development and maintenance of anxiety, it is important to note that attentional processes are malleable. MacLeod and colleagues (2002) showed that biases toward particular environmental stimuli can be induced if paired frequently enough with target stimuli, emphasizing the basic role of associative learning and attention. Experimentally induced attentional biases toward specific environmental stimuli have resulted in increases in relevant emotional states among low-anxiety, community adult (MacLeod et al., 2002) and youth (Eldar, Ricon, & Bar-Haim, 2008) samples, although attention training away from threat did not result in increases in negative affective states. For example, Johnson (2009) found those trained to control attend toward happy faces to be less frustrated during a stressful anagram task. Indeed, changes in attentional biases have also been shown to occur following successful CBT treatment for adult anxiety (e.g., Mathews, Mogg, Kentish, & Eysenck, 1995; Mattia, Heimberg, & Hope, 1993).

The change in attentional bias post treatment is perhaps less clear for anxiety-disordered youth. Waters and colleagues (2008) found no change in attentional bias among youth, even those considered to be treatment responders, as evidenced by reduction in anxiety symptoms and failure to meet criteria for principal anxiety disorder posttreatment. Although it is possible that youth may respond differently to CBT than adults, it may also be that attentional biases toward threat were maintained by underlying residual symptomatology for the youth in this study. Legerstee and colleagues (2009) found that presence of an attention bias prior to treatment was predictive of treatment response following a course of CBT for anxiety. A follow-up study indicated that youth who previously evidenced an attention away from threat pretreatment had no such bias at posttreatment (Legerstee et al., 2010). Given that attentional control is proposed to be the mechanism behind attentional avoidance of threat, these results suggest that CBT treatment may improve attentional control for youth with low self-regulatory capacities prior to treatment. Similar reductions in attentional bias were found for adolescents with panic disorder following an intensive, eight-day CBT program (Wiener, Perloe, Whitton, & Pincus, 2012). Replicating recent findings from the adult literature (Price et al., 2011), Waters and colleagues (2012) found that anxiety-disordered youth with a pretreatment attentional bias toward threat evidenced greater reductions in anxiety symptomatology and presence of anxiety diagnosis posttreatment. However, youth with a pretreatment bias away from threat evidenced less reduction in symptoms and rate of diagnosis. Interestingly, youth with a bias away from threat at pretreatment increased their attentional bias *toward* threat at posttreatment, along with a significant reduction in anxiety symptomatology (Waters et al., 2010). No difference between bias-direction group was detected posttreatment, indicating that youth with initial biases away from threat may be working to mitigate overt attentional avoidance patterns, increase awareness of the context of threat, and experience reduction in anxiety. Changes in attentional bias toward threat for youth is supported by imaging data that indicate posttreatment changes in requisite neural threat orientation systems. Specifically, greater recruitment of the ventro-lateral PFC and its connection to the amygdala was associated with greater treatment response, even when differences in reactive attentional biases were not evident (Maslowsky, Mogg, & Bradley, 2010). Future work is needed in this area to assess likely moderating variables (i.e., attentional control) and compare other explanatory constructs to appropriately assess attentional change posttreatment for anxiety-disordered youth.

Attention Bias Modification Treatment Studies (ABMT)

As information processing biases have been identified as important risk factors in the development of anxiety, researchers and clinicians have considered treatment modifications and designs to address these differences. Attention bias modification treatments (ABMT) allow us to examine the malleability of attentional processes among individuals diagnosed with anxiety disorders. These bias modification paradigms are proposed to target bottom-up, involuntary trajectories of attention that contribute to the development and maintenance of anxiety (Bar-Haim, 2010; Eldar & Bar-Haim, 2010). These interventions aim to loosen the initial "sticky" attention bias toward threat by training individuals to look away from threat when it appears; in these procedures, targets are paired more frequently with neutral or happy stimuli to allow more complete environmental processing (Bar-Haim, 2010). Although such paradigms are relatively new, a number of studies have lauded the success of attention retraining in reducing anxiety symptoms among high worriers without anxiety diagnoses (scores > 60 on the Penn State Worry Questionnaire; Hazen, Vasey, & Schmidt, 2009) and adults diagnosed with anxiety disorders (Amir et al., 2009; Schmidt, Richey, Buckner, & Timpano, 2009). Reductions in presence of diagnosis and severity of symptomatology were assessed to be similar to CBT treatment outcome studies. A recent meta-analysis of adult modification studies showed a moderate effect of attention retraining ($d = .61$; Hakamata, Lissek, Bar-Haim et al., 2010).

