Anxiety and Differences in Physiological Responding to Ambiguous Situational Vignettes in Adolescents

Donice M. Banks

University of New Orleans, dmbanks1@uno.edu

Follow this and additional works at: https://scholarworks.uno.edu/td

Recommended Citation
Banks, Donice M., "Anxiety and Differences in Physiological Responding to Ambiguous Situational Vignettes in Adolescents" (2016). University of New Orleans Theses and Dissertations. 2244.
https://scholarworks.uno.edu/td/2244

This Dissertation is protected by copyright and/or related rights. It has been brought to you by ScholarWorks@UNO with permission from the rights-holder(s). You are free to use this Dissertation in any way that is permitted by the copyright and related rights legislation that applies to your use. For other uses you need to obtain permission from the rights-holder(s) directly, unless additional rights are indicated by a Creative Commons license in the record and/or on the work itself.

This Dissertation has been accepted for inclusion in University of New Orleans Theses and Dissertations by an authorized administrator of ScholarWorks@UNO. For more information, please contact scholarworks@uno.edu.
Anxiety and Differences in Physiological Responding to Ambiguous Situational Vignettes in Adolescents

A Dissertation

Submitted to the Graduate Faculty of the University of New Orleans in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Applied Developmental Psychology

by

Donice Meriwether Banks

B.S., Louisiana State University, 2005
M.S., University of New Orleans, 2013

December, 2016
ABSTRACT

Research has documented a tendency among some youth to have biased interpretations of ambiguous information. For example, anxious youth are more likely to interpret ambiguous situations as negative or threatening (e.g., Cannon & Weems, 2010). Similarly, when interpreting social cues, aggressive youth exhibit hostile attribution biases more often than non-aggressive youth in response to ambiguous situations (e.g., Crick & Dodge, 1996). A growing body of research suggests that youth with anxiety and aggression exhibit differential physiological reactivity (e.g., heart rate and skin conductance) in response to threat. Despite theoretical predictions, research has yet to examine the linkages amongst physiological reactivity to ambiguous situations, anxiety, and aggression in adolescents. The current study had several interrelated aims. The nature of youths’ physiological responding (i.e., heart rate and skin conductance) to a series of animated vignettes depicting ambiguous social situations was examined. Anxiety, aggression, and hostile attributional bias (HAB) were also tested as predictors of differential physiological responding to the vignettes, as well as the interrelations between anxiety and HAB and aggression and HAB.

Eighty youth (aged 11-17 years; 51% female; 37.5% African American) participated in the study. Youth completed a physiological assessment in which they viewed a series of hypothetical situational vignettes while their heart rate and skin conductance were measured. Participants also completed questionnaires measuring symptoms of anxiety, aggression, and HAB. The results indicated that there was differential physiological responding to the vignettes such that participants’ heart rates showed a pattern of deceleration followed by acceleration across time, as predicted. Skin conductance levels decreased across time, but findings were interpreted with caution due to low variability in the physiological index. Physiological
responses were predicted by HAB such that those with high HAB had higher heart rates and exhibited more pronounced deceleration and acceleration across time than those with low HAB. There was support for anxiety as a significant predictor of responses, but only among those participants with higher levels of HAB such that heart rates remained elevated with very little deceleration across time, suggesting a pattern of physiological hyperarousal and blunted reactivity. However, aggression did not predict differential physiological responding to the ambiguous vignettes, nor did HAB moderate the association between aggression and physiological responding. These findings add to the literature by contributing to knowledge about physiological responding to ambiguous situations and associations between this link with anxiety, aggression, and HAB.

Keywords: heart rate, skin conductance, anxiety, aggression, hostile attributional bias
Anxiety and Differences in Physiological Responding to Ambiguous Situational Vignettes in Adolescents

Introduction

Every day, individuals are faced with ambiguity, such as words that have several possible meanings, others’ facial expressions that are unclear, and social situations that may have various interpretations (Blanchette & Richards, 2003). The process of interpreting and resolving ambiguity is an ongoing and important cognitive task. Ambiguity or uncertainty may lead to situations in which one’s judgment is biased by factors like emotion or emotional states (Blader, 2007), and such emotional states may affect one’s interpretations of events (Blanchette & Richards, 2003). Research suggests that anxiety is associated with a tendency to negatively interpret ambiguous stimuli as threatening (e.g., Barrett, Rapee, Dadds, & Ryan, 1996; Blanchette & Richards, 2003). Theoretically, this tendency makes sense, as anxiety is linked to an attentional bias towards threat (e.g., Cannon & Weems, 2010), and ambiguous stimuli or situations may potentially signify threat as the danger is unknown (Hirsh & Inzlicht, 2008).

Research suggests that anxiety is associated with differences in physiological arousal in response to stimuli that are perceived as threatening (e.g., elevated heart rate, breathing, and skin conductance, low heart rate variability, as well as cortisol differences; e.g., Anderson & Hope, 2009; Carrion et al., 2002; Noteboom, Barnholt, & Enoka, 2001; Scott & Weems, 2014; Weems, Zakem, Costa, Cannon, & Watts, 2005). The literature also suggests that aggression is associated with differential physiological responses to stressful or threatening events (e.g., Bollmer, Harris, & Milich, 2006; Hubbard et al., 2002; Kibler et al., 2004; Ortiz & Raine, 2004). While there are theoretical grounds to suggest that there should be differential physiological reactivity among anxious and aggressive adolescents in response to ambiguous social situations, research has yet
to examine the linkages amongst physiological reactivity to ambiguous situations, anxiety, and aggression in adolescents.

The current study had several related aims. The first of these was to examine nature of youths’ physiological responding (i.e., heart rate and skin conductance) to a series of animated vignettes depicting ambiguous social situations. Background information relative to this aim will be presented in Section 1, which reviews physiological responses to stress and emotional events, measures of such responses, and physiological reactions to ambiguous situations.

The second aim of the study was to assess anxiety as a predictor of differential physiological responding to the vignettes. Section 2 of this document presents information from the literature regarding the physiological reactions to threat that are associated with anxiety. Additionally, this section discusses the cognitive mechanisms underlying anxiety, and, in particular, the interpretive bias associated with anxiety.

The third aim of the study was to assess whether aggression and hostile attributional bias (HAB) predict differential responding to the vignettes. Section 3 reviews background information regarding aggression and physiological reactions to stress and threat. Additionally, information from the literature about social information processing and HAB is presented. The document concludes with the rationale for and description of the study, including a delineation of the study’s hypotheses, the methods used to collect the data, results, and discussion.
1. Physiological Responses to Stressful and Emotional Events

An individual's physiological reaction to stressful or emotional events occurs following the activation of the autonomic nervous system (ANS; Appelhans & Luecken, 2006; Porges et al., 1994; Thayer & Lane, 2000). The ANS is comprised of the sympathetic nervous system (SNS) and the parasympathetic nervous system (PNS). The SNS and PNS innervate several parts of the body (e.g., the heart, larynx, lungs, etc.) and are responsible for both the production of an emotional response (i.e., reactivity) and the regulation of such responses through controlled changes or modulation of emotional response characteristics (i.e., latency, intensity, rise time, magnitude, and duration) through various afferent and efferent neurobiological connections (e.g., vagal-heart connection; Beauchaine, 2000; Porges, Doussard-Roosevelt, & Maiti, 1994; Thayer & Lane, 2000).

Functionally, the ANS is responsible for the maintenance of bodily homeostasis during rest and for the rapid and efficient adaptation to emotional and stressful events that require immediate action (Porges et al., 1994; Thayer & Lane, 2000). Within this process, the SNS prepares the body for increased metabolic output and helps to organize several sub-systems (e.g., cognitive, neurobiological, behavioral) during stressful events. In other words, sympathetic activation aims to mobilize bodily resources to cope with threats or challenges (Dietrich et al., 2007). These responses are accomplished primarily via efferent outputs from “fight or flight” neurological areas of the brain (e.g., amygdala) which have an excitatory effect on the body’s organs (e.g., one’s heart rate is increased). Conversely, parasympathetic influences help to regulate the amount of time and control that the SNS has over the bodily sub-systems during stressful or emotional events and promote restoration of health following threats or challenges during calm or rest states (Dietrich et al., 2007; Porges et al., 1994; Thayer & Lane, 2000). Like
the SNS, this is also accomplished through neurobiological connections, but has an inhibitory effect on the bodily systems (e.g., one's heart rate is decreased).

1.1 Measures of Physiological Response to Stressful and Emotional Events

Researchers have included measures of physiological responses in studies of youth for several years following from theory and data suggesting that over-active or under-active physiological responses are associated with avoidant (flight) and approach (fight) behaviors, respectively (e.g., Culbert, Kajander, & Reaney, 1996; De Young, Kenardy, & Spence, 2007; Porges et al., 1994; Weems et al., 2005). Thus, the extant literature suggests that internalizing and externalizing symptoms or difficulties are differentially associated with physiological responses to stressful or emotional events.

Two of the most commonly measured psychophysiological parameters are heart rate (Goncalves et al., 2015; Pittig, Arch, Lam, & Craske, 2013) and skin conductance level (El-Sheikh, 2005; El-Sheikh et al., 2007; Najström & Jansson, 2006). These more general indicators of physiological states are relatively easy to measure and yield indices of emotional reactions associated with internalizing and externalizing difficulties that are both reliable and valid (Van Lang et al., 2007; Weems et al., 2005).

Heart rate (HR) is a physiological measure that reflects the balance of activity between the SNS and PNS (Dietrich et al., 2007). Previous studies have demonstrated that HR has a good correspondence with self-reported fear & threat (Field & Schorah, 2007; Lang, Melamed, & Hart, 1970; Sartory, Rachman, & Grey, 1977). For example, Field and Schorah (2007) conducted an experiment in which children aged 6-9 were given varied information (i.e., threatening, positive, or none) about three novel animals and were then asked to place their hands into boxes
that the children believed contained each of the animals. The children’s HRs were significantly higher when approaching the box supposedly containing the animal that was associated with threatening information relative to the control animal with no information.

Skin conductance level (SCL) is an index of reactivity within the SNS. It has long been used as a non-verbal measure of cognitive and emotional processes within general psychophysiology, and it is widely accepted as a main technique of measuring an individual’s emotional response to various types of stimuli in research concerning fear and anxiety (Najström & Jansson, 2006). Heightened SCL is thought to be a potential marker of youth’s hypersensitivity to environmental challenges (Boucsein, 1991). Research has shown that heightened SCL in response to laboratory stressors is associated with several psychosocial outcomes, such as shyness and inhibition (Kagan, Reznick, & Snidman, 1987), emotional disorders (Garralda, Connell, & Taylor, 1991), internalizing and externalizing difficulties (El-Sheikh, 2005; El-Sheikh et al., 2007), reactive aggression (Hubbard et al., 2004; Hubbard et al., 2002), and anxiety (Dieleman et al., 2015). For example, Dieleman and colleagues (2015) conducted a study examining the physiological profiles among youth with different anxiety disorders and their non-disordered peers and reported that anxious youth exhibited significantly higher SCL compared to controls during baseline as well as during a stressful math task.

1.2 Physiological Responses to Ambiguous Situations

Despite a growing body of research of the physiological correlates of internalizing and externalizing problems in youth (Bauer, Quas, & Boyce, 2002), there remain gaps within this area of literature. One area that has received very little attention is the physiological response to ambiguous situations. To date, there are only three studies identified in the literature that have
assessed youths’ physiological responses to ambiguous social situations (Chen, Langer, Raphaelson, and Matthews; 2004, Chen & Matthews, 2001; Chen, Matthews, and Zhou, 2007). This series of studies examined the role of psychological interpretations of ambiguous social scenarios in the relationship between low socioeconomic status (SES) and physiological responses among youth. Participants were presented with vignettes in which the outcome of the situation was ambiguous, both in terms of what would happen and the intent of the individual in the story (e.g., browsing in a department store with a very attentive saleswoman watching). The vignettes were either written hypothetical scenarios that were read aloud to participants (Chen & Matthews, 2001) or presented on a computer screen for participants to read (Chen, Matthews, & Zhou, 2007), or were presented in a video (Chen et al., 2004). The ambiguous vignette video used in the Chen et al. (2004) study was professionally directed and edited and lasted just over three minutes. The findings from the studies showed that lower SES was associated with a greater likelihood of making threat interpretations during ambiguous social situations and also with significantly heightened physiological reactivity (i.e., HR and blood pressure increases) to the situations both concurrently in the laboratory and daily life (Chen et al., 2004; Chen, Matthews, and Zhou, 2007) and longitudinally (Chen & Matthews, 2003).

1.3 Summary

The three aforementioned studies of physiological responses to ambiguous situations (Chen & Matthews, 2001; Chen et al., 2004; Chen, Matthews, & Zhou, 2007) suggest that adolescent youth may exhibit heightened physiological responses to ambiguous social situations relative to baseline conditions. However, these studies were examining responding among low SES youth and thus further study is needed among a broader sample of youth to examine the general nature of physiological responding to a series of ambiguous social situations.
Additionally, it is important to examine how anxious individuals respond physiologically to ambiguous social situations. These types of situations are encountered regularly during everyday life. As research suggests that anxious youth and adults tend to appraise ambiguous situations as threatening, these individuals are subject to both frequent and intensified experiences of negative emotions and feelings of threat (e.g., Carthy, Horesh, Apter, & Gross, 2010; Chorpita, Albano, & Barlow, 1996; Richards & French, 1992). In other words, the cognitive biases associated with anxiety may result in the interpretation of ambiguous situations as threatening even when it is not warranted. Further, heightened physiological responses associated with the emotions of distress or impairment may be exacerbated by such cognitive biases (Alfano, Beidel, & Turner, 2002; Weems & Silverman, 2008). The following section presents information from the literature on the physiological reactions to threat that are associated with anxiety and cognitive biases that may result in increased threat interpretations of ambiguous social situations.

2. Physiological Reactions to Threat Associated with Anxiety

Physiological models of anxiety suggest that one defining characteristic of anxiety disorders is a difference in physiological arousal to stimuli, such that responses are intensified (hyperarousal) when threatening stimuli are encountered (Barlow, 2004; Weems et al., 2005). For example, a recent review and meta-analysis by Goncalves and colleagues (2015) found that adult participants diagnosed with anxiety disorders (i.e., social phobia, obsessive-compulsive disorder, panic disorder, specific phobias, acute stress disorder, and posttraumatic stress disorder) exhibited an increase in HR in response to anxiety-provoking stimuli. The activation of the stress response system normally leads to behavioral and physical changes that are adaptive and theoretically improve an organism’s survival ability (Dieleman et al., 2015). However, youth
with anxiety have a tendency to perceive the world as full of stressors demanding vigilance and coping (Sapolsky, 2002), potentially resulting in heightened physiological responses to perceived or actual stressors. In the absence of anxiety, research suggests that the normal pattern of HR and SCL responding to a potential threat is characterized by a decrease initially, which is followed by a subsequent increase corresponding to the actual threat value (Barlow, 2004; Weems et al., 2005). In other words, the presence of a threat or an extreme stressor results in heightened autonomic arousal as part of the fight-or-flight response. In contrast to a normal pattern of arousal in the absence of anxiety, research suggests that individuals with elevated symptoms of anxiety exhibit elevated arousal during baseline periods relative to controls and also exhibit a more pronounced response to stressors (e.g., HR remains elevated following the removal of the stressor; Harrison & Turpin, 2003).

Relative to the research on adult anxiety, there are fewer studies that have investigated emotional and physiological reactivity in anxious children and adolescents (Carthy et al., 2010). Among those studies that have examined youths’ physiological reactivity, there is support for similar physiological hyperarousal in anxious youth. For example, Weems and colleagues (2005) examined a community sample of children and adolescents aged 6–17 years in which youth viewed a film of a large dog (i.e., a mildly phobic stimulus) and physiological responses (i.e., HR and galvanic skin responses) were measured while viewing the film. Results indicated that youth with high levels of anxiety symptoms reacted with significantly higher HRs during and after the film compared to the low-anxiety group. While the mean galvanic skin responses were not statistically significantly different between low and high anxious individuals, the findings do suggest a pattern in which skin conductance responses of high anxious youth were apparently
increasing, while responses among the low anxious youth were either staying the same or decreasing (Weems et al., 2005).

Westenberg and colleagues (2009) assessed physiological responses (i.e., HR and SCL) to a public speaking task, designed to be a condition of social-evaluative threat, in a community sample of adolescents aged 12 to 15 participating in a longitudinal study of social anxiety. Measurements taken between the end of the baseline phase (during which participants watched a nature video) and the speech phase showed that there was a statistically significant increase in both HR and SCL. In addition, HR and skin conductance activity were significantly higher during the speech task relative to the recovery period. At the end of the baseline period, HR was significantly higher than at the end of the recovery period, indicating an anticipation effect; however, contrary to expectations, SCL was lower at baseline than after recovery. Taken together, the findings suggest that participants demonstrated a moderate stress response, as indexed by heightened physiological reactivity, to the public speaking task.

However, not all studies have found such heightened physiological reactivity in anxious youth as in the Weems et al. (2005) and Westenberg et al. (2009) studies. For instance, one study found that there were no significant differences in HR reactivity or blood pressure change between adolescent participants with social anxiety or no disorder when the participants were giving a speech or interacting with another person, despite the fact that the socially anxious adolescents reported higher perceived physiological reactivity (Anderson & Hope, 2009). Similar results were found with regard to HR reactivity when assessed among subclinical socially anxious adolescents and non-anxious controls (Anderson, Veed, Inderbitzen-Nolan, & Hansen, 2010).
These divergent findings in the literature point to two important issues. The first is that perceived arousal does not always correspond with actual arousal. The second issue highlights the importance of assessing more than one measure of physiological reactivity to more accurately determine whether there is an increased physiological response (e.g., HR is regulated by both the SNS and PNS, and these systems have generally opposing functions; Schmitz, Tuschen-Caffier, Wilhelm, & Blechert, 2013). Noting these two issues, Mesa, Beidel, and Bunnell (2014) assessed HR and SCL during a speech and social interaction tasks among adolescents aged 13 to 17 with social anxiety and normal controls. Consistent with some studies of socially anxious adolescents, HR did not differ between the groups during either the speech or social interaction tasks. However, the socially anxious participants did have significantly higher mean SCLs than controls during the speech task. In explaining the findings, the authors noted that the divergent physiological outcomes could result from the different autonomic systems that influence HR and SCL; while both are stimulated by the SNS, HR is also affected by the PNS which generally functions to counter the sympathetic response (Mesa et al., 2014).

Similarly, Schmitz and colleagues (2013) investigated the autonomic characteristics of youth aged 10-12 with high and low levels of social anxiety during baseline, anticipation, a social stress (i.e., speech) task, and recovery phases. A close examination of HR showed that the participants with higher levels of social anxiety manifested higher sympathetic activation during baseline. The results also demonstrated that high socially anxious participants showed a blunted HR reactivity and recovery from the speech task. The finding of a blunted HR reactivity and recovery in response to stressors has been found among adults with social phobia and high-trait anxiety (Pujol et al., 2013; see also meta-analysis by Chida & Hamer, 2008) but has rarely been described in youth with social anxiety (Schmitz et al., 2013). However, this pattern of blunted
reactivity and recovery is in line with theoretical models that propose that anxiety is associated with restricted autonomic flexibility, such that anxious individuals demonstrate tonic hyperarousal during rest which then leads to blunted and inflexible reactivity when coping with threat or a stressor (Friedman, 2007; Thayer & Lane, 2000). Additionally, the ANS is thought to be less effective in regulating the heightened physiological arousal following stressful events which would result in prolonged autonomic arousal and recovery (Santucci et al., 2008; Schmitz, Kramer, Tushen-Caffier, Heinrichs, & Blechert, 2011).

While these studies show that there are some inconsistencies within the findings reported in the literature, overall, the research on ANS functioning in youth with anxiety problems suggests their physiological profiles are characterized by increased SNS activity (e.g., Dietrich et al., 2007; Schmitz et al., 2011; Kossowsky et al., 2012) and decreased parasympathetic control (e.g., Schmitz et al., 2011). This suggests that a response to stress or threat should likely be associated with elevated SCL and HR. Theoretically, individuals with elevated symptoms of anxiety should exhibit differential, elevated physiological reactivity to threatening stimuli (Weems et al., 2005), as anxiety is thought to be characterized by both differences in normal or average autonomic activity and responses to threat compared to individuals with low levels of anxiety symptoms (Barlow, 2004; Weems et al., 2005).

In summary, theory and some research suggest physiological reactivity to stressors among anxious youth should be heightened but the results within the literature are somewhat inconsistent, as previously noted. Some of these discrepant findings may be due to procedural (e.g., the nature of the stressful task) or methodological (e.g., physiological measures) issues. What is still not known is the pattern of physiological reactivity to ambiguous social situations associated with anxiety and aggression.
2.1 Cognitive Mechanisms Underlying Anxiety

According to cognitive and information processing models of anxiety disorders, anxious youth have negatively biased cognitive processing (e.g., Beck, 1976; Knapp & Beck, 2008; Weems & Watts, 2005). The emotional hyperreactivity characteristic of anxiety is theorized to result from biased processing of threat-related information (Beck, Emery, & Greenberg, 1985; Wilson, MacLeod, Mathews, & Rutherford, 2006). There are four broad categories of cognitive biases, including selective attention, memory, interpretive, and judgment biases (Cannon & Weems, 2010). The stages of cognition, which include encoding new information, interpretation of the information, and the recall of prior events, may play a role in the emergence of anxiety (Vasey, Dalgleish, & Silverman, 2003), and have the potential to promote or hinder factors such as learning acquisition, exacerbate biological predispositions to anxiety, and maintain symptoms of anxiety disorders (Weems & Silverman, 2008). These stages of cognition, such as the attention to and appraisal of information or a situation, may be considered the cognitive components of an individual’s effort to regulate an elicited emotion (Esbjørn et al., 2012; Gross & Thompson, 2007). Theoretically, as cognitive biases influence youths’ ways of thinking, interpreting, and judging ability to handle anxiety, these biases may interfere with the successful regulation of the emotion of anxiety and result in heightened anxiety and distress.

Various models have been proposed to illustrate how these biases may operate in youth’s emotional regulation. Weems and Watts (2005) proposed that relations among the cognitive biases function to heighten one’s anxiety and distress. Selective attention biases, or one’s attention towards what he or she perceives to be possibly threatening information in the environment, may promote the selective encoding of threat information into one’s memory and thereby function to increase an individual’s number of negatively biased threat-related memories.
The resulting memory biases may then be internalized in one’s cognitive schemas, and this impact on how one globally views his or her environment may foster interpretive and judgment biases. These associations or connections among the cognitive biases may then serve to heighten anxiety. A memory bias, or existing threat memories, could lead one’s focus towards only the potentially threatening aspect of a situation, while simultaneously directing attention away from safe or benign aspects of the situation. Additionally, a memory bias could result in a biased interpretation of a current situation and then strengthen one’s existing interpretation and judgment biases.

Collectively, the processes operating together both in the short and long term function to produce heightened anxiety and distress which in turn affect one’s behavioral outcomes (Weems & Watts, 2005). This model is in line with Kendall’s (1985) cognitive theory, which postulates that pathological manifestations of anxiety follow from the chronic over-activity of schemas that are centered around themes of vulnerability and danger. Overactive schemas are presumed to focus one’s processing resources on information that may be threat-relevant and result in cognitive distortions (e.g., cognitive biases), which then result in dysfunction and maladaptive thoughts and behaviors (Muris & Field, 2008).
2.2 Biased Interpretation in Anxiety

Of particular relevance to the current study is the interpretive bias. This is characterized by an individual’s predisposition toward disproportionately negative or erroneous interpretations of stimuli or situations that are neutral, ambiguous, or potentially threatening (Weems, Costa, Watts, Taylor, & Cannon, 2007; Weems & Watts, 2005). Negatively biased cognitions, such as those characteristic of interpretive biases, are thought to play a central role in anxiety disorders (Beck, 1976; 1985; Ellis, 1962; Weems & Watts, 2005). Several studies have assessed the presence of an interpretation bias among anxious youth (e.g., Barrett et al., 1996; Bögels & Zigterman, 2000; Bögels, van Dongen, & Muris, 2003; Chorpita et al., 1996; Creswell, Schniering, & Rapee, 2005; Muris, Kindt, Bögels, Merckelbach, Gadet, & Moulard, 2000). Past research has shown that childhood anxiety is associated with a bias toward drawing negative interpretations of ambiguous situations (Barrett et al., 1996; Bögels & Zigterman, 2000; Creswell & O’Connor, 2006), selecting the threat interpretation of ambiguous homophones (Hadwin, Frost, French, & Richards, 1997; Taghavi, Moradi, Neshat-Doost, Yule, & Dalgleish, 2000), and being faster and requiring less information to conclude that ambiguous vignettes will have a threatening conclusion (Muris, Merkelbach, & Damsma, 2000). The findings from these studies consistently indicate that anxious youth have negatively biased and/or threat-related interpretations of hypothetical ambiguous or mildly threatening scenarios compared to their non-anxious peers.

For example, Bell-Dolan (1995) conducted a study of anxious children’s interpretation of social cues. The author reasoned that because anxious individuals have a tendency to over-perceive threat within the environment, challenging situations, such as ambiguous social situations entailing peer provocation, would likely be perceived as threatening. As such, Bell-
Dolan wanted to explore the possibility that anxious youth would be more likely than their non-anxious peers to perceive peer behavior as hostile, threatening, or negative even when such behaviors were not. Fourth and fifth grade participants viewed a series of videotaped vignettes in which the provocateur’s intentions were varied, including hostile, purposeful, and with malice; non-hostile and unintentional; and ambiguous such that the intention was not clear. Following the vignettes, participants were asked a series of questions to assess social-cue interpretation accuracy and bias, causal attribution, and proposed response to the situation. Both anxious and non-anxious youth were accurate at identifying hostile actions; however, anxious youth were more likely to misinterpret non-hostile acts as hostile than the non-anxious youth, and anxious youth were just as likely to perceive hostility in ambiguous situations as they were in the non-hostile situations.

In a study of the association between information processing biases and childhood psychopathology, Reid and colleagues (2006) presented youth aged 8 to 14 with an attention allocation task, a memory recall task, a vignette interpretation measure, and measures of anxiety, depression, and aggression. Interpretation biases were assessed by having participants rate their initial interpretations of the social situations depicted in the vignettes as positive/neutral or as negative. Participants were also asked to choose between four different explanations for each of the hypothetical vignettes, two of which attributed hostile intent toward the peer in the situation and two of which attributed benign intent toward the peer. The results suggested that youth’s interpretations of the vignettes did not differ by anxiety, fear, depression, or aggression scores, but rather that anxiety, fear, depression, and aggression were associated with a number of biases, including hypervigilance for threat-related cues, negative interpretations of social situations, and the perception of hostile intent in peers’ actions. Therefore, the authors postulated that anxiety,
aggression, and depression were all associated with a negative schematic processing style that was present across all processing biases. Beyond the finding of a general negative bias, however, were results indicating that anxiety was specifically associated with attention to threat.

Barrett and colleagues (1996) assessed the presence of a threat interpretive bias by presenting brief stories of ambiguous physical and social situations to youth aged 7 to 14 with clinical levels of anxiety, oppositional defiant disorder, and control youth. Participants were asked what was happening in each situation and which of two possible outcomes (one neutral, one threatening) was more likely. The authors found that anxious and oppositional participants interpreted the ambiguous situations, and in particular the ambiguous social situations, as threatening more frequently than the control youth, providing support for the presence of a threat interpretive bias among both anxious and aggressive youth.

Miers, Blote, Bögels, and Westenberg (2008) conducted a study examining the presence of an interpretation bias among socially anxious adolescents. The authors assessed the attribution process through a series of hypothetical situation presentations and follow-up questions. Participants were presented with descriptions of ten ambiguous situations (five social and five non-social scenarios). Following each situation, participants were presented with three interpretations of the situation (i.e., positive, negative, and neutral) and asked to rate each statement in terms of how likely it is that it would pop up in their mind. Additionally, the participants had to choose which one of the three interpretations they thought was the most believable. Socially anxious adolescents were indeed significantly more likely to provide negative interpretations of social situations and were significantly more likely to believe these negative interpretations than were control participants.
Other researchers have found results similar to those in the above Miers et al. (2008) study. For example, Bögels, Snieder, and Kindt (2003) found that youth aged 7 to 12 who reported high levels of symptoms of social phobia and separation anxiety disorder tended to display negative interpretation biases in response to vignettes that were relevant to their particular types of anxiety (social and separation situations). Huppert and colleagues (2003) measured positive and negative interpretation biases in response to hypothetical ambiguous social situations among participants with social anxiety. The study results showed that the anxious participants interpreted the ambiguous social situations more negatively than did the less anxious participants, and that the degree of the negative interpretation bias for the social situations was related to the severity of participants’ social anxiety. Taken together, the results of these studies suggest that there may be some content specificity associated with negative or threatening interpretive biases among anxious individuals such that they mimic or follow from the particular type of anxiety that the individual is experiencing (Muris, 2010).

Vassilopoulos and Banerjee (2008) conducted a study with participants aged 11 to 13 to examine whether socially anxious youth interpreted mildly negative social events in a catastrophic manner. Participants were presented with eight descriptions of mildly negative social events (e.g., “During arts education, you ask your fellow student for one of his/her crayons, but he/she refuses”), followed by two possible thought interpretations, one of which was a negative judgment about his or herself (e.g., “He/she dislikes me”) and the other was neutral (e.g., “He/she needs to finish painting”). Additionally, participants were asked to rate how likely it was these thoughts would come to mind, how likely they believed it would be to happen to them, and how bad it would be if the event were to occur. The results of the study showed that greater social anxiety was associated with more catastrophic interpretations of the mildly
negative events, and socially anxious youth were more likely to attribute the events to either negative characteristics of themselves or their peers’ negative attitudes towards them. The authors noted that while additional research is needed on the consequences of such interpretations, it would be reasonable to expect that this process of events could elevate anxiety levels by increasing the perception of danger in social situations.

A recent study by Deschenes, Dugas, and Gouin (2015) examined whether participants with generalized anxiety disorder exhibited more negative information processing styles than participants with lower levels of anxiety symptoms following three mood inductions of worry, anger rumination, and relaxation. No differences were found in information processing styles by induction condition, but the participants who met diagnostic criteria for generalized anxiety disorder did have a greater number of threatening interpretations and hostile attributions in response to written ambiguous situational vignettes than did their less anxious counterparts.

2.3 Summary

The studies reviewed in Section 2 indicate that there is evidence of a biased interpretation of threat that is associated with ambiguity among anxious individuals (e.g., Barrett et al., 1996; Bell-Dolan, 1995; Reid et al., 2006). One thing to note that has particular relevance to the present study is that within the anxiety literature, maladaptive interpretations of ambiguous situations or attributions of intent are typically termed threatening (e.g., Barrett et al., 1996) or negative (e.g., Bögels et al., 2003; Miers et al., 2008) rather than being characterized as hostile attributions such as in the study by Deschenes et al. (2015). However, despite the varying terminology, the literature suggests that there is a tendency to negatively interpret ambiguous situations among
anxious individuals and that these interpretations may be characterized by threat or hostile attributions.

The findings from the extant literature also suggest that theoretically, anxiety should predict differential physiological responses to ambiguous situations (e.g., Barlow, 2004; Weems et al., 2005). However, as there are no studies identified that have directly examined this proposition, one of the aims of the current study is to fill this gap in the empirical literature.

The next section of the document will focus on aggression and hostile attributional bias. Within the study of aggression, there is a vast amount of literature that has examined deficits in social information processing and biased interpretations of ambiguous situations. An examination of aggression as a predictor of differential physiological responses to ambiguous situations is warranted, given the research that suggests that aggression is associated with differential physiological responses to stressful or threatening events and a greater tendency to interpret ambiguous social situations as malicious or threatening. Therefore, it is important to determine if anxiety is a unique predictor of physiological responding to ambiguous social situations. The following section will review information regarding physiology and aggression, as well as social information processing and the hostile attributional bias.

3. Physiological Reactions to Stress and Threat Associated with Aggression

A well-replicated finding among youth with externalizing problems is physiological underarousal (e.g., lower resting HR; Dietrich et al., 2007; Lorber, 2004; Ortiz & Raine, 2004). This association may be explained by theories of autonomic underarousal or fearlessness leading to sensation-seeking and disruptive behaviors (Dietrich et al., 2007; Ortiz & Raine, 2004; Raine, 1993). According to the fearlessness theory, low levels of arousal (e.g., HR) are indicative of low
levels of fear; while most people would experience fear and exhibit increased HR in response to an event such as an attack on another individual, the fearlessness theory suggests that this is not the case among aggressive individuals, and thus it has been suggested that aggressive behaviors are related to fearlessness (Raine, 2002). In support of this theory is the finding that high levels of fear have been shown to be protective against the onset of aggressive behavior (Raine, Reynolds, Venables, & Mednick, 1997). By contrast, stimulation or sensation-seeking theory suggests that low physiological levels of arousal are aversive, similar to boredom, and therefore such individuals might engage in behaviors such as aggression to increase physiological arousal back to a homeostatic level (Raine, 2002).

Despite the association between lower resting HR and aggression, there is some research to suggest that in the face of stressful tasks, aggressive behavior problems in youth may be associated with increased physiological reactivity, although the findings are mixed. Some researchers argue that heightened reactivity in the face of threat or provocation promotes aggressive behaviors such that there is a positive association between physiological reactivity to provocation or stress and aggressive behaviors (e.g., Bollmer, Harris, & Milich, 2006; Hubbard et al., 2002). Additionally, it has been suggested that this positive association is more likely to emerge when measuring relatively pure indices of SNS arousal (e.g., skin conductance) as opposed to indices such as HR that are influenced by both the SNS and PNS (Hubbard et al., 2002).

In contrast to the suggestion that aggressive behaviors may be associated with heightened reactivity when encountering threat or provocation, some researchers (e.g., Ortiz & Raine, 2004) have argued that aggressive youth exhibit underarousal or blunted reactivity in the face of stressors or aversive situations. In a meta-analysis, Ortiz and Raine (2004) found that the effect
size for the association between antisocial behavior and HR during a stressor \(d = -0.76\) was nearly twice that of the effect size between antisocial behavior and resting HR \(d = -0.44\).

Kibler, Prosser, and Ma (2004) found in their meta-analysis that HR was negatively associated with misconduct (e.g., externalizing or aggressive behavior) in children and adolescents. Similar findings regarding underarousal have been noted in measures of skin conductance. Both low resting skin conductance (e.g., Beauchaine, Katkin, Strassberg, & Snarr, 2001; Gatzke-Kopp, Raine, Loeber, Stouthamer-Loeber, & Steinhauer, 2002; Kruesi, Hibbs, Zahn, & Keysor, 1992) and blunted skin conductance reactivity (e.g., Harden, Pihl, Vitaro, & Gendreau, 1995; Herpertz et al., 2003) have been positively associated with aggressive behavior.

In sum, while there are some conflicting findings in the literature regarding the nature of physiological responses to stress or threat associated with aggression, the findings do suggest that aggression is associated with differential physiological responses to stressful or threatening events (e.g., Bollmer, Harris, & Milich, 2006; Hubbard et al., 2002; Kibler et al., 2004; Ortiz & Raine, 2004). Therefore, theoretically, aggression should predict differential physiological responding to ambiguous social situations, given that they may be interpreted as threatening or as involving others with hostile intent. The next part of this section will review the social information processing model and the role of the theory of the hostile attributional bias, which concerns interpreting ambiguous situations in an aggressive or negative manner, in the model.

### 3.1 Social Information Processing Model and Hostile Attributional Bias

The Social Information Processing model (SIP; Dodge, 1986; Crick & Dodge, 1994) describes the cognitive processes that are involved in an individual’s social interactions and how these processes contribute to individual variations in attribution style (Boseovski, Lapan, &
Bosacki, 2013). Similar to the manner described above in which the cognitive biases among anxious individuals affect how an individual’s emotional reactivity is processed and the resulting behavior is determined, SIP mechanisms may be viewed as the way in which interactional situations and preexisting thoughts are combined to determine behavior (Kunimatsu & Marsee, 2012).

According to the SIP model, youth in a social situation must successfully negotiate a series of steps of information processing to have competent social interactions (i.e., encoding of situational cues, representation and interpretation of cues, clarification of goals, response construction, response decision, and behavior enactment; Crick & Dodge, 1994). The literature suggests that the principal SIP mechanism underlying the fight or flight system is the attribution of intent (Kunimatsu & Marsee, 2012). Difficulty in social information processing may potentially lead to maladaptive social interaction styles in which youth interpret others’ intentions as malicious or hostile, and this potentially results in inappropriate behavioral responses in retaliation (e.g., Crick & Dodge, 1996; Dodge, McClaskey, & Feldman, 1985).

While the SIP model delineates six steps that occur during processing, the first two steps in the model (i.e., encoding and interpretation of cues) are the most relevant to the current study. Social information processing begins when an individual attends to, encodes, and interprets social cues (Lemerise & Arsenio, 2000). For example, imagine a child who is hit by a ball while walking across the playground. The child must figure out what happened (attention, encoding) and why it happened (interpretation: was it an accident or was it an intentional act by another?). After the encoding of cues (i.e., the first step of the SIP model), the second step of processing entails the mental representation and interpretation of the cues (Dodge et al., 2002). One of these
cue interpretations may involve the presence of hostile intent among peer provocateurs (i.e., hostile attributional bias; Prinstein, Cheah, & Guyer, 2005).

Hostile attributional bias (HAB) is an individual’s tendency to interpret ambiguous situations or provocation as negative and intentional (Dodge, 1986). For instance, a child who has experienced rejection by his or her peers in the past may be more likely to assume that the ambiguous situation of a peer walking by without saying hello is an intentionally negative act compared to a child who has not experienced such peer rejection (e.g., “The child ignored me because he/she was being mean.”). HAB has been termed a type of interpretive bias by some researchers (Hawkins & Cougle, 2013) and has been discussed as an important point in which social, emotional and cognitive information intersect (Nelson & Perry, 2015).

The association between hostile attributions and aggression is well-established (de Castro, Veerman, Koops, Bosch, & Monshouwer, 2002; Kunimatsu & Marsee, 2012). Indeed, research has consistently demonstrated that when interpreting social cues, aggressive youth exhibit HAB more often than non-aggressive youth in response to ambiguous situations (e.g., Crick & Dodge, 1996; Dell Fitzgerald, & Asher, 1987; Dodge, 1980; Dodge & Frame, 1982; Guerra & Slaby, 1989; Hubbard et al., 2010; Nasby, Hayden, & DePaulo, 1980). In other words, aggressive youth have a tendency to attribute malicious intent to a peer more so than other youth and are then more likely to respond in an unkind or aggressive manner than if they were to interpret a peer’s intent as accidental or benign (Crick & Dodge, 1996; de Castro et al., 2002; Dodge, Pettit, Mcclaskey, & Brown, 1986).
3.2 Summary

In summary, the extant literature suggests that aggressive youth have a greater tendency than non-aggressive youth to exhibit HAB, resulting in the biased interpretation of ambiguous social situations as malicious or threatening (e.g., Crick & Dodge, 1996; Dell Fitzgerald, & Asher, 1987; Dodge, 1980; Dodge & Frame, 1982; Guerra & Slaby, 1989; Hubbard et al., 2010; Nasby, Hayden, & DePaulo, 1980). The literature also suggests that aggression is associated with differential physiological responses to stressful or threatening events (e.g., Bollmer, Harris, & Milich, 2006; Hubbard et al., 2002; Kibler et al., 2004; Ortiz & Raine, 2004). Therefore, theoretically, aggression and HAB should predict differential physiological responses to ambiguous social situations.

4. The Present Study

The present study aims to fill gaps in the literature related to physiological responding to ambiguous situations. The results of the few studies that have examined this suggest that adolescent youth may exhibit heightened physiological responses to ambiguous situational vignettes relative to baseline conditions (Chen & Matthews, 2001; Chen et al., 2004; Chen, Matthews, & Zhou, 2007). To address the question of the general pattern of responding to the vignettes, the first aim is to examine whether ambiguous situational vignettes produce a consistent change in physiological responding among participants. Studies that have assessed participants’ subjective feelings of distress in response to vignettes depicting ambiguous situations have found that participants report heightened feelings of distress in response to ambiguous situational vignettes (e.g., Crick, 1995; Crick, Grotz, & Bigbee, 2002). However, only three studies have tested the theory that participants would exhibit differential physiological
responses to ambiguous social scenarios (Chen & Matthews, 2001; Chen et al., 2004; Chen, Matthews, & Zhou, 2007). These studies found that participants exhibited heightened physiological reactivity to the ambiguous situations. There are some important distinctions to note between the aforementioned studies by Chen and colleagues and the present study. The ambiguous situational scenarios presented in the studies by Chen and colleagues were vignettes in which the outcome of the situation was ambiguous, both in terms of what would happen and the intent of the other individual in the story. The ambiguous situational vignettes for use in the present study [i.e., modified version of the Crick (1995) HAB vignettes] entail situations with a negative outcome where the intent of the provocateur is ambiguous. Additionally, this study presented participants with 10 animated and narrated vignettes, in contrast to the use of written vignettes (either read to the participants or by the participants; Chen & Matthews, 2001; Chen et al., 2007) or one video filmed with actors (Chen et al., 2004). Thus, the present study will allow for the examination of physiological responding among a sample of youth to a series of animated and narrated ambiguous situational vignettes entailing a negative outcome and ambiguous intent of the provocateur.

An additional related aim is to test how or if anxiety affects physiological responding to the vignettes. In other words, do anxiety levels predict a stronger physiological response to the ambiguous situations in a series of animated vignettes? Theoretically, anxiety should be associated with differential, elevated physiological reactivity to ambiguous situations. This is because anxiety is thought to be characterized by both differences in normal or average autonomic activity and responses to threat compared to individuals with low levels of anxiety symptoms (Barlow, 2004; Weems et al., 2005). The literature indicates that there is a biased interpretation of threat in response to ambiguity among anxious individuals (e.g., Barrett et al.,
and that symptoms of anxiety result from an interaction between physiological reactions and cognitive biases (Weems et al., 2005). Further, given the tendency among anxious individuals to negatively interpret ambiguous situations and that these interpretations may be characterized by threat or hostile attributions (Bell-Dolan, 1995; Deschenes et al., 2015), the study examines the interrelations between anxiety and HAB.

Finally, this study examines whether aggression and HAB are associated with differential physiological responses to the vignettes. Research suggests that aggression is associated with differential physiological responses to stressful or threatening events (e.g., Bollmer, Harris, & Milich, 2006; Hubbard et al., 2002; Kibler et al., 2004; Ortiz & Raine, 2004) and has consistently demonstrated that aggressive youth exhibit HAB more often than non-aggressive youth when interpreting social cues in ambiguous situations (e.g., Crick & Dodge, 1996; Dell Fitzgerald, & Asher, 1987; Dodge, 1980; Dodge & Frame, 1982; Guerra & Slaby, 1989; Nasby, Hayden, & DePaulo, 1980). Within the literature, assessments of aggressive youths’ subjective feelings of distress in response to the presentation of vignettes depicting ambiguous situations have found that youth do report feeling more distress in response to these situations (e.g., Crick, 1995; Crick et al., 2002). Theoretically, aggression should predict physiological reactivity in response to ambiguous situations, and this association may be moderated by HAB. However, no studies identified within the extant literature have examined physiological responding among aggressive youth with HAB to a series of ambiguous social scenarios.
4.1 Hypotheses

4.1.1 Hypothesis 1: The ambiguous situational vignettes were hypothesized to produce a consistent change in physiological responding among participants. Specifically:

a. Physiological responding while viewing the vignettes would be characterized by an initial deceleration in HR and SCL and a subsequent increase in HR and SCL relative to baseline levels (Barlow, 2004; Weems et al., 2005).

4.1.2 Hypothesis 2: Participants with anxiety would exhibit differential physiological responding to the vignettes relative to control participants. Specifically:

a. Youths’ anxiety symptoms would predict physiological hyperarousal during the vignettes such that higher levels of anxiety would predict less initial physiological (i.e., HR and SCL) deceleration from baseline to video followed by greater physiological acceleration from the video to post-video segments (Weems et al., 2005).

b. The association between anxiety and HR and SCL responses may be moderated by HAB (e.g., Bell-Dolan, 1995; Deschenes et al., 2015).

4.1.3 Hypothesis 3: Aggression and HAB would predict differential physiological responding to the vignettes. Specifically:

a. Higher levels of aggression would predict a blunted response (little to no change in HR and SCL from baseline to the video and post-video segments; Kibler et al., 2004; Ortiz & Raine, 2004) or an increase in HR and SCL (e.g., Bollmer, Harris, & Milich, 2006; Hubbard et al., 2002) from baseline to the video and post-video segments.
b. The association between aggression and HR and SCL responses would be moderated by HAB (e.g., Crick, 1995; Crick et al., 2002).

5. Method

5.1 Participants

Ninety-six youth aged 11-17 were recruited from a metropolitan region of the gulf south of USA and the surrounding areas through the following recruitment procedures: (1) the distribution of flyers throughout the community; (2) announcements made in undergraduate psychology classes at the University of New Orleans; and, (3) advertisements posted on the internet (i.e., Craigslist and Facebook). The flyers and advertisements stated that caregivers and their adolescent(s) were being recruited for a project examining the emotional reactivity of caregivers and their teenage children. Families were eligible to participate if the caregiver had an adolescent child between the ages of 11 and 17. Families were compensated for their time with a small monetary reward for participating in the study, which lasted approximately two and a half hours.

The goal was to recruit a representative community sample, and thus there were no specific exclusion criteria. However, the caregivers of two adolescent participants reported that the youth had a history of a pervasive developmental disorder (i.e., autism and Asperger’s syndrome), and those participants were excluded from analysis in accord with previous research (e.g., Blom, Olsson, Serlachius, Ericson, & Ingvar, 2010). Additionally, per caregiver report, 27% \( (n = 25) \) of participants were currently taking stimulants (e.g., Adderall, Vyvanse, Concerta; \( n = 8 \)), cold/allergy/asthma-related medicine (e.g., Singular, Albuterol pump; \( n = 5 \)), serotonin reuptake inhibitors (SSRIs; e.g., Celexa; \( n = 1 \)), anti-seizure medication (\( n = 1 \)), anti-psychotic medication (\( n = 1 \)), antibiotics (\( n = 2 \)), birth control (\( n = 3 \)), and a natural supplement (i.e.,
Biotin; \( n = 1 \). Two of the caregivers reported that their child was taking multiple types of medication (e.g., stimulants, allergy medicine, SSRIs) and one caregiver did not report the specific medication(s) being taken by their child. Previous research suggests that the use of medications such as stimulants, SSRIs, anti-seizure, and anti-psychotics may affect physiological responding (e.g., Blom et al., 2010), and thus the participants currently taking these medications and the participant whose parent did not report medication information were excluded from further analyses \(( n = 14 \) ). The final sample for the study therefore consisted of 80 youth aged 11-17 \(( M_{age} = 13.88, S_{Dage} = 1.95; 51\% \text{ female} \) ). The participants’ ethnicities were as follows: 37.5% African American \(( n = 30 \) ), 33.8% Euro-American \(( n = 27 \) ), 23.8% other/mixed ethnic background \(( n = 19 \) ), and 5% Hispanic \(( n = 4 \) ). The median annual family income \(( n_{family} = 67 \) ) was between $20,000 and $49,999.

5.2 Measures

5.2.1 Demographic Information. Demographic information was obtained from the caregivers of all participants. This information included age, gender, ethnicity, and family income. Additionally, caregivers were asked to provide information regarding any medications their child or children were currently taking, including the type of medication and last dose of administration.

5.2.2 Anxiety. The Revised Child Anxiety and Depression Scale (RCADS-C; Chorpita, Yim, Moffitt, Umemoto, & Francis, 2000) was used to measure child-reported anxiety symptoms. The measure consists of 47 items that assess the symptoms of anxiety (i.e., generalized anxiety disorder, separation anxiety disorder, social phobia, and panic disorder) and major depressive disorder based on the Diagnostic and Statistical Manual of Mental Disorders-IV (DSM-IV)
criteria (American Psychological Association, 1994) in youth aged 8 to 18 years. Youth are asked to rate how often they experience these symptoms on a four-point scale. Possible responses consist of Never (0), Sometimes (1), Often (2), and Always (3). For this study, the Total Anxiety Score (sum of all five anxiety scales, 37 items) was used. The RCADS has a factor structure that has been demonstrated to be consistent with the DSM-IV anxiety disorders and depression, as well as convergent validity with existing measures of childhood anxiety and depression (Chorpita et al., 2000). The RCADS-C total anxiety scale is reported to have excellent reliability in a sample of youth aged 6 to 17 ($\alpha = .94$; Scott & Weems, 2010). The internal consistency estimate for the Total Anxiety scale in the present study was excellent (Cronbach’s $\alpha = .93$).

5.2.3 Aggressive Behavior. Child-reported aggression was evaluated with the 40-item Peer Conflict Scale – Youth Self-Report (PCS-C; Marsee & Frick, 2007), which assesses the four subtypes of aggression (i.e., reactive relational, reactive overt, proactive relational and proactive overt) in children and adolescents. Youth were asked to rate how true each statement describes him or herself on a 4-point rating scale that consists of 0 (Not at all true), 1 (Somewhat true), 2 (Very true), and 3 (Definitely true). Some example items presented to youth on the PCS-C were: “When I am teased, I will hurt someone or break something” (reactive overt); “When others make me mad, I write mean notes about them and pass the notes around” (reactive relational); “I threaten others to get what I want” (proactive overt); and “To get what I want, I try to steal other’s friends from them” (proactive relational). Higher scores indicate more self-reported aggression. For this study, the PCS-C total aggression score will be used as a global measure of the child’s aggressive behavior.
Internal consistency estimates for the four subscales (coefficient αs = .76 to .90) suggest the PCS is a reliable measure for non-clinical and clinical samples (Marsee & Frick, 2007; Marsee et al., 2011). In a study of 882 youth (high school students, detained youth, residential youth), the PCS showed good factor structure validity and the four subscales were uniquely associated with other measures of delinquency and externalizing problems (Marsee et al., 2011). For the current study, reliability estimates for the four aggression subtype scales were similar to past reports [reactive relational (α = .81), reactive overt (α = .81), proactive relational (α = .84) and proactive overt (α = .73)], and the reliability for the total aggression score was excellent (Cronbach’s α = .92).

5.2.4 Ambiguous Situational Vignettes. Participants viewed a set of animated/narrated vignettes based on a modified version of the Crick (1995) HAB vignettes. Each story involves a situation with a negative outcome (e.g., having milk spilled on your back, not being invited to a party) where the intent of the provocateur is ambiguous. The stories consist of five relational (e.g., seeing two peers whispering and looking at you in the hallway) and five overt (e.g., being bumped from behind and falling into a mud puddle) provocation situations. These stories have demonstrated good reliability for both relational (α = .65-.78) and overt (α = .77-.86) situations (Crick et al., 2002), as well as predictive utility for both the forms (Crick, 1995; Crick et al., 2002) and functions (Crick & Dodge, 1996) of aggression.

In the original stories, the provocateur was described as a ‘kid’, but five of the vignettes (two overt and three relational situations) were modified to be gender specific, two stories involve mixed gender groups (both relational situations), and three (overt situation) stories were kept the same, leaving the gender of the provocateur ambiguous. Additionally, the content of two of the stories was altered to increase salience for the age range being studied. For example, an
original vignette involves bringing a radio to school to show other kids. In the modified vignette, the story contains a cell phone instead of a radio. Another modified story involves seeing a friend receive a text message from someone unknown instead of the original version, which involved seeing a friend playing with someone unknown. Additionally, animation and narration components were added to the vignettes in order to better illustrate the ambiguity of each provocation situation, as well as to control for participants’ reading levels. Previous work using this version of the vignettes found them to be comparable to the written-only version (Kunimatsu, Marsee, Lau, & Fassnacht, 2012).

The youth then were asked to orally answer six questions after each video vignette that assessed their level of hostile attribution in response to each video vignette. The questions ask how likely is it that specific thoughts about the provocateur’s motive will pop into the participant’s mind rated on a 0 to 4 Likert scale with three rating markers (0 = doesn’t pop up in my mind, 2 = might pop up in my mind, 4 = definitely pops up in my mind, where 1 and 3 are intermediate ratings between these three statements). The first question involves a proactive motive for the act (e.g., the boy spilled paint on my project because he wants a better grade than me), the second a reactive motive (e.g., the girl didn’t invite me because she is trying to get back at me for something), and the third is a benign option (e.g., the kids didn’t say anything because they didn’t see me standing there). The fourth question is a forced-choice version of the first three questions and asks participants to pick the thought that they think is most believable. The fifth question assesses overall HAB, asking whether or not participants think that the provocateur was trying to be mean or not trying to be mean (1 = yes, 2 = no). In this study, the possible range of scores for overall HAB is 10-20, with lower scores representing higher levels of HAB.
The final question asks how upset or angry the child would be if this situation had happened to them (0 = *not upset or mad at all*, 1 = *a little upset or mad*, 2 = *very upset or mad*).

In a sample of high school students, Kunimatsu et al. (2012) found the items on this version of the vignettes to demonstrate good to fair internal consistency reliability for each scale (general HAB $\alpha = .56$, proactive motive suspicion $\alpha = .85$, and reactive motive suspicion $\alpha = .85$). Similar reliability estimates were found in the current study (general HAB $\alpha = .53$, proactive motive suspicion $\alpha = .80$, and reactive motive suspicion $\alpha = .75$). The revised vignettes, as well as several screen shots from the animations, can be found in Appendix A.

5.2.5 **Physiological measures.** Physiological measures (i.e., heart rate, respiration, skin conductance, and temperature) were collected and stored on a Dell Studio XPS, Intel Core, 2.67 GHz, 3 GB RAM using Biograph Infiniti software, and raw signals from the physiological sensors were received and transmitted to the computer via the ProComp Infiniti encoder (Myers, 2010). The Biograph Infiniti software was run using a Microsoft Windows 7, 64-bit operating system, and output was automatically stored within a designated file (using only the child’s unique id number) on the computer. Sensors connected to the ProComp Infiniti encoder were attached to participants via specially designed cables, and fiber optic wiring was used to link the sensors to the computer. The electrocardiogram (ECG) sensors (3-lead system) were attached first using UniGel electrodes (pregelled) and were placed on the right (1) and left (1) abdomen (below the rib cage) and at the top of the sternum (1). The respiration band was next strapped around the chest after the participant was asked to fully expand his or her abdomen (i.e., exhale). Lastly, the blood volume pulse sensor was placed on the participant’s middle finger, the galvanic skin response sensors on the index and ring fingers, and the temperature sensor on the baby finger of the child’s non-dominant hand (Scott & Weems, 2014).
5.3 Procedures

Data collection occurred in a university research data collection setting as part of a larger series of studies (Scott, 2013; Scott & Weems, 2014). Youth were instructed if possible to not eat, drink (with the exception of water) or smoke cigarettes at least one hour prior to arriving at the lab. Upon arrival, both parental consent and youth assent were attained for all participants. Participants were brought to a separate room for the physiological assessment. During the assessment, the experimenter followed a scripted protocol. In the first phase of the physiological assessment, the experimenter asked the participant to relax and watch a five-minute film clip of the coral reef and undersea fish (i.e., “Coral Sea Dreaming” film clip; adapted from Piferi, Kline, Younger, and Lawler, 2000). The purpose of this video baseline was to give the participants an opportunity to adjust to the environment as well as to standardize collection of baseline physiological data, which was possible since all of the participants were cognitively engaged in the same task during this first phase. The second phase was a traditional resting baseline procedure. Participants were asked to relax and breathe normally for 5 min. Following the third and fourth assessment phases (i.e., a heart rate control task and mental arithmetic task, respectively), participants viewed the animated vignettes (see Appendix A). The vignettes ranged in length from 10 to 20 seconds, and participants had a 10 second resting baseline before each vignette as well as a 30 second recovery period after each vignette ended. The experimenter then read a series of follow-up questions assessing level of hostile attribution in response to each vignette to the participant and recorded the answers. Once participants had viewed all of the vignettes and answered the follow-up questions, they were escorted to another room to complete the questionnaire packet. After completing the questionnaires, participants and parents were
provided with a debriefing form and had the opportunity to ask questions. Participants were compensated for their time ($20 for youth, $30 for parents).

5.3.1 Data Analytic Strategy

Multilevel modeling was conducted using the software program HLM 7.0 (Raudenbush, Bryk, Cheong, Congdon, & Toit, 2011; see also Bryk & Raudenbush, 1987; Bryk & Raudenbush, 1992) in order to examine individual differences in HR and SCL change (random effects at level-1; repeated observations within the individual) from the baseline physiological recordings (Pre-Video Baseline) to the ambiguous social situational vignettes (Video) and to the post-vignette period (Post-Video). Specifically, five separate time observations (one pre-video, one video, and three 10-second post-video segments) were nested within each of the 10 videos. HLM accommodates the nested nature of the dataset and does not assume that individual observations are independent or that error terms are uncorrelated (Bryk & Raudenbush, 1992). In the HLM models tested, the identifying variable across Level 1 and 2 was the child ID number (i.e., each child received a single unique identification number). In predicting the physiological recordings, time and time squared were Level 1 predictors. The inclusion of the time squared variable as a predictor allowed for the pattern of physiological responding across time to assume a non-linear shape rather than being constrained to a linear shape. Thus, the time squared analysis allowed for the test of physiological responding to assume a pattern characterized by deceleration followed by acceleration. Video and time by video interactions were also included as Level 1 predictors in the appropriate analyses. Anxiety (RCADS-C Total Anxiety), aggression (PCS-C), and hostile attributional bias (HAB scores) were entered as continuous predictors at Level 2; moderation was tested by the significance of the effects of the Level 2 predictors on the Level 1 associations.
5.3.2 Physiological Data Extraction. HR and SCL data from the HAB task (i.e., pre-video resting period, video presentation, and post-video recovery period) were analyzed using the Biograph Infiniti software. Visual inspection of the resulting waveforms of the biometric data suggested that the video display did not interfere with the data collection as the appearance of the waveforms was consistent and continuous. The presence of flat lines across the channels, in contrast, would have indicated a problem with the data transmission and collection.

HR (beats per minute; bpm) was sampled at 2,048 Hz and SCL (Siemens units) was sampled at 256 Hz. The data were then cleaned for artifact. Consistent with previous research (e.g., Hubbard et al., 2002; Weems et al., 2005), HR artifact was defined as responses less than 50 bpm or greater than 170 bpm and SCL responses less than .12 Siemens units and greater than 50 Siemens units. Finally, mean HR and SCL values for each segment (pre-video resting period, video presentation, and post-video recovery period) were calculated for use in the subsequent analyses.

6. Results

6.1 Preliminary Data Analyses

Preliminary examination of the data indicated that all missing data was missing at random. There were no missing data for the self-report measures (RCADS-C Total Anxiety, PCS-C Total Aggression, and overall HAB). Examination of the distributions and scatter plots of the main study variables identified two univariate outliers for the RCADS-C Total Anxiety ($n = 1$) and PCS-C Total Aggression ($n = 1$) scales. Pairwise deletion of cases was used to handle these univariate outliers since different variables were used in each analysis and each case had usable data for other analyses. Potential univariate outliers were also identified among the
physiological outcome variables of skin conductance (pre-vignette resting periods \(n = 11\); vignette presentation periods \(n = 11\); and post-vignette recovery periods \(n = 10\)) and heart rate (pre-vignette resting periods \(n = 2\) and post-vignette recovery period \(n = 1\)). Analyses were conducted both with and without these outliers and the pattern of the results were the same. Thus, the potential physiological univariate outliers were retained for analyses. Multiple regression techniques were used to evaluate multivariate outliers (i.e., calculation of Mahalanobis distances for each case based on the study variables used to test the main hypotheses) and found no evidence of multivariate outliers \(\chi^2(5) = 20.52, p > .001\).

As shown in Table 1 below, The RCADS-C Total Anxiety scores were slightly positively skewed. PCS-C Total Aggression scores were positively skewed as is the case with previous research that has used this measure (Crapanzano, Frick, & Terranova, 2010; Scott, 2013) and thus the variable was not transformed. The means, standard deviations, range, and skewness of the self-report measures (following the exclusion of the two univariate outliers) and of the physiological measures are summarized in Table 1. Skin conductance indices for the pre-vignette resting periods, vignette presentations, and post-vignette recovery periods across the 10 vignettes were also positively skewed, as is common for skin conductance data (e.g., Dawson, Schell, & Filion, 2007; Norris, Larsen, & Cacioppo, 2007). Thus, these scores were transformed using base 10 [\(\log(10)\)] to produce a more normal distribution as recommended within the literature (e.g., Dawson et al., 2007; Venables & Christie, 1980). The skewness of the SCL indices was significantly improved as a result of the log-transformation. However, as show in Table 1, there was very little variability in SCL. In fact, several of the video segments for SCL correlated 1.0. Thus, there was not sufficient variability for confidence in this index of physiological responding; SCL results should be considered in this light and are discussed further below.

<table>
<thead>
<tr>
<th>Measure</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>Min – Max</th>
<th>Skew</th>
</tr>
</thead>
<tbody>
<tr>
<td>RCADS-C Total Anxiety</td>
<td>79</td>
<td>61.88</td>
<td>14.53</td>
<td>38 – 104</td>
<td>.76</td>
</tr>
<tr>
<td>PCS-C Total Aggression</td>
<td>79</td>
<td>10.28</td>
<td>10.44</td>
<td>0.00 – 49.23</td>
<td>1.74</td>
</tr>
<tr>
<td>HAB (Overall)</td>
<td>80</td>
<td>16.39</td>
<td>2.03</td>
<td>13 – 20^a</td>
<td>.08</td>
</tr>
<tr>
<td>Mean Pre-Video HR</td>
<td>77</td>
<td>80.87</td>
<td>9.49</td>
<td>57.10 - 106.87</td>
<td>.04</td>
</tr>
<tr>
<td>Mean Video HR</td>
<td>77</td>
<td>78.54</td>
<td>9.89</td>
<td>55.96 - 105.57</td>
<td>.15</td>
</tr>
<tr>
<td>Mean Post-Video 1 HR</td>
<td>77</td>
<td>79.04</td>
<td>10.37</td>
<td>56.04 - 108.45</td>
<td>.28</td>
</tr>
<tr>
<td>Mean Post-Video 2 HR</td>
<td>77</td>
<td>79.23</td>
<td>10.53</td>
<td>55.73 - 109.15</td>
<td>.26</td>
</tr>
<tr>
<td>Mean Post-Video 3 HR</td>
<td>77</td>
<td>79.28</td>
<td>10.37</td>
<td>55.24 - 107.36</td>
<td>.20</td>
</tr>
<tr>
<td>Mean Pre-Video SCL</td>
<td>74</td>
<td>.41</td>
<td>.35</td>
<td>-.71 - 1.37</td>
<td>-.43</td>
</tr>
<tr>
<td>Mean Video SCL</td>
<td>74</td>
<td>.40</td>
<td>.34</td>
<td>-.71 - 1.36</td>
<td>-.42</td>
</tr>
<tr>
<td>Mean Post-Video 1 SCL</td>
<td>74</td>
<td>.40</td>
<td>.34</td>
<td>-.71 - 1.35</td>
<td>-.41</td>
</tr>
<tr>
<td>Mean Post-Video 2 SCL</td>
<td>74</td>
<td>.40</td>
<td>.34</td>
<td>-.71 - 1.35</td>
<td>-.40</td>
</tr>
<tr>
<td>Mean Post-Video 3 SCL</td>
<td>74</td>
<td>.39</td>
<td>.34</td>
<td>-.71 - 1.35</td>
<td>-.39</td>
</tr>
</tbody>
</table>

*Note: RCADS-C = Revised Child Anxiety and Depression Scale – Child Version; PCS-C = Peer Conflict Scale – Child Version; HAB = hostile attributional bias; ^a = lower scores represent higher HAB; HR, Heart Rate; SCL, Log Transformed Skin Conductance Level.*
Pearson’s correlations were conducted to examine relations across the study variables and are summarized in Table 2.

Table 2. *Pearson’s Correlations for Demographics and Self-Report Measures*

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Age</td>
<td>80</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Gender</td>
<td>80</td>
<td>.00*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Ethnicity</td>
<td>80</td>
<td>.09</td>
<td>.04</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. RCADS-C Total Anxiety</td>
<td>79</td>
<td>-.01</td>
<td>.05</td>
<td>.03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. PCS-C Total Aggression</td>
<td>79</td>
<td>.18</td>
<td>-.23*</td>
<td>.16</td>
<td>.33**</td>
<td></td>
</tr>
<tr>
<td>6. HAB (Overall)</td>
<td>80</td>
<td>-.13</td>
<td>-.02</td>
<td>.31**</td>
<td>.20</td>
<td>.16</td>
</tr>
</tbody>
</table>

Note: **p < .01; * p < .05. * = .002. Gender coded 1 = boy, 2 = girl. RCADS-C = Revised Child Anxiety and Depression Scale – Child Version; PCS-C = Peer Conflict Scale – Child Version; HAB = hostile attributional bias.

6.2 Hypothesis 1: The ambiguous situational vignettes were hypothesized to produce a consistent change in physiological responding among participants.

Multilevel modeling was conducted using HLM 7 to account for the nested nature of the data. Specifically, the HLM analyses nested multiple participant observations in time (level 1) as a function of HR and SCL. HR and SCL were each outcome variables in the model. Time, time squared, video, time by video, and time squared by video (interactions grand-mean centered to
reduce multicollinearity; Tabachnick & Fidell, 2007) were level 1 predictors such that two analyses were run in total.

As summarized in Table 3 and depicted in Figure 1, the results indicated that there was a significant effect of time squared such that participants’ HRs decelerated during the pre- and during video segments, followed by an acceleration in HRs during the post-video segments [coefficient = 0.265, t(3670) = 2.932, p < .01]. A comparison of HR between the earlier and later videos indicated that participants’ HRs were significantly higher during the later videos than the earlier ones [coefficient = 0.354, t(3670) = 2.472, p < .05]. The results indicated that there was no significant interaction between time and video for HR.

The results also indicated a significant negative association between time linearly and SCL [coefficient = -0.003, t(3591) = -2.469, p < .05], such that participants’ SCL decreased across time. Additionally, there was a significant negative association between video and SCL [coefficient = -0.008, t(3591) = -3.230, p = .001], such that SCL decreased across the animated vignettes (see Table 3 and Figure 2). Results indicated that there was no significant interaction between time and video for SCL.

The lack of a significant interaction between time and video for both HR and SCL suggested that there was not differential physiological responding to the earlier versus later videos. Despite differences in levels of responding between earlier and later videos (i.e., overall increases in HR and decreases in SCL in the later videos), as seen in Figures 1 and 2, the pattern of responding to the vignettes was the same across videos for both physiological indices; it was thus possible to collapse the model and remove video as a level 1 factor for parsimony in the subsequent analyses. Additionally, the interactions of time by video and time squared by video
were not included in the subsequent analyses for parsimony given the lack of significant findings associated with the interactions.

Table 3. *Hierarchical Linear Modeling of Time and Video Main Effect*

<table>
<thead>
<tr>
<th>Fixed Effect</th>
<th>Coefficient</th>
<th>SE</th>
<th>t-ratio</th>
<th>df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept, $\beta_0$</td>
<td>80.060</td>
<td>1.789</td>
<td>44.757</td>
<td>74</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Time slope, $\beta_1$</td>
<td>-1.769</td>
<td>0.603</td>
<td>-2.934</td>
<td>3670</td>
<td>0.003**</td>
</tr>
<tr>
<td>Video slope, $\beta_2$</td>
<td>0.354</td>
<td>0.143</td>
<td>2.472</td>
<td>3670</td>
<td>0.013*</td>
</tr>
<tr>
<td>Time$^2$ slope, $\beta_3$</td>
<td>0.265</td>
<td>0.090</td>
<td>2.932</td>
<td>3670</td>
<td>0.003**</td>
</tr>
<tr>
<td>Time x Video slope, $\beta_4$</td>
<td>-0.065</td>
<td>0.093</td>
<td>-0.702</td>
<td>3760</td>
<td>0.483</td>
</tr>
<tr>
<td>Time$^2$ x Video slope, $\beta_5$</td>
<td>0.009</td>
<td>0.015</td>
<td>0.621</td>
<td>3670</td>
<td>0.535</td>
</tr>
<tr>
<td>SCL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept, $\beta_0$</td>
<td>0.445</td>
<td>0.041</td>
<td>10.901</td>
<td>73</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Time slope, $\beta_1$</td>
<td>-0.003</td>
<td>0.001</td>
<td>-2.469</td>
<td>3591</td>
<td>0.014*</td>
</tr>
<tr>
<td>Video slope, $\beta_2$</td>
<td>-0.008</td>
<td>0.002</td>
<td>-3.230</td>
<td>3591</td>
<td>0.001**</td>
</tr>
<tr>
<td>Time$^2$ slope, $\beta_3$</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>-0.424</td>
<td>3591</td>
<td>0.672</td>
</tr>
<tr>
<td>Time x Video slope, $\beta_4$</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>-1.718</td>
<td>3591</td>
<td>0.086</td>
</tr>
<tr>
<td>Time$^2$ x Video slope, $\beta_5$</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>1.922</td>
<td>3591</td>
<td>0.055</td>
</tr>
</tbody>
</table>

Note: **p < .01; *p < .05. HR, Heart Rate; SCL, Log Transformed Skin Conductance Levels.
Figure 1. Average heart rate across all ten vignettes.

Figure 2. Average skin conductance levels across all ten vignettes.
6.3 Hypothesis 2: Participants with anxiety would exhibit differential physiological responding to the vignettes relative to control participants.

Multilevel modeling was conducted using HLM 7. The HLM analyses nested multiple participant observations in time (level 1) as a function of HR and SCL. HR and SCL were each outcome variables in the model. Time and time squared were level 1 predictors such that two analyses were run in total. The variables of age, gender, RCADS-C Total Anxiety (grand-mean centered), PCS-C Total Aggression (grand-mean centered), and overall HAB (grand-mean centered) were level 2 predictors.

As summarized in Table 4, the results did not indicate a significant effect of anxiety levels on HR over time [coefficient = -0.008, \( t(3663) = -1.848, p = .065 \)]. Because anxiety was approaching significance as a predictor of physiological responding, however, the effect was graphed for visual inspection. As seen in Figure 3, the HRs of participants with lower levels of anxiety decelerated during the pre- and during video segments, followed by an acceleration in HRs during the post-video segments. The HRs of participants with higher levels of anxiety were higher than those with lower anxiety; HRs were highest during the pre-video segments, followed by slight deceleration from the pre-video to the second post-video segment and a slight acceleration in HRs from the second to third post-video segments.
Table 4. *Hierarchical Linear Modeling of Time by Anxiety for HR*

<table>
<thead>
<tr>
<th>Fixed Effect</th>
<th>Coefficient</th>
<th>SE</th>
<th>t-ratio</th>
<th>df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HR</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept, $\beta_0$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept, $\gamma_{00}$</td>
<td>93.672</td>
<td>7.957</td>
<td>11.773</td>
<td>69</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Age, $\gamma_{01}$</td>
<td>-1.329</td>
<td>0.509</td>
<td>-2.612</td>
<td>69</td>
<td>0.011*</td>
</tr>
<tr>
<td>Gender, $\gamma_{02}$</td>
<td>4.840</td>
<td>1.974</td>
<td>2.452</td>
<td>69</td>
<td>0.017*</td>
</tr>
<tr>
<td>RCADS-C Anxiety, $\gamma_{03}$</td>
<td>0.025</td>
<td>0.073</td>
<td>0.342</td>
<td>69</td>
<td>0.733</td>
</tr>
<tr>
<td>PCS-C, $\gamma_{04}$</td>
<td>-0.060</td>
<td>0.114</td>
<td>-0.530</td>
<td>69</td>
<td>0.598</td>
</tr>
<tr>
<td>HAB, $\gamma_{05}$</td>
<td>-1.057</td>
<td>0.455</td>
<td>-2.323</td>
<td>69</td>
<td>0.023*</td>
</tr>
<tr>
<td><strong>Time slope, $\beta_1$</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept, $\gamma_{10}$</td>
<td>2.456</td>
<td>2.867</td>
<td>0.856</td>
<td>3663</td>
<td>0.392</td>
</tr>
<tr>
<td>Age, $\gamma_{11}$</td>
<td>-0.303</td>
<td>0.187</td>
<td>-1.618</td>
<td>3663</td>
<td>0.106</td>
</tr>
<tr>
<td>Gender, $\gamma_{12}$</td>
<td>-0.269</td>
<td>0.851</td>
<td>-0.316</td>
<td>3663</td>
<td>0.752</td>
</tr>
<tr>
<td>RCADS-C Anxiety, $\gamma_{13}$</td>
<td>0.049</td>
<td>0.029</td>
<td>1.694</td>
<td>3663</td>
<td>0.090</td>
</tr>
<tr>
<td>PCS-C, $\gamma_{14}$</td>
<td>-0.006</td>
<td>0.036</td>
<td>-0.168</td>
<td>3663</td>
<td>0.867</td>
</tr>
<tr>
<td>HAB, $\gamma_{15}$</td>
<td>0.497</td>
<td>0.200</td>
<td>2.481</td>
<td>3663</td>
<td>0.013*</td>
</tr>
<tr>
<td><strong>Time^2 slope, $\beta_2$</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept, $\gamma_{20}$</td>
<td>-0.349</td>
<td>0.451</td>
<td>-0.774</td>
<td>3663</td>
<td>0.439</td>
</tr>
<tr>
<td>Age, $\gamma_{21}$</td>
<td>0.042</td>
<td>0.030</td>
<td>1.427</td>
<td>3663</td>
<td>0.154</td>
</tr>
<tr>
<td>Gender, $\gamma_{22}$</td>
<td>0.055</td>
<td>0.135</td>
<td>0.406</td>
<td>3663</td>
<td>0.685</td>
</tr>
<tr>
<td>RCADS-C Anxiety, $\gamma_{23}$</td>
<td>-0.008</td>
<td>0.005</td>
<td>-1.848</td>
<td>3663</td>
<td>0.065</td>
</tr>
<tr>
<td>PCS-C, $\gamma_{24}$</td>
<td>&lt;0.001</td>
<td>0.006</td>
<td>-0.069</td>
<td>3663</td>
<td>0.945</td>
</tr>
<tr>
<td>HAB, $\gamma_{25}$</td>
<td>-0.079</td>
<td>0.031</td>
<td>-2.564</td>
<td>3663</td>
<td>0.010**</td>
</tr>
</tbody>
</table>

Note: **p < .01; * p < .05. HR, Heart Rate; RCADS-C Anxiety, Revised Child Anxiety and Depression Scale Total Anxiety Scale; PCS-C, Peer Conflict Scale – Youth Self-Report; HAB, Overall HAB.
Figure 3. Effect of anxiety levels on heart rates over time.

There was a significant effect of anxiety on SCL over time linearly [coefficient = -.001, \(t(3584) = 2.175, p < .05\); see Table 5 and Figure 4]. All of the participants exhibited a decreasing trend in SCL across video segments; however, SCL across segments were higher for those with lower anxiety than higher anxiety.

Table 5. Hierarchical Linear Modeling of Time by Anxiety for SCL

<table>
<thead>
<tr>
<th>Fixed Effect</th>
<th>Coefficient</th>
<th>SE</th>
<th>t-ratio</th>
<th>df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCL Intercept, (\beta_0)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept, (\gamma_{00})</td>
<td>0.665</td>
<td>0.376</td>
<td>1.770</td>
<td>68</td>
<td>0.081</td>
</tr>
<tr>
<td>Age, (\gamma_{01})</td>
<td>-0.018</td>
<td>0.025</td>
<td>-0.719</td>
<td>68</td>
<td>0.474</td>
</tr>
<tr>
<td>Gender, (\gamma_{02})</td>
<td>-0.009</td>
<td>0.087</td>
<td>-0.109</td>
<td>68</td>
<td>0.914</td>
</tr>
</tbody>
</table>
Table 5 (continued)

<table>
<thead>
<tr>
<th>Fixed Effect</th>
<th>Coefficient</th>
<th>SE</th>
<th>t-ratio</th>
<th>df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RCADS-C Anxiety, $\gamma_{03}$</td>
<td>-0.003</td>
<td>0.003</td>
<td>-0.950</td>
<td>68</td>
<td>0.346</td>
</tr>
<tr>
<td>PCS-C, $\gamma_{04}$</td>
<td>&lt;0.001</td>
<td>0.004</td>
<td>-0.065</td>
<td>68</td>
<td>0.948</td>
</tr>
<tr>
<td>HAB, $\gamma_{05}$</td>
<td>0.022</td>
<td>0.022</td>
<td>1.011</td>
<td>68</td>
<td>0.316</td>
</tr>
<tr>
<td><strong>Time slope, $\beta_1$</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept, $\gamma_{10}$</td>
<td>-0.009</td>
<td>0.007</td>
<td>-1.329</td>
<td>3584</td>
<td>0.184</td>
</tr>
<tr>
<td>Age, $\gamma_{11}$</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>0.739</td>
<td>3584</td>
<td>0.460</td>
</tr>
<tr>
<td>Gender, $\gamma_{12}$</td>
<td>&lt;0.001</td>
<td>0.002</td>
<td>-0.249</td>
<td>3584</td>
<td>0.803</td>
</tr>
<tr>
<td>RCADS-C Anxiety, $\gamma_{13}$</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>2.175</td>
<td>3584</td>
<td>0.030*</td>
</tr>
<tr>
<td>PCS-C, $\gamma_{14}$</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>-0.566</td>
<td>3584</td>
<td>0.571</td>
</tr>
<tr>
<td>HAB, $\gamma_{15}$</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>-0.537</td>
<td>3584</td>
<td>0.591</td>
</tr>
<tr>
<td><strong>Time² slope, $\beta_2$</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept, $\gamma_{20}$</td>
<td>0.001</td>
<td>0.001</td>
<td>0.859</td>
<td>3584</td>
<td>0.390</td>
</tr>
<tr>
<td>Age, $\gamma_{21}$</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>-0.574</td>
<td>3584</td>
<td>0.566</td>
</tr>
<tr>
<td>Gender, $\gamma_{22}$</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>-0.236</td>
<td>3584</td>
<td>0.813</td>
</tr>
<tr>
<td>RCADS-C Anxiety, $\gamma_{23}$</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>-1.876</td>
<td>3584</td>
<td>0.061</td>
</tr>
<tr>
<td>PCS-C, $\gamma_{24}$</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>0.188</td>
<td>3584</td>
<td>0.851</td>
</tr>
<tr>
<td>HAB, $\gamma_{25}$</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>0.849</td>
<td>3584</td>
<td>0.396</td>
</tr>
</tbody>
</table>

Note: ** $p < .01$; * $p < .05$. SCL, Log Transformed Skin Conductance Level; RCADS-C Anxiety, *Revised Child Anxiety and Depression Scale Total Anxiety Scale*; PCS-C, *Peer Conflict Scale – Youth Self-Report*; HAB, *Overall HAB.*
Figure 4. Effect of anxiety levels on SCL over time.

The results from the analyses indicated that aggression did not significantly predict HR responding [coefficient = -0.001, \( t(3663) = -0.069, p = .95 \)] or SCL responding [coefficient = -0.001, \( t(3584) = 0.188, p = .85 \)]. However, HAB was a significant predictor of HR responses across time squared [coefficient = -0.079, \( t(3663) = -2.564, p = .01 \); see Table 4 and Figure 5]. The HRs of participants with lower levels of HAB were lower overall than those with higher levels of HAB. Among participants with lower levels of HAB, HRs were highest during the pre-video segments, followed by slight deceleration from the pre-video to the second post-video segment and a slight acceleration in HRs from the second to third post-video segments. Among participants with higher levels of HAB, HRs decelerated during the pre- and during video segments, followed by an acceleration in HRs during the post-video segments.
To examine whether an interaction between anxiety and HAB predicted changes in physiological responding, an HLM analysis was conducted with HR as the outcome variable in the model. Time and time squared were level 1 predictors. The variables of age, gender, RCADS-C Total Anxiety, PCS-C Total Aggression, overall HAB, and RCADS-C by HAB interaction were level 2 predictors. RCADS-C Total Anxiety, PCS-C Total Aggression, overall HAB, and the RCADS-C by HAB interaction were all grand-mean centered (interaction grand-mean centered to reduce multicollinearity; Tabachnick & Fidell, 2007).

There was a significant effect of the interaction between anxiety and HAB on HR across time squared \[\text{coefficient} = 0.003, t(3661) = 2.105, p < .05;\text{ see Table 6}.\] In order to decompose the interaction, conditional moderator (HAB) variables were computed and two new interactions
were computed incorporating each of the conditional moderator variables (Holmbeck, 2002). Two additional HLM models were run to decompose this interaction by calculating the simple slopes (Holmbeck, 2002; see Appendix B for full tables). There was a significant effect of anxiety on HR across time squared in the context of higher levels of HAB [coefficient = -0.014, \( t(3661) = -2.321, p < .05 \)] but not in the context of lower levels of HAB [coefficient = <-0.001, \( t(3661) = -0.093, p = 0.93 \)]. These findings indicate that anxiety influences individuals’ HR response to the vignettes but only for those with high HAB scores. As seen in Figure 6, among those with lower HAB levels, the pattern of HR responding was similar (i.e., deceleration followed by acceleration) between participants with lower and higher levels of anxiety and HR overall was only slightly higher for those with higher anxiety. Among those with higher HAB, participants with lower anxiety levels had HR responses characterized by deceleration from the pre- to first post video segments, followed by acceleration across the subsequent post video segments. Participants with higher anxiety levels and high HAB, by contrast, had higher HR overall and responding was characterized by only slight deceleration across all of the video segments. Thus, individuals with high HAB and high anxiety show little or none of the typical deceleration but instead remain at a heightened HR.

Table 6. Hierarchical Linear Modeling of Time by Anxiety and HAB for HR

<table>
<thead>
<tr>
<th>Fixed Effect</th>
<th>Coefficient</th>
<th>SE</th>
<th>t-ratio</th>
<th>df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR</td>
<td>Intercept, ( \beta_0 )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HR</td>
<td>Intercept, ( \gamma_{00} )</td>
<td>93.657</td>
<td>8.002</td>
<td>11.704</td>
<td>68</td>
</tr>
<tr>
<td>HR</td>
<td>Age, ( \gamma_{01} )</td>
<td>-1.326</td>
<td>0.516</td>
<td>-2.568</td>
<td>68</td>
</tr>
<tr>
<td>HR</td>
<td>Gender, ( \gamma_{02} )</td>
<td>4.816</td>
<td>1.944</td>
<td>2.478</td>
<td>68</td>
</tr>
<tr>
<td>RCADS-C Anxiety, ( \gamma_{03} )</td>
<td>-0.049</td>
<td>0.485</td>
<td>-0.100</td>
<td>68</td>
<td>0.920</td>
</tr>
<tr>
<td>PCS-C, ( \gamma_{04} )</td>
<td>-0.061</td>
<td>0.115</td>
<td>-0.533</td>
<td>68</td>
<td>0.595</td>
</tr>
<tr>
<td>HAB, ( \gamma_{05} )</td>
<td>-1.346</td>
<td>2.009</td>
<td>-0.670</td>
<td>68</td>
<td>0.505</td>
</tr>
</tbody>
</table>
Table 6 (continued)

<table>
<thead>
<tr>
<th>Fixed Effect</th>
<th>Coefficient</th>
<th>SE</th>
<th>t-ratio</th>
<th>df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RCADS-C x HAB, $\gamma_{06}$</td>
<td>0.005</td>
<td>0.031</td>
<td>0.145</td>
<td>68</td>
<td>0.885</td>
</tr>
<tr>
<td>Time slope, $\beta_1$</td>
<td>\hspace{1cm}</td>
<td>\hspace{1cm}</td>
<td>\hspace{1cm}</td>
<td>\hspace{1cm}</td>
<td>\hspace{1cm}</td>
</tr>
<tr>
<td>Intercept, $\gamma_{10}$</td>
<td>2.529</td>
<td>2.858</td>
<td>0.885</td>
<td>3661</td>
<td>0.376</td>
</tr>
<tr>
<td>Age, $\gamma_{11}$</td>
<td>-0.321</td>
<td>0.187</td>
<td>-1.723</td>
<td>3661</td>
<td>0.085</td>
</tr>
<tr>
<td>Gender, $\gamma_{12}$</td>
<td>-0.146</td>
<td>0.839</td>
<td>-0.175</td>
<td>3661</td>
<td>0.861</td>
</tr>
<tr>
<td>RCADS-C Anxiety, $\gamma_{13}$</td>
<td>0.421</td>
<td>0.187</td>
<td>2.248</td>
<td>3661</td>
<td>0.025*</td>
</tr>
<tr>
<td>PCS-C, $\gamma_{14}$</td>
<td>-0.002</td>
<td>0.036</td>
<td>-0.045</td>
<td>3661</td>
<td>0.964</td>
</tr>
<tr>
<td>HAB, $\gamma_{15}$</td>
<td>1.963</td>
<td>0.804</td>
<td>2.440</td>
<td>3661</td>
<td>0.015*</td>
</tr>
<tr>
<td>RCADS-C x HAB, $\gamma_{16}$</td>
<td>-0.023</td>
<td>0.011</td>
<td>-2.106</td>
<td>3661</td>
<td>0.035*</td>
</tr>
<tr>
<td>Time$^2$ slope, $\beta_2$</td>
<td>\hspace{1cm}</td>
<td>\hspace{1cm}</td>
<td>\hspace{1cm}</td>
<td>\hspace{1cm}</td>
<td>\hspace{1cm}</td>
</tr>
<tr>
<td>Intercept, $\gamma_{20}$</td>
<td>-0.360</td>
<td>0.449</td>
<td>-0.802</td>
<td>3661</td>
<td>0.422</td>
</tr>
<tr>
<td>Age, $\gamma_{21}$</td>
<td>0.045</td>
<td>0.030</td>
<td>1.520</td>
<td>3661</td>
<td>0.129</td>
</tr>
<tr>
<td>Gender, $\gamma_{22}$</td>
<td>0.037</td>
<td>0.133</td>
<td>0.275</td>
<td>3661</td>
<td>0.783</td>
</tr>
<tr>
<td>RCADS-C Anxiety, $\gamma_{23}$</td>
<td>-0.064</td>
<td>0.028</td>
<td>-2.266</td>
<td>3661</td>
<td>0.023*</td>
</tr>
<tr>
<td>PCS-C, $\gamma_{24}$</td>
<td>-0.001</td>
<td>0.006</td>
<td>-0.185</td>
<td>3661</td>
<td>0.853</td>
</tr>
<tr>
<td>HAB, $\gamma_{25}$</td>
<td>-0.296</td>
<td>0.120</td>
<td>-2.463</td>
<td>3661</td>
<td>0.014*</td>
</tr>
<tr>
<td>RCADS-C x HAB, $\gamma_{26}$</td>
<td>0.003</td>
<td>0.002</td>
<td>2.105</td>
<td>3661</td>
<td>0.035*</td>
</tr>
</tbody>
</table>

Note: ** $p < .01$; * $p < .05$. HR, Heart Rate; RCADS-C Anxiety, Revised Child Anxiety and Depression Scale Total Anxiety Scale; PCS-C, Peer Conflict Scale – Youth Self-Report; HAB, Overall HAB.
6.4 Hypothesis 3: Aggression and HAB would predict differential physiological responding to the vignettes.

To examine whether aggression and HAB would interact to predict differential physiological responding to the vignettes, two HLM analyses were conducted with HR and SCL as the outcome variables. Time and time squared were level 1 predictors. The PCS-C by HAB interaction was added to the level 2 predictors of age, gender, RCADS-C Total Anxiety, PCS-C Total Aggression, and overall HAB (RCADS-C Total Anxiety, PCS-C Total Aggression, overall HAB, and the PCS-C by HAB interaction were all grand mean centered to reduce multicollinearity; Tabachnick & Fidell, 2007). Results indicated that the aggression by HAB interaction term was not a significant predictor of participants’ HR [coefficient = -0.001, t(3661) = -0.290, p = .77] or SCL [coefficient = <0.001, t(3582) = 0.386, p = .70] across the video segments.
7. Discussion

The present study makes a number of incremental contributions to knowledge about physiological responding to ambiguous situations and associations between this link with anxiety, aggression, and hostile attributional bias. The first aim of the study was to examine whether there is a consistent change in physiological responding (i.e., HR and SCL) among adolescents exposed to a series of animated vignettes depicting ambiguous social situations. This is one of the few studies that have examined physiological responding in youth to a series of ambiguous social scenarios. The ambiguous situational vignettes produced a consistent change in responding such that participants’ HR responses across the vignette segments (pre-video, during the video, and post-video) were characterized by an initial deceleration and subsequent acceleration, as predicted and in line with the extant literature (e.g., Barlow, 2004; Weems et al., 2005).

The finding of physiological responding to the vignettes observed in this study provides support for studies that have found that participants report heightened feelings of distress in response to ambiguous situational vignettes (e.g., Crick, 1995; Crick, Grotpeter, & Bigbee, 2002) and is consistent with previous studies that have examined physiological responses to ambiguous social scenarios (Chen & Matthews, 2001; Chen et al., 2004; Chen et al., 2007). This study’s findings extend the previous research by demonstrating a consistent pattern of physiological responding among a broad sample of community youth in response to a series of animated and narrated situational vignettes with a negative outcome where the intent of the provocateur is ambiguous. The nature of these video vignettes has advantages over previous approaches used to measure cognitive appraisals that have often relied on written hypothetical scenarios (Crick, 1995). Written vignettes have limitations associated with them such as susceptibility to
differences in participants’ reading ability and ability to visualize the scenarios (Chen et al., 2004). These vignettes provide participants with visual and auditory cues that may enhance comprehension and increase participants’ ability to imagine themselves in the hypothetical situation being presented. Additionally, the vignettes have the benefit of ease of administration. Thus, the results of this study indicate that these animated and narrated vignettes have potential utility as a standardized method for assessing individuals’ physiological reactivity to ambiguous situational scenarios.

The SCL responses to the vignettes were contrary to predictions. The pattern of participants’ responding was characterized by a linear decrease in participants’ SCL across time rather than by initial deceleration and subsequent acceleration as hypothesized. However, given the low variability in the SCL indices in this study, it is likely that there was not sufficient variation to detect potential changes in physiological responding from this measurement and the findings with regard to this physiological index should be interpreted with caution. Within the literature on physiological responding, one noted limitation is that the use of only one measure of reactivity, such as only HR, may potentially obscure important information regarding reactivity since different indices of physiological responses do not always follow the same response pattern (Schommer, Hellhammer, & Kirschbaum, 2003). Thus, given the potential benefit from the inclusion of more than one measure of reactivity and the low SCL variability in this study that limited confidence in this index, future studies should seek to replicate these findings in a sample with greater SCL variability.

There was support for anxiety as a significant predictor of responses among participants with higher levels of HAB. Similar to the pattern of HR responding observed among participants with higher anxiety in the absence of the moderating effect of HAB, the pattern of HR
responding among these participants with high anxiety and HAB levels was characterized by elevated physiological reactivity (i.e., HRs remained elevated across the video segments) and by very slight deceleration from baseline to the post-video segments (i.e., prolonged autonomic arousal and recovery, which may be indicative of blunted HR reactivity and recovery from viewing the vignettes). This is in line with theory suggesting that anxiety should be associated with elevated physiological reactivity to ambiguous situations (Barlow, 2004; Weems et al., 2005), as well as with studies demonstrating that anxiety is associated with both a tendency to interpret ambiguous stimuli as threatening (e.g., Barrett, Rapee, Dadds, & Ryan, 1996; Blanchette & Richards, 2003) and exhibit heightened HRs in response to tasks perceived as stressful or threatening (e.g., Weems et al., 2005; Westenberg et al., 2009). The pattern of prolonged autonomic arousal and recovery is similar to patterns of responding to stressors among anxious individuals found in previous research (Harrison & Turpin, 2003) and is in accord with models of anxiety suggesting that anxiety is associated with restricted autonomic flexibility (Friedman, 2007; Thayer & Lane, 2000). However, high anxious participants with high HAB exhibited a pattern of HR responding that was more restricted than that exhibited only under conditions of high anxiety, such that there was less deceleration and an absence of acceleration. Comparing this pattern of responding to that produced by high anxiety alone suggests that high anxiety interacted with high HAB to produce a more intense physiological reaction to the vignettes. Theoretically, this pattern of responding may suggest that these anxiety was associated with a tendency to view the vignettes as threatening, and that to some degree, anxious individuals limited attending to the video (as suggested by the slight deceleration after baseline; Kuniecki, Barry, & Kaiser, 2003; Schwerdtfeger, 2006) and had difficulty regulating heightened arousal to the vignettes (as suggested by the restricted reactivity patterns; Friedman, 2007;
Santucci et al., 2008; Schmitz et al., 2011; Thayer & Lane, 2000). However, these participants also experienced more intense physiological responding due to the bias (i.e, HAB) to interpret the vignettes as involving hostile intent on the part of the provocateur. Indeed, the pattern of responding characterized by greater HR deceleration among high HAB participants suggests physiologically that they are attending to the vignettes more so than those with low HAB (Kuniecki et al., 2003; Palomba, Angrilli, & Mini, 1997), presumably following from the greater negative and hostile bias associated with higher levels of HAB. Thus, the effect of high anxiety levels accompanied by high HAB levels function to produce a more intense physiological reaction to the ambiguous situational vignettes than is produced by anxiety alone. This finding extends the research on threat interpretations of ambiguous situations associated with anxiety and physiological hyperarousal in response to stimuli perceived as threatening by suggesting there is differential, heightened physiological reactivity associated with anxiety and HAB.

While the results of this study did not find that anxiety alone significantly predicted participants’ HR responses, the pattern of physiological responses by anxiety was in accord with both theoretical models of anxiety and findings within the extant literature. This warrants further examination and future research should seek to replicate this finding. Anxiety did significantly predict a linear decrease in SCL across the video segments, but contrary to predictions, SCL was lower among those with higher anxiety compared to participants with lower anxiety. As previously mentioned, though, the low variability in SCL limits confidence in this index and results should be interpreted with caution.

The study also assessed whether aggression predicted differential responding to the vignettes and whether HAB would moderate an association between aggression and physiological responding. Contrary to predictions, aggression did not predict differential
physiological responding to the ambiguous vignettes, nor did HAB moderate the association between aggression and responding. Based on the results of the study, one explanation for these non-significant findings is that HAB is a more direct predictor of physiological responding than aggression. Another consideration is that participants’ aggression scores were low in this sample, and this may have precluded the likelihood of finding results that would otherwise be significant among participants with higher levels of aggression. Additionally, some studies have found that individuals with lower levels of aggression tend to shift towards less hostile attributions or “benign attributional bias” following a threat induction (Dodge & Somberg, 1987; Williams et al., 2003). It is possible that the low levels of aggression among participants in this study may have resulted in such a shift. Further research including participants with higher aggression levels is warranted to explore possible associations between aggression, HAB, and corresponding physiological responses to ambiguous social situations.

This study’s contributions to the existing literature must be considered in light of its limitations. First, there was very little variability in SCL, thereby limiting confidence in this index of physiological responding. Additionally, the cross-sectional design of the study precludes directional or causal interpretations of the findings. In terms of participants, the goal was to recruit a representative community sample. While the results of the study are informative with regard to a community sample, the findings may not generalize to clinical populations. One possibility for future research would be to replicate these findings with a clinic-referred sample of youth. Finally, the sample size may not have been large enough to detect small between- and within-group effect sizes of the larger HLM models reported in the present study. Thus, future research testing these models using a larger sample size may detect effects not found in the current study.
Despite the limitations, this study makes a number of important contributions to the literature. First, the study adds to the scant amount of literature that has examined physiological responding in youth to a series of ambiguous social scenarios and suggests that there is consistent change in physiological responding to the ambiguous situational vignettes. Second, the finding that the vignettes used in this study do produce a physiological response suggests that these animated vignettes have potential utility for use in future research. Third, the study is the first identified in the literature to examine pattern of physiological reactivity to ambiguous social situations associated with anxiety, aggression, and hostile attributional bias. These findings provide preliminary evidence that anxiety and HAB both play a role in physiological responding to ambiguous situational vignettes as well as support for the theoretical suggestion of differential, elevated physiological reactivity to ambiguous situations associated with anxiety and HAB. Additional research is warranted to further explore the nature of these associations.
References


Appendix A:
Revised Vignettes, Questions, and Animation Screenshots
Story 1 (Books): Imagine that you are sitting at your desk at school before class starts, and another kid runs down the aisle past your desk. Your books get knocked off the desk onto the floor, making a mess.

The kid knocked over my books to show me who’s boss.

Doesn’t pop upMight pop upDefinitely pops up in my mind in my mind in my mind

12 3 4 5

The kid knocked over my books because he/she is mad at me.

Doesn’t pop upMight pop upDefinitely pops up in my mind in my mind in my mind

12 3 4 5

The kid knocked over my books on accident.

Doesn’t pop upMight pop upDefinitely pops up in my mind in my mind in my mind

12 3 4 5

Which thought is most believable?

○ The kid knocked over my books because he/she is mad at me.
○ The kid knocked over my books on accident.
○ The kid knocked over my books to show me who’s boss

In this story, do you think the kid was

○ Trying to be mean?
○ Not trying to be mean?

How upset or mad would you be if the things in this story really happened to you?

○ Not upset or mad at all
○ A little upset or mad
○ Very upset or mad
Story 2 (Lunch): Imagine that you are at lunch one day and looking for a place to sit. You see some kids you know at a table across the room. The kids are laughing and talking to each other and they look like they are having a good time. You walk over to their table. As soon as you sit down, the kids stop talking and no one says anything to you.

The kids stopped talking because they want to look cooler in front of the other kids.

Doesn’t pop up Might pop up Definitely pops up
in my mind in my mind in my mind

12 3 4 5

The kids stopped talking because they are angry at me for something.

Doesn’t pop up Might pop up Definitely pops up
in my mind in my mind in my mind

12 3 4 5

The kids stopped talking because they are waiting for me to say something first.

Doesn’t pop up Might pop up Definitely pops up
in my mind in my mind in my mind

12 3 4 5

Which thought is most believable?

- The kids stopped talking because they are waiting for me to say something first.
- The kids stopped talking because they want to look cooler in front of the other kids.
- The kids stopped talking because they are angry at me for something.

In this story, do you think the kids were

- Trying to be mean?
- Not trying to be mean?

How upset or mad would you be if the things in this story really happened to you?

- Not upset or mad at all
- A little upset or mad
- Very upset or mad
Story 3 (Cell Phone): Imagine that you brought your new cell phone to school today. You saved up your allowance to buy it and you want to show it to the other kids at school. You let another boy look at it for a few minutes while you go get a drink of water. When you get back you realize that the boy has dropped your new cell phone and it broke.

The boy dropped my cell phone because he doesn’t want me to have something better than him.

Doesn’t pop up Might pop up Definitely pops up
in my mind in my mind in my mind

12 3 4 5

The boy dropped my cell phone because he is mad at me.

Doesn’t pop up Might pop up Definitely pops up
in my mind in my mind in my mind

12 3 4 5

The boy dropped my cell phone because he is kind of clumsy.

Doesn’t pop up Might pop up Definitely pops up
in my mind in my mind in my mind

12 3 4 5

Which thought is most believable?

- The boy dropped my cell phone because he is mad at me.
- The boy dropped my cell phone because he is kind of clumsy.
- The boy dropped my cell phone because he doesn’t want me to have something better than him.

In this story, do you think the boy was

- Trying to be mean?
- Not trying to be mean?

How upset or mad would you be if the things in this story really happened to you?

- Not upset or mad at all
- A little upset or mad
- Very upset or mad
Story 4 (Art): Imagine that you have just finished an art project for school. You’ve worked on it a long time and you’re really proud of it. Another boy comes over to look at your project. The boy is holding a jar of paint. You turn away for a minute and when you look back the boy has spilled paint on your art project. You worked on the project for a long time and now it’s ruined.

The boy spilled paint on my project because he wants a better grade than me.

Doesn’t pop up Might pop up Definitely pops up
in my mind in my mind in my mind

12 3 4 5

The boy spilled paint on my project because he is trying to get back at me for something.

Doesn’t pop up Might pop up Definitely pops up
in my mind in my mind in my mind

12 3 4 5

The boy spilled paint on my project on accident.

Doesn’t pop up Might pop up Definitely pops up
in my mind in my mind in my mind

12 3 4 5

Which thought is most believable?

- The boy spilled paint on my project because he wants a better grade than me.
- The boy spilled paint on my project because he is trying to get back at me for something.
- The boy spilled paint on my project on accident.

In this story, do you think the boy was

- Trying to be mean?
- Not trying to be mean?

How upset or mad would you be if the things in this story really happened to you?

- Not upset or mad at all
- A little upset or mad
- Very upset or mad
Story 5 (Invite): Imagine that you are in the bathroom washing your hands one day after recess. While you are in there, two other boys from your class come in and start talking to each other. One of the boys invites the other one to a birthday party. The boy says there are going to be a lot of people at the party. You have not been invited to this party.

The boy didn’t invite me because he only wants the most popular kids to come to the party.

Doesn’t pop up\textup{ Might pop up\textup{ Definitely pops up} in my mind \hspace{0.2cm} in my mind \hspace{0.2cm} in my mind}

12 3 4 5

The boy didn’t invite me because he is trying to get back at me for something.

Doesn’t pop up\textup{ Might pop up\textup{ Definitely pops up} in my mind \hspace{0.2cm} in my mind \hspace{0.2cm} in my mind}

12 3 4 5

The boy hasn’t had the chance to invite me to the party yet.

Doesn’t pop up\textup{ Might pop up\textup{ Definitely pops up} in my mind \hspace{0.2cm} in my mind \hspace{0.2cm} in my mind}

12 3 4 5

Which thought is most believable?

\begin{itemize}
\item The boy hasn’t had the chance to invite me to the party yet.
\item The boy didn’t invite me because he only wants the most popular kids to come to the party.
\item The boy didn’t invite me because he is trying to get back at me for something.
\end{itemize}

In this story, do you think the boy was

\begin{itemize}
\item Trying to be mean?
\item Not trying to be mean?
\end{itemize}

How upset or mad would you be if the things in this story really happened to you?

\begin{itemize}
\item Not upset or mad at all
\item A little upset or mad
\item Very upset or mad
\end{itemize}
**Story 6 (Milk):** Imagine that you are sitting at the lunch table at school, eating lunch. You look up and see another kid coming over to your table with a carton of milk. You turn around to eat your lunch, and the next thing that happens is that the kid spils milk all over your back. The milk gets your shirt all wet.

The kid spilled milk on me because he/she wants to make other kids laugh.

```
Doesn't pop up Might pop up Definitely pops up
in my mind in my mind in my mind
```

12 3 4 5

The kid spilled milk on me because he/she is mad at me.

```
Doesn't pop up Might pop up Definitely pops up
in my mind in my mind in my mind
```

12 3 4 5

The kid spilled milk on me because he/she wasn’t looking where he/she was going.

```
Doesn't pop up Might pop up Definitely pops up
in my mind in my mind in my mind
```

12 3 4 5

Which thought is most believable?

- The kid spilled milk on me because he/she is mad at me.
- The kid spilled milk on me because he/she wasn’t looking where he/she was going.
- The kid spilled milk on me because he/she wants to make other kids laugh.

In this story, do you think the kid was

- Trying to be mean?
- Not trying to be mean?

How upset or mad would you be if the things in this story really happened to you?

- Not upset or mad at all
- A little upset or mad
- Very upset or mad
Story 7 (Text): Imagine that you are standing in the hallway at school talking to a boy you know. You ask him if he wants to hang out with you after school and he says yes. Just then, he gets a text message on his cell phone from another boy in your class. Right after reading it, the boy says that he actually can’t hang out after school today.

The boy can’t hang out because he wants to hang out with more popular kids instead.

- Doesn’t pop up
- Might pop up
- Definitely pops up

in my mind  in my mind  in my mind

12  3  4  5

The boy can’t hang out because the text-message said I had bad-mouthed him.

- Doesn’t pop up
- Might pop up
- Definitely pops up

in my mind  in my mind  in my mind

12  3  4  5

The boy can’t hang out because he forgot that he has something else to do after school.

- Doesn’t pop up
- Might pop up
- Definitely pops up

in my mind  in my mind  in my mind

12  3  4  5

Which thought is most believable?

- The boy can’t hang out because he wants to hang out with more popular kids instead.
- The boy can’t hang out because the text-message said I had bad-mouthed him.
- The boy can’t hang out because he forgot that he has something else to do after school.

In this story, do you think the boy was

- Trying to be mean?
- Not trying to be mean?

How upset or mad would you be if the things in this story really happened to you?

- Not upset or mad at all
- A little upset or mad
- Very upset or mad
**Story 8 (Shoes):** Imagine that you are walking to school and you’re wearing your new tennis shoes. You really like your new shoes and this is the first day you have worn them. Suddenly, you are bumped from behind by another kid. You stumble and fall into a mud puddle and your new shoes get muddy.

The kid bumped me because he/she wants to make me look stupid in front of others.

Doesn’t pop up\textit{ Might pop up}\textit{ Definitely pops up}  
\textit{ in my mind} \textit{ in my mind} \textit{ in my mind}  
\begin{tabular}{ccc}
12 & 3 & 4 & 5 \\
\end{tabular}

The kid bumped me because he/she is angry with me.

Doesn’t pop up\textit{ Might pop up}\textit{ Definitely pops up}  
\textit{ in my mind} \textit{ in my mind} \textit{ in my mind}  
\begin{tabular}{ccc}
12 & 3 & 4 & 5 \\
\end{tabular}

The kid bumped me because he/she was fooling around and pushed too hard by accident.

Doesn’t pop up\textit{ Might pop up}\textit{ Definitely pops up}  
\textit{ in my mind} \textit{ in my mind} \textit{ in my mind}  
\begin{tabular}{ccc}
12 & 3 & 4 & 5 \\
\end{tabular}

Which thought is most believable?

- The kid bumped me because he/she was fooling around and pushed too hard by accident.
- The kid bumped me because he/she wants to make me look stupid in front of others.
- The kid bumped me because he/she is angry with me.

In this story, do you think the kid was

- Trying to be mean?
- Not trying to be mean?

How upset or mad would you be if the things in this story really happened to you?

- Not upset or mad at all
- A little upset or mad
- Very upset or mad
Story 9 (Hallway): Imagine that you are standing in the hallway one morning at school. As you are standing there, two boys from your class walk by. As they walk by you, the two boys look at you, whisper something to each other and then they laugh.

The boys laughed because it makes them feel better about themselves.

 Doesn't pop up  Might pop up  Definitely pops up
in my mind  in my mind  in my mind

12  3  4  5

The boys laughed because they thought I had looked at them funny.

 Doesn't pop up  Might pop up  Definitely pops up
in my mind  in my mind  in my mind

12  3  4  5

The boys laughed because they were just having fun.

 Doesn't pop up  Might pop up  Definitely pops up
in my mind  in my mind  in my mind

12  3  4  5

Which thought is most believable?

- The boys laughed because they thought I had looked at them funny.
- The boys laughed because they were just having fun.
- The boys laughed because it makes them feel better about themselves.

In this story, do you think the boys were

- Trying to be mean?
- Not trying to be mean?

How upset or mad would you be if the things in this story really happened to you?

- Not upset or mad at all
- A little upset or mad
- Very upset or mad
**Story 10 (Park):** Imagine that you are at a park near your house, and you see a bunch of kids talking in a circle about 15 feet away. You yell out, "Hey everybody!" The kids keep on talking and don’t say anything to you.

The kids didn’t say anything because they want to act like they’re better than me.

Doesn’t pop up\ Might pop up\ Definitely pops up
in my mind    in my mind  in my mind
12    3    4    5

The kids didn’t say anything because they are mad at me about something.

Doesn’t pop up\ Might pop up\ Definitely pops up
in my mind    in my mind  in my mind
12    3    4    5

The kids didn’t say anything because they didn’t see me standing there.

Doesn’t pop up\ Might pop up\ Definitely pops up
in my mind    in my mind  in my mind
12    3    4    5

Which thought is most believable?

- The kids didn’t say anything because they want to act like they’re better than me.
- The kids didn’t say anything because they are mad at me about something.
- The kids didn’t say anything because they didn’t see me standing there.

In this story, do you think the kids were

- Trying to be mean?
- Not trying to be mean?

How upset or mad would you be if the things in this story really happened to you?

- Not upset or mad at all
- A little upset or mad
- Very upset or mad
Appendix B.

Hierarchical Linear Modeling of Time by Anxiety and High HAB for HR

<table>
<thead>
<tr>
<th>Fixed Effect</th>
<th>Coefficient</th>
<th>SE</th>
<th>t-ratio</th>
<th>df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR</td>
<td>Intercept, $\beta_0$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Intercept, $\gamma_{00}$</td>
<td>93.680</td>
<td>7.958</td>
<td>11.772</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td>Age, $\gamma_{01}$</td>
<td>-1.326</td>
<td>0.516</td>
<td>-2.568</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td>Gender, $\gamma_{02}$</td>
<td>4.816</td>
<td>1.944</td>
<td>2.478</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td>RCADS-C Anxiety, $\gamma_{03}$</td>
<td>0.017</td>
<td>0.074</td>
<td>0.231</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td>PCS-C, $\gamma_{04}$</td>
<td>-0.061</td>
<td>0.115</td>
<td>-0.533</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td>HAB, $\gamma_{05}$</td>
<td>-1.063</td>
<td>0.455</td>
<td>-2.337</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td>RCADS-C x hiHAB, $\gamma_{06}$</td>
<td>0.005</td>
<td>0.031</td>
<td>0.145</td>
<td>68</td>
</tr>
<tr>
<td>Time slope, $\beta_1$</td>
<td>Intercept, $\gamma_{10}$</td>
<td>2.414</td>
<td>2.854</td>
<td>0.846</td>
<td>3661</td>
</tr>
<tr>
<td></td>
<td>Age, $\gamma_{11}$</td>
<td>-0.321</td>
<td>0.187</td>
<td>-1.723</td>
<td>3661</td>
</tr>
<tr>
<td></td>
<td>Gender, $\gamma_{12}$</td>
<td>-0.146</td>
<td>0.839</td>
<td>-0.175</td>
<td>3661</td>
</tr>
<tr>
<td></td>
<td>RCADS-C Anxiety, $\gamma_{13}$</td>
<td>0.088</td>
<td>0.039</td>
<td>2.253</td>
<td>3661</td>
</tr>
<tr>
<td></td>
<td>PCS-C, $\gamma_{14}$</td>
<td>-0.002</td>
<td>0.036</td>
<td>-0.045</td>
<td>3661</td>
</tr>
<tr>
<td></td>
<td>HAB, $\gamma_{15}$</td>
<td>0.529</td>
<td>0.199</td>
<td>2.648</td>
<td>3661</td>
</tr>
<tr>
<td></td>
<td>RCADS-C x hiHAB, $\gamma_{16}$</td>
<td>-0.023</td>
<td>0.011</td>
<td>-2.106</td>
<td>3661</td>
</tr>
<tr>
<td>Time$^2$ slope, $\beta_2$</td>
<td>Intercept, $\gamma_{20}$</td>
<td>-0.343</td>
<td>0.449</td>
<td>-0.765</td>
<td>3661</td>
</tr>
<tr>
<td></td>
<td>Age, $\gamma_{21}$</td>
<td>0.045</td>
<td>0.030</td>
<td>1.520</td>
<td>3661</td>
</tr>
<tr>
<td></td>
<td>Gender, $\gamma_{22}$</td>
<td>0.037</td>
<td>0.133</td>
<td>0.275</td>
<td>3661</td>
</tr>
<tr>
<td></td>
<td>RCADS-C Anxiety, $\gamma_{23}$</td>
<td>-0.014</td>
<td>0.006</td>
<td>-2.321</td>
<td>3661</td>
</tr>
<tr>
<td></td>
<td>PCS-C, $\gamma_{24}$</td>
<td>-0.001</td>
<td>0.006</td>
<td>-0.185</td>
<td>3661</td>
</tr>
<tr>
<td></td>
<td>HAB, $\gamma_{25}$</td>
<td>-0.083</td>
<td>0.031</td>
<td>-2.708</td>
<td>3661</td>
</tr>
<tr>
<td></td>
<td>RCADS-C x hiHAB, $\gamma_{26}$</td>
<td>0.003</td>
<td>0.002</td>
<td>2.105</td>
<td>3661</td>
</tr>
</tbody>
</table>

Note: ** $p < .01$; * $p < .05$. HR, Heart Rate; RCADS-C Anxiety, Revised Child Anxiety and Depression Scale Total Anxiety Scale; PCS-C, Peer Conflict Scale – Youth Self-Report; HAB, Overall HAB.
Hierarchical Linear Modeling of Time by Anxiety and Low HAB for HR

<table>
<thead>
<tr>
<th>Fixed Effect</th>
<th>Coefficient</th>
<th>SE</th>
<th>t-ratio</th>
<th>df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HR</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept, $\gamma_0$</td>
<td>93.673</td>
<td>7.972</td>
<td>11.751</td>
<td>68</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Age, $\gamma_1$</td>
<td>-1.326</td>
<td>0.516</td>
<td>-2.568</td>
<td>68</td>
<td>0.012*</td>
</tr>
<tr>
<td>Gender, $\gamma_2$</td>
<td>4.816</td>
<td>1.944</td>
<td>2.478</td>
<td>68</td>
<td>0.016*</td>
</tr>
<tr>
<td>RCADS-C Anxiety, $\gamma_3$</td>
<td>0.036</td>
<td>0.120</td>
<td>0.296</td>
<td>68</td>
<td>0.768</td>
</tr>
<tr>
<td>PCS-C, $\gamma_4$</td>
<td>-0.061</td>
<td>0.115</td>
<td>-0.533</td>
<td>68</td>
<td>0.595</td>
</tr>
<tr>
<td>HAB, $\gamma_5$</td>
<td>-1.063</td>
<td>0.455</td>
<td>-2.337</td>
<td>68</td>
<td>0.022*</td>
</tr>
<tr>
<td>RCADS-C x loHAB, $\gamma_6$</td>
<td>0.005</td>
<td>0.031</td>
<td>0.145</td>
<td>68</td>
<td>0.885</td>
</tr>
<tr>
<td><strong>Time slope, $\beta_1$</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept, $\gamma_{10}$</td>
<td>2.451</td>
<td>2.855</td>
<td>0.858</td>
<td>3661</td>
<td>0.391</td>
</tr>
<tr>
<td>Age, $\gamma_{11}$</td>
<td>-0.321</td>
<td>0.187</td>
<td>-1.723</td>
<td>3661</td>
<td>0.085</td>
</tr>
<tr>
<td>Gender, $\gamma_{12}$</td>
<td>-0.146</td>
<td>0.839</td>
<td>-0.175</td>
<td>3661</td>
<td>0.861</td>
</tr>
<tr>
<td>RCADS-C Anxiety, $\gamma_{13}$</td>
<td>-0.006</td>
<td>0.033</td>
<td>-0.167</td>
<td>3661</td>
<td>0.868</td>
</tr>
<tr>
<td>PCS-C, $\gamma_{14}$</td>
<td>-0.002</td>
<td>0.036</td>
<td>-0.045</td>
<td>3661</td>
<td>0.964</td>
</tr>
<tr>
<td>HAB, $\gamma_{15}$</td>
<td>0.529</td>
<td>0.200</td>
<td>2.648</td>
<td>3661</td>
<td>0.008**</td>
</tr>
<tr>
<td>RCADS-C x loHAB, $\gamma_{16}$</td>
<td>-0.023</td>
<td>0.011</td>
<td>-2.106</td>
<td>3661</td>
<td>0.035*</td>
</tr>
<tr>
<td><strong>Time^2 slope, $\beta_2$</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept, $\gamma_{20}$</td>
<td>-0.349</td>
<td>0.449</td>
<td>-0.777</td>
<td>3661</td>
<td>0.437</td>
</tr>
<tr>
<td>Age, $\gamma_{21}$</td>
<td>0.045</td>
<td>0.030</td>
<td>1.520</td>
<td>3661</td>
<td>0.129</td>
</tr>
<tr>
<td>Gender, $\gamma_{22}$</td>
<td>0.037</td>
<td>0.133</td>
<td>0.275</td>
<td>3661</td>
<td>0.783</td>
</tr>
<tr>
<td>RCADS-C Anxiety, $\gamma_{23}$</td>
<td>&lt;0.001</td>
<td>0.005</td>
<td>-0.093</td>
<td>3661</td>
<td>0.926</td>
</tr>
<tr>
<td>PCS-C, $\gamma_{24}$</td>
<td>-0.001</td>
<td>0.006</td>
<td>-0.185</td>
<td>3661</td>
<td>0.853</td>
</tr>
<tr>
<td>HAB, $\gamma_{25}$</td>
<td>-0.083</td>
<td>0.031</td>
<td>-2.708</td>
<td>3661</td>
<td>0.007**</td>
</tr>
<tr>
<td>RCADS-C x loHAB, $\gamma_{26}$</td>
<td>0.003</td>
<td>0.002</td>
<td>2.105</td>
<td>3661</td>
<td>0.035*</td>
</tr>
</tbody>
</table>

Note: ** $p < .01$; * $p < .05$. HR, Heart Rate; RCADS-C Anxiety, Revised Child Anxiety and Depression Scale Total Anxiety Scale; PCS-C, Peer Conflict Scale – Youth Self-Report; HAB, Overall HAB.
The author was born in New Orleans, LA and received her primary and secondary education in New Orleans. She obtained her Bachelor of Science degree in psychology from Louisiana State University in 2005 and Master of Science degree in applied developmental psychology from the University of New Orleans in 2013. She pursued a Ph.D. in applied developmental psychology in the University of New Orleans psychology graduate program. She worked with Dr. Carl F. Weems in the Youth and Family Stress, Phobia, and Anxiety Research Laboratory from 2011 to 2015.