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# Predicting Anxiety Using Measures of Negative Interpretation Bias in Clinically Anxious Youth: A Pilot Study

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UNIVERSITY OF MIAMI

PREDICTING ANXIETY USING MEASURES OF NEGATIVE INTERPRETATION  
BIAS IN CLINICALLY ANXIOUS YOUTH: A PILOT STUDY

By

Jamie Alexa Mash

A THESIS

Submitted to the Faculty  
of the University of Miami  
in partial fulfillment of the requirements for  
the degree of Master of Science

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Negative interpretation bias is defined as an individual's tendency to interpret ambiguous events in the environment as negative or threatening (Beard, 2011; Beard & Amir, 2009; Miers, Blote, Bogels, & Westenberg, 2008; Muris & Field, 2008; Rozenman, Amir, & Weersing, 2014). A heightened negative interpretation bias predicts high levels of trait anxiety and clinical levels of anxiety in adults and youth (Amin, Foa, & Coles, 1998; Amir, Prouvost, & Kuckertz, 2012; Muris & Field, 2008). Understanding the psychopathology of anxiety disorders through a lens of underlying information processing biases, including interpretation biases, can allow researchers to take a mechanistic approach to investigating cognitive processes associated with impairment and dysfunction (Muris & Field, 2008), resulting in the identification of potential treatment targets (Pine, 2007). The current study aims to examine associations between several interpretation bias indices and anxiety symptoms in clinically anxious youth, with the hypothesis that, if these measures all tap into the same underlying construct of interpretation bias, resulting bias scores should be strongly related and should also be associated with symptoms of anxiety. Thirty anxious youth were assessed using the Anxiety Disorders Interview Schedule for the DSM-IV (or for the DSM-5), Child Version (ADIS-IV-C/P or ADIS-5-C/P, respectively). Parents and children reported child anxiety symptoms via the Screen for Child Anxiety Related Disorders (SCARED-C/P).

Youth also completed implicit (IM), explicit-personally irrelevant (EM), and explicit-personally relevant (ERM) measures of interpretation biases (WSAP; Amir et al., 2012; Beard & Amir, 2009; Rozenman et al., 2014, AIBQ; Miers et al., 2008). Consistent with hypotheses, correlational analyses show a strong relationship between the IM of bias towards threat and the EM of bias towards threat ( $r = 0.55, p < 0.01$ ) and a negative correlation between the IM of bias away from benign and the EM of bias towards benign ( $r = -0.49, p < 0.01$ ). Contrary to hypotheses, no association was found between the ERM of negative bias and the other two measures of negative interpretation bias. SCARED-C/P scores were only associated with the ERM of interpretation biases (Total anxiety  $r = 0.45, p < 0.05$ ; Generalized Anxiety Disorder (GAD) symptoms  $r = 0.61, p < 0.01$ ).

Interpretation bias measures may assess different constructs, with personally relevant explicitly measured negative interpretation bias uniquely relating to anxiety symptomatology in anxious youth. Moderation analyses revealed that while females displayed marginally higher total anxiety symptoms than males ( $t(26) = 1.72, p = 0.098$ ), males showed more intense levels of negative interpretation bias via the IM ( $t(28) = 1.77, p = 0.07$ ). Hispanic individuals displayed both marginally higher total anxiety symptoms ( $t(25) = 1.96, p = 0.06$ ) and enhanced negative interpretation bias via the IM ( $t(27) = 2.297, p < 0.05$ ). Results indicate that, while associations exist between the intensity of negative interpretation bias measured via IMs and EMs, only ERMs reliably predict anxiety disorder symptoms in clinically anxious youth. Results also suggest that ethnicity may play an important role in the relevance of negative interpretation bias in assessment and treatment of anxious youth.

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## Chapter 1: Introduction

Anxiety disorders are among the most prevalent mental health concerns for children and adolescents (Merikangas et al., 2011). These disorders are associated with substantial impairment across multiple domains including social, academic, and family functioning (Bittner et al., 2007; Brunner et al., 2014; Garber & Weersing, 2010; Goodwin, Fergusson, & Horwood, 2004; Strauss, Lahey, Frick, Frame, & Hynd, 1988). A number of etiological and maintenance factors for the development of anxiety disorders have been identified, including genetic, familial, and cognitive risk factors (Muris & Field, 2008). Muris and Field (2008) specifically theorize that symptoms of anxiety in youth are caused and maintained by cognitive factors, such as negative attention, interpretation, and memory biases (see Figure 1).

In the adult literature, the presence of cognitive processing biases (i.e., attention bias, interpretation bias, and memory bias) appears to be a risk/maintenance factor for anxiety (Amir, Beard, & Przeworski, 2005; Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007; Beard & Amir, 2009; Mathews & MacLeod, 2005). However, much less work on cognitive processing biases exists using child and adolescent samples; thus, little is known about the role of development in such biases and their relevance to clinical versus normative samples of youth. Although much of Muris & Field's (2008) model remains theoretical at this point, there is a small emergent literature on cognitive biases in children and adolescents. Specifically, self-report and reaction time based measures have been used to identify attention and interpretation biases in youth.

(Creswell & O'Connor, 2011; Muris & Field, 2008; Pine, 2007; Rozenman et al., 2014; Salemink, van den Hout, & Kindt, 2010; Shechner et al., 2012; Waters, Bradley, & Mogg, 2014).

Pine (2007) conceptualizes the development of cognitive biases and anxiety through a neurocognitive framework (see Figure 2). According to this model, biology and one's behavioral interactions with the environment intersect to create functional changes in the brain and a resultant cognitive vulnerability for the development and maintenance of anxiety. Pine (2007) indicates that one particular process, fear learning, contributes to the development of anxiety. Fear learning (the process of learning about a threatening stimulus through classical conditioning), and extinction (the process of learning that a situation is no longer threatening and understanding the difference between threatening and non-threatening stimuli) comprise fear learning. Abnormalities within this process have been linked to brain-based and behavioral indicators of anxiety (Britton et al., 2013; Britton, Lissek, Grillon, Norcross, & Pine, 2011; Lissek et al., 2014).

To demonstrate how Pine's (2007) conceptualization contributes to the understanding of cognitive biases underlying anxiety, we use fear learning as one model for the development of negative interpretation bias in anxious individuals. Through studies on fear conditioning (Britton et al., 2013; Britton et al., 2011; Lissek et al., 2014) investigators have found that anxious individuals have a heightened subjective response to conditioned fear, display greater difficulty distinguishing between threatening and benign stimuli post-extinction, and, most importantly, specifically demonstrate difficulty when distinguishing the valence of stimuli within the "ambiguous zone" between threatening and benign stimuli, which can be interpreted as a tendency to have difficulty

deciding with certainty that a stimulus is not threatening. The cognitive bias implicated in this fear learning process which is also particularly relevant to the development and maintenance of anxiety in children is a negative interpretation bias, or the tendency to interpret ambiguous situations as negative or threatening (Beard, 2011; Beard & Amir, 2009; Miers et al., 2008; Muris & Field, 2008; Rozenman et al., 2014). Theoretically, such a tendency to interpret situations as threatening leads children to experience more negative cognitions and contributes to the development and maintenance of anxiety (Muris & Field, 2008).

Although Muris and Field (2008) hypothesize a relationship between negative interpretation bias and anxiety, no one measure of interpretation bias has been determined to be the “gold standard” measure for assessing such relationships in adults or youth. Currently used measures of interpretation bias differ in exactly what stage of the cognitive process of stimulus detection and interpretation they assess. Different paradigms measure different aspects of the process of negative interpretation, such as implicit, associative interpretation biases occurring outside of an individual’s awareness, as well as explicit, situation-specific biases occurring within the individual’s awareness. Researchers have yet to evaluate the relative efficacy of such measures for assessing the intensity of negative interpretation bias in anxious individuals. In the current study, we aimed to determine the utility of several different measures of negative interpretation bias in a diagnostically diverse sample of clinically anxious youth thought to be representative of the population (i.e., many children within the sample experiencing high levels of comorbidity between internalizing disorders as well as accompanying externalizing symptoms). Specifically, the present investigation examines whether different measures

of negative interpretation bias appear to assess a similar cognitive process, and which measures relate most closely to expected outcomes (i.e., greater anxiety disorder severity, expected moderators) based on the cognitive model of anxiety outlined by Muris and Field (2008).

### **Measurement of interpretation bias in anxious populations**

A number of measures of negative interpretation bias exist. Here, we refer descriptively to such measures as *implicit measures (IMs)*, *explicit-personally irrelevant measures (EMs)*, and *explicit-personally relevant measures (ERMs)*. An IM of negative interpretation bias typically examines cognitive associations outside of an individual's awareness but indicating an individual's tendency to more readily (quickly) endorse (vs. reject) negative interpretations and/or more readily (quickly) reject (vs. endorse) neutral interpretations of ambiguous stimuli. IMs assess such preferences through reaction time differences in one's endorsement/rejection of proposed stimulus pairs (i.e., ambiguous stimuli paired with a variety of threatening and benign stimuli). An EM examines an individual's propensity to endorse negative/threatening interpretations of ambiguous stimuli during a specified timeframe, typically via item endorsement following the presentation of stimulus pairs (See Figure 3 for example of stimulus presentation). ERMs assess an individual's tendency to choose negative situational and personally relevant interpretations. ERMs of negative interpretation bias typically consist of the presentation of ambiguous vignettes or stories, which an individual is instructed to appraise in terms of its valence or threat value (see Appendix 1D for example). Of note, in this latter paradigm, individuals make subjective decisions about how they would respond to a hypothetical situation, while the former paradigms rely on performance-based data.

Although IMs, EMS, and ERMs are all used to assess negative interpretation bias, they differ in design and consequently provide different types of information (i.e., reaction time based implicit preferences, time-limited endorsements of relationships between stimuli, time-unlimited, personalized threat evaluations [more time for analysis of situation and/or potential re-structuring], respectively). Such substantial differences in data output provided by these measures indicate that these paradigms may tap into slightly different components of the same cognitive process of making negative or threatening associations more readily than neutral ones when presented with ambiguous situations. Previous studies have primarily examined paradigms individually (e.g., Beard & Amir, 2009; Constans, Penn, Ihen, & Hope, 1999; Franklin, Huppert, Langner, Leiberg, & Foa, 2005; Hirsch & Clark, 2004; Hirsch & Mathews, 2000; Huppert, Foa, Furr, Filip, & Mathews, 2003; Huppert, Pasupuleti, Foa, & Mathews, 2007; Stopa & Clark, 2000; Miers et al., 2008), but it is not yet clear whether these paradigms tap into distinct or overlapping constructs, nor is it clear that they assess the same cognitive process. To date, no studies have examined how all three resultant negative interpretation bias measures correlate within the same sample.

The most frequently studied interpretation bias measures are ERMs, which have been used by investigators to demonstrate the presence of negative interpretation bias among high (trait) anxious and clinically anxious adults (Beard & Amir, 2009; Constans, Penn, Ihen, & Hope, 1999; Franklin, Huppert, Langner, Leiberg, & Foa, 2005; Hirsch & Clark, 2004; Hirsch & Mathews, 2000; Huppert, Foa, Furr, Filip, & Mathews, 2003; Huppert, Pasupuleti, Foa, & Mathews, 2007; Stopa & Clark, 2000). Evidence supporting the presence of negative interpretation bias measured using IMs and EMS is more limited.

The investigation of the utility of such measures for assessing negative interpretation bias requires implementation of performance-based paradigms such as the Word-Sentence Association Paradigm (WSAP, described below; Amir et al., 2012; Beard & Amir, 2009; Rozenman et al., 2014).

Administration of the WSAP and similar paradigms requires individuals to determine whether certain words (threatening or neutral), appearing on a computer screen for 500 ms each, are related to an ambiguous sentence. This task includes a reaction time-based measure (i.e., an IM) of interpretation bias that assesses how long it takes individuals to determine whether or not words and sentences are related, as well as an EM of interpretation bias calculated via the endorsement rate (percentage) for associations between words and sentences. For example, each word-sentence pair includes either a neutral/positive (e.g., “cool”) or a threatening/negative (e.g., “weird”) word, which is then replaced by an ambiguous sentence (e.g., “Someone looks at you as you walk by”). Then, participants are instructed to indicate whether the word is related to the sentence as quickly as possible (“endorse association”) or not (“reject association”). This way, such a paradigm allows investigators to assess negative interpretation bias using both an IM (reaction time measure) and an EM (item endorsement measure). Results from these studies have provided evidence for an elevated negative interpretation bias (obtained via IM and EM) in high anxious and clinically anxious adults (Amir, Bomyea, & Beard, 2010; Amir et al., 2012; Amir & Taylor, 2012; Beard & Amir, 2009; Beard, Weisberg, & Amir, 2011).

Across theoretical paradigms and tasks, relatively less work has focused upon measuring negative interpretation bias in youth. ERMs have been used in several studies to illustrate heightened negative interpretation bias in anxious youth (i.e., vignette tasks with ambiguous social and nonsocial sentences during which children are asked to choose a “most likely” explanation from a list of choices) (Barrett, Rapee, Dadds, & Ryan, 1996; Bögels, Snieder, & Kindt, 2003; Bögels & Zigterman, 2000; Creswell, Schniering, & Rapee, 2005; Miers et al., 2008; Muris, Merckelbach, & Damsma, 2000; Muris, Rapee, Meesters, Schouten, & Geers, 2003). With regard to IMs and EMs, pilot study results by Rozenman et al. (2014) and de Hullu, de Jong, Sportel, and Nauta (2011) indicated that anxious youth with greater self-reported anxiety symptoms have higher levels of negative interpretation bias than their less anxious peers when assessed via an EM. However, these authors failed to report significant differences between youth when negative interpretation bias was assessed using an IM. These outcomes are surprising considering that both EMs and IMs have been used to support the presence of a heightened negative interpretation bias in high anxious and clinically anxious adults (Amir et al., 2012; Beard & Amir, 2009).

With these recent studies in mind, the present investigation builds on this literature by replicating previous findings that anxious adults evidence heightened negative interpretation bias in a clinically diverse sample of anxious children. Further, this investigation uses all three measures of negative interpretation bias, including an EM, an IM, and an ERM of negative interpretation bias, to determine whether reaction time based measures (IMs) can potentially serve as construct-valid means of assessing negative interpretation bias in clinically anxious youth. Finally, the current study

investigates whether gender and ethnicity moderate negative interpretation bias in anxious youth. In order to develop the rationale for further research on this topic, literature related to the assessment of negative interpretation bias using IMs and EMs in anxious samples will be reviewed, followed by research indicating that anxious individuals displaying such heightened negative interpretation biases (assessed via IMs and EMs) are also expected to display a negative interpretation bias measured using an ERM. Lastly, previous efforts to investigate moderators of negative interpretation bias will be discussed.

### **IMs and EMs of negative interpretation bias in anxious samples**

Time-limited measures of negative interpretation bias assess threat biases processed either outside of an individual's awareness (implicit/reaction time based measures) or via an individual's tendency to choose negative one-word explanations for de-personalized ambiguous sentences (explicit/item endorsement measures). Reaction time based IMs of negative interpretation bias have been used to confirm the presence of a larger implicit bias away from benign information in individuals with social anxiety as compared to that of control participants. In studies by Beard and Amir (2009) and Amir et al. (2012) using the WSAP (WSAP; Beard & Amir, 2009), a socially anxious group was significantly slower to endorse benign interpretations of ambiguous sentences than control participants were. Additionally, Amir et al. (2012) observed that individuals diagnosed with social phobia more quickly rejected benign interpretations than control participants without a social phobia diagnosis. These findings suggest that socially anxious individuals tend to implicitly make threat-related interpretations.

However, observed relationships between anxiety and negative interpretation bias assessed via EMs differed between studies. Specifically, results from one study of individuals with elevated levels of social anxiety suggested heightened negative interpretation bias in socially anxious individuals using an EM (percentage of endorsed associations between threatening words and ambiguous sentences; Beard & Amir, 2009), while a second study of individuals with clinical levels of social anxiety using this same EM provided no evidence for a heightened negative interpretation bias in socially anxious individuals, as compared to that of healthy controls (Amir et al., 2012). Overall, the use of IMs (vs. EMs) of negative interpretation bias has more consistently evidenced a heightened negative bias in anxious adults.

There are limited numbers of studies with anxious children evaluating negative interpretation bias, as assessed using EMs, and relationships between anxiety and IMs of negative interpretation bias in youth remain unclear (de Hullu et al., 2011; Rozenman et al., 2014). de Hullu et al. (2011) implemented an implicit association test with adolescent participants. In this task, participants categorized socially relevant words as being linked to positive or negative outcomes. Adolescents with higher self-reported social anxiety categorized significantly more socially relevant words as being related to negative outcomes than youth reporting lower levels of social anxiety (demonstrating heightened negative interpretation bias in more socially anxious adolescents obtained via an EM). However, there was no significant association between anxiety level and negative interpretation bias assessed through a reaction time based IM. Similarly, Rozenman et al. (2014) developed and presented clinically anxious youth with an age-appropriate downward adaptation of the WSAP (paradigm including both an IM and an EM of

interpretation bias), observing that clinically anxious youth with higher levels of self-reported anxiety symptoms also endorsed a greater percentage of negative word-sentence pairs. While such results suggest that clinically anxious youth with *relatively* more severe anxiety symptoms possess a more intense negative interpretation bias examined via the EM (i.e., item endorsement), the authors found no association between anxiety symptom severity and the intensity of negative interpretation bias assessed via the IM. Authors cite measurement issues as a potential cause of this lack of findings, suggesting that stimuli were too complex for children to interpret quickly enough to use reaction time as a reliable IM of bias.

### **Relationships between negative interpretation bias assessed using IMs, EMs, and ERMs**

Cognitive bias modification (CBM) studies feature the manipulation of negative interpretation bias through bias reduction training (Amir et al., 2010; Amir & Taylor, 2012; Beard et al., 2011; Lau, Molyneaux, Telman, & Belli, 2011; Lau, Pettit, & Creswell, 2013; Lothmann, Holmes, Chan, & Lau, 2011). Specifically, authors of such studies administer computer tasks to anxious youth, training them to more quickly pair benign (vs. threatening) and ambiguous stimuli (i.e., reducing reaction time and bias scores obtained via IM) and more often pair benign and ambiguous stimuli (i.e., increasing endorsement of stimulus pairs and bias scores obtained via EM). Some groups have observed reductions in negative interpretation bias scores computed via IMs and EMs over time by using IMs and EMs of interpretation bias to measure pre to post CBM training changes (Amir et al., 2010; Amir & Taylor, 2012; Beard et al., 2011). However, authors of a subset of such studies utilize ERMs of interpretation bias administered pre

and post training as well to assess intervention-related changes in negative interpretation bias (Bowler et al., 2012; Lau et al., 2011; Lau et al., 2013; Lothmann et al., 2011).

Through use of the latter study design, investigators assume that IMs, EMs, and ERMs of negative interpretation bias all tap into the same cognitive process, such that implicitly/explicitly-personally irrelevant manipulated biases lead directly to changes in personally relevant negative interpretation bias assessed using ERMs.

In studies employing cognitive bias modification, clinically anxious youth and adults do show a decrease in bias scores calculated using ERMs of negative interpretation bias as well as symptoms of anxiety and negative affect post-training (Bowler et al., 2012; Lau et al., 2011; Lau et al., 2013; Lothmann et al., 2011). Results from such studies suggest that youth demonstrating reductions in negative interpretation bias scores obtained via IMs and EMs also display reductions in negative interpretation bias scores calculated via ERMs. As such, existent CBM studies illustrate close associations between these measures of negative interpretation bias. Although this evidence suggests the presence of relationships between anxiety and the intensity of negative interpretation bias assessed using IMs, EMs, and ERMs, data directly linking a more extreme ERM bias score to heightened IM and/or EM bias scores is lacking. The three measures of interpretation bias may assess the same underlying cognitive process, but this theory has never been directly tested.

### **Moderators of negative interpretation bias**

In addition to investigating relationships between anxiety and negative interpretation bias measured using various paradigms, it is also important to consider potential moderators of the relationship between negative interpretation bias and anxiety.

As explained by Muris and Field (2008), many factors influence an anxious individual's level of cognitive bias. One potential moderator that has gained initial empirical support is gender. Gender-based differences in levels of negative interpretation bias may relate to known gender-based differences in internalizing disorder symptoms during childhood and adolescence, with adolescent girls reporting greater symptoms of internalizing disorders than adolescent boys (Costello, Mustillo, Erkanli, Keeler, & Angold, 2003; Merikangas et al., 2010). Additionally, Salemink and Wiers (2011) found that, among a community sample of adolescents, females exhibited an implicitly measured negative bias relative to males. Interestingly, females also reported higher levels of trait anxiety as compared to those indicated by males. Similarly, when Gluck et al. (2014) implemented Miers' ERM of situational interpretation bias, (AIBQ; Miers et al., 2008), adolescent girls demonstrated a greater negative interpretation bias than boys did. If more intense negative interpretation bias does lead to heightened anxiety in youth (Muris & Field, 2008), females with greater levels of negative interpretation bias would be expected to also exhibit more intense symptoms of anxiety.

Another potential moderator of the association between negative interpretation bias and anxiety is ethnicity. Specifically, symptoms of anxiety depression are generally higher in Hispanic versus Non-Hispanic individuals (Anderson & Mayes, 2010; Cuellar & Roberts, 1997; Joiner, Perez, Wagner, Berenson, & Marquina, 2001; Siegel, Aneshensel, Taub, Cantwell, & Driscoll, 1998). Although in the relationship between ethnicity and negative interpretation bias has not yet been examined, Hispanic youth tend to report higher levels of anxiety sensitivity (the fear of physiological sensations associated with anxiety), one cognitive factor thought to indicate heightened risk for

anxiety in youth, than their Non-Hispanic counterparts (Pina & Silverman, 2004; Weems, Hayward, Killen, & Taylor, 2002). As another cognitive factor thought to lead to the development of anxiety in youth (Muris & Field, 2008), negative interpretation bias is expected to be elevated in Hispanic youth as well. Additionally, if more intense negative interpretation bias does lead to heightened anxiety in youth, Hispanic youth with heightened negative interpretation bias are expected to also demonstrate more intense symptoms of anxiety.

The purpose of the current study was first to replicate prior investigations demonstrating the presence of negative interpretation bias assessed using EMs (endorsement/rejection of associations between stimulus pairs on the WSAP) and ERMs (threatening appraisals of personally relevant ambiguous scenarios on the AIBQ). Second, we sought to examine the reliability of an IM (i.e., the WSAP) for assessing negative interpretation bias within the same sample, and to determine whether EMs, ERMs, and IMs tap into a single construct or are better understood as assessing separable steps involved in information processing. Additionally, we evaluated gender and ethnicity as moderators of the relationship between the level of negative interpretation bias and severity of anxiety symptoms. By extending previous literature through delineation of the three measures of negative interpretation bias, this study contributed to the understanding of cognitive biases underlying the development and maintenance of anxiety disorders. The careful examination of information processing deficits associated with anxiety disorder severity serves as an important step toward better understanding causes and maintenance factors, and improving treatments for anxious youth in a personalized way.

### **Specific Aims**

**Aim 1: To characterize the relationship between heightened anxiety symptoms and negative bias using both an EM and an IM of interpretation bias in a diagnostically diverse clinical sample.** To test this aim, we administered procedures described in Rozenman et al., 2014 using a simplified task. Specifically, in the current study, WSAP stimuli have been adjusted by minimizing sentence and syllabic complexity. With a simplified task structure, youth were hypothesized to have greater success reading and quickly responding to task items within the allotted timeframe, producing a more accurate measure of reaction time, as it is hypothesized to be less affected by variation in reading speed.

**Hypothesis 1:** Clinically anxious youth would display negative interpretation bias, based on item endorsement (EM of bias) on the WSAP (Rozenman et al., 2014). Specifically, anxious youth were hypothesized to endorse associations between ambiguous sentences and negative words (vs. reject such associations).

**Hypothesis 2:** Unlike Rozenman et al. (2014), youth would display a negative bias, based on reaction time (IM of bias) on the WSAP (Amir et al., 2012; Beard & Amir, 2009). Specifically, anxious youth were expected to more quickly endorse (vs. reject) associations between ambiguous sentences and threatening words (implicit negative bias towards threat) and to more quickly reject (vs. endorse) associations between ambiguous sentences and benign words (implicit negative bias away from benign).

**Aim 2: To define how output from IM, EM, and ERM of negative interpretation biases are related in a clinical sample of anxious youth (i.e., do they measure the same or separable constructs?).**

**Hypothesis 3:** Consistent with previous findings and theoretical underpinnings, negative interpretation bias scores calculated from IM, EM, and ERM would be correlated (Amir et al., 2012; Beard & Amir, 2009; Muris & Field, 2008).

**Hypothesis 4:** We hypothesized that negative interpretation bias scores calculated from IM, EM, and ERM would positively correlate with self- and parent-reported anxiety disorder symptoms and severity (Chorpita, Albano, & Barlow, 1996; Miers et al., 2008; Muris et al., 2003; Rozenman et al., 2014). Additionally, since both ERM of negative interpretation bias and anxiety symptom measures are subjective reports of self-relevant judgments, it was hypothesized that bias scores obtained via ERM of negative interpretation bias would be more highly correlated (than other indices assessing negative interpretation bias) with self- and parent- reported anxiety symptoms.

**Aim 3: To investigate the impact of potential moderators, including gender and ethnicity, on relationships between negative interpretation bias and anxiety symptoms.**

**Hypothesis 5:** Sex would moderate the relationship between negative interpretation bias and anxiety symptoms, such that negative interpretation bias would more strongly predict anxiety symptoms in girls than in boys. However, given the relatively low power of this study, we also examined sex differences in negative interpretation bias and expected that females would exhibit higher reports of anxiety symptoms and more intense negative interpretation bias than boys.

**Hypothesis 6:** Ethnicity would moderate the relationship between negative interpretation bias and anxiety symptoms, such that negative interpretation bias would more strongly predict anxiety symptoms in Hispanic youth than in Non-Hispanic youth. However, given the relatively low power of this study, we also examined ethnicity-related differences in negative interpretation bias and expected that Hispanics would exhibit higher reports of anxiety symptoms and more intense negative interpretation bias than Non-Hispanics.

## Chapter 2: Method

### Participants

Participants were 30 children and adolescents between ages 8-17 years ( $M = 12.17$ ,  $SD = 2.72$ ; 63% female) referred consecutively to a research clinic in a large metropolitan area in the Southeastern United States. All participants in the sample met diagnostic criteria for at least one DSM-5 anxiety disorder or a disorder previously classified as an anxiety disorder in the DSM-IV, including Obsessive-Compulsive and Related Disorders and Stress Disorders, in accordance with clinician-rated composite diagnosis following administration of the Anxiety Disorders Interview Schedule for the DSM-IV, Child and Parent versions (or for the DSM-5), Child Version (ADIS-IV-C/P or ADIS-5-C/P, respectively) (Silverman & Albano, 1996; Silverman & Albano, in press). Data collection took place during an initial assessment visit that served as a prerequisite to the receipt of any evidence-based treatment and/or clinical research studies at this research clinic.

In order to meet eligibility criteria, youth (a) were between 8 and 17 years of age, (b) met criteria for a current diagnosis of generalized anxiety disorder, social anxiety disorder, separation anxiety disorder, specific phobia, selective mutism, other specified anxiety disorder, unspecified anxiety disorder, or met diagnostic criteria for disorders previously classified as anxiety disorders in the DSM-IV, including obsessive-compulsive and related disorders and stress disorders, based on results of a clinical interview administered by a trained clinician at intake, (c) spoke/read English sufficiently (and had at least one parent who did) to complete all study measures, (d) read at a minimum of an 8-year-old reading level, as determined by a short reading fluency test (e)

had a legal guardian available to sign study consents, remain present during assessments, and fill out questionnaires. In addition to failure to meet inclusion criteria above, youth were excluded if they (a) obtained a Full Scale IQ score below 80 on the Vocabulary and Matrix Reasoning subtests of an abbreviated IQ test indicating possible cognitive delays that could have interfered with successful completion of study procedures. Of note, youth who did not meet criteria for the current study were not excluded from the overarching baseline assessment process or any subsequent treatment/clinical research services offered at this research clinic.

Within this sample, principal diagnoses included: generalized anxiety disorder ([GAD];  $n = 10$ , 33%), social anxiety disorder ( $n = 6$ , 20%), obsessive-compulsive disorder ([OCD];  $n = 3$ ; 10%), agoraphobia ([AG]  $n = 1$ , 3%), panic disorder ([PD];  $n = 1$ , 3%), persistent depressive disorder ([PDD];  $n = 1$ , 3%), co-principal social anxiety disorder and GAD ( $n = 2$ , 7%), co-principal social anxiety disorder and PDD ( $n = 1$ , 3%), co-principal social anxiety disorder and ODD ( $n = 1$ , 3%), co-principal separation anxiety disorder (SAD) and ODD ( $n = 1$ , 35%), attention-deficit/hyperactivity disorder ([ADHD];  $n = 1$ , 3%), and Tourette's disorder ( $n = 1$ , 3%). All participants had at least one clinical anxiety or OCD diagnosis and many also had a depressive disorder diagnosis and/or externalizing diagnoses (See Table 2 for clinical profile of the sample).

The sample was seemingly representative of the larger Miami-Dade County community in which data was collected with 14 youth (47%) identified as Hispanic/Latino and 15 youth (50%) reporting ethnicity as Non-Hispanic/Latino.

Of those Non-Hispanic/Latino participants, 11 (37%) participants reported their race as White, Non-Hispanic, 2 (8%) as Black or African-American, 2 (8%) as Asian-American, and 1 (4%) did not report their race.

Study approval was granted by the Institutional Review Board (IRB). Study personnel obtained parental consent and adolescent assent prior to conducting study procedures.

### **Measures**

With the exception of the ADIS-IV-C/P and ADIS-5-C/P, all study measures are presented in Appendix 1.

**Anxiety Disorders Interview Schedule, Child and Parent Versions (ADIS-IV-C/P; ADIS-5-C/P) (Silverman & Albano, 1996).** The ADIS-IV-C/P is a downward extension of the Anxiety Disorders Interview Schedule for DSM-IV (ADIS-IV) (Brown, DiNardo, & Barlow, 1994). It is a semi-structured interview commonly used to assist trained clinicians in the diagnosis of DSM-IV anxiety disorders, mood disorders, and externalizing disorders in children and adolescents 7 to 18 years old (Lyneham, Abbott, & Rapee, 2007; Silverman, Saavedra, & Pina, 2001). The ADIS-5-C/P is a new version of this measure adapted for use with the DSM-5. Both versions of the measure also include additional screening questions for other disorders such as psychotic disorders, eating disorders, and somatization disorders. In addition to assisting clinicians to indicate diagnoses, the ADIS-IV-C/P and ADIS-5-C/P also allow for the assessment of Clinical Severity Ratings (CSR) for each diagnosis, with scores ranging from 0 to 8, and scores less than 4 indicating sub threshold levels of disorder-relevant impairment.

Indicated diagnoses and CSRs obtained through the ADIS-IV-C/P ( $n = 24$ ) and the ADIS-5-C/P ( $n = 6$ ) in the current sample were used to examine relationships between clinical presentation (i.e. diagnoses as well as severity of diagnoses) and negative interpretation bias, and also to determine study eligibility (e.g., meeting criteria for a DSM-IV or 5 anxiety disorder using a CSR  $> 4$  by clinician's report as the marker of such). Using these measures,  $n = 2$  youth were excluded due to failure to meet specified diagnostic criteria. On average, subjects in the current study presented with moderately severe principal diagnoses, as measured by the CSR assigned to their principal or co-principal diagnoses ( $M = 5.43$ ,  $SD = 0.97$ , Range = 4-7). CSRs of principal diagnoses between individuals assessed via the ADIS-IV-C/P ( $M = 5.50$ ,  $SD = 1.10$ ) versus the ADIS-5-C/P ( $M = 5.17$ ;  $SD = 0.41$ ) were not significantly different  $t(28) = 0.75$ , *ns*.

Evidence indicates excellent inter-rater reliability for principal diagnoses using the ADIS-IV-C/P ( $\kappa = 0.92$ ) and anxiety diagnoses ( $\kappa = 0.8-1.0$ ), as well as good agreement on comorbid diagnoses ( $\kappa = 0.65-0.77$ ) (Lyneham et al., 2007). Silverman et al. (2001) also demonstrated excellent test-retest reliability on anxiety disorders symptoms scales ranging from 0.81 to 0.99 for the child interview and 0.86 to 0.99 for the parent interview. The ADIS-IV-C/P also has adequate convergent validity, with children meeting criteria for Social Anxiety Disorder on the ADIS-IV-C/P scoring significantly higher on the MASC Social Anxiety Scale than children with other anxiety diagnoses, and with those meeting diagnostic criteria for Separation Anxiety on the ADIS-IV-C/P scoring significantly higher on the MASC Separation and Harm Avoidance

Scales than children with other anxiety disorders (Wood, Piacentini, Bergman, McCracken, & Barrios, 2002). Psychometrics on the ADIS-5-C/P are currently being investigated, but the measure's structure and components mirror those of the ADIS-IV-C/P.

**Screen for Child Anxiety Related Emotional Disorders (SCARED-C; SCARED-P) (Birmaher et al., 1997).** The SCARED-C and SCARED-P are 41-item (in each version) child- and parent-report questionnaires used to assess anxiety disorder symptoms based on DSM-IV anxiety disorder criteria. The SCARED-C/P measures levels of symptom severity within and across various domains of anxiety (i.e. Social Anxiety, Generalized Anxiety Disorder, Separation Anxiety, Panic Disorder, Social Anxiety Disorder, and Specific Phobias) in children and adolescents aged 7-19 years. Using the SCARED-C/P, a child or parent responds to each item on a 3-point Likert scale (0 = not true or hardly true; 1= somewhat true or sometimes true; 2= very true or often true). Total and subscale scores are computed by summing across relevant and related items. The SCARED-C/P is a reliable and valid measure of youth anxiety with good internal consistency, a test-retest correlation of 0.81 for the total anxiety score, and subscale test-retest correlations ranging from 0.40 to 0.78. Further, the SCARED-C/P has adequate concurrent validity, with high correlations between the SCARED-C/P and the STAI-C, RCMAS, FSSC, and the internalizing scale of the CBCL (Birmaher et al., 1999; Muris et al., 1998; Muris, Merckelbach, Van Brakel, & Mayer, 1999).

The SCARED-C/P was used to examine relationships between child- and parent-reported total anxiety symptom severity as well as anxiety symptom severity within specific relevant domains (i.e. Social Anxiety Disorder and Generalized Anxiety Disorder Subscales) and negative interpretation bias.

For the current sample, internal consistency values for the SCARED-C were as follows:  $\alpha = 0.93$  for total anxiety,  $\alpha = 0.84$  for panic subscale,  $\alpha = 0.89$  for generalized anxiety subscale,  $\alpha = 0.84$  for separation anxiety subscale,  $\alpha = 0.90$  for social anxiety subscale, and  $\alpha = 0.76$  for school anxiety subscale. Internal consistency values for the SCARED-P were as follows:  $\alpha = 0.84$  for total anxiety,  $\alpha = 0.70$  for panic subscale,  $\alpha = 0.80$  for generalized anxiety subscale,  $\alpha = 0.78$  for separation anxiety subscale,  $\alpha = 0.91$  for social anxiety subscale, and  $\alpha = 0.52$  for school anxiety subscale. Due to greater internal consistency values for most subscales (other than social anxiety) of the SCARED-C (vs. the SCARED-P), subscales of the SCARED-C were used in most analyses examining relationships between anxiety disorder symptoms and interpretation bias scores. However, the social anxiety subscale of the SCARED-P was also used in analyses due to its strong internal consistency.

#### **Wechsler Abbreviated Scale of Intelligence- Second Edition (WASI-II)**

(Wechsler, 2011). The WASI-II is a reliable and valid abbreviated Intelligence test for individuals between the ages of 6 to 90. Adequate test-retest reliability was established for all four subtests of the measure, and for composite measures as well as for full-scale IQ measures based on composites of all four and two of four subtests. Additionally, concurrent validity was established with more comprehensive measures of intelligence (WISC-IV, WAIS-IV, KBIT-2) as well as with the original version of the WASI

(Maccow, 2011). Investigators administered the Vocabulary and Matrix Reasoning subtests in order to ensure that participants can comprehend and accurately complete tasks and questionnaires. Any child with a Full Scale IQ below 80 was excluded ( $n = 0$  in the current sample). Subjects included in the current study had Full Scale IQ scores of 80 and above, with a high average overall mean IQ score observed ( $M = 112.77$ ,  $SD = 13.62$ ,  $Range = 89-136$ ).

**Test of Word Reading Efficiency- Second Edition (TOWRE-2) (Torgesen, Wagner, & Rashotte, 2012).** The TOWRE-2 is a reliable and valid measure of ability to pronounce printed words (Sight Word Efficiency) and phonemically regular non-words (Phonemic Decoding Efficiency) accurately and fluently in individuals between the ages of 6-24, and takes 5-10 minutes to administer. The average test-retest coefficients for the same form of the TOWRE-2 exceed 0.90 and for different forms of the subtests are 0.87. Data from multiple independent research studies provide strong evidence for the construct validity of the test, and for its clinical utility in diagnosing reading delays and disabilities in children. Concurrent validity has been established by relating skills assessed by the TOWRE-2 to those assessed by other prominent tests of reading skill (Torgesen, Wagner, & Rashotte, 2012). Investigators administered the Sight Word Efficiency subtest in order to ensure that participants were able to read tasks and questionnaires. Raw scores are the number of real words read correctly in 45 seconds. Subtest standard scores have a mean of 100 and a standard deviation of 15. Data collected from youth with insufficient reading fluency (reading fluency below a second grade or a minimum of 52 words read correctly in 45 seconds) were excluded ( $n = 1$  in the current

sample). Subjects included in the current study were able to read at or above a second grade reading level ( $M = 75.63$ ,  $SD = 30.95$ ,  $Range = 63-103$ ). None of the youth included in the study scored significantly below grade level on the TOWRE-2.

**Adolescent Interpretation and Belief Questionnaire (AIBQ) (Miers et al., 2008).** The AIBQ is a questionnaire designed to assess interpretations and beliefs about social and non-social ambiguous situations in youth. In the current study, the AIBQ served as the ERM of negative interpretation bias. Following the presentation of a scenario meant to appear ambiguous (e.g. *“You’re standing with a group of classmates. When you begin to talk, no-one looks at you. Why isn’t anyone looking at you?”*), three possible interpretations of the scenario (positive, neutral, and negative in nature) are given and participants are asked to rate how likely it is that each potential interpretation would pop up in their mind on a scale from 1 (does not pop up in my mind) to 5 (definitely pops up in my mind). Overall positive, neutral, and negative interpretation bias scores can also be computed by summing scores on all items and dividing by the total number of items on the scale (10 items). The resultant scores range from 1 (no bias) to 5 (strong bias). One’s tendency to believe provided positive, neutral, and negative interpretations is calculated similarly by taking the mean of individual belief scores across five social and five non-social situations, respectively. The AIBQ has been used to assess interpretation biases at baseline in non-clinical samples of adolescents (Gluck, Lynn, Dritschel, & Brown, 2014; Miers et al., 2008) and post-treatment in a sample of adolescents with elevated anxiety symptoms (Sportel, de Hullu, de Jong, & Nauta, 2013). For the current sample, internal consistency values for the AIBQ were as follows:  $\alpha = 0.78$  for positive bias and  $\alpha = 0.77$  for negative bias.

### **Word Sentence Association Paradigm- Downward Adaptation (WSAP)**

(Amir et al., 2012; Beard & Amir, 2009; Rozenman et al., 2014). The WSAP is a computer-based paradigm used to assess interpretation bias, which includes an IM and an EM of negative interpretation bias. The WSAP was originally developed by Beard and Amir (2009) for use with socially anxious adults and was later downward-adapted for use with clinically anxious children by Rozenman et al. (2014). In order to ensure its relevance for probing for negative social and nonsocial interpretation of situations in youth, Rozenman et al. (2014) reviewed the anxiety and depression literature focusing on youth for developmentally-relevant task items. Further, this research team validated the stimuli for use with anxious youth, and determined sensitivity to treatment effects (Rozenman, Bettis, Goldberg, Amir, & Weersing, 2011). Due to reported issues pertaining to the readability of the stimuli for children ages 10-17, we further modified this task for this study in order to increase readability for younger children (ages 8-17) in this sample. Sentences were filtered for complexity, and only sentences containing less than 10 syllables and 6 or less words were included.

During this task, research assistants read directions and instructed youth to listen carefully, as the task can be difficult to explain. Children and adolescents were told to look at the computer screen. Youth were told that a word would first appear in the center of the screen (for 500 ms) and would be followed by a sentence (for 1500 ms). Children and adolescents were instructed to press one button on a keypad if they thought that the word and sentence were related and another button if they thought that the word and sentence were unrelated as quickly and accurately as possible. Word-sentence pairs were set up to include either a neutral (e.g., “fly”) or a threatening/negative (e.g., “attack”)

word replaced by an ambiguous sentence (e.g., “*The bird flapped its wings*”) for 110 trials (55 threatening and 55 neutral word/sentence pairs). This task took youth approximately 10-15 minutes to complete (See Figure 1).

Interpretation bias via the WSAP is computed in several ways (separate IM and EM of bias). The explicit-personally irrelevant component of the paradigm is based on the percentage of threatening relationships endorsed between threatening word/ambiguous sentence pairs (negative interpretation bias) and the percentage of benign relationships endorsed between the total number of neutral word/ ambiguous sentence pairs (benign interpretation bias). The implicit component of the paradigm is based on reaction time (RT), or how quickly youth respond when endorsing negative interpretations, rejecting negative interpretations, endorsing neutral interpretations, and rejecting neutral interpretations. Higher implicit bias scores on the WSAP indicate greater levels of negative interpretation bias (i.e., Negative interpretation bias towards threat =  $RT \text{ reject negative association} - RT \text{ endorse negative association}$ , with greater scores indicating more intense negative interpretation bias; Negative interpretation bias away from benign =  $RT \text{ endorse benign association} - RT \text{ reject benign association}$ , with greater scores again indicating a higher negative interpretation bias, or bias away from benign).

## **Procedure**

**Participant recruitment procedures.** Youth were referred to this research clinic by a parent or legal guardian. Prior to the initiation of study procedures, parents of potential participants completed a phone screening in which general questions pertaining to presenting problems as well as inclusion and exclusion criteria were reviewed by a postbaccalaureate research assistant and subsequently a clinical supervisor. Additionally,

assessment, research, and treatment opportunities were discussed with eligible families. At this point, the research assistant scheduled an assessment visit during which the child or adolescent and his/her legal guardian(s) came into the clinic to complete baseline study procedures including psychological assessment, questionnaires, and study-related tasks.

**Screening procedures.** Following administration of a semi-structured diagnostic interview with the child/adolescent (i.e. ADIS and child/parent report questionnaires), collection of brief medical and psychological history information by the clinician administering the psychological evaluation, and the administration of the WASI-II by a research assistant, eligibility for the proposed study was determined. Study-specific data collection with youth occurred during the parent portion of the ADIS.

**Psychological assessment procedure.** The ADIS-IV-C/P or ADIS-5-C/P was administered and completed by a clinician trained to reliably assign diagnoses and severity levels based on DSM-IV-TR and DSM 5 criteria by independently coding three interviews and matching diagnoses and severity-level with a previously trained clinician. Clinicians were post-doctoral and doctoral student clinicians. Weekly clinical supervision meetings were held to review intakes, establish case formulations and treatment recommendations based on intake assessments, and to determine eligibility for inclusion in all ongoing research and treatment research studies. In order to further ensure reliability, all interviews were video-recorded, and approximately 15% of interviews were rated for reliability for principal diagnosis by ADIS-IV-C/P and ADIS-5-C/P reliable clinicians who did not conduct the original interview. Inter-rater reliability for the ADIS-IV-C/P between clinicians at this research clinic (Ehrenreich-May et al., under review) is very good for principal disorder diagnoses and CSR values ( $\kappa = 0.82$ ).

**Assessment of interpretation bias procedure.** During the course of this initial assessment visit, a trained undergraduate or postbaccalaureate research assistant administered the study-specific questionnaire (i.e., AIBQ) and task (i.e., downward adaptation of WSAP). When a child or adolescent seemed to be struggling to understand task-related instructions, the research assistant sat next to youth and assisted them in understanding instructions and procedures. This task was administered along with one other cognitive task presented in a randomized order to prevent contamination. The research assistant remained in the room with the child or adolescent in order to answer any questions and to make sure that the child or adolescent completed measures and tasks as directed. Data was de-identified, with each study participant receiving an ID number through the research clinic. Consent forms were stored in a separate locked cabinet from all de-identified, study-specific data.

**Data cleaning procedure.** Following the completion of data collection, a double-entry data procedure was used, and any discrepancies were corrected. Then, the dataset was screened for errors and outliers. Descriptive statistics were used and assumptions of normality and linearity were met. In order to prevent errors from being included in the reaction time based data, data was screened and cleaned to eliminate errors, using methods consistent with prior studies using the WSAP with adults and youth (Amir et al., 2012; Beard & Amir, 2009; Rozenman et al., 2014; Rozenman et al., 2011). Specifically, response latencies less than 200ms and greater than 3500ms were excluded from analyses. Then, data points 2.5 standard deviations or more away from each subject's mean reaction time within each response category (i.e., RT reject benign, RT accept benign, RT reject negative, RT accept negative) were also excluded from analyses.

(Beard & Amir, 2009; Rozenman et al., 2014). Previous data suggests that responses outside of this range are likely to be the result of lack of attention to the task, technical error, or the use of higher-order processing that encompasses cognitions beyond those being targeted in an automatic processing task (Amir et al., 2012; Beard & Amir, 2009; Rozenman et al., 2014; Rozenman et al., 2011).

**Calculation of interpretation bias scores procedure.** Mean interpretation bias scores were computed based on each youth's responses on the AIBQ (ERM) as well as percentages of item endorsements and average reaction times on the WSAP (IM and EM, respectively). Negative and positive interpretation bias scores on the AIBQ were based on youths' endorsements of negative, positive, and neutral explanations of ambiguous social and non-social scenarios (greater percentage of negative interpretations = higher total negative interpretation bias score and greater percentage of positive interpretations = higher total positive interpretation bias score). Total negative interpretation bias scores were computed from each individual's average score across all ten test items.

The WSAP for youth supplies two IMs (towards threat and away from benign) and an EM of interpretation bias based on each youth's percentage endorsement of word-sentence pairs. The percentage of negative word, ambiguous sentence pairs endorsed by each youth out of all negative/ambiguous pairs possible were computed in order to establish a the negative bias score from the EM, and the percentage of neutral word, ambiguous sentence pairs endorsed by each youth out of all possible neutral pairs was computed to serve as the benign bias score from the EM (Beard & Amir, 2009; Rozenman et al., 2014).

In terms of the IM of negative interpretation bias, four sets of reaction time measures were computed: a) mean RT for endorsement of negative interpretations, b) mean RT for rejection of negative interpretations, c) mean RT for endorsement of neutral interpretations, and d) mean RT for rejection of neutral interpretations. Presumably, if youth automatically jump to negative conclusions, it should take longer for youth to endorse neutral associations (vs. reject such associations) and to reject negative associations (vs. endorse such associations). Two different *negative* bias scores were computed based on reaction times, one measuring bias towards negative and one indicating bias away from benign: negative interpretation bias towards threat = reject negative-endorse negative; negative interpretation bias away from benign = endorse benign-reject benign. Higher scores represent more intense bias towards negative and away from benign interpretations, respectively.

**Statistical Analysis Plan.** Following the completion of data collection, a double-entry data procedure was used, and discrepancies were corrected. Then, the dataset was screened for errors and outliers. Descriptive statistics were computed and assumptions of normality and linearity were met. Skewness and kurtosis for all variables were acceptable. Rates of missing data were low and missing data was checked for randomness. Pearson's correlations, T-tests, and moderated multiple linear regression analyses were performed in SPSS to address hypotheses. T-tests were used to address questions pertaining to statistical significance of negative and neutral/benign bias scores. Due to low power indicated by small sample size, post-hoc power analyses were completed for T-tests. Pearson's correlations were implemented to examine relationships between bias measures and between bias measures and self- and parent-reported anxiety

disorder symptoms. Moderated multiple linear regression analyses were performed in SPSS to determine whether the relationship between level of negative interpretation bias and anxiety symptoms varied with participant gender and ethnicity. For gender, a categorical moderator, the predictors (negative interpretation bias scores and anxiety symptoms) were centered, and interaction terms were created by calculating the product of centered anxiety symptoms scores and a dummy-coded gender variable (0 = male, 1 = female). For ethnicity, another categorical moderator, centered interaction terms were created determining the product of centered anxiety symptoms and ethnicity. Due to low power indicated by the small sample size in the current study, post-hoc effect size and power analyses were completed (i.e., *Cohen's d* calculation for T-tests, observed statistical power calculation for tests of moderation) and Pearson's correlations were also computed between variables used in moderation analyses.

### Chapter 3: Results

See Table 1 for a summary of sample characteristics (i.e., age, IQ and reading fluency scores, and accuracy on youth version of WSAP). Of note, seven subjects were disqualified due to failure to meet inclusion/exclusion criteria. Within this group, four subjects were disqualified for low accuracy score on the youth WSAP (below 80% valid responses based on response time criteria), two did not have a clinical anxiety disorder diagnosis, and one had a low reading fluency score (below a second grade reading level). Data from these participants is not presented in subsequent analyses.

#### **Diagnostic diversity of sample**

Consistent with expectations, this sample was diagnostically diverse as compared to previous samples of youth used in studies of negative interpretation bias (Bögels et al., 2003; Bögels & Zigterman, 2000; Creswell et al., 2005; Rozenman et al., 2014; Waters, Wharton, Zimmer-Gembeck, & Craske, 2008). As a predominantly internalizing disorder sample, principal diagnoses included: anxiety disorders and OCD, depressive disorders, co-principal anxiety and externalizing disorders, tic disorders, and externalizing disorders. Specifically, all participants had at least one clinical anxiety or OCD diagnosis and many also had a depressive disorder diagnosis and/or externalizing diagnoses (See Table 2 for clinical profile of the sample). As compared to samples used in prior studies, the current study included youth with a broader range of anxiety disorders (i.e., separation anxiety disorder, generalized anxiety disorder, specific phobia, panic disorder, agoraphobia, selective mutism, other specified anxiety disorder) as well as OCD, major depressive disorder, and persistent depressive disorder.

