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Biased Attentional Processing for Negative Emotion and Youth Internalizing Psychopathology: The Role of Attentional Control Deficits

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Biased attention for salient negative emotional stimuli is a proposed cognitive mechanism of internalizing disorders, namely depression and anxiety. Previous studies have demonstrated biases in bottom-up, stimulus-driven attentional systems, as well as top-down, goal-oriented attentional systems, in the context of negative emotion. However, the underlying cognitive mechanisms that drive these biases, such as attentional control deficits, are not well understood. Furthermore, given the high degree of conceptual and empirical overlap between depression and anxiety, it is unclear how biased attention might relate to constructs common across both disorders, such as general distress, versus what is specific to each disorder. The current study utilized an emotional adaptation of the Antisaccade Task with eye-tracking to precisely and accurately tease apart components of attentional control, including inhibition and shifting, in the context of social threat (i.e., anger) in a community sample of youth and young adults (ages 13-22; N = 80). Findings show that difficulty inhibiting attention for social threat is associated with symptoms of general distress, which are shared across depression and anxiety, as well as symptoms of physiological hyperarousal that are specific to anxiety. Overall, findings further clarify what specific components of attentional control deficits underlie biased attentional processing, a well-established cognitive mechanism of internalizing disorders.

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Abstract

Biased attention for salient negative emotional stimuli is a proposed cognitive mechanism of internalizing disorders, namely depression and anxiety. Previous studies have demonstrated biases in bottom-up, stimulus-driven attentional systems, as well as top-down, goal-oriented attentional systems, in the context of negative emotion. However, the underlying cognitive mechanisms that drive these biases, such as attentional control deficits, are not well understood. Furthermore, given the high degree of conceptual and empirical overlap between depression and anxiety, it is unclear how biased attention might relate to constructs common across both disorders, such as general distress, versus what is specific to each disorder. The current study utilized an emotional adaptation of the Antisaccade Task with eye tracking to precisely and accurately tease apart components of attentional control, including inhibition and shifting, in the context of social threat (i.e., anger) in a community sample of youth and young adults (ages 13-22; N = 80). Findings show that difficulty inhibiting attention for social threat is associated with symptoms of general distress, which are shared across depression and anxiety, as well as symptoms of physiological hyperarousal that are specific to anxiety. Overall, findings further clarify what specific components of attentional control deficits underlie biased attentional processing, a well-established cognitive mechanism of internalizing disorders.

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Chapter One: Introduction

Depression and anxiety are debilitating internalizing disorders with significant implications for cognitive, interpersonal, and occupational functioning, as well as physical health (Bistricky, Ingram, & Atchley, 2011). Moreover, the prevalence rates of depression and anxiety increase dramatically in mid-to-late adolescence (e.g., Hankin et al., 1998, Teubert & Pinquart, 2011). It is therefore critical for research to elucidate potential mechanisms of internalizing disorders in youth. The current study investigates one well-established cognitive mechanism of both depression and anxiety disorders, namely biased attentional processing of negative emotional information. Information processing theories maintain that negative attentional biases act as filters for stimuli in the environment, affecting the way an individual perceives, evaluates, attends to, and remembers emotionally salient information (Gotlib & Joormann, 2010, Joorman & Siemer, 2011). It is hypothesized that these negative biases are associated with the onset, maintenance, and recurrence of internalizing problems, including depression and anxiety (e.g. Beck, 1976, Gibb, McGeary, & Beevers, 2015, Koster, De Lissnyder, Derakshan, & De Raedt, 2011).

Theories of Biased Attentional Processing in Depression and Anxiety

Attention is defined as a set of processes that filter incoming information from the environment and select relevant information for further downstream processing. First, attention facilitates automatic orienting towards salient information, via bottom-up, stimulus-driven systems, especially in the early stages of the information-processing stream (Armstrong & Olatunji, 2012). Second, attention is responsible for disregarding inappropriate and irrelevant information via top-down, goal-oriented systems, mostly in the later stages of the information-processing stream (Armstrong & Olatunji, 2012; Thayer & Lane, 2000). Cognitive theories of internalizing disorders maintain that *biased* attentional processes, which reflect preferential attention for *emotionally* salient stimuli, are putative cognitive mechanisms of depression and anxiety. Biased attentional processes are critical because they exert a relatively early impact on an unfolding emotional response. In other words, if an emotionally salient stimulus is attended to in the environment, it then affects cognitive appraisals of a situation, and ultimately impacts the resulting emotional response to the situation.

Theories of biased attention in internalizing disorders can be further broken down into specific hypotheses regarding patterns of bottom-up and top-down attentional processing. For example, biased attention is characterized by the tendency to automatically orient attention, during the early stages of information processing, towards emotionally salient information in the environment, especially negative information such as sadness, anger, or fear (e.g., Beck, 2008). For example, imagine you are giving an oral presentation to a group of colleagues. You might, for instance, quickly and immediately pick up on the sole person in the audience who is furrowing her eyebrows and frowning.

Biased attention is also characterized by problems disregarding emotionally salient information in the later stages of information processing, especially if it is irrelevant or inappropriate. There are two alternative theories regarding how biases in top-down, goal-oriented systems operate. One theory argues that biased attention is characterized by the tendency to direct attention away from a negative emotional stimulus once it is automatically detected, a process sometimes referred to as attentional avoidance (e.g., Williams, Watts, MacLeod, Matthews, 1988). This theory posits that avoidance precludes the opportunity to further assess a negative emotional stimulus and reappraise it in a way that mitigates the resulting emotional response. Returning to the earlier example of the oral presentation, this theory would suggest that if you quickly and immediately orient to the frowning colleague and then subsequently direct your attention away, you might make the immediate appraisal that the colleague does not like your presentation, leading you to feel nervous or upset. Relatedly, you would miss the opportunity to reappraise the colleague's seemingly negative facial expression as actually reflecting her focus and concentration on your presentation.

An alternative hypothesis posits that biased attention is instead characterized by an inability to direct attention away from a negative emotional stimulus once it is automatically detected, which leads to increased maintenance of attention on the negative emotional stimulus (e.g., Eysenck, Derakshan, Santos, & Calvo 2007). This theory posits that difficulty disengaging not only leads to elaborative processing of the negative emotional stimulus, but also precludes the opportunity to detect other critical information in the environment that could facilitate an appropriate reappraisal of situation. According to this theory, if you quickly and immediately orient to the frowning colleague and have difficulty directing your attention away, you might make the appraisal that the colleague does not like your presentation, leading you to feel nervous and upset. Furthermore, by not directing attention away from the frowning colleague to other parts of the room, you would not notice other positive facial expressions in the audience, and would miss the chance to reappraise the situation and recognize that most colleagues in the room are probably enjoying your presentation.