A few studies have examined the effects of attention bias modification on anxiety among youth. Similar to the adult literature, use of an attention training dot-probe task, with stimulus presentation of 500ms, indicated decreased response to a puzzle stress-induction task and increased ability to disengage from threat cues among their sample of youth self-reporting high levels of anxiety (i.e., Screen for Child Anxiety Related Emotional Disorders [SCARED] anxiety scores within top 50% of sample; Bar-Haim, Morag, & Glickman, 2011). Again, the increased ability to shift attention away from threat indicates improvement of attentional control using this procedure. The authors also reported that anxiety decreased for both the attention training group and dot probe control group (Bar-Haim, Morag, & Glickman, 2011). These results may indicate that some improvement in attentional control occur with task practice, indicating habituation, rather than overt pairing of targets with neutral stimuli. These results align with findings from the adult literature, wherein individuals with OCD evidenced attenuation of the degree of attentional bias over the course of a dot-probe task (Amir, Najmi, & Morrison, 2009). Rozenman and colleagues (2011) found similar decrease in anxiety symptoms and presence of disorder using a dot-probe attention modification training program with a sample of anxiety-disordered adolescents (*M* = 14). Reduction in attention bias did not reach statistical significance in this evaluation, although change in bias was in the expected direction (Rozenman, Weersing, & Amir, 2011). Results of these few attention modification studies with youth are consistent with the adult literature in implicating the amenable role of attention in the improvement of anxiety symptoms across developmental stages (Diamond, Barnett, Thomas, & Munro, 2007). Although the results of these studies are limited by small sample sizes (e.g., Bar-Haim, Morag, & Glickman, 2011), results support the clinical importance of considering attention in the treatment of anxious youth. Even young children can learn not to prioritize attention toward environmental threat, and rather weight the presence of safety cues and contextual information regarding potential threats (Eldar, Ricon, Bar-Haim, 2008; Mathews & MacLeod, 2002; White et al., 2009).

Although retraining of bottom-up, reactive attention to threat is proposed to be the targeted mechanism among such studies, it may be that attention modification paradigms more accurately target and strengthen voluntary attentional control capacities. Bar-Haim (2010) argues for the importance of discriminating between top-down retraining, evident in more explicit strategies like CBT for anxiety, and retraining of initial, reactive bottom-up attentional biases. However, the stimulus presentation times for successful retraining studies consistently falls between 500 and 1500ms (Amir et al., 2009; Bar-Haim, Morag, & Glickman, 2011; Dandeneau & Baldwin 2004; Schmidt, Richey, Buckner, & Timpano, 2009). Research from the interplay between attentional biases and higher-order attentional control capacities indicates the involvement of more voluntary, controlled attention at these presentation intervals (e.g., Gamble & Rapee, 2009). It stands to reason, then, that attention bias paradigms are likely providing training opportunities for attentional *control*, rather than the lower-order attentional biases. Support for this view finds that attention biases are less modifiable at subliminal presentation times (MacLeod, et al., 2002), which reflect "encapsulated," reactive biases toward threat (Ohman & Mineka, 2001), that remain outside of the influence of higher-order processes or overt intervention (Stolz, 1996). Koster and colleagues (2010) found that bias induction among a community adult sample resulted in changes in threat processing at later stages of information processing, rather than the early stage of attentional bias. Evidence from an event-related potential study (ERP; Eldar & Bar-Haim; 2010) indicated that attention bias training modulated attentional control, as evidenced by later ERP component changes rather than initial attentional orientation to threat, supporting the role of attentional control as the mechanism of change at work for modification paradigms. Klumpp and Amir (2010) also found support for the attentional control theory, in that individuals who completed training paradigms evidenced decreased anxiety during a subsequent speech task, regardless of whether they were trained towards or away from threat; exercising attentional control via modification programs encourages greater consideration of environmental context and mitigation of negative affect. The attentional control theory was also validated with samples of anxiety-disordered youth (Bar-Haim, Morag, Glickman, 2011). However, current empirical evidence provides only indirect support for the malleability of attentional control, opposed to early attentional biases, in the mechanism of anxiety change post intervention. As such, future research is needed to elucidate the relative influence of these systems.

Empirical evidence from trials utilizing ABMTs highlights the importance of attentional control as a malleable emotion regulation resource. The success of attention modification studies is similar to the positive effects of working-memory training programs for attention-deficit/hyperactivity disorder (ADHD; Kerns, Esso, & Thompson, 1999; Klingberg et al., 2005). This is particularly true given the link between attentional control and working memory (Barrett, Tugade, & Engle, 2004); studies have shown that engaging working memory capacity significantly interferes with attentional control capacity (Chen & Chan, 2007; De Fockert, Rees, Frith, & Lavie, 2001; Kim, Kim, & Chun, 2005), particularly given that these cognitive systems share same neurological circuitry within the DLPFC (Cohen et al., 1997; D'Esposito et al., 1995). As such, attention modification paradigms appear to engage and strengthen attentional control. Such a conclusion has important implications for the treatment of clinically impairing anxiety. Although attention modification studies have been criticized for facilitating avoidance, which is thought to interfere with extinction learning (Hudson & Rapee, 2004; Rapee, 2001), the active mechanism in attention modification paradigms may not be far from that of cognitive behavioral therapy for anxiety. One could argue that a goal of cognitive-behavioral approaches to the treatment of anxiety is to strengthen the higher-order self-regulation systems that encourage approach behavior and consideration of long-term goals in the face of immediate threat (Bar-Haim, 2010; Beck & Clark, 1997). Techniques for achieving this include, among others, cognitive reappraisal that alters the processing of threat and strengthens willful direction of attention toward threat through exposure tasks (Delgado, Nearing, LeDoux, & Phelps, 2008; Schaefer et al., 2002). Neurological imaging evidence shows that the redirection of attention serves to down-regulate the amygdala and allow for executive processes, such as effortful/attentional control, to manage attention and subsequent emotional responses (Delgado et al., 2008). For example, in CBT treatment, a socially anxious youth would be coached to approach social situations (e.g., conversation initiation) despite environmental threat (potential perceived social rejection) in order to attain the long-term goal of inception and maintenance of friendship. Similarly, attention modification paradigms, argued here to operate by similar higher-order attentional control mechanisms, encourages the use of self-regulatory mechanism by strengthening one's ability to shift attention away from immediate threat toward additional contextual information. However, the role of attentional control has not been systematically studied within attentional modification studies, remaining an important aim for future research.

Integrative Model of Attention and Future Directions

The preceding review provides evidence of the role of initial reactive and later self-regulatory processes in the early information processing biases that confer significant risk for anxiety disorders among youth. Lines of research from the psychopathology and temperamental literature bases tend to be examined separately (Lonigan et al., 2004). Increased integration of these theories over recent years illustrates important overlap of models that propose both inflexible reactive patterns and malleable self-regulation capacities. Overall, evidence from the extant literature presents an integrated, hierarchical system model of attention at play in the development and maintenance of anxiety (Posner & Petersen, 1990; Posner & Raichle, 1994; Posner & Rothbart, 1998). Here, initial anxiety increases a bottom-up, stimulus-driven automatic reaction to environmental threat, in the form of facilitated detection to threat. This system, based in increased amygdalar reactions, develops early in life, occurs temporally sooner than other cognitive processes, and is relatively inflexible or “encapsulated” (Ohman & Mineka, 2001; Stolz, 1996). This initial reactive system is then coupled with a top-down, effortful regulation of cognitive and emotional resources in the form of attentional control (Derryberry & Reed, 1998; 2002). The roles of these opposing systems shape the success of coping mechanisms (Derryberry, Reed, & Pilkenton-Taylor, 2003). Difficulty controlling attention is seen behaviorally as difficulty disengaging from threat as well as attentional avoidance of threat stimuli. This system is based in increased PFC activity, develops gradually over the first few years of life, occurs at subsequent stages of information processing, and is open to the influence of intervention. For youth with elevated symptoms of anxiety, evidence points to the relative dysfunction in these two systems, including an overactive attentional bias toward threat with deficits in attentional control capacities as an important mechanism that serves to maintain and amplify anxiety to pathological levels. However, the integration of these systems has yet to be examined within samples of anxiety-disordered youth. Furthermore, early attention is tied to later stages of information processing such that dysfunction in attention control may lead to increased anxious cognition (e.g., worry, problem-solving; Compas & Boyer, 2001) and decreased self-efficacy (Bandura, 1997; Gonzales, Tein, Sandler, & Friedman, 2001) in the face of threat (Shechner et al., 2012). Examination of a dual system of dysregulated attention for anxiety disorders appears to be supported by the empirical evidence reviewed above. However, inconsistent results regarding the exact chronometry of these early attentional processes remain.

These systems are further impacted by temperament, environment, and typical development. From a developmental psychopathology perspective (Cicchetti, 1984), it is important to consider how the interaction of these multiple factors inform trajectories of anxiety, including potential reciprocal relationships that impact one another over time (Hinde, 1992), rather than the individual impact of each factor. The specific *interaction* of reactive and self-regulatory systems proposed here is a critical component for anxiety disorders, given that reactive different reactive self-regulatory patterns confer risk for different forms of psychopathology. For example, low levels of attentional control coupled with high levels of positive affectivity, rather than the negative affectivity seen with anxiety, confers risk for ADHD (Rothbart & Posner, 2006). For anxiety, temperamental traits predispose one toward anxiety and interact with heightened amygdalar response to threat, such that fear-based reactions to the environment are amplified for temperamentally anxious or inhibited children (Kagan, 2001). Here, dysregulation in attention systems serve as one method by which temperamental differences lead to difficulties with anxiety.

In summary, anxiety is a complex and multifaceted construct, which is exemplified when considering it from a developmental perspective among a still-developing demographic. Empirical examination of the presented model of early cognitive biases allows us to consider individual differences in attention and self-regulation dimensionally with respect the relative risk for anxious psychopathology. Although much research indicates anxiety-related dysfunction in multiple attentional systems that are impacted by temperamental traits and environmental interactions, few studies have examined both early bottom-up and top-down regulatory attention processes simultaneously and in conjunction with potential moderators (e.g., parental influence). Future research should examine the complex interplay of these systems longitudinally within a developmental framework for youth. Furthermore, the interactions of these dynamic systems have yet to be assessed within samples of youth that meet criteria for anxiety disorders. Future research should focus on evaluating points of influence within these systems that may indicate potential targets of early detection and intervention, especially during developmentally critical periods. Attention appears to gate learning (Shechner et al., 2012), implicating use and intervention of attentional systems in therapeutic extinction, as individuals learn new associations and inhibit pathological responses to the environment (Bardeen & Orcutt, 2011; Bouton, 2002; McNally, 2007; Myers & Davis, 2002). It is clear that attentional processes, particularly attentional control, are engaged in successful mitigation of anxiety (Degnan & Fox, 2007); as such, examination of attentional processes may be helpful in identifying markers for poor treatment response or noncompliance in the treatment of anxiety-disordered youth.

CHAPTER 3

RESULTS

Preliminary Analyses

In line with previous research (Bar-Haim et al., 2010; Bardeen & Orcutt, 2011), data trials from the dot probe task were excluded if participant response was less than 200ms or greater than two standard deviations above their personal mean response rate ($M_{dptrialsexcluded}$ = 11.04%). Additionally, two participants' dot probe data were excluded as extreme outliers (e.g., more than 2 standard deviations from the overall mean). Per the design of the ANT task, trials were excluded if response time was greater than three standard deviations above the median response time (Reinholdt-Dunne et al., 2009; $M_{anttrialexcluded}$ = 5.42%). Additionally, youths' performance on both computer measures was excluded if more than 75% of their responses were incorrect (2 dot probe cases, 0 ANT cases), indicating potential difficulty understanding task rules. None of the demographic factors or child characteristics examined were significantly associated with overall parental accommodation (Table 1); thus, none of these variables was included as covariates.

Table 1

Descriptive Information for Study Participants (N = 107)

Variable	*n*	(%)
Youth age in years	*M* = 11.17	
Gender		
Males	44	41.1
Race		
Caucasian	83	77.57
African-American	8	7.47

Table 1, continued

Asian-American	4	3.74
Hispanic	3	2.80
Other	7	6.54
Not reported	2	1.87
Principal Anxiety Diagnosis		
GAD	35	32.71
SoP	20	18.70
SAD	8	7.47
SP	15	14.02
OCD	4	3.74
AD-NOS	3	2.80
Co-Principal Anxiety	22	20.56
Total Household Income		
$0-19,999	3	2.80
$20,000-39,999	8	7.48
$40,000-59,999	17	10.00
$60,000-79,999	10	5.88
Over $80,000	58	54.21
Not reported	11	10.28

Note. GAD = Generalized Anxiety Disorder, SAD = Separation Anxiety Disorder, OCD = Obsessive Compulsive Disorder, AD-NOS = Anxiety Disorder, Not Otherwise Specified .

Study variables were examined for skewness and kurtosis; these analyses indicated that variables were approximately normally distributed. Means and standard deviations of study variables are presented in Table 2. Bivariate correlations between study variables is presented in Table 3.

Table 2

Descriptive Information for Study Variables

Measures	*M*	*SD*	*Missing n (%)*
Youth Anxiety Variables			
Max CSR	5.69	.79	0 (0.00)
MASC-C	49.50	19.04	1 (0.9)
MASC-P	59.30	18.15	0 (0.00)
PANAS-C Pre	1.90	2.56	1 (0.9)
Attention Variables			
Threat Bias	5.57	32.26	8 (7.5)
ANT	80.68	49.49	14 (13.1)
ACS-C	48.06	8.68	1 (0.9)
ACS-C-P	49.51	9.76	15 (14.0)
Other Youth Variables			
CBCL-ADHD	4.65	3.46	28 (26.2)
CBCL-Depression	5.40	4.20	28 (26.2)
Parent Variables			
STAI-A	11.87	3.90	2 (1.9)
BDI	6.23	5.82	1 (0.9)
ACS-A	40.98	9.14	3 (2.8)
PSI-Autonomy	25.39	3.86	1 (0.9)
PSI- Involvement	29.52	4.25	1 (0.9)

Note: Max CSR = maximum clinician severity rating of composite diagnoses, MASC-C = Multidimensional Anxiety Scale for Children, child report, MASC-P = Multidimensional Anxiety Scale for Children, parent report, PANAS Anxiety Pre = Positive and Negative Affectivity Scale for Children anxiety rating pre computer tasks, Threat Bias = Dot-probe threat-related attention bias scores, ANT = Attention Network Task Conflict Scores, ACS-C = Attention Control Scale- child report total scores, ACS-C-P = Attention Control Scale- parent report of child total scores, CBCL-ADHD = CBCL DSM-Oriented ADHD scale raw score, CBCL-Depression = CBCL DSM-Oreinted Affective Problems scale raw score, STAI-A = State/Trait Anxiety Index- Anxiety scale, BDI = Beck Depression Inventory, ACS-A = Attention Control Scale- adult report, PSI-Autonomy = Parenting Styles Inventory, autonomy granting subscale, PSI Involvement = Parenting Styles, involvement subscale.

Table 3

Bivariate Correlations for Study Variables

Measures	Max CSR	MASC -C	MASC -P	PANA S-Pre	Threat Bias	ANT Conflict	ASC- C	ACS- C-P
Max CSR	-							
MASC-C	.24*	-						
MASC-P	.26**	0.25**	-					
PANAS-C Pre	0.14	0.23*	0.03	-				
Threat Bias	-0.01	-0.10	0.09	0.06	-			
ANT	0.05	0.27**	0.18	-0.04	0.07	-		
ACS-C	0.21*	0.13	0.16	0.08	-0.04	0.05	-	
ACS-C-P	-0.02	-0.07	0.03	-0.04	0.06	-0.03	-0.05	-

Note: All variables represent Pearson's *r* bivariate correlations. Max CSR = maximum clinician severity rating of composite diagnoses, MASC-C = Multidimensional Anxiety Scale for Children, child report, MASC-P = Multidimensional Anxiety Scale for Children, parent report, PANAS Anxiety Pre = Positive and Negative Affectivity Scale for Children anxiety rating pre computer tasks, Threat Bias = Dot-probe threat-related attention bias scores, ANT = Attention Network Task Conflict Scores, ACS-C = Attention Control Scale- child report total scores, ACS-C-P = Attention Control Scale- parent report of child total scores. * p <.05; ** p < .01.

A Missing Value Analysis examined the pattern of missing data and determine if data were missing in a random or a non-random fashion. Most variables were missing less than 5% of cases, with the exception of scores for the dot-probe task, ANT task, the ACS-C-P scale, and CBCL variables (Table 2). Missing data resulted from participant and technological error. Little's MCAR Chi-Square statistic was found to be non-significant ($\chi2$ (27)= 28.74, p= .37), indicating that there were no significant differences on study variables for participants who were missing data versus those that were not. As such, we proceeded under the assumption that data were missing at random (MAR), which does not assume listwise deletion for SEM-based calculations in Mplus. Given the presence of missing data greater than 5% for some variables, full information maximum likelihood (FIML) estimation was used in this study to analyze the full and incomplete data set. This method does not impute any data, but rather utilizes all data present in the sample to estimate parameter values; thus, the FIML estimate of a parameter is the value of the parameter that is most likely to have resulted in the observed data. This method provides unbiased parameter estimates and standard errors (Allison, 2000), whereas listwise deletion, mean imputation, and other strategies potentially bias analyses (e.g., Bodner, 2008; Little & Rubin, 2002).

Aim 1: The Moderating Role of Attentional Control on the Relationship Between Attention Bias to Threat and Anxiety Severity.

The ability of attention variables to predict anxiety severity individually was examined. ANT conflict scores ($\beta_{ANT} = 0.35$, $t = 2.63$, $p = 0.01$) significantly predicted anxiety severity, such that greater attentional conflict was associated with increased youth anxiety severity. Attention bias scores ($\beta_{BIAS} = -0.001$, $t = -0.01$, $p = 0.99$), ACS-C total scores ($\beta_{ACSC} = 0.38$, $t = 1.94$, $p = 0.053$), and ACS-C-P total scores ($\beta_{ACSCP} = 0.05$, $t = 0.35$, $p = 0.73$) did not significantly predict anxiety severity.

ANT Task: ANT conflict scores did not moderate the relationship between attention bias and anxiety severity ($\beta_{ANTXBIAS} = -0.17$, $t = -1.26$, $p = 0.21$). The conditional effect of ANT score was significant ($\beta_{ANT} = 0.34$, $t = 2.65$, $p = 0.008$), such that, when youth displayed an average attention bias, increased attention conflict was associated with increased anxiety severity (see Table 3). When controlling for state anxiety (PANAS anxiety rating), the relationships between attention variables did not change; the conditional effect of ANT scores ($\beta_{ANT} = 0.35$, $t = 2.93$, $p = 0.003$) remained a significant predictor. State anxiety did significantly predict anxiety severity ($\beta_{PANAS} =$

0.31, $t = 2.67$, $p = 0.008$), such that higher state anxiety immediately prior to computer task administration was associated with increased anxiety severity overall (see Table 4).

ACS-C: ACS-C total scores did not moderate the relationship between threat-related bias and anxiety severity ($\beta_{ACSCXBIAS} = -0.04$, $t = -0.43$, $p = 0.66$). The conditional effect of ACS-C scores did predict anxiety severity ($\beta_{ACSC} = 0.41$, $t = 2.43$, $p = 0.015$), such that increased youth-reported attention control was associated with increased anxiety severity when an average threat-related attention bias was displayed. When analyses controlled for state anxiety (PANAS state anxiety $\beta_{PANAS} = 0.15$, $t = 1.62$, $p = 0.11$), no change in the moderation relationship was found ($\beta_{ACSCXBIAS} = -0.03$, $t = -0.33$, $p = 0.74$) and the conditional effect of ACS-C ($\beta_{ACSC} = 0.42$, $t = 2.98$, $p = 0.003$) remained a significant predictor.

ACS-C-P: ACS-C-P scores were found to moderate the relationship between attention bias and anxiety severity ($\beta_{ACSCPXBIAS} = -0.31$, $t = -1.96$, $p = 0.05$). This moderation effect was probed using recommendations described by Aiken and West (1991) and Holmbeck (2002), such that the relationship between attention bias and anxiety severity was examined at both high (+1 SD from mean) and low (-1 SD from mean) levels of attention control by the ACS-C-P. Results of this analyses indicated that both the slopes for high ACS-C-P scores ($\beta_{HIACSCPXBIAS} = -0.65$, $t = -2.43$, $p = 0.02$) and low ACS-C-P scores ($\beta_{LOACSCPXBIAS} = -0.45$, $t = -2.43$, $p = 0.02$; see Figure 1) were significant. These results suggest that high threat-related attention bias with low parent-reported attention control and low threat-related attention bias with high parent-reported attention control are associated with greater anxiety severity.

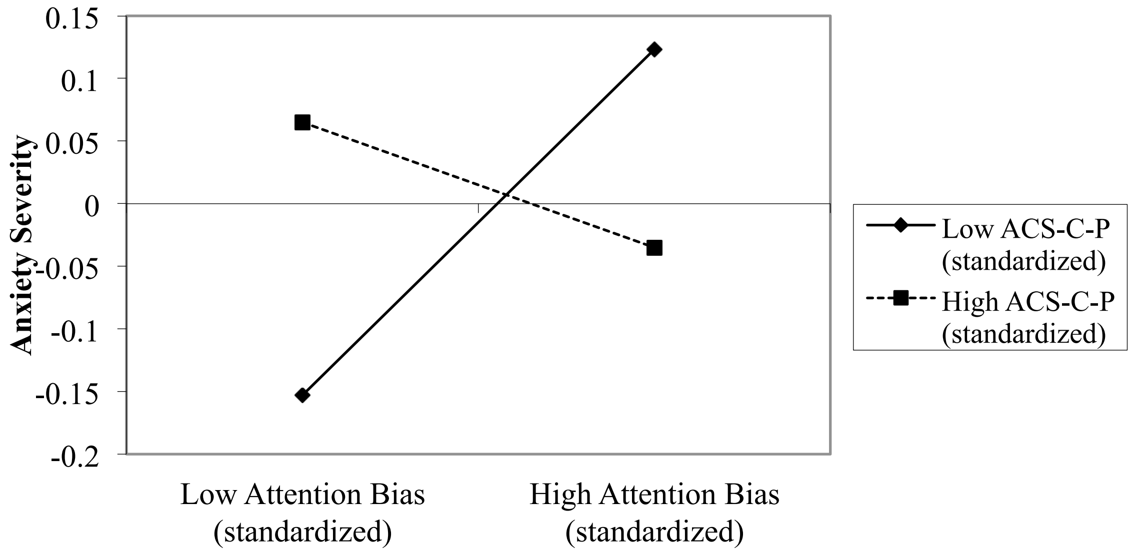

Figure 1. Moderation effect of ACS-C-P scores on the relationship between threat-related attention bias and anxiety severity. Attention bias and control scores z-standardized. Anxiety severity latent variable includes CSR for principal composite anxiety disorder and MASC Total scores by parent and child report. Intercept for latent dependent variable set at 0, per recommendation by Muthen (2012).

When analyses controlled for state anxiety (βPANAS = 0.25, t = 1.80, p = 0.07), ACS-C-P total scores no longer moderated the relationship between attention bias and anxiety severity (βACSCPXBIAS = -0.22, t = -1.35, p = 0.18; see Table 4).

Table 4

Multiple Regression Examining Moderation of Attention Control Measures in the Relationship between Threat-Related Attention Bias and Anxiety Severity

Model	Variable	B	SE B	β	R^2	f^2
ANT					0.15	0.18
	Threat Bias	0.01	0.04	0.02		
	ANT	0.10	0.05	0.34**		
	Bias * ANT	-0.06	0.05	-0.17		
	--				0.25*	0.33
	Threat Bias	0.01	0.03	0.03		
	ANT	0.09	0.05	0.35**		
	PANAS pre	0.03	0.02	0.31**		
	Bias *ANT	-0.05	0.04	-0.17		

Table 4, continued

					0.17	0.21
ACS-C						
	Threat Bias	0.01	0.02	0.07		
	ACS-C	0.06	0.07	0.41*		
	Bias * ACS-C	-0.01	0.01	-0.04		
	--				0.22	0.28
	Threat Bias	0.01	0.02	0.07		
	ACS-C	0.06	0.07	0.42**		
	PANAS pre	0.01	0.01	0.15		
	Bias * ACS-C	-0.01	0.02	-0.03		
					0.08	0.09
ACS-C-P	Threat Bias	0.04	0.06	0.11		
	ACS-C-P	0.02	0.06	0.04		
	Bias * ACS-C-P	-0.09	0.06	-0.31*		
	--				0.13	0.15
	Threat Bias	0.03	0.06	0.08		
	ACS-C-P	0.01	0.06	0.03		
	PANAS pre	0.04	0.02	0.25		
	Bias * ACS-C-P	-0.06	0.05	-0.22		

Note: All analyses predicting youth anxiety severity latent variable, which includes maximum clinician severity rating for principal anxiety disorder (Max CSR), Multidimensional Anxiety Scale for Children, child (MASC-C) and parent (MASC-P) total scores; attention variables all z-standardized; ANT = Attention Network Task Conflict Scores, Threat Bias = Dot-probe threat-related attention bias scores, ACS-C = Attention Control Scale- child report total scores, ACS-C-P = Attention Control Scale- parent report of child total scores. f^2 = Cohen's f^2 effect size for multiple regression. * p <.05; ** p < .01.

Aim 2: Comorbid Symptoms and Measures of Attention

ADHD. The relationship between attention variables and parent-reported symptoms of ADHD in the prediction of anxiety severity was examined (all variables standardized for moderation analyses). Examined individually, ADHD symptoms did not significantly predict anxiety severity (β_{ADHD} = 0.21, t = 1.14, p = 0.25). Parent-reported ADHD symptoms did not moderate the relationship between anxiety severity and attention bias ($\beta_{ADHDXBIAS}$ = -0.05, t = -0.31, p = 0.76); ANT conflict scores ($\beta_{ADHDXANT}$ =

0.26, $t = 1.61$, $p = 0.11$); ACS-C total scores ($\beta_{ADHDXACSC} = -0.12$, $t = -1.05$, $p = 0.29$); or ACS-C-P total scores ($\beta_{ADHDXACSCP} = -0.01$, $t = -0.05$, $p = 0.96$). See Table 5.

Table 5

Multiple Regression Examining Moderation of Symptoms of ADHD in the Relationship between Threat Bias or Attention Control and Anxiety Severity

Model	**Variable**	**B**	**SE B**	**β**	R^2	f^2
Threat Bias					0.07	0.08
	Threat Bias	0.004	0.02	0.02		
	ADHD	0.05	0.08	0.28		
	ADHD * Bias	-0.01	0.03	-0.05		
ANT					0.20	0.25
	ANT	0.09	0.06	0.27		
	ADHD	0.07	0.06	0.23		
	ADHD * ANT	0.08	0.06	0.26		
ACS-C					0.16	0.19
	ACS-C	0.04	0.08	0.39		
	ADHD	-0.01	0.01	-0.05		
	ADHD * ACS-C	-0.01	0.03	-0.12		
ACS-C-P					0.02	0.02
	ACS-C-P	0.02	0.07	0.06		
	ADHD	0.03	0.09	0.08		
	ADHD * ACS-C-P	-0.01	0.09	-0.01		

Note: All analyses predicting youth anxiety severity latent variable, which includes maximum clinician severity rating for principal anxiety disorder (Max CSR), Multidimensional Anxiety Scale for Children, child (MASC-C) and parent (MASC-P) total scores; attention variables and ADHD symptoms variable all z-standardized; ANT = Attention Network Task Conflict Scores, Bias = Dot-probe threat-related attention bias scores, ACS-C = Attention Control Scale- child report total scores, ACS-C-P = Attention Control Scale- parent report of child total scores, ADHD = CBCL DSM-Oriented ADHD scale raw score. f^2 = Cohen's f^2 effect size for multiple regression.

Depression. The relationship between attention variables and parent-reported symptoms of youth depression in the prediction of anxiety severity was examined. Examined individually, depression symptoms significantly predicted anxiety severity ($\beta_{DEP} = 0.46$, $t = 4.00$, $p < 0.001$). Parent-reported symptoms of youth depression did not moderate the relationship between anxiety severity and attention bias ($\beta_{DEPXBIAS} = 0.29$, $t = 1.93$, $p = 0.053$); ANT scores ($\beta_{DEPXANT} = 0.19$, $t = 1.17$, $p = 0.24$); ACS-C total scores

($\beta_{DEPXACSC}$ = -0.18, t = -1.58, p = 0.12); and ACS-C-P total scores ($\beta_{DEPXACSCP}$ = 0.24, t = 1.34, p = 0.18). The conditional effects of ANT conflict scores (β_{ANT}= 0.37, t = 2.81, p = 0.005) and depression (β_{DEP} = 0.41, t = 2.80, p = 0.005) were significant in this interaction, such that when youth displayed average attentional conflict, increased depression was associated with increased anxiety severity. Similarly with average parent-reported depression, increases in youth attention conflict were associated with increases in youth anxiety severity. The conditional effect of ACS-C was significant (β_{ACSC} = 0.45, t = 2.51, p = 0.012). Additionally, when included in the model with ACS-C-P total scores, the conditional effect of depression was significant (β_{DEP} = 0.42, t = 2.54, p = 0.011), such that increases in depression were associated with increased anxiety severity when parents reported an average level of attention control abilities for youth. See Table 6.

Table 6

Multiple Regression Examining Moderation of Symptoms of Depression in the Relationship between Threat Bias or Attention Control and Anxiety Severity

Model	**Variable**	**B**	**SE B**	**β**	***R^2***	***f^2***
Threat Bias					0.21	0.27
	Threat Bias	-0.04	0.04	-0.14		
	DEP	0.11	0.07	0.36*		
	DEP * Bias	0.07	0.05	0.29		
ANT					0.29*	0.41
	ANT	0.13	0.06	0.37**		
	DEP	0.14	0.07	0.41**		
	DEP * ANT	0.07	0.07	0.19		
ACS-C					0.20	0.25
	ACS-C	0.06	0.07	0.45*		
	DEP	-0.003	0.01	-0.20		
	DEP * ACS-C	-0.03	0.03	-0.18		
ACS-C-P					0.19	0.23
	ACS-C-P	-0.04	0.07	-0.10		
	DEP	0.16	0.08	0.42*		
	DEP * ACS-C-P	0.000	0.000	0.24		

Table 6, continued
Note: All analyses predicting youth anxiety severity latent variable, which includes maximum clinician severity rating for principal anxiety disorder (Max CSR), Multidimensional Anxiety Scale for Children, child (MASC-C) and parent (MASC-P) total scores; attention variables and depression symptoms variable all z-standardized; ANT = Attention Network Task Conflict Scores, Bias = Dot-probe threat-related attention bias scores, ACS-C = Attention Control Scale- child report total scores, ACS-C-P = Attention Control Scale- parent report of child total scores, DEP = CBCL DSM-Oriented Affective Disorders scale raw score. f^2 = Cohen's f^2 effect size for multiple regression. * p <.05; ** p < .01.

Aim 3: Parental Factors

Parental Behaviors. Parental autonomy granting did not significantly predict youth anxiety severity (β_{AUT} = -0.01, t = -0.05, p = 0.96); attention bias (β_{AUT} = -0.07, t = -0.66, p = 0.51); ANT scores (β_{AUT} = -0.16, t = -1.56, p = 0.12); ACS-C total scores (β_{AUT} = 0.03, t = 0.31, p = 0.75); or ACS-C-P total scores (β_{AUT} = -0.07, t = -0.58, p = 0.56). Parental involvement did not significantly predict youth anxiety severity (β_{INV} = -0.02, t = -0.13, p = 0.90), attention bias (β_{INV} = -0.01, t = -0.13, p = 0.89), ANT scores (β_{INV} = -0.11, t = -1.03, p = 0.30), ACS-C total scores (β_{INV} = 0.11, t = 1.09, p = 0.28), or ACS-C-P total scores (β_{INV} = -0.11, t = -1.04, p = 0.30). See Table 7.

Parental Psychological Factors. Parent attention control did not significantly predict youth anxiety severity (β_{ATTN} = 0.19, t = 1.38, p = 0.17); attention bias (β_{ATTN} = 0.16, t = 1.60, p = 0.11); ANT scores (β_{ATTN} = 0.15, t = 1.47, p = 0.14); ACS-C total scores (β_{ATTN} = 0.13, t = 1.28, p = 0.20); or ACS-C-P total scores (β_{ATTN} = 0.18, t = 1.82, p = 0.07).

Parental anxiety did not significantly predict youth anxiety severity (β_{ANX} = -0.08, t = -0.54, p = 0.59); threat-related attention bias (β_{ANX} = 0.17, t = 1.65, p = 0.10); ANT conflict scores (β_{ANX} = -0.06, t = -0.61, p = 0.54); or ACS-C total scores (β_{ANX} = 0.17, t =

1.77, $p = 0.08$). Parental anxiety did significantly predict ACS-C-P total scores ($\beta_{ANX} = 0.24$, $t = 2.35$, $p = 0.02$), such that increases in parental anxiety were associated with increased parent-reported youth attention control.

Parental depression significantly predicted youth anxiety severity ($\beta_{DEP} = 0.29$, $t = 2.41$, $p = 0.016$), such that higher parental depression was associated with greater youth anxiety severity. Parental depression also significantly predicted ACS-C-P total scores ($\beta_{DEP} = 0.22$, $t = 2.32$, $p = 0.02$), such that higher levels of parental depression were associated with increased parent-reported attention control for youth. Parental depression did not predict attention bias ($\beta_{DEP} = 0.02$, $t = 0.20$, $p = 0.84$); ANT conflict scores ($\beta_{DEP} = 0.19$, $t = 1.87$, $p = 0.06$); or ACS-C total scores ($\beta_{DEP} = 0.11$, $t = 1.76$, $p = 0.28$). All results are presented in Table 7.

Table 7

Multiple Regression Examining Relationship between Youth Variables and Parental Behaviors and Psychological Variables

Model	**Variable**	**B**	**SE B**	**β**	***R*²**	***f*²**
PSI-Autonomy	Anxiety Severity	-0.07	1.57	-0.01	0.000	<0.001
	Threat Bias	-0.01	0.01	-0.07	0.004	0.004
	ANT	-0.01	0.01	-0.16	0.03	0.03
	ACS-C	0.01	0.04	0.03	0.001	0.001
	ACS-P	-0.03	0.04	-0.07	0.004	0.004
PSI-Involvement	Anxiety Severity	-0.22	1.69	-0.02	0.000	<0.001
	Threat Bias	-0.002	0.01	-0.01	0.000	<0.001
	ANT	-0.01	0.01	-0.11	0.01	0.01
	ACS-C	0.05	0.05	0.11	0.01	0.01
	ACS-P	-0.05	0.05	-0.11	0.01	0.01
ACS-A	Anxiety Severity	4.46	3.50	0.19	0.04	0.04
	Threat Bias	0.05	0.03	0.16	0.03	0.03
	ANT	0.03	0.02	0.15	0.02	0.02
	ACS-C	0.14	0.11	0.13	0.02	0.02
	ACS-P	0.17	0.10	0.18	0.03	0.03
STAI-A	Anxiety Severity	-0.82	1.54	-0.08	0.01	0.01
	Threat Bias	0.02	0.01	0.17	0.03	0.03
	ANT	-0.01	0.01	-0.06	0.004	0.004
	ACS-C	0.08	0.05	0.17	0.03	0.03

Table 7, continued

	ACS-P	0.10	0.04	0.24*	0.06	0.06
BDI	Anxiety Severity	6.28	4.49	0.29*	0.08	0.09
	Threat Bias	0.004	0.02	0.02	0.000	<0.001
	ANT	0.02	0.12	0.19	0.04	0.04
	ACS-C	0.07	0.07	0.11	0.01	0.01
	ACS-P	0.13	0.06	0.22*	0.05	0.05

Note: All analyses run as separate models. Anxiety Severity = latent variable including maximum clinician severity rating for principal anxiety disorder (Max CSR), Multidimensional Anxiety Scale for Children, child (MASC-C) and parent (MASC-P) total scores, ANT = Attention Network Task Conflict Scores, Threat Bias = Dot-probe threat-related attention bias scores, ACS-C = Attention Control Scale- child report total scores, ACS-C-P = Attention Control Scale- parent report of child total scores, PSI-Autonomy = Parenting Styles Inventory, autonomy granting subscale, PSI-Involvement = Parenting Styles Inventory- Involvement subsale, ACS-A = Attention Control Scale, adult report, STAI-A = State/Trait Anxiety Index- Anxiety scale, BDI = Beck Depression Inventory. f^2 = Cohen's f^2 effect size for multiple regression. * $p < .05$.

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