**Negative interpretation biases (via an IM and an EM; replication of Rozenman et al. (2014) study)**

With regard to the display of interpretation biases scores calculated from the EM, clinically anxious youth in the current sample displayed a slight but non-significant negative interpretation bias based on item endorsement on the WSAP (Beard & Amir, 2009; Rozenman et al., 2014). Specifically, anxious youth were likely to endorse (vs. reject) a slightly greater number of associations between ambiguous sentences and negative words. Within the current study, youth endorsed an average of 55% ( $SD = 18\%$ ) of negative word/sentence pairs, evidence of a slight but not statistically significant tendency to endorse (vs. reject) negative associations,  $t(29) = 1.5$ , *ns*, *Cohen's d* = 0.28 (small effect size; may be unable to detect true effects with current sample size.). This result is comparable to findings by Rozenman et al., (2014), who reported an average of a 58% ( $SD = 15\%$ ) endorsement rate of negative word/sentence pairs on average. Also similar to findings by Rozenman et al. (2014), youth in the current study endorsed relatively greater numbers of ( $M = 73\%$ ,  $SD = 12\%$ ) benign word/ambiguous sentence pairs than negative word/ambiguous sentence pairs ( $M = 63\%$ ,  $SD = 15\%$ ) in the Rozenman et al. (2014) study). However, one surprising result was that youth tended to endorse (vs. reject) benign associations ( $M = 22.90$ ,  $SD = 11.57$ ) at a statistically significant level (different than would be expected by chance);  $t(29) = 10.8$ ,  $p < 0.001$ , *Cohen's d* = 1.97 (large effect size).

In terms of negative interpretation biases calculated via the IM, youth displayed a slight tendency to more quickly endorse (vs. reject) threatening interpretations based on reaction time data from the youth WSAP ( $M = 56.75$ ,  $SD = 320.71$ ). However, this effect

was not statistically significant;  $t(29) = 0.68, ns$ ; *Cohen's d* = 0.12 (small effect size; may be unable to detect true effects with current sample size). This is also consistent with results of the prior study implementing the WSAP with anxious youth, in which Rozenman et al. (2014) did not report a significant implicitly measured negative interpretation bias. An additional unexpected finding was that youth displayed a statistically significant benign interpretation (bias towards benign) according to scores calculated from the IM of interpretation bias ( $M = -242.49, SD = 317.23$ );  $t(29) = -4.19, p < 0.001, Cohen's d = 0.76$  (medium effect size).

### **Correlations between negative interpretation scores obtained via explicit, automatic, and implicit measures**

Consistent with hypotheses, negative interpretation bias scores calculated from the implicit measure positively correlated with the negative interpretation bias score calculated via the explicit-personally irrelevant measure ( $r = 0.55, p < 0.01$ ). Additionally, the score computed from the implicit measure of negative interpretation bias also positively correlated with the benign interpretation bias score calculated from the explicit-personally irrelevant measure ( $r = 0.48, p < 0.01$ ) suggesting the possible presence of a response bias on the explicit-personally irrelevant measure of interpretation bias. In order to correct for this, total negative and benign bias scores from the explicit-personally irrelevant measure were corrected for total endorsement (i.e., negative/benign endorsement/total endorsement). Even after this correction was made, negative bias scores were significantly correlated with the negative interpretation bias towards threat, as calculated from the implicit measure of interpretation bias ( $r = 0.40, p < 0.05$ ). Contrary to hypotheses, negative interpretation bias scores computed from the explicit-

personally relevant measure were not significantly correlated with the other negative bias scores. See Table 3 for full Pearson's correlation matrix depicting relationships between interpretation bias scores.

### **Correlation between negative interpretation bias and anxiety disorder symptoms**

Consistent with hypotheses, child-reported total, social, and general anxiety disorder symptoms on the SCARED were positively correlated with the negative interpretation bias score obtained via the explicit-personally relevant measure (child-reported total anxiety symptoms,  $r = 0.45$ ,  $p < 0.05$ ; child-reported social anxiety symptoms,  $r = 0.47$ ,  $p < 0.05$ ; child-reported general anxiety disorder symptoms,  $r = 0.61$ ,  $p < 0.01$ ). Additionally, parent-reported symptoms of social anxiety were negatively correlated with the positive interpretation bias score obtained via the ERM ( $r = -0.53$ ,  $p < 0.05$ ). Contrary to hypotheses, negative interpretation bias scores calculated from the IM and EM failed to correlate with child or parent reported anxiety symptoms. See Table 4 for full Pearson's correlation matrix depicting relationships between interpretation bias scores and child/parent-reported anxiety symptoms.

### **Impact of potential moderators (i.e., gender and ethnicity) on negative interpretation bias and anxiety symptoms**

First, age was examined as a potential confound impacting moderation effects. In terms of gender (63% female in current sample), the average age of females ( $M = 12.42$ ,  $SD = 2.63$ ) and males ( $M = 11.73$ ,  $SD = 2.94$ ) in this sample was not significantly different,  $t(28) = 0.67$ ,  $ns$ . With regard to ethnicity (50% Hispanic in current sample),

Hispanic youth ( $M = 12.93$ ,  $SD = 2.89$ ) were slightly but non-significantly older than Non-Hispanic youth ( $M = 11.13$ ,  $SD = 2.03$ ),  $t(27) = 1.94$ ,  $p = 0.06$ . (See Table 1 for sample characteristics).

Consistent with hypotheses, females reported marginally higher internalizing symptoms (total child reported anxiety symptoms;  $M = 29.72$ ,  $SD = 16.47$ ) than those indicated by males (total child reported anxiety symptoms;  $M = 19.60$ ,  $SD = 11.60$ ),  $t(26) = 1.72$ ,  $p = 0.098$ , *Cohen's d* = 0.33 (small effect size). However, contrary to hypotheses, males ( $M = 0.62$ ,  $SD = 0.15$ ) had significantly greater negative bias scores on the EM ( $M = 0.51$ ,  $SD = 0.19$ ) than females within the current sample,  $t(28) = 2.06$ ,  $p < 0.05$ , *Cohen's d* = 0.71 (medium effect size). Additionally, males ( $M = 181.49$ ,  $SD = 353.23$ ) evidenced a trend toward more intense negative bias scores (towards threat) on the IM than females ( $M = -40.51$ ,  $SD = 291.12$ ) in this sample ( $t(28) = 1.77$ ,  $p = 0.07$ , *Cohen's d* = 0.69 [medium effect size]). None of the other negative interpretation bias scores varied significantly based on gender. Within the current sample, gender did not serve as a moderator of the intensity of negative interpretation bias,  $F$  change (4, 27) = 1.93,  $p = 0.18$ ,  $R^2$  change = 0.06. Of note, statistical power for the above analysis was low (Observed statistical power = 0.14), which may have reduced the ability to detect moderation effects.

Consistent with hypotheses, Hispanic youth ( $M = 30.77$ ,  $SD = 11.45$ ) showed a trend with regard to report of more severe total anxiety symptoms than Non-Hispanic youth ( $M = 20.00$ ,  $SD = 16.37$ ),  $t(25) = 1.96$ ,  $p = 0.06$ , *Cohen's d* = 0.76 (medium effect size). Further, Hispanic youth ( $M = 8.21$ ,  $SD = 4.35$ ) reported more severe GAD symptoms than Non-Hispanic youth did at a trend level ( $M = 4.80$ ,  $SD = 4.92$ ),  $t(27) =$

1.97,  $p = 0.06$ , *Cohen's d* = 0.73 (medium effect size). Additionally, Hispanic youth displayed a significantly greater negative interpretation bias on the IM ( $M = 167.36$ ,  $SD = 343.28$ ) as compared to that of Non-Hispanic youth ( $M = -94.78$ ,  $SD = 269.21$ );  $t(27) = 2.297$ ,  $p < 0.05$ , *Cohen's d* = 0.85 (large effect size). However, within the current sample, ethnicity did not serve as a moderator of the intensity of negative interpretation bias,  $F$  change (4, 26) = 0.98,  $p = 0.33$ ,  $R^2$  change = 0.03. Of note, statistical power for the above analysis was low (Observed statistical power = 0.09), which may have reduced the ability to detect moderation effects. None of the other negative interpretation bias scores varied significantly based on ethnicity.

## Chapter 4: Discussion

This study examined relationships between three different measures of interpretation biases and anxiety symptom severity among a sample of clinically-referred youth with anxiety and other related emotional disorders. While several studies have examined associations between indices of interpretation bias and anxiety in youth, this is the first known study to directly compare different measures of interpretation bias (implicit, explicit-personally irrelevant, and explicit-personally relevant measures) and to look at relationships between three commonly used individual measures of such and anxiety symptomology in a child and adolescent sample. Findings from this study shed light on the inherent measurement-related complexity involved in investigating information processing biases. Due to the small sample size used in this study, results must be interpreted with the assumption that future studies might provide additional insight into phenomena by implementing procedures with a larger sample.

The present investigation replicates several key findings reported in the only other known study of negative interpretation bias in clinically anxious youth using the WSAP (Rozenman et al., 2014). Youth in the current sample were slightly more likely to endorse associations between ambiguous sentences and negative words (vs. reject such associations), indicating a small, but not statistically significant, negative interpretation bias assessed via the explicit-personally irrelevant measure. Similarly, when assessed using the implicit measure, youth displayed a non-significant negative interpretation bias in which they evidenced a slight tendency to more quickly endorse (vs. reject) negative interpretations of ambiguous sentences. This slight negative bias observed on both the EM and the IM is consistent with hypotheses and with results from prior work showing

that clinically anxious youth have a slightly higher than chance likelihood of endorsing (vs. rejecting) associations between negative words and ambiguous sentences (Rozenman et al., 2014). This further supports the information processing theory discussed by Muris and Field (2008) that youth more readily interpret ambiguous situations as negative (Bögels et al., 2003; Bögels & Zigterman, 2000; Miers et al., 2008; Muris & Field, 2008; Muris et al., 2000; Muris et al., 2003; Rozenman et al., 2014; Sportel et al., 2013). Such results also suggest that anxious youth (even those with complex diagnostic comorbidities) are making threat-based assumptions about the world around them, potentially leading to the further propagation of pre-existing anxiety concerns (Muris & Field, 2008; Pine et al., 2007).

The observation that anxious youth in the current sample tended to interpret threat in the face of ambiguity is consistent with previous findings of a negative bias towards threat in children and adults, assessed using IMs and EMs (Amir et al., 2010; Amir et al., 2012; Amir & Taylor, 2012; Beard & Amir, 2009; Beard et al., 2011; In-Albon, Dubi, Rapee, & Schneider, 2009; In-Albon, Klein, Rinck, Becker, & Schneider, 2008; Rozenman et al., 2014). However, data from the present investigation and that conducted by Rozenman et al. (2014) also suggest that anxious youth are not more likely than *chance* to make negative interpretations about less salient or “personally irrelevant” situations. The finding that anxious youth in the present sample did not display a significant implicit or explicit (personally irrelevant) negative interpretation bias is consistent with prior research showing that anxious individuals are more likely to make

threat-based assumptions about situations that pose risk to them *personally* as opposed to those that do not (Beck & Clark, 1988; Blankstein, Flett, Boase, & Toner, 1990; Micco & Ehrenreich, 2008).

Findings that youth displayed a significant tendency to endorse benign interpretations of ambiguous scenarios and to also more quickly endorse proposed associations between benign words and ambiguous sentences suggests that youth displayed a more generalized bias towards benign interpretation as measured via the IM and the EM. These results were unexpected and inconsistent with hypotheses. The diagnostic profile of the current sample may help explain this effect. First, many youth within the current sample reported symptoms of social anxiety and interpersonal worries associated with generalized anxiety, which may have led youth to be more likely to endorse associations in general (benign or threatening) in order to please the examiner in the room or better follow perceived task instructions (Beidel, Turner, & Morris, 1995; Ginsburg, La Greca, & Silverman, 1998; Kearney, 2005). Second, many youth had co-occurring externalizing disorders with symptoms of impulsivity. Perhaps factors such as impulsive responding (i.e., children may have automatically endorsed more often than rejecting) and attention problems during the task (i.e., not attending to stimuli) also affected youth's response patterns. Third, participants in the current study completed computer tasks after finishing a semi-structured interview lasting one to two hours in length. Therefore, fatigue may have played a role in youth's unexpected performance patterns as well.

While a greater tendency to endorse benign associations is consistent with results reported by Rozenman et al. (2014), this pattern has not been observed in the adult literature. Such a discrepancy in the literature raises the question of whether a potential developmental phenomenon might also be playing a role in this process. One possible explanation for this effect is that youth, who are clearly still developing attitudes about the self and the world, do not yet possess stable negative biases. Anxious youth may instead have a slightly greater tendency than non-anxious youth to interpret ambiguous events as negative, but also still retain the ability to readily make neutral associations. In fact, several previous studies have found that negative cognitions are less strongly associated with anxiety in youth (vs. adults), and that when negative interpretations are associated with child anxiety, such associations are weaker than those found in adult samples (Alfano, Beidel, & Turner, 2002; Beidel, 1991; Bögels & Zigterman, 2000; Kendall & Chansky, 1991; Treadwell & Kendall, 1996). Based on evidence from the current study and other recent studies, negative biases might still be developing in youth. This provides hope that early intervention could help to manipulate biases in children, enhancing positive biases and attenuating negative biases before they become stable later in development (Fu, Du, Au, & Lau, 2013; Lau, 2013; Lau et al., 2011; Salemink & Wiers, 2011; Sportel et al., 2013; Telman, Holmes, & Lau, 2013).

Bias scores calculated via the IM and EM of interpretation biases were also positively correlated, suggesting that these measures may tap into a similar cognitive process of initial detection and comprehension of ambiguous situations not necessarily involving the self. Such an explanation follows logic proposed by Muris and Field (2008) and Pine (2007) that cognitive processes underlying specific anxiety disorders (e.g.,

tendency to worry about the unknown, to fear negative evaluation in social situations, to fear specific stimuli, to fear germs) must stem from an automatic and general tendency to process ambiguous information as negative or threatening. Individuals in the current sample who were more likely to quickly endorse negative interpretations in ambiguous situations (on the IM) were also more likely to jump to immediate negative interpretations (connecting the IM to the EM), and to resultantly endorse a greater percentage of negative interpretations overall (on the EM).

Within the present sample, youth's average scores on the explicit-personally irrelevant measure of *benign* bias were also positively correlated with scores on both the implicit measure of *negative* bias and the explicit-personally irrelevant measure of *negative* bias, indicating that those who endorsed *more* relationships between negative words and ambiguous situations also more frequently endorsed associations between benign words and ambiguous situations, and more quickly endorsed (vs. rejected) negative associations via the IM. This response pattern may indicate that anxious individuals in the current sample with a more intense IM negative interpretation bias have a tendency to remain uncertain about how to interpret an ambiguous stimulus (i.e., negatively or benignly), consequently endorsing most proposed relationships. Perhaps this response bias of endorsing more items than not overall indicates deficits in fear learning within this clinically anxious group (Britton et al., 2013; Britton et al., 2011; Lissek et al., 2014).

Previous studies (Britton et al., 2013; Britton et al., 2011; Lissek et al., 2014) have provided support for the idea that anxious individuals (youth and adults) display relatively greater difficulty differentiating between threatening and neutral stimuli when

stimuli contain features of both previously encountered threatening and non-threatening stimuli. Youth in the current study also showed this pattern by frequently endorsing words (benign, threatening) as being related to sentences, regardless of the emotional valence of the words. However, negative bias scores from the IM and the EM of bias remained correlated after negative bias scores from the EM were corrected for total endorsement of relationships between stimuli (threat endorsements / benign + threat endorsements). Despite the fact that negative bias scores computed from the IM were generally positively correlated with overall item endorsement rate (i.e., the tendency to endorse every relationship, whether neutral or threatening), this sustained relationship between negative bias scores on the IM and the EM suggests that the implicit tendency to react more quickly when endorsing (vs. rejecting) threat given ambiguity does predict a tendency to explicitly endorse relationships between ambiguous situations and threatening stimuli.

Importantly, while Rozenman et al. (2014) examined relationships between an IM and an EM of negative interpretation bias in clinically anxious youth, the authors did not administer an explicit-personally *relevant* measure to study participants. Considering that most other studies of interpretation bias in anxious populations implement primarily an ERM, one important innovation of the present study was the examination of relationships between scores on the ERM of interpretation bias, scores obtained via the other two measures, and anxiety symptom severity.

Within the current study, scores on the ERM of negative interpretation bias did not correlate with scores from the IM or EM of bias. However, scores on the ERM of negative interpretation bias were associated with child-reported anxiety symptoms (i.e.,

child-reported total anxiety symptoms, generalized anxiety symptoms, and social anxiety symptoms). One explanation for this finding is that the variability in the anxiety measure (all youth in the sample were clinically anxious) was not great enough to detect subtle anxiety-related differences in bias scores obtained via the IM and the EM, which may reflect processes more distal to subjective report of anxiety symptoms on the SCARED-C/P. Another potential explanation is that ERMs of interpretation biases, and specifically the personally-relevant nature of the questions included in these measures, relate more directly to the experience of anxiety or the perception of one's anxiety-related experience (Muris & Field, 2008). Specifically, the unique association between the ERM of negative interpretation bias and anxiety may be due to the fact that clinically anxious individuals are much more likely to perceive threat in situations directly involving themselves, and less likely to perceive threat from the environment at large. The personally relevant nature of this measure may differentiate it from the other measures of negative interpretation bias (Micco & Ehrenreich, 2008; Miers et al., 2008).

Parent-reported social anxiety symptoms were found to be negatively associated with the positive interpretation bias score on the ERM. This result suggests that those with higher levels of social anxiety (reported by parents) are less likely to interpret personally relevant ambiguous situations as having positive explanations. Prior studies have established that individuals with heightened social anxiety do have a tendency to endorse negative self-statements and have low self-esteem and feelings of self-worth (Cox, Fleet, & Stein, 2004; Ginsburg et al., 1998; La Greca & Stone, 1993). The fear of negative evaluation associated with social phobia along with associated traits of low self-esteem, high self-criticism, and low self-worth have been found to relate to high levels of

pessimism, low levels of optimism, and to depressive symptoms (Anderson & Hope, 2008; Cannon & Weems, 2006; Davis, Hanson, Edson, & Ziegler, 1992; Heinonen, Rääkkönen, & Keltikangas-Järvinen, 2005; Mineka, Watson, & Clark, 1998; Olino, Klein, Lewinsohn, Rohde, & Seeley, 2008). These previous findings are in line with the observation that individuals with heightened social anxiety symptoms in the current sample specifically displayed reduced positive interpretation bias scores on the ERM, or a diminished inclination to make *positive/optimistic* interpretations of personally relevant ambiguous situations.

Few studies have examined gender as a moderator of negative interpretation bias in youth (Gluck et al., 2014; Salemink & Wiers, 2011). Results provided support for the hypotheses that females would report more severe anxiety symptoms, but associations between gender and indices of interpretation bias were mixed. Contrary to hypotheses and results from previous studies (Gluck et al., 2014; Salemink & Wiers, 2011), males actually displayed marginally greater levels of negative interpretation bias measured via the IM and higher bias scores on the EM. These results are puzzling, as prior studies have found females to display more intense negative interpretation bias (Gluck et al., 2014; Salemink & Wiers, 2011).

One possible explanation for this unexpected effect is that males in the current study, which included parent or self-referred clinically anxious youth, may not represent this population more broadly for several reasons. First, youth in the current sample had moderate to severe anxiety diagnoses, often with additional comorbid externalizing and internalizing disorders. Second, the current sample is also more diagnostically diverse than samples from previous studies evidencing gender differences in youth negative

interpretation bias (Gluck et al., 2014; Salemink & Wiers, 2011). Third, a referral bias (i.e., since males tend to endorse less internalizing symptoms those who were referred may have had particularly severe and observable symptom presentations) may have led to males in the current sample having more severe or impairing symptoms of anxiety than those experienced by male youth in the general population. Finally, observed gender-based effects might be influenced by the greater number of females versus males in the current sample ( $n = 19$  females;  $n = 11$  males). Perhaps the male participants in the current study displayed much more severe interpretation bias scores than those possessed by the average males, and results were skewed by this due to small sample size.

The present study is the first to examine relationships between negative interpretation bias and ethnicity in youth. Consistent with hypotheses and prior work demonstrating that Hispanic individuals report more severe internalizing symptoms than Caucasians (Anderson & Mayes, 2010; Cuellar & Roberts, 1997; Joiner et al., 2001; Siegel et al., 1998) and also show heightened cognitive risk factors (i.e., anxiety sensitivity) for anxiety and depression (Pina & Silverman, 2004; Weems et al., 2002), Hispanic children within the current sample reported slightly greater anxiety symptoms and displayed significantly higher scores on the IM of negative interpretation bias compared to Non-Hispanic youth. Although ethnicity did not moderate the relationship between negative interpretation bias and anxiety symptoms, Hispanic youth did display higher levels of negative interpretation bias. Future studies (with a larger sample size) should examine whether ethnicity does in fact moderate the relationship between anxiety and negative interpretation bias in clinically anxious youth. As mentioned, the IM of negative interpretation bias does not predict heightened anxiety symptoms in this sample

overall, which suggests that this approach might be measuring an immediate and automatic process of stimulus detection and interpretation more distal to the subjective experience of anxiety. However, since both anxiety and negative interpretation bias scores on the IM were elevated in Hispanics versus Non-Hispanics, perhaps this implicit tendency to readily interpret ambiguous situations as threatening is stronger and more closely associated with anxiety in Hispanic youth as compared to Non-Hispanic youth.

The present study has a number of strengths. Importantly, high depression and externalizing comorbidity was observed in our sample. Our sample therefore replicates the general population of clinically anxious and depressed youth, approximately 20% of whom demonstrate significant externalizing symptoms or disorders (McConaughy & Skiba, 1993). Additionally, we did not exclude subjects for any anxiety disorder nor OCD, which allowed for the study of a broader sample of youth with internalizing disorders. Also consistent with prevalence rates of disorders within the population, the majority of youth in the current sample presented with GAD or Social Anxiety Disorder. Another strength is that all participants received clinical diagnoses via a well-validated and reliable semi-structured clinical interview using DSM-IV criteria (i.e., ADIS-IV-C/P or ADIS-5-C/P). Lastly, this study utilized three different measures to thoroughly assess an underlying information processing bias hypothesized to closely relate to anxiety symptoms and disorders in a sample of clinically anxious youth.

While the present study contains clear and obvious strengths, study limitations should also be noted. General characteristics of the sample including size and age range may have reduced the statistical strength of results. First, sample size was small ( $N = 30$ ) and other significant findings may have emerged had the sample been larger, as power

was currently limited in the present investigation. Additionally, the current sample contained youth between the ages of 8 and 17 years, which span a large developmental range. With a larger sample, future studies may be better able to parse apart any developmental differences in relationships between key study variables.

Sample characteristics including diagnostic profile and gender distribution serve as additional limitations. While great diagnostic diversity within the study sample serves as a strength, the potential impact of attention problems on youth's performance on study measures could have presented additional error variance. Since individuals with symptoms of ADHD struggle to remain on-task for prolonged periods of time, those individuals in the current sample with attention problems may have had difficulty consistently attending to the task, rendering their performance on tasks measuring negative interpretation bias less representative of their true preferences. Especially when implementing a task like the WSAP, which relies on quick and time-limited performance, attention problems or even significant inattention due to group fatigue may substantially influence results (Rozenman et al., 2014).

Uneven gender distribution within the sample ( $n = 19$  females;  $n = 11$  males), while representative of the prevalence of internalizing disorders in the general population of anxious youth, renders it difficult to make direct comparisons between genders. The limitations imposed by small sample size are particularly important to consider when interpreting gender-related findings that were inconsistent with those reported in prior studies (e.g., heightened negative interpretation bias in males vs. females).

Further, methodological constraints of the current study must also be noted. First, the lack of a control group in the present study makes it difficult to draw conclusions

about whether clinically anxious youth display more intense levels of negative interpretation bias and/or a relatively less intense positive/benign bias as compared to that of non-anxious youth.

Additionally, only subjective self- and parent- report measures of anxiety symptoms were assessed, and the majority of findings were based on relationships between self-reported anxiety symptoms (SCARED-C) and negative interpretation bias scores obtained via the ERM (also a self-report measure). An important factor influencing the choice to use the SCARED-C over the SCARED-P was that internal consistency on most subscales (other than social anxiety subscale) was higher for the SCARED-C than the SCARED-P in the current sample (see methods for internal consistency statistics). However, in order to eliminate inherent biases present when a single informant completes most study measures, future studies should more thoroughly examine associations between anxiety disorder symptoms and measures of interpretation bias by incorporating anxiety ratings from multiple informants.

Future studies should extend these findings to carefully investigate the ways in which clinical profile of a sample can change the conclusions drawn about the relationship between information processes and anxiety disorders. Specifically, many psychopathology studies of both pre-treatment status and post-treatment change use a “clean” sample, which often includes little ethnic, socioeconomic, and diagnostic variability. Such work is important, as it allows researchers to delineate mechanisms of psychopathology and treatment with little extraneous variability that might skew results.

However, that work is missing important variability inherent in the true population of anxious youth, and therefore may not be representative of the population of anxious youth as a whole.

### **Conclusions**

In addition to contributing to the understanding of complexities inherent in the assessment and monitoring of underlying information processing biases in anxious populations, findings from this study also support the importance of precise measurement when attempting to draw conclusions about relationships between psychopathology and underlying cognitive processes. Results of this study suggest that information processing is a multi-faceted process and that current measures of negative interpretation bias may only provide insight into certain components of the phenomenon. Also, important moderators such as gender and ethnicity are imperative to consider, as results from this study suggest that gender and ethnicity influence one's propensity to exhibit more intense levels of negative interpretation bias. Prior to creating and implementing novel treatments aimed at modifying interpretation biases in anxious populations, we must first gain a better understanding of which cognitive processes we evaluate using different measures of interpretation bias, and whether currently used cognitive bias modification programs target the processes most closely impacting anxiety disorder development and maintenance (Amir et al., 2010; Amir & Taylor, 2012; Beard et al., 2011; Lau et al., 2011; Lau et al., 2013; Lothmann et al., 2011).

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## Figures

Figure 1. *Muris & Field's Framework: Several Cognitive Distortions Contributing to Development and Maintenance of Anxiety in Youth (Adapted from Muris & Field, 2008)*

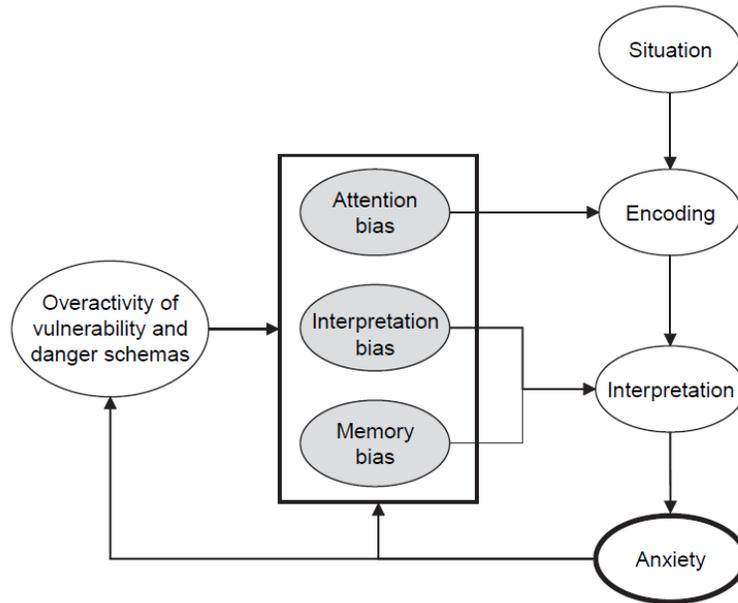


Figure 2. *Pine's Framework: Multiple Neurological, Environmental, and Cognitive Factors contributing to Development of Anxiety (Adapted from Pine, 2007)*

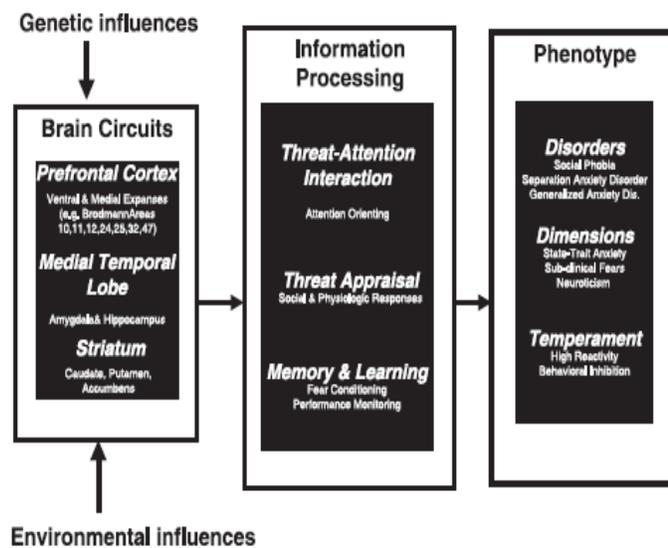
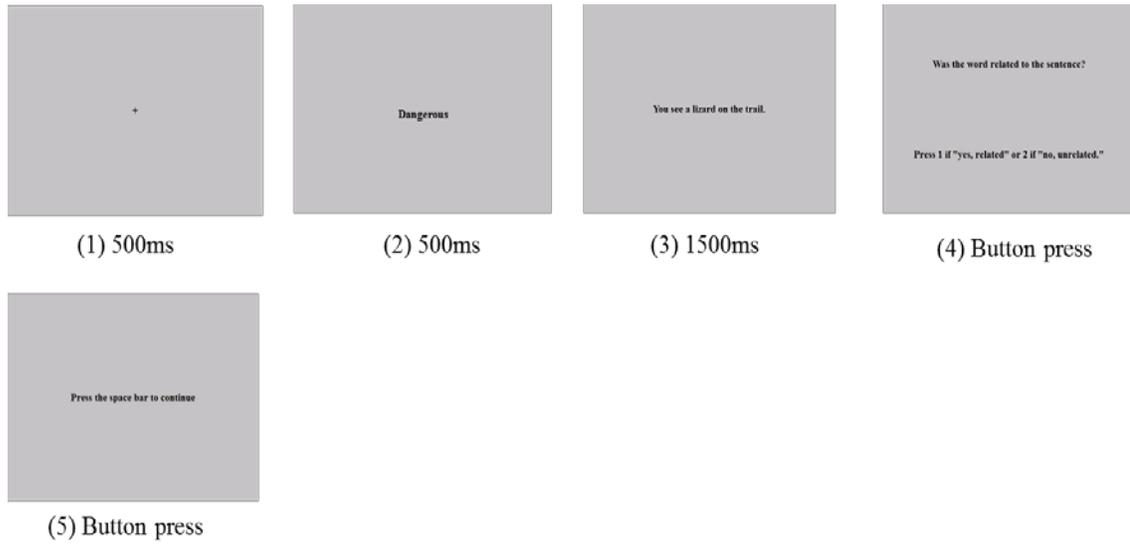


Figure 3: *Example of Word-Sentence Pair Presentation*



## Tables

Table 1. *Summary of Sample Characteristics*

Measure	<i>M</i>	<i>SD</i>
Age	12.17	2.72
IQ	112.77	13.62
Reading Fluency	75.63	30.95
WSAP Accuracy	93%	1.3%

	<i>[ Frequency (%) ]</i>
Gender	
Female	19 (63%)
Male	11 (37%)
Ethnicity	
Hispanic	14 (47%)
Non-Hispanic	15 (50%)
Not reported	1 (4%)
Race	
Asian	2 (8%)
Black	2 (8%)
White	26 (87%)

*Note.* IQ = Intelligence Quotient

Table 2. *Clinical Profile of Sample*

Diagnosis	Frequency (%)
Generalized Anxiety Disorder (GAD)	16 (53%)
Social Anxiety Disorder (SAD)	14 (47%)
Separation Anxiety Disorder (Social Phobia; SocPh)	1 (3%)
Obsessive-Compulsive Disorder (OCD)	4 (13%)
Panic Disorder (PD)	2 (7%)
Agoraphobia (AG)	1 (3%)
Selective Mutism (SM)	1 (3%)
Specific Phobia (SpecPhob)	2 (7%)
Tic Disorder	1 (3%)
Other Specified Anxiety Disorder	3 (10%)
Persistent Depressive Disorder (PDD)	3 (10%)
Major Depressive Disorder (MDD)	2 (7%)
ADHD	4 (13%)
Oppositional-Defiant Disorder (ODD)	4 (13%)
Principal Diagnosis	Frequency (%)
GAD	10 (33%)
Social Anxiety Disorder	6 (20%)
OCD	3 (10%)
AG	1 (3%)
PD	1 (3%)
PDD	1 (3%)
Co-principal Social Anxiety Disorder and GAD	2 (7%)
Co-principal Social Anxiety Disorder and PDD	1 (3%)
Co-principal Social Anxiety Disorder and ODD	1 (3%)
Co-principal Separation Anxiety Disorder and ODD	1 (3%)
ADHD	1 (3%)
Tic Disorder (Tourette's Disorder)	1 (3%)

\* *Note.* Percentages do not add to 100 because most subjects had multiple diagnoses

\* *Note.* All participants with a primary diagnosis other than anxiety/OCD also had at least one clinical anxiety diagnosis.

Table 3  
*Correlation Matrix across Interpretation Bias Scores*

	IM Towards Threat	IM Away Benign	EM Towards Threat	EM Towards Benign	ERM Negative	ERM Positive
IM Towards Threat	1	-.41*	.55**	.48**	-.05	-.02
IM Away Benign		1	-.18	-.49**	-.17	-.06
EM Towards Threat			1	.62**	.25	-.05
EM Towards Benign				1	.11	.11
ERM Negative					1	-.13
ERM Positive						1

\*Note. IM = Implicit measure; EM = Explicit-personally irrelevant measure; ERM = Explicit-personally relevant measure

\* $p < .05$

\*\* $p < .01$

Table 4  
*Bivariate Correlations between Interpretation Bias Scores and Anxiety Symptoms*

	IM Towards Threat	IM Away Benign	EM Towards Threat	EM Towards Benign	ERM Negative	ERM Positive
Child SCARED Total	-.50	-.31	.13	.27	.45*	-.29
Child SCARED GAD	-.05	-.30	-.18	.33	.61**	-.21
Child SCARED Social	.07	-.32	.24	.38*	.47*	-.34
Parent SCARED Total	-.17	.20	-.11	-.12	-.15	-.35
Parent SCARED GAD	-.08	.08	-.13	-.07	-.11	-.38
Parent SCARED Social	-.17	.01	.06	.38*	.09	-.53*

\*Note. SCARED = Screen for Child Anxiety Related Emotional Disorders (parent/child report measure); Total = Total score on SCARED measure; GAD = Generalized Anxiety Disorder subscale; Social = Social Anxiety Disorder Subscale; IM = Implicit measure EM = Explicit-personally irrelevant measure; ERM = Explicit-personally relevant measure

\* $p < .05$

\*\* $p < .$

## Appendix I

### Copies of Measures

#### A. CGI

Severity of Illness:

Considering your total clinical experience with this particular population, how mentally ill is the patient at this time?

#### **NO PSYCHIATRIC ILLNESS**

**SLIGHT:** Psychiatric illness slight, doubtful, or transient; no functional impairment

**MILD:** Little functional impairment; and/or symptoms are mild in severity or intensity

**MODERATE:** Functions with effort; and/or symptoms are moderate in severity or intensity

**MODERATE-SEVERE:** Limited functioning; and/or symptoms are moderate to severe in severity or intensity

**SEVERE:** Functions mainly with assistance; and/or symptoms are very severe or intense

**EXTREMELY SEVERE:** Completely nonfunctional; and/or symptoms are extremely severe or intense

Global Improvement:

Rate improvement whether or not in your judgment improvement is due entirely to treatment. Compared to his/her condition **at admission to the project**, how much has he/she changed?

**VERY MUCH IMPROVED:** Symptoms have markedly improved

**MUCH IMPROVED:** Symptoms have significantly improved

**MINIMALLY IMPROVED:** Symptoms have slightly improved

**NO CHANGE:** Symptoms have not changed for the better or worse

**MINIMALLY WORSE:** Symptoms have slightly worsened

**MUCH WORSE:** Symptoms have significantly worsened

**VERY MUCH WORSE:** Symptoms have markedly worsened

## B. SCARED-C

Below is a list of items that describe how people feel. For each item that describes you, please circle the **2** if the item is **very true or often true** of you. Circle the **1** if the item is **somewhat or sometimes true** of you. If the item is **not true** of you, please circle the **0**. Please answer all of the items as well as you can, even if some do not seem to concern you.

**0 = Not true or hardly ever true, 1 = Somewhat true or sometimes true, 2 = Very true or often true**

1.	When I feel frightened, it is hard to breathe.	0	1	2
2.	I get headaches when I am at school.	0	1	2
3.	I don't like to be with people I don't know well.	0	1	2
4.	I get scared if I sleep away from home.	0	1	2
5.	I worry about other people liking me.	0	1	2
6.	When I get frightened, I feel like passing out.	0	1	2
7.	I am nervous.	0	1	2
8.	I follow my mother or father wherever they go	0	1	2
9.	People tell me that I look nervous.	0	1	2
10.	I feel nervous with people I don't know well.	0	1	2
11.	I get stomachaches at school.	0	1	2
12.	When I get frightened, I feel like I am going crazy.	0	1	2
13.	I worry about sleeping alone.	0	1	2
14.	I worry about being as good as other kids.	0	1	2
15.	When I get frightened, I feel like things are not real.	0	1	2
16.	I have nightmares about something bad happening to my parents	0	1	2
17.	I worry about going to school.	0	1	2
18.	When I get frightened, my heart beats fast.	0	1	2
19.	I get shaky.	0	1	2
20.	I have nightmares about something bad happening to me.	0	1	2
21.	I worry about things working out for me.	0	1	2
22.	When I get frightened, I sweat a lot.	0	1	2
23.	I am a worrier.	0	1	2

24.	I get really frightened for no reason at all.	0	1	2
25.	I am afraid to be alone in the house.	0	1	2
26.	It is hard for me to talk with people I don't know well.	0	1	2
27.	When I get frightened, I feel like I am choking.	0	1	2
28.	People tell me that I worry too much.	0	1	2
29.	I don't like to be away from my family.	0	1	2
30.	I am afraid of having anxiety (or panic) attacks.	0	1	2
31.	I worry that something bad might happen to my parents.	0	1	2
32.	I feel shy with people I don't know well.	0	1	2
33.	I worry about what is going to happen in the future.	0	1	2
34.	When I get frightened, I feel like throwing up.	0	1	2
35.	I worry about how well I do things.	0	1	2
36.	I am scared to go to school.	0	1	2
37.	I worry about things that have already happened.	0	1	2
38.	When I get frightened, I feel dizzy.	0	1	2
39.	I feel nervous when I am with other children or adults and have to do something while they watch me (for example: read aloud, speak, play a game, play a sport.)	0	1	2
40.	I feel nervous about going to parties, dances, or any place where there will be people I don't know well.	0	1	2
41.	I am shy.	0	1	2

### C. SCARED-P

**Directions:**

Below is a list of statements that describe how people feel. Read each statement carefully and decide if it is “Not True or Hardly Ever True” or “Somewhat True or Sometimes True” or “Very True or Often True” for your child. Then for each statement, fill in one circle that corresponds to the response that seems to describe your child for the last 3 months. Please respond to all statements as well as you can, even if some do not seem to concern your child.

	0 Not True or Hardly Ever True	1 Somewhat True or Sometimes True	2 Very True or Often True
1. When my child feels frightened, it is hard for him/her to breathe.	0	1	2
2. My child gets headaches when he/she is at school.	0	1	2
3. My child doesn't like to be with people he/she doesn't know well.	0	1	2
4. My child gets scared if he/she sleeps away from home.	0	1	2
5. My child worries about other people liking him/her.	0	1	2
6. When my child gets frightened, he/she feels like passing out.	0	1	2
7. My child is nervous.	0	1	2
8. My child follows me wherever I go.	0	1	2
9. People tell me that my child looks nervous.	0	1	2
10. My child feels nervous with people he/she doesn't know well.	0	1	2
11. My child gets stomachaches at school.	0	1	2
12. When my child gets frightened, he/she feels like he/she is going crazy.	0	1	2
13. My child worries about sleeping alone.	0	1	2
14. My child worries about being as good as other kids.	0	1	2
15. When he/she gets frightened, he/she feels like things are not real.	0	1	2
16. My child has nightmares about something bad happening to his/her parents.	0	1	2
17. My child worries about going to school.	0	1	2
18. When my child gets frightened, his/her heart beats fast.	0	1	2
19. He/she gets shaky.	0	1	2
20. My child has nightmares about something bad happening to him/her.	0	1	2

	<b>0</b> <b>Not True</b> <b>or Hardly</b> <b>Ever True</b>	<b>1</b> <b>Somewhat</b> <b>True or</b> <b>Sometimes</b> <b>True</b>	<b>2</b> <b>Very</b> <b>True or</b> <b>Often</b> <b>True</b>
21. My child worries about things working out for him/her.	0	1	2
22. When my child gets frightened, he/she sweats a lot.	0	1	2
23. My child is a worrier.	0	1	2
24. My child gets really frightened for no reason at all.	0	1	2
25. My child is afraid to be alone in the house.	0	1	2
26. It is hard for my child to talk with people he/she doesn't know well.	0	1	2
27. When my child gets frightened, he/she feels like he/she is choking.	0	1	2
28. People tell me that my child worries too much.	0	1	2
29. My child doesn't like to be away from his/her family.	0	1	2
30. My child is afraid of having anxiety (or panic) attacks.	0	1	2
31. My child worries that something bad might happen to his/her parents.	0	1	2
32. My child feels shy with people he/she doesn't know well.	0	1	2
33. My child worries about what is going to happen in the future.	0	1	2
34. When my child gets frightened, he/she feels like throwing up.	0	1	2
35. My child worries about how well he/she does things.	0	1	2
36. My child is scared to go to school.	0	1	2
37. My child worries about things that have already happened.	0	1	2
38. When my child gets frightened, he/she feels dizzy.	0	1	2
39. My child feels nervous when he/she is with other children or adults and he/she has to do something while they watch him/her (for example: read aloud, speak, play a game, play a sport.)	0	1	2
40. My child feels nervous when he/she is going to parties, dances, or any place where there will be people that he/she doesn't know well.	0	1	2
41. My child is shy.	0	1	2

#### D. AIBQ: Instructions and Example

In this questionnaire different situations are described which you might have experienced. Written below each situation are three different things a person might think in these sorts of situations. A person will usually have a number of different thoughts as an explanation for a situation.

Imagine **yourself** in the following situations. Using the scale provided, indicate whether each of the three thoughts would pop up in your mind.

#### AN EXAMPLE:

**A few weeks after the beginning of the new school year your teacher (mentor) asks to speak to you.**

**Why does he or she want to speak to you**

He or she wants to tell me that they are very satisfied with my work.

Doesn't pop up in my mind		Might pop up in my mind		Definitely pops up in my mind
1	2	3	4	5

If you circle a 4 here, it means that the thought that the teacher was satisfied with you popped up in your mind.

He or she expected much better work from me and thinks that I need to work harder.

Doesn't pop up in my mind		Might pop up in my mind		Definitely pops up in my mind
1	2	3	4	5

The 3 here means that the thought that the teacher expected better work might have popped up in your mind.

He or she might want to ask me something.

Doesn't pop up in my mind		Might pop up in my mind		Definitely pops up in my mind
(1)	2	3	4	5

The 1 here means that the thought that your school teacher might want to ask you something did not pop up in your mind.

In the end, you believe that one thought is more correct than the other thoughts. If, in the end, you really believe that your school teacher expected better work from you, put a cross next to that thought, as shown below:

**Which thought is most believable?**

• He or she might want to ask me something.	
• He or she expected much better work from me and thinks that I need to work harder.	X
• He or she wants to tell me that they are very satisfied with my work.	

**That was the example. We will now continue with the questionnaire.**

## E. WSAP: Instructions and Example

### Instructions that appear on computer screen, pages 1-5:

#### Page 1:

In this task, you will be asked to read a series of words and sentences and decide if they are related to each other.

#### Page 2:

At the beginning of each trial, a cross will appear in the middle of the screen. Please be sure to look at that cross. Next, a word will appear on the screen for a short period of time. After the word disappears, a sentence will appear. Please read this sentence carefully.

#### Page 3:

Finally, you will be asked whether you thought the word and the sentence were related to each other. If you think they WERE related, you should press #1 on your mouse. If you think they WERE NOT related, you should press #2 on your mouse. Please respond as quickly as possible, while still making your best guess.

#### Page 4:

After you have finished each trial, you will be asked to press the SPACEBAR to continue on to the next one. Do you have any questions about these instructions or about how this task will work?

#### Page 5:

You will begin with some practice trials. Press the SPACEBAR when you are ready to begin.

### Stimuli: Word-Sentence Pairs

ID	Word	Sentence	Type	Category	Endorsed	Socialval
1	Rain	You notice lots of clouds outside.	2	threat	1	2
2	Shade	You notice lots of clouds outside.	1	benign	1	2
3	Offend	Your friend does not call you back.	2	threat	1	1
4	Busy	Your friend does not call you back.	1	benign	1	1
5	Tumor	The doctor examined your growth.	2	threat	1	2
6	Height	The doctor examined your growth.	1	benign	1	2
7	Junk	You find some old clothes.	2	threat	1	1
8	Useful	You find some old clothes.	1	benign	1	1
9	Upset	You feel restless.	2	threat	1	2
10	Active	You feel restless.	1	benign	1	2
11	Cry	You feel upset for no reason.	2	threat	1	2
12	Brief	You feel upset for no reason.	1	benign	1	2
13	Fail	You study for your exam.	2	threat	1	2
14	Prepared	You study for your exam.	1	benign	1	2
15	Ghost	You walk into your dark bedroom.	2	threat	1	2
16	Sleep	You walk into your dark bedroom.	1	benign	1	2
17	My Fault	Your team loses a game.	2	threat	1	1
18	Tough Match	Your team loses a game.	1	benign	1	1
19	Tragedy	You read a newspaper article.	2	threat	1	2
20	Information	You read a newspaper article.	1	benign	1	2
21	Lost	Your dog does not return home.	2	threat	1	2
22	Playing	Your dog does not return home.	1	benign	1	2
23	Conflict	You and your friend start yelling.	2	threat	1	1
24	Cheering	You and your friend start yelling.	1	benign	1	1
25	Panic	You feel detached from your body.	2	threat	1	2
26	Sleepy	You feel detached from your body.	1	benign	1	2
27	Uncomfortable	Your muscles feel tense.	2	threat	1	2
28	Stretch	Your muscles feel tense.	1	benign	1	2
29	Avoid	You are invited to a party.	2	threat	1	1
30	Accept	You are invited to a party.	1	benign	1	1
31	Ignore	A classmate calls your cell phone.	2	threat	1	1
32	Talk	A classmate calls your cell phone.	1	benign	1	1
33	Scary	It is Friday the 13th	2	threat	1	2
34	Superstition	It is Friday the 13th	1	benign	1	2
35	Hopeless	You think about the future.	2	threat	1	2
36	Hopeful	You think about the future.	1	benign	1	2
37	Stress	Your test will be difficult.	2	threat	1	2
38	Study	Your test will be difficult.	1	benign	1	2
39	Nightmare	You wake up.	2	threat	1	2
40	Dream	You wake up.	1	benign	1	2

41	Kidnap	A stranger asks you for help.	2	threat	1	2
42	Directions	A stranger asks you for help.	1	benign	1	2
43	Call-police	Your front door is open.	2	threat	1	2
44	Wind	Your front door is open.	1	benign	1	2
45	Dangerous	You see a lizard on the trail.	2	threat	1	2
46	Small	You see a lizard on the trail.	1	benign	1	2
47	Nerd	You read a book.	2	threat	1	1
48	Student	You read a book.	1	benign	1	1
49	Earthquake	You feel vibration.	2	threat	1	2
50	Music	You feel vibration.	1	benign	1	2
51	Flooded	The floor is wet.	2	threat	1	2
52	Washed	The floor is wet.	1	benign	1	2
53	Blind	You get dust in your eyes.	2	threat	1	2
54	Blink	You get dust in your eyes.	1	benign	1	2
55	Cut	You break a glass.	2	threat	1	2
56	Clean-up	You break a glass.	1	benign	1	2
57	Unhappy	You feel sore and tired.	2	threat	1	2
58	Work-out	You feel sore and tired.	1	benign	1	2
59	Baby	You feel so upset that you cry.	2	threat	1	1
60	Normal	You feel so upset that you cry.	1	benign	1	1
61	Mess-up	Your parents watch you perform.	2	threat	1	1
62	Game	Your parents watch you perform.	1	benign	1	1
63	Blast	You see sparks in the dark.	2	threat	1	2
64	Fireworks	You see sparks in the dark.	1	benign	1	2
65	Theif	Your money is not here.	2	threat	1	2
66	Borrowed	Your money is not here.	1	benign	1	2
67	Bomb	You see a big flash of light.	2	threat	1	2
68	Camera	You see a big flash of light.	1	benign	1	2
69	Outcast	You take a walk alone.	2	threat	1	1
70	Exercise	You take a walk alone.	1	benign	1	1
71	Loner	It is the first day of school.	2	threat	1	1
72	Class	It is the first day of school.	1	benign	1	1
73	Fever	Your face feels sweaty.	2	threat	1	2
74	Exercise	Your face feels sweaty.	1	benign	1	2
75	Argument	You discuss chores with your parent.	2	threat	1	2
76	Responsibility	You discuss chores with your parent.	1	benign	1	2
77	Afraid	You quickly walk outside.	2	threat	1	2
78	Hurry	You quickly walk outside.	1	benign	1	2
79	Exhausted	You lie down.	2	threat	1	2
80	Relaxed	You lie down.	1	benign	1	2
81	Bad	Your mood changes.	2	threat	1	2
82	Indifferent	Your mood changes.	1	benign	1	2
83	Worry	You find it hard to concentrate.	2	threat	1	2
84	Bored	You find it hard to concentrate.	1	benign	1	2
85	Lucky	You did well on an assignment.	2	threat	1	2
86	Proud	You did well on an assignment.	1	benign	1	2
87	On purpose	You said something mean last night.	2	threat	1	1
88	Accident	You said something mean last night.	1	benign	1	1
89	Daily	You look at all your homework.	1	benign	1	2
90	Overwhelmed	You look at all your homework.	2	threat	1	2
91	Light	You plug in the lamp.	1	benign	1	2
92	Electrocute	You plug in the lamp.	2	threat	1	2
93	Excited	Your friend exclaims something loudly.	1	benign	1	1
94	Angry	Your friend exclaims something loudly.	2	threat	1	1
95	Candle	You strike a match.	1	benign	1	2
96	Explosion	You strike a match.	2	threat	1	2
97	Vacation	You are far away from home.	1	benign	1	2
98	Danger	You are far away from home.	2	threat	1	2
99	Traffic	Your parent is late getting home.	1	benign	1	2
100	Car-wreck	Your parent is late getting home.	2	threat	1	2
101	Wind	You hear a noise outside.	1	benign	1	2
102	Danger	You hear a noise outside.	2	threat	1	2
103	Bread	The toaster is hot.	1	benign	1	2
104	Burn	The toaster is hot.	2	threat	1	2
105	Breezy	The wind is blowing outside.	1	benign	1	2
106	Tornado	The wind is blowing outside.	2	threat	1	2
107	Night	You go to bed.	1	benign	1	2
108	Sad	You go to bed.	2	threat	1	2
109	Photograph	Your parent tells you to smile.	1	benign	1	1
110	Unhappy	Your parent tells you to smile.	2	threat	1	1