Taken together, these two theories seem to suggest contradictory pathways by which biases in top-down, goal-oriented attention operate as a cognitive mechanism for internalizing disorders. One theory suggests that *avoidance* patterns of attention contribute to sustained negative affect, whereas the other theory posits that *increased maintenance* of attention is related to sustained negative affect. Despite these differences, both theories share a common component, namely that they both describe difficulties effectively directing attention in a top-down, goal-oriented fashion in the context of current situational demands. This emphasis on top-down, goal-oriented processing mirrors constructs of cognitive control or executive functioning (Miyake & Friedman, 2012). Cognitive control represents a set of general-purpose cognitive mechanisms that help an individual respond to changing environmental demands or make progress towards a self-directed goal (Miyake & Friedman, 2012). Cognitive control processes also facilitate behavioral and emotional self-regulation, and therefore have important implications for cognitive mechanisms of internalizing disorders. According to the *university/diversity model,* three key aspects of cognitive control include shifting, inhibition, and updating working memory (Miyake, Friedman, Emerson, Witzki, & Howerter, 2000). More specifically, shifting is defined as switching between tasks. Inhibition refers to resisting a dominant or prepotent response. Finally, updating is defined as replacing task-irrelevant information with newer and more relevant information. Although somewhat separable, these cognitive control processes are moderately correlated (Miyake et al., 2000).

Deficits in cognitive control processes may underlie difficulties directing attention in a top-down, goal-oriented manner in the context of salient emotional stimuli, and therefore, may explain seemingly contradictory pathways linking later stages of biased attentional processing and internalizing disorders (e.g., for a review in anxiety, see Cisler & Koster, 2010, for a review in depression, see Joormann & D'Avanzato, 2010; Joormann & Vanderlind, 2014). Studies to date have demonstrated links between broad cognitive control deficits and internalizing psychopathology using a variety of methods, including self-report questionnaires, traditional neuropsychological tasks, as well as adaptations of these neuropsychological tasks with emotionally salient information.

More specifically, some studies have examined effortful control, a construct of temperament that includes the ability to maintain or shift attentional focus (Eisenberg et al., 2005). These studies have shown associations between low levels of effortful control, as indexed by self-report questionnaire, and higher levels of anxiety and depression in youth (e.g., Muris, van der Pennen, Sigmond, Mayer, 2008) and young adults (Reinholdt-Dunne, Mogg, & Bradley, 2013). Through the use of self-report questionnaires, such studies suggest that an individual's *perceived* awareness of cognitive control deficits is related to internalizing psychopathology.

Other studies have employed neuropsychological tasks to demonstrate links between *observed* cognitive control deficits and internalizing psychopathology. For instance, adolescents who exhibited reduced cognitive flexibility, as measured by the Wisconsin Card Sorting Task, also showed higher levels of depression and anxiety symptoms (Han, Helm, Iucha, Zahn-Waxler, Hastings, & Klimes-Dougan, 2016). A similar study showed that children and adolescents who exhibited deficits in working memory (e.g., Digit Span Forward and Backward) and cognitive flexibility (e.g., Wisconsin Card Sorting Task) demonstrated higher levels of depression symptoms (Evans, Kouros, Samanez-Larkin, & Garber 2015). Finally, some studies have adapted traditional neuropsychological tasks with affective stimuli in order to investigate how cognitive control deficits in the context of salient emotional information, in particular, might be related to internalizing psychopathology. For instance, one study modified the *n*-back working memory task by incorporating emotional distractors, such as fearful and happy faces (Ladouceur, Silk, Dahl, Ostapenko, Kronuahs, & Philips, 2009). This study found that reduced reaction time in the context of fearful distractors was associated with higher levels of anxiety in a sample of children, adolescents, and adults. Another study adapted a negative priming task with affective stimuli, namely positive and negative words (Joormann, 2004). This study found that reduced reaction time on trials in the context of negative words (e.g., sad, ugly) was associated with higher levels of depression symptoms in a sample of young adults. Taken together, these findings suggest that *observed* cognitive control deficits, especially in the context salient negative emotional information, are related to internalizing psychopathology.

Despite a large body of work showing an association between cognitive control deficits, broadly speaking, and internalizing psychopathology, it is unclear how these cognitive control deficits might manifest in attentional processes, specifically. Moreover, no study to date has considered how specific components of cognitive control (i.e., inhibition, shifting, and updating) might drive associations between biased attentional processing and internalizing psychopathology. Similar to the *university/diversity model* of cognitive control, inhibition of *attention* refers to resisting a dominant or prepotent urge to direct attention when it is inappropriate or irrelevant in the context of current demands (Eysenck et al., 2007). Relatedly, shifting of *attention* reflects the ability to direct attention appropriately in the context of current demands or in service of a self-directed goal (Eysenck et al., 2007). Returning to the earlier example of the oral presentation, deficits in cognitive control might make it difficult to inhibit a prepotent urge to direct attention towards the face of the frowning colleague. Similarly, deficits in cognitive control might contribute to problems shifting attention away from the seemingly negative facial expression once it becomes the focus of attention. Taken together, deficits in cognitive control processes, especially in the context of top-down, goal-directed attention, may underlie various patterns of biased attentional processing in depression and anxiety. Throughout this paper, this will be referred to simply as deficits in attentional control (Posner & Rothbart, 2000, Eysneck et a., 2007).

Limitations of Prior Work

Despite theoretical accounts linking deficits in attentional control to biased attention, and ultimately, depression and anxiety, prior studies have not been able to sufficiently test these hypotheses due to key methodological limitations. One key limitation is that experimental tasks that assess biased attentional processes are not designed to index attentional control, broadly speaking, as well as specific components of attentional control, such as inhibition or shifting. Rather, previous studies have overwhelmingly used the visual dot probe and spatial cueing tasks, which cannot tease apart bottom-up, stimulus-driven attention from top-down, goal-oriented attention in the context of salient emotional stimuli. In addition, these paradigms only provide a snapshot of attention at one moment in an experimental trial, and cannot assess how attention unfolds over time. The current study assessed inhibition and shifting components of attentional control using a rigorous experimental paradigm with eye-tracking methodology in order to tease apart putative processes of bottom-up, stimulus driven attention from top-down, goal-oriented attention in the context of negative emotional information.

A second key limitation refers to how depression and anxiety have been indexed in past research. The preponderance of studies to date has used case-control designs comparing healthy controls to participants with DSM-defined depression or anxiety disorders. This approach ignores the striking comorbidity between these two internalizing disorders, as well as the fact that depression and anxiety share many features in common. The current study therefore examined internalizing psychopathology according to the Tripartite Model (Watson, Clark, Weber, Assenheimer, Strauss, & McCormick, 1995) by identifying what is common across depression and anxiety, namely symptoms of general distress, as well as what is specific to each disorder (i.e., anhedonia in depression, physiological hyperarousal in anxiety).

Methodological Limitations in the Study of Attentional Control.

One of the most common methods to assess attentional biases is the visual probe task (Gibb, McGeary, & Beevers 2015). In each trial of the visual probe task, two stimuli (e.g., an emotional and a neutral face) are presented simultaneously on a computer screen for a given amount of time (e.g., 500ms or 1000ms). Participants respond as quickly as possible to a probe stimulus that replaces either the emotional or neutral face; faster response reaction time indicates preferential attention to the facial expression replaced by the probe. A similar, but less common method, is an emotional variant of the Posner spatial cueing task. In the spatial cueing task, only one stimulus (i.e., either an emotional *or* neutral face) is presented, and participants respond as quickly as possible to a probe stimulus that appears on the same side of the screen as the face (i.e., “valid” trails), or on the opposite side of the screen (i.e., “invalid” trials) (see Gibb, McGeary, & Beevers 2015).

Essentially, the visual probe task and the spatial cueing task are only able capture the focus of attention at *one point in time* (i.e. the offset of the facial expression immediately before the presentation of the probe stimulus) (Gibb, McGeary, Beevers, 2015). Consequently, the duration of the facial stimulus presentation has important implications for which type of attentional process is likely being indexed at the offset of the facial stimulus. If facial stimulus is presented for a relatively short period of time (e.g., 250-500ms), then it can be inferred that tasks are roughly capturing early stages of attentional processing, such as bottom-up, stimulus-driven attention, but also potentially top-down, goal-oriented attention. However, if face stimulus is presented for a longer duration (e.g., 1000ms), then these tasks are potentially indexing aspects of attention that occur at later stages of processing, namely top-down, goal-oriented attention. The methodological parameters of the visual probe and spatial cueing tasks therefore affect the types of conclusions that can be made about how particular components of biased attentional processing are related to anxiety and depression.

For instance, studies investigating attentional biases in anxiety have typically presented a facial stimulus for relatively short periods of time (e.g., 500ms). Most studies have found greater bias for threat, as indexed by faster response reaction times for probes replacing facial displays of anger or fear, in adults diagnosed with anxiety disorders, as well as at-risk adults who score high on self-report questionnaires of state or trait anxiety (for a review, see Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & Van IJzendoorn, 2007, Cisler & Koster, 2010), therefore concluding that biased attentional processing in anxiety is characterized by an increased tendency to orient attention towards threatening information (Bar-Haim et al., 2007). Tasks with such a short stimulus presentation time cannot, however, answer questions about later stages of top-down, goal oriented attentional processing. Studies investigating attentional biases in anxiety that have presented a facial stimulus for relatively longer periods of time (e.g., 1000ms, 1250ms) have produced mixed findings. Some of these studies have found greater bias for threat at longer presentation times, thus suggesting increased maintenance of attention on threatening information in anxiety at later stages of attentional processing (e.g., Hankin, Gibb, Abela, & Flory, 2010). However, other studies have failed to find a bias at these longer presentation times, therefore concluding that biased attention in anxiety is characterized by attentional avoidance of threatening information at later stages of processing (e.g., Mogg, Bradley, Miles, & Dixon, 2004).

Studies of attentional biases in depression, on the other hand, have largely failed to find biases for negative emotional information, such as sadness or anger, when a stimulus is presented for 500ms (e.g. Mogg, Bradley, & Williams, 1995), thus suggesting that biased attentional processing in depression is *not* characterized by a greater tendency to orient attention towards negative emotion. Instead, studies have found biases for sadness and anger when a stimulus is presented for at least 1000ms (see Peckham, McHugh, & Otto, 2010). Prior research has found attention biases to sad faces in formerly and currently depressed adults (e.g., Joormann and Gotlib, 2007) and youth (e.g., Hankin et. al, 2010), as well as never-disordered offspring of depressed mothers, who are at risk for depression (e.g., Joormann, Talbot, & Gotlib, 2007; Kujawa, et al., 2011). These findings thus suggest that depression is primarily characterized by increased maintenance of attention on negative emotional information at later stages of processing (see Gibb, McGeary, & Beevers, 2015, Peckham et al., 2010).

Although the visual probe and spatial cueing tasks can potentially tease apart biased attentional processing based on early and late-stages of the information-processing stream, these tasks have two important limitations. The first limitation is these tasks are not specifically designed to tease apart bottom-up, stimulus-driven attention from top-down, goal-oriented attention. Furthermore, these tasks cannot separate top-down, goal-oriented attention into even more discrete, but meaningful components, namely inhibition and shifting of attention (Eysenck et al., 2007). Instead, these tasks merely provide a snapshot of attention at one particular point in time. In order to stringently test components of attentional process in the context of salient emotional stimuli, an experimental task must separate bottom-up, stimulus-driven attention from top-down, goal-oriented attention.

One such task is the Antisaccade Task (e.g., Friedman, Miyake, Young, DeFries, Corley, & Hewitt, 2008), a well-established paradigm from the attention literature that is purposely designed to tease apart bottom-up, stimulus driven attention from top-down, goal-oriented attention. In the prosaccade condition, participants are instructed to look at a cue that flashes on one side of the screen, and identify a number that replaces the cue. The prosaccade condition therefore indexes automatic, bottom-up, orienting towards a salient stimulus in the early stages of information processing. In the antisaccade condition, the number appears on the opposite side of the screen as the cue, and so participants must not only inhibit the automatic tendency to orient towards the cue, but also shift attention in the opposite direction of the cue. The antisaccade condition therefore not only indexes goal-oriented, top-down attentional control in the context of a salient stimulus in the later stages of information-processing, but further separates inhibition and shifting of top-down, goal-oriented attention. Recent studies have created emotional adaptations of the Antisaccade Task, using affective (e.g., happy, sad, and angry) and neutral facial stimuli in place of the cue. Studies with anxious (e.g., Derakshan, Ansari, Hansard, Shoker, & Eysenck, 2009), depressed (e.g., Smyrnis et al., 2003), dysphoric (e.g., Derkashan, Salt, & Koster, 2009) adults have found evidence for reduced attentional control in emotional adaptations of the Antisaccade Task. The few studies investigating anxious or depressed youth samples have also demonstrated reduced attentional control (e.g., Hardin, Mandell, Mueller, Dahl, Pine, & Ernst, 2009; Mueller et al., 2012).

A second limitation of the visual probe and spatial cueing tasks is that they can only provide a single snapshot of attention within an ongoing stream of information processing. Recent studies of biased attentional processing have begun to utilize eye-tracking methodology, which provides a continuous measure of many components of attentional processing, as measurements are taken frequently (e.g. every 16ms) (Armstrong & Olatunji, 2012). Eye movement data overcomes the methodological limitations of the visual probe and spatial cueing task in its ability to help to index attentional processing across an entire trial, instead of only at one moment in time. In addition, eye movement data can separate spatial and temporal components of attention, including *where* attention is directed, as well as *when* and for *how long* (Armstrong &

Olatunji, 2012). Bottom-up, automatic orienting towards a salient emotional stimulus in the early stages of processing can be indexed in event-related ways, such as the proportion of initial fixations or latency to initial fixation on an emotional stimulus (Armstrong & Olatunji, 2012). Automatic orienting can also be indexed according to temporal domains, such as the number of fixations or average fixation duration within the first 500ms of a trial. Top-down, goal-oriented direction of attention in the later stages of processing, on the other hand, is typically measured by total number of fixations or fixation duration across the length of an experimental trial (Armstrong & Olatunji, 2012).

Findings using eye-tracking methodology have mostly corroborated those of visual probe and spatial cueing tasks. A meta-analysis of eye-tracking studies in depression and anxiety (i.e., high trait-level and clinical diagnosis) by Armstrong & Olatunji (2012) found support for automatic orienting towards threatening information in anxiety, but not depression. In addition, this meta-analysis found mixed evidence for the later stages of attentional processing in anxiety, with some studies finding avoidance of attention on threatening information, and others finding increased maintenance of attention. Studies in depression largely showed support for increased maintenance of attention towards sadness (Armstrong & Olatinji, 2012).

Methodological Limitations in the Study of Internalizing Psychopathology.

The preponderance of research to date has examined links between attentional processing and specific forms of internalizing psychopathology using case-control designs comparing healthy controls to participants with DSM-defined depression or anxiety disorders, with very few studies incorporating comorbid diagnostic groups (see Hankin et al., 2010 for an exception). However, large-scale epidemiological studies show a striking comorbidity among depression and anxiety disorders (Avenevoli, Stolar, Li, Dierker, & Ries Merikangas, 2001; Garber & Weersing, 2010; Yorbik, Birmaher, Axelson, Williamson, & Ryan, 2004). Reviews have estimated that about 15-75% of youth with a depression diagnosis also carry a comorbid anxiety diagnosis. Relatedly, about 10-15% of youth with an anxiety diagnosis are also diagnosed with depression (e.g., Avenevoli et al., 2001; Garber & Weersing, 2010; Yorbik et al., 2004). Moreover, self-report measures of depression and anxiety symptoms are moderately to highly correlated in both clinical and nonclinical samples (r = .45-75; Watson et al., 1995; r = .50-.70; Brady & Kendall, 1992).

One explanation for the strong correlation among constructs of depression and anxiety is the overlap of symptoms across both disorders (Watson et al., 1995). For example, major depression and generalized anxiety disorder share several symptom criteria, including irritability, insomnia, fatigue, restlessness, or difficulty concentration. It may be the case that correlations among self-report measures are inflated because these overlapping symptoms appear in both depression and anxiety scales. However, there is still a substantial intercorrelation among constructs even if overlapping symptom items are removed from both measures (r = .34; Clark & Watson, 1991, Stark & Laurent, 2001). Researchers have therefore concluded that the strong interrelation among depression and anxiety may reflect an underlying shared variance (Seligman & Ollendick, 1998, Watson et al., 1995).

The Tripartite Model of anxiety and depression is one model that seeks to explain the theoretical and empirical interrelation among anxiety and depression. This model posits that anxiety and depression share symptoms in common, namely high levels of negative affect. Negative affect is defined as the tendency to feel upset or unpleasantly aroused, and includes emotions such as sadness, irritability, anger, guilt, and disgust (Watson et al., 1995). In addition, depression and anxiety also share a set of nonspecific symptoms, such as irritability, insomnia, fatigue, restlessness, or difficulty concentration (e.g. Markon, Krueger, & Watson, 2005). The combination of high levels of negative affect and nonspecific symptoms, which are collectively labeled as general distress, explain the interrelation between depression and anxiety. At the same time, depression and anxiety are also characterized by separate and unique constructs that distinguish the two disorders. Depression is specifically characterized by low levels of positive affect, which is defined as a lack of interest or low levels of pleasure in daily activities (Watson et al., 1995). Low levels of positive affect are also related to feeling tired, fatigued, or sluggish. Anxiety, on the other hand, is uniquely described by somatic symptoms of tension and arousal, such as shortness of breath, feeling dizzy or lightheaded, or trembling and shaking (Watson et al., 1995). Taken together, the Tripartite Model hypothesizes that depression is marked by high levels of general distress and low levels of positive affect, and anxiety is marked by high levels of general distress and high levels of physiological hyperarousal. Empirical support for the Tripartite Model has been found in clinical samples of child and adolescent psychiatric inpatients (e.g., Lonigan, Carey, & Finch, 1994; Joiner, Catanzaro, & Laurent, 1996), as well as community samples of youth (e.g., Stark & Laurent, 2001).

Given high levels of empirical and theoretical overlap between depression and anxiety disorders, relationships with biased attentional processing may be better understood by examining common aspects of internalizing psychopathology, namely general distress, as well as specific components of depression (e.g., anhedonia) or anxiety (e.g., physiological hyperarousal). This alternative conceptualization has the potential to elucidate a clearer pattern of findings regarding biased attentional processing of negative emotional information in internalizing disorders. To our knowledge, no study to date has investigated associations between attentional processing and dimensional measures of depression and anxiety organized according to the framework of the Tripartite Model.

The Present Study

The current study therefore sought to address two important questions regarding biased attentional processing of negative emotional information in youth internalizing disorders. First, in light of alternative, and seemingly contradictory pathways by which biases in goal-oriented, top-down attentional processes are hypothesized to operate in depression and anxiety, the current study sought to test whether deficits in attentional control processes may underlie patterns of biased attention. We utilized an emotional adaptation of the Antisaccade Task, combined with eye-tracking methodology, to precisely and accurately tease apart bottom-up, stimulus driven attention from top-down, goal-oriented attention. Moreover, the current study sought to further tease apart top-down, goal-oriented attention into two distinct components: 1) inhibition of an automatic tendency to orient attention towards salient emotional information when it is irrelevant in the context of current task goals, and, 2) shifting attention to meet task-relevant goals (Hutton & Ettinger, 2006). Previous studies have suggested that deficits in attentional control are largely due to difficulties inhibiting attention, as opposed to difficulties shifting attention. The first hypothesis was that that greater difficulty inhibiting attention in the context of a salient emotional stimulus, but not shifting attention, would be associated with youth internalizing symptoms.

Second, given high rates of empirical and theoretical overlap between depression and anxiety disorders, the current study sought to investigate whether the relationship between biased attentional processing and internalizing psychopathology might be better understood by examining associations with common features of depression and anxiety, such as general distress, as well as features that are unique to depression (e.g., anhedonia) or anxiety (e.g., physiological hyperarousal), in accordance with the Tripartite Model of anxiety and depression. The second hypothesis was that deficits in attentional control, namely difficulties inhibiting attention in the context of a negative emotional stimulus, would be associated with what is common across depression and anxiety, namely symptoms of general distress. In addition, it was hypothesized that these deficits in attentional control would be associated with high levels physiological hyperarousal, a construct that reflects reactivity to salient stimuli in the environment. Previous studies examining hyperarousal via physiological measurements (e.g., skin conductance) have found associations with attentional bias for threat (e.g., Carr, Scully, Webb, Felmingham, 2016; Felmingham, Rennie, Manor, & Bryan, 2011). Finally, it was hypothesized that attentional control deficits would *not* be related to anhedonia, as this construct is typically linked to attentional biases for positive, and not negative, emotional information (e.g., Peckham et al., 2010). Taken together, the current study offers an alternative conceptualization of associations between attentional control deficits and continuous symptom domains of general distress, anhedonia, and physiological hyperarousal in order to elucidate cognitive mechanisms of youth internalizing psychopathology (McLaughlin & Nolen-Hoeksema, 2011).

Chapter Two: Method

Participants

Participants in the present study included 80 adolescents and young adults recruited from school districts in metropolitan Denver, Colorado and from the University of Denver. Adolescents and young adults were recruited as part of a larger study investigating cognitive control and associations with internalizing psychopathology. The sample of youth ranged in age from 13 to 22 years old (mean age 16.76 years old, SD 2.39). The sample was approximately evenly divided by sex (males: 57%, females: 43%), and was ethnically and racially representative of the geographic area from which it was recruited (Hispanic/Latino: 25%, Caucasian: 50%, African American: 15%, Asian/Pacific Islander: 4%, Other/Mixed Race: 6%).

Procedure

As part of the larger study, participants came to the lab in one 6-hour laboratory visit, with breaks to reduce fatigue. Youth under age 18 came with one parent, and this parent provided informed written consent while the adolescent provided informed written assent. Young adults who were over 18 years of age provided informed written consent. Adolescents and young adults completed computer tasks to assess attentional control over emotional stimuli, and all participants completed questionnaires to assess depression and anxiety. The Institutional Review Board approved all procedures. Participants were reimbursed for their participation.

Measures

Depression Symptoms.

The Children's Depression Inventory (CDI: Kovacs, 1992) is a widely used measure of depressive symptoms in children and adolescents and includes 27 items consisting of three statements (e.g., I am sad once in a while, I am sad many times, I am sad all the time), which are rated on a 0 to 2 Likert scale. A total score, ranging from 0 to 54, is generated by summing all items, with a higher score indicating higher levels of depressive symptoms. The CDI has sound psychometric properties, including good reliability and validity (Timbremont, Braet, Dreesen, 2004). Internal consistency (α) for the current study was .89.

The Center for Epidemiologic Studies-Depression Scale for Children (CES-DC: Faulstich, Carey, Ruggiero, Enyart, & Gresham, 1986) is a widely used depression inventory for children and adolescents. Each of the 20 items presents a symptom of depression (e.g., "I felt lonely, like I didn't have any friends") and participants indicate how true each item is on a four-point Likert scale ranging from "Not at All" (0) to "A Lot" (3). A total score, ranging from 0 to 60, is generated by summing ratings across all items, and a higher score indicates higher levels of depressive symptoms. The CES-DC has good psychometric properties, including good reliability and validity (Faulstich et al., 1986). Internal consistency (α) for the current study was .92.

Anxiety Symptoms.

The Multidimensional Anxiety Scale for Children (MASC: March, Parker, Sullivan, Stallings, & Conners, 1997) is a widely used measure of anxiety symptoms in children and adolescents that contains 39 items assessing physical symptoms of anxiety, harm avoidance, social anxiety, and separation anxiety. Each item presents a symptom of anxiety (e.g. “gets scared when parents go away” or “worries about getting called on in class”), and participants indicate how true each item is on a four-point Likert scale ranging from “Never true” (0) to “Very true” (3). A total score, ranging from 0 to 117, is generated by summing all items, with a higher score indicating higher levels of anxious symptoms. The MASC has good reliability and validity (Muris et al., 2002). In the current study, items in the harm avoidance scale were not included in the total score, as previous research has suggested that these items do not load onto latent factors of internalizing symptoms (Schneider, Arch, & Hankin, 2016). Therefore, in the current study, a total score, ranging from 0 to 90 was calculated. In the current study, internal consistency (α) was .93.

The Penn State Worry Questionnaire for Children (PSWQ-C; Chorpita, Tracey, Brown, Collica, Barlow, 1997) assesses worry in children and adolescents. This scale includes 14 statements (e.g., “Many things make me worry”), and participants rate how true each statement is on a four-point Likert scale ranging from “Never” (0) to “Always” (3). A total score, ranging from 0 to 42, is generated by summing ratings across all items. A higher score indicates a greater tendency to worry. The PSWQ-C has good psychometric properties, such as convergent validity with related constructs, such as anxiety diagnostic status (Pestle, Chorpita, Schiffman, 2008). In the current study, internal consistency (α) was .80.

Tripartite Model Symptom Constructs.

For the purpose of the current study, we reassigned items from our depression and anxiety symptom questionnaires to new outcome variables reflecting general distress, anhedonia, and physiological hyperarousal (Table 1). Symptoms of general distress were selected based on the General Distress subscale from the Mood and Anxiety Symptom Questionnaire (MASQ: Watson et al., 1995). The General Distress scale includes relatively nonspecific symptoms related to both anxiety and depression disorders, such as irritability, difficulty concentrating or making decisions, and fatigue. Internal consistency (α) for General Distress in the current study was .95. Symptoms of anhedonia were selected based on the Loss of Interest subscale from the MASQ, as well as prior work examining anhedonia scales from depression symptom questionnaires (e.g., Chorpita, Albano, & Barlow, 1998), which has been used in previous studies investigating anhedonic symptoms of depression (Hankin, 2008; Hankin, Stone, & Wright, 2010). The Loss of Interest scale includes symptoms specific to depression disorders, such as difficulty findings pleasure or enjoyment in activities, feeling withdrawn from others, and trouble getting started with tasks. Internal consistency (α) for the Anhedonia scale was .89. Finally, symptoms of physiological hyperarousal were selected based on the Anxious Arousal subscale from the MASQ, as well as prior work examining physical symptoms scales from anxiety symptom questionnaires (e.g., March, Parker, Sullivan, Stallings, & Conners, 1997). The Anxious Arousal subscale includes items specific to anxiety disorders, such as racing or pounding heart, nausea, or trouble getting breath. Internal consistency (α) for the Physiological Hyperarousal Scale was .87.

Attention.

Emotional Antisaccade Task. For the purpose of this study, we developed an emotional adaptation of the Antisaccade Task (Friedman et al., 2008). In the Antisaccade Task, participants must correctly identify a target number. In the prosaccade condition, a cue (e.g. small black box) flashes on one side of the screen, and the target number flashes on the same side of the screen and is masked after 150ms. In the prosaccade condition, participants are instructed to look at the same side of the screen as the cue and to say the number out loud to the experimenter, who enters the response. The prosaccade condition thus measures an automatic tendency to saccade to the cue. In the antisaccade condition, the target number flashes on the opposite side of the screen and is masked after 150ms. In the antisaccade condition, participants are instructed to look at the opposite side of the screen as the cue and to say the number out loud. The antisaccade condition thus measures the inhibition of an automatic tendency to saccade to the cue, as well as the ability to shift attention toward the opposite side of the screen as the cue. The Antisaccade Task therefore not only isolates bottom-up, stimulus-driven systems of attention (i.e., in the prosaccade condition) but also separates these systems from top-down, goal-directed systems of attention (i.e., in the antisaccade condition). Several other versions of the antisaccade task have also been used in studies of attention and psychopathology. For instance, some tasks have used a mixed-block design (e.g., De Lissnyder, Derakshan, de Raedt, & Koster, 2011), which requires participants to switch between prosaccades and antisaccades across experimental trials, thereby increasing cognitive load. Other tasks have included reward and punishment conditions (e.g., Jazbec, McClure, Hardin, Pine, & Ernst, 2005) to examine the influence of motivational systems on attention. The focus of the current study was to tease apart bottom-up, stimulus-driven systems of attention, as well as top-down, goal-directed systems of attention, and so we chose to adapt the Antisaccade Task by Friedman and colleagues because it offered the most stringent design to test the hypotheses of the current study.

In our emotional adaptation, the cue (e.g. small black box) was replaced by an emotional face (e.g. neutral, angry) (Figure 1). The task consisted of 204 total trials, divided into three conditions, with two blocks per condition. Trials were presented in a fixed randomized order to each participant in order to maximize the ability to detect individual differences across participants. In the prosaccade condition, participants practiced on 12 trials and then received 60 target trials. In the antisaccade condition, participants practiced on 12 trials and then received 60 target trials. This adapted task also had an additional antisaccade condition consisting of 60 target trials, which was exploratory, and so therefore was not included in the analysis of the current study. Each trial began with a fixation cross in the center of the screen for a variable amount of time (i.e., one of nine times between 1500 ms and 3500 ms in 250ms intervals). In the prosaccade condition, a face stimulus cue then appeared on one side of the screen for 175ms, followed by a number inside of an open square on the same side of the screen for 175ms. In the antisaccade condition, a face stimulus cue then appeared on one side of the screen for 233ms, followed by a number inside of an open square on the opposite side of the screen for 175ms. The number was then masked with gray cross-hatching, and the mask remained on the screen until the participant identified the number out loud to the experimenter, who entered the number on the keyboard.

The face stimuli for the two experimental tasks were colored photographs of males and females from the NIMSTIM face set (Tottenham et. al., 2009). Twenty-four faces (12 female) were selected; 12 were Caucasian, 6 were Asian/other, and 6 were African American. Each face was shown in both a closed-mouth neutral and open-mouth angry expression, totaling 48 face stimuli. Stimuli were presented on a Tobii T120 infrared eye-tracker monitor (Tobii Technology, Stockholm, Sweden) using E-prime Professional Version 22. Participants sat at a distance of approximately 60 cm away from the computer monitor (17" TFT monitor, 1280 x 1024 pixel resolution). The Tobii T120 eye tracker recorded gaze data of both eyes at 60 Hz with an average accuracy of 0.5^{o} visual angle. The gaze data was calibrated using a nine-point calibration procedure prior to the task. Experimenters repeated calibration for missing or poorly assessed calibration points before proceeding with the experimental tasks. Left and right eye gaze positions were recorded separately and averaged to determine gaze position.

Raw eye movement data was analyzed using Tobii Studio software. Fixations were defined as at least 100 ms of looking within a 50-pixel radius. Three unique areas of interest were identified during the presentation of the facial stimulus cue (Figure 2). In the prosaccade condition, an area of interest was drawn on the face stimulus cue. In the antisaccade condition, an area of interest was also drawn on the facial stimulus cue. Finally, in the antisaccade condition, only, an area of interest was drawn on the *opposite* side of the screen, in the location where a number inside of an open square would appear at the offset of the facial cue. This area of interest was defined as the target location.

Areas of interest were divided into two separate groups based on the type facial cue (i.e., angry, neutral) presented in the trial. One variable of interest was proportion of reflexive prosaccades, which was defined by the proportion of trials in the antisaccade condition in which a fixation was made on the face stimulus cue. Two proportions of reflexive prosaccades were calculated: for the angry and neutral facial cues in the antisaccade condition. A second variable of interest for the current study was time to first fixation, which was defined as the time elapsed between the onset of the face stimulus cue and the first fixation on an area of interest. Six time to first fixation variables were calculated: for the angry and neutral facial cues in the prosaccade condition, the angry and neutral facial cues in the antisaccade condition, and the target location in the context of angry and neutral facial cues in the antisaccade condition.

Statistical Power

Power analyses conducted with G*Power3 showed that power to detect effect sizes of 0.1 (i.e., R^2) was 80%, power to detect effect sizes of .075 was 67%, and power to detect effect sizes of .05 was 50% ($\alpha = 0.05$) (Faul, Erdfelder, Lang, & Buchner, 2007).

Data Analytic Strategy

Multivariate regressions were conducted to assess the relationship between indices of attentional orienting and attentional control and symptoms of general distress, anhedonia, and anxious arousal. All analyses included age and gender as covariates.

Attentional orienting was indexed in the prosaccade condition in two ways. First, attentional orienting was indexed by subtracting percentage of correctly identified numbers in the context of neutral facial cues from the percentage of correctly identified numbers in the context of angry cues. A *positive* difference score would indicate *greater* accuracy for angry versus neutral facial cues, and thus would suggest *greater* attentional orienting towards angry facial cues as compared to neutral facial cues in the prosaccade condition. A *negative* difference score would index reduced accuracy for angry versus neutral facial cues, and thus reduced attentional orienting towards angry versus neutral cues.

Second, attentional orienting was indexed by subtracting the time to first fixation towards neutral facial cues from time to first fixation towards angry facial cues. The use of difference scores to examine attentional processing of emotional versus neutral information has been widely used, such as in calculating attentional bias scores for emotion in the modified dot probe task (Mogg et al., 1995). A *positive* difference score would indicate a *longer* latency to orient towards angry facial cues relative to neutral facial cues. A *negative* difference score would indicate a *shorter* latency to orient towards angry relative to neutral cues, and thus would thus index *greater* attentional orienting towards angry facial cues as compared to neutral facial cues in the prosaccade condition.

Attentional control was indexed in the antisaccade condition in four ways. This is because the execution of correct antisaccades is hypothesized to reflect two separate processes: 1) inhibition of an incorrect reflexive prosaccade towards the cue and, 2) generation of a correct antisaccade towards the target location (Hutton & Ettinger, 2006), which will be referred to as shifting of attention. Studies suggest that antisaccade errors are largely due to difficulties inhibiting a reflexive prosaccade, as opposed to difficulties generating a correct antisaccade (Hutton & Ettinger, 2006).

We indexed inhibition of a reflexive prosaccade towards the cue in two ways. First, inhibition was indexed by subtracting the proportion of reflexive prosaccades towards neutral facial cues from the proportion of reflexive prosaccades towards angry facial cues. A *positive* difference would indicate a *greater* proportion of incorrect reflexive prosaccades in the context of angry facial cues as compared to neutral facial cues, and thus *reduced* inhibition in the context of angry as compared to neutral facial cues. A *negative* difference would indicate a smaller proportion reflexive prosaccades in the context of angry as compared to neutral facial cues. Second, inhibition was indexed by subtracting time to first fixation for the neutral facial cues from the time to first fixation for the angry facial cues. A *positive* difference score would indicate a *longer* latency to fixate on the angry cues relative to neutral cues, and thus would suggest relatively *greater* inhibition in the context of angry as compared to neutral facial cues. A *negative* difference would indicate a *shorter* latency to fixate on angry relative to neutral facial cues, and would thus suggest *reduced* inhibition in the context of angry versus neutral facial cues.

We indexed shifting of attention towards the target location in two ways. First, shifting was indexed by subtracting percentage of correctly identified numbers in the context of neutral facial cues from the percentage of correctly identified numbers in the context of angry cues. A *positive* difference score would indicate *greater* accuracy in the context angry versus neutral facial cues, and thus would index *greater* shifting of attention in the context of angry versus neutral cues. A *negative* difference score would index *reduced* accuracy in the context of angry versus neutral facial cues, and thus would index *reduced* shifting of attention in the context of angry cues versus neutral cues. Second, successful generation of antisaccades was indexed by subtracting time to first fixation for the target location in the context of neutral facial cues from the time to first fixation for the target location in the context of angry facial cues. A *positive* difference score would indicate a *longer* latency to fixate on the target location in the context of angry cues relative to neutral cues, and thus would index *reduced* shifting of attention in the context of angry as compared to neutral facial cues. A *negative* difference would indicate a *shorter* latency to fixate on the target location in the context of angry relative to neutral facial cues.

Because outliers have the potential to distort analyses, all extreme values were windsorized to less extreme values (Lipsey and Wilson 2001). More specifically, outliers that were more than three standard deviations from the mean were recoded to the value at three standard deviations from the mean.

Chapter Three: Results

Preliminary Data Analysis

Means, standard deviations, and inter-correlations for all variables are shown in Table 2.

A manipulation check was conducted to determine the effect of experimental condition (e.g., prosaccade versus antisaccade) on behavioral accuracy. More specifically, behavioral accuracy should be higher in the prosaccade condition because it is easier than the antisaccade condition. A paired-samples t-test determined that behavioral accuracy was higher in the prosaccade condition ($M = 0.99$, $SD = 0.02$) as compared to the antisaccade condition ($M = 0.93$, $SD = 0.07$); $t\ (77) = 7.51$, $p < .001$), thus reflecting a successful experimental manipulation.

Attentional Orienting

Percentage of correctly identified numbers for angry versus neutral facial cues in the prosaccade condition was not associated with symptoms of general distress, anhedonia, or anxious arousal (Table 3). Time to first fixation for angry versus neutral facial cues in the prosaccade condition was also not associated with symptoms of general distress, anhedonia, or anxious arousal (Table 4). This suggests that bottom-up, stimulus-driven systems of attention do not underlie biased attentional processing of negative emotional information in internalizing psychopathology.

Attentional Control

In terms of inhibition of reflexive prosaccades towards the facial cue, proportion of reflexive prosaccades towards angry versus neutral facial cues was not associated with symptoms of general distress, anhedonia, or anxious arousal (Table 5). This suggests that symptoms of internalizing psychopathology are not necessarily associated with a tendency to make *more* incorrect reflexive prosaccades in the context of angry versus neutral cues. However, time to first fixation for angry versus neutral cues was negatively associated with symptoms of general distress (β= -.264, t(74) = -2.605, $p < .05$) (Figure 3, Table 6) and symptoms of anxious arousal (β= -.302, t(77) = -2.795, $p < .05$) (Figure 4, Table 6), meaning that general distress and physiological hyperarousal were associated with a tendency to make incorrect reflexive prosaccades *more quickly* in the context of angry versus neutral facial cues. Time to first fixation for angry versus neutral facial cues was not associated with symptoms of anhedonia (β= -.185, t(73) = -1.570, $p = .121$). Taken together, these results show support for the theory that reduced inhibition of a prepotent tendency to direct attention towards irrelevant negative emotional stimuli is associated with what is common across depression and anxiety, namely symptoms of general distress, as well as symptoms of physiological hyperarousal specific to anxiety.

In terms of shifting attention towards the target location, percentage of correctly identified numbers for angry versus neutral facial cues in the antisaccade condition was not associated with symptoms of general distress, anhedonia, or anxious arousal (Table 7). In addition, time to first fixation for the target location in the context of angry versus neutral facial cues was not associated with symptoms of general distress, anhedonia, or anxious arousal (Table 8). Taken together, these results suggest that symptoms of internalizing psychopathology are not related to difficulties shifting attention towards the target location in the context of angry versus neutral cues. Therefore, the results of the current study suggest that reduced attentional control for angry versus neutral facial stimuli is specifically linked to difficulties inhibiting attention, as opposed to difficulties shifting attention, in the context of salient negative emotional stimuli.

Chapter Four: Discussion

Cognitive theories of internalizing disorders (e.g., Williams et al., 1988) have long proposed that biased attention for salient emotional stimuli is associated with internalizing psychopathology, including anxiety and depression. However, the precise attentional mechanisms responsible for these biases have not been well explicated, as very few studies have investigated how attentional control deficits drive biases in directing top-down, goal-oriented attention in the context of salient emotional stimuli. Furthermore, the affective symptom specificity of these attentional mechanisms has also been unclear due to strong overlap between measures of depression and anxiety. No study to date has tested how attentional control deficits might be linked to constructs common to both disorders, namely symptoms of general distress, as well as those symptom constructs that are putatively more specific to each disorder, including anhedonia and physiological hyperarousal. By using an experimental attentional control task with eye tracking methods to predict symptom constructs from the tripartite model of depression and anxiety, results showed that deficits in attentional control, as indexed by difficulty inhibiting a prepotent tendency to direct attention towards social threat, is associated with higher levels of general distress and physiological hyperarousal in youth and young adults. In contrast, no significant associations were observed with initial automatic orienting towards social threat, or with shifting attention in the context of social threat. In summary, the current study teased apart components of attention and answered detailed and specific questions about how attentional control deficits affect biased attentional processing and associations with internalizing symptoms.

These results provide evidence suggesting that deficits in attentional control, specifically deficits in inhibition of attention, might be a core cognitive control process that underlies biased top-down, goal-oriented attention in the context of negative emotion and its association with internalizing symptoms of anxiety and depression. A large body of research in the anxiety and depression literatures has found biases for salient negative emotional information in the later stages of information processing (e.g., for reviews, see Bar-Haim et al., 2007; Peckham et al., 2010), with some suggesting that these biases reflect attentional *avoidance* (e.g., Williams, et al., 1988), whereas others have suggested that these biases reflect increased *maintenance* of attention on negative emotion (e.g., Eysenck et al., 2007). Results from the current study suggest that difficulties inhibiting a prepotent tendency to direct attention towards salient negative emotional stimuli, especially when it is irrelevant or inappropriate, may be a critical component of attentional control that operates as a cognitive mechanism for depression and anxiety.

Findings are further strengthened by the use of rigorous experimental paradigms combined with eye-tracking methodology to more precisely and accurately index attention via event and temporal-related parameters. Using multiple indicators of attention (e.g., time to first fixation, number of fixations), on multiple areas of interest (e.g., facial cue location and target location), parsed apart components of attention, including bottom-up, stimulus-driven automatic orienting of attention, as well as top-down, goal-oriented inhibition and shifting of attention. Such a fine-grained approach facilitated the investigation of how particular aspects of attentional control might be related to biased attentional processing. First, high levels of general distress and physiological hyperarousal were associated with difficulties inhibiting a prepotent tendency to direct attention towards social threat. This deficit was observed via decreased latency to make reflexive prosaccades towards angry faces, however, not via proportion of reflexive prosaccades. This reduced latency suggests deficits inhibiting the automatic tendency to direct attention towards salient emotional stimuli, especially when it is irrelevant. In addition, the current study did not find evidence for difficulties shifting attention away from social threat, as indexed by latency to make correct antisaccades toward the target location. Therefore, general distress and physiological hyperarousal may *not* be associated with the components of attentional control that eventually correct for this inhibition deficit and shift attention to meet task-relevant goals.

Findings from the current study may help to clarify a mixed picture of how patterns of biased top-down, goal-oriented attention may operate as a cognitive mechanism for internalizing disorders. Deficits inhibiting a prepotent tendency to direct attention towards negative emotional information, especially when it is irrelevant or inappropriate, have crucial implications for downstream cognitive processing. Most importantly, this irrelevant emotional information enters into working memory (Joormann & Vanderlind, 2014). Working memory is a limited-capacity system that temporarily stores and manipulates information in the service of current cognitive processes (Friedman & Miyake, 2004). Irrelevant negative emotional information that enters into working memory may interfere with the ability to effectively respond to changing environmental demands or make progress towards a self-directed goal (Joormann & Vanderlind, 2014; Miyake & Friedman, 2012). Returning to the earlier example of the oral presentation, difficulty inhibiting attention towards the colleague that is frowning and furrowing her eyebrows would lead to this negative emotional information entering into working memory. Regardless of whether you immediately direct your attention away from, or alternatively, maintain your attention on the face of the frowning colleague, it is still the case that irrelevant negative emotional information has now entered working memory. In other words, regardless of the *overt* allocation of attention after the frowning face has become the focus of attention, it maybe the case that *covert* processing of the irrelevant content in working memory occurs (Cisler & Koster, 2010). Irrelevant content in working memory would therefore lead to negative appraisals of the situation, such that the colleague does not like your presentation, leading you to feel nervous and upset (Joormann & Vanderlind, 2014). By taking into account the greater literature on how cognitive control processes impact an unfolding response, the results of the current study therefore illustrate how difficulties inhibiting attention for irrelevant or inappropriate negative emotional information is related to sustained negative affect, regardless of whether subsequent avoidance of attention or increased maintenance of attention occurs.

In addition to offering a potential explanation of a seemingly mixed picture of findings in the literature on biased attention, the current study also provides a theoretically-informed conceptualization of how biased attention is related to what is common and shared across dimensional constructs of depression and anxiety, namely symptoms of general distress. Most studies examining biased attentional processing have utilized case-control designs comparing healthy controls to participants with DSM-defined depression or anxiety disorders, with few studies investigating comorbid groups.

Although these studies have demonstrated relationships between biased attentional processing and anxiety on the one hand, and depression on the other hand, this approach ignores the theoretical and empirical comorbidity between these two types of internalizing disorders (Watson et al., 1995). Results from the current study demonstrate that deficits in attentional control are indeed associated with constructs that are shared across anxiety and depression, namely negative affect, as well as nonspecific symptoms such as fatigue or difficulty concentrating. In addition, deficits in attentional control are also associated with physiological hyperarousal. High levels of physiological hyperarousal might reflect greater bottom-up affective reactivity to salient environmental stimuli (Rothbart & Rueda, 2005), such as social threat, which may make it difficult for top-down, goal-oriented attention to successfully override the influence of bottom-up behavioral and physiological systems and direct attention in the context of situational demands or in the service of a self-directed goal. Taken together, our findings therefore provide an alternative, and potentially more organized approach to conceptualizing how biased attentional processing might relate to both shared and unique constructs of anxiety and depression.

The finding that deficits in attentional control was not associated with anhedonia is consistent with expected cognitive, emotional, and behavioral sequelae linked to anhedonia, a construct that is specific to depression, and not anxiety. Anhedonia is associated with low levels of positive affectivity, reduced approach towards motivating or reinforcing stimuli, and diminished energy and activity. Relatedly, studies of attentional bias in depression have largely found that depression, but not anxiety, is associated with reduced attention for *positive* emotional stimuli, such as facial displays of happiness (e.g., Peckham et al., 2010). It therefore may be the case that the specific symptom construct of anhedonia is not related to attentional control deficits in the context of *negative* emotional stimuli, namely social threat. It is likely that future studies that incorporate both positive and negative emotional stimuli in tasks indexing attention control might find associations between specific constructs of anhedonia and positive stimuli.

Relation to Previous Literature on Attentional Control Deficits

Very few studies have investigated attentional control processing in youth with internalizing disorders. Some studies have administered emotional adaptations of the Antisaccade Task, including both affective (e.g., happy, angry, sad, fearful) and neutral faces as cues. A study by Mueller and colleagues (2012) compared anxious youth (i.e., diagnosed with General Anxiety Disorder, Social Phobia, and Separation Anxiety Disorder) to healthy controls in a mixed-block emotional antisaccade task with affective (e.g., happy, angry, fearful) and neutral faces. This study found that anxious youth demonstrated a shorter latency to orient to angry faces in the prosaccade condition, which was not found in the current study. However, consistent with the current study, Mueller and colleagues did not find that anxiety was associated with proportion of reflexive prosaccades or latency to fixate on the target location in the context of affective versus neutral faces. In contrast, a study by Derakshan and colleagues (2009) compared dysphoric adults (i.e., BDI-II scores > 13) to non-dysphoric young adults (i.e., BDI-II scores < 5) on an emotional antisaccade task with affective (e.g., happy, angry) and neutral faces. This task include standard versions of the prosaccade and antisaccade conditions, as well as delayed versions of the prosaccade and antisaccade condition, in which participants were instructed to make saccades only after an 800 ms delay. This study found that dysphoric young adults exhibited higher rates of erroneous reflexive prosaccades, which was not consistent with the current study. However, the study by Derakshan and colleagues found that dysphoria was not associated with latency to fixate on the target location, which corroborates findings in the current study.

Other studies examining attentional control in youth with internalizing psychopathology have administered versions of the Antisaccade Task that utilize reward and punishment conditions, but do not include affective and neutral facial stimuli in place of the cue. For instance, Jazbec et al., (2005) compared anxious (i.e., diagnosed with General Anxiety Disorder, Social Phobia, and Separation Anxiety Disorder) and depressed (i.e., diagnosed with Major Depressive Disorder) adolescents on a mixed-block design task with monetary rewards and punishments. In this task, the initial fixation in the center of the screen indicated the opportunity for monetary gain or loss in the trial. This study also did not find that anxiety or depression diagnosis was associated with proportion of reflexive prosaccades in the antisaccade condition. Finally, Hardin et al., (2007) utilized a similar Antisaccade Task in anxious (i.e., diagnosed with an anxiety disorder) and depressed (i.e., diagnosed with Major Depressive Disorder) adolescents. This task was different from the one utilized by Jazbec and colleagues in that it only included antisaccade trials. This study found that depressed adolescents demonstrated a greater proportion of reflexive prosaccades in the antisaccade condition. Taken together, the results of the current study add to previous studies in depressed and anxious adolescents and young adults showing deficits attentional control, even though studies vary according to what particular indicator (i.e., latency of saccades, proportion of reflexive prosaccades) reflects deficits in attentional control. Moreover, it should be noted that there are important methodological differences between previous research and the current study. For instance, the small body of studies has largely compared healthy controls to those with DSM-defined depression or anxiety disorders, and the current study examined continuous symptom domains of general distress, anhedonia, and physiological hyperarousal according to the Tripartite Model. In addition, some methodological differences across experimental tasks limits direct comparisons across studies, such as mixed-block or valence conditions. Therefore, given the relative dearth of research in youth, future studies investigating deficits in attentional control in youth depression and anxiety are warranted.

Translational Implications of Attentional Control Deficits

Findings and conclusions of the current study have important translational implications, especially for attention bias modification (ABM) interventions. ABM interventions are computer-based tasks designed to re-train attentional processing so as to reduce biased processing of negative emotional information, and therefore improve symptomatic functioning (e.g., Beevers, Clasen, Enock, & Schnyer, 2015). ABM tasks are typically adaptations of the visual probe task, with one important difference. Whereas in the original visual probe task, the probe stimulus replaces the emotional and neutral faces with equal frequency, in the ABM task, the probe stimulus replaces the neutral faces with a much greater frequency (e.g., 80%) compared to the emotional faces. Therefore, participants learn orienting towards the neutral face is more likely to facilitate a prompt behavioral response to the probe stimulus (Koster, Baert, Bockstaele, De Raedt, 2010). Recent studies have shown that ABM is associated with reductions in symptoms and stress reactivity, as well as improvements in connectivity between brain regions implicated in cognitive control (for a review, see Beevers et al., 2015).

More specifically, the findings of the current study have direct implications for the approach to training attentional processing. Some ABM paradigms, for instance, train participants to direct attention away from negative stimuli and towards neutral stimuli (e.g., Koster, Baert, Bockstaele, & De Raedt, 2010; Wells & Beevers, 2010), whereas other studies train participants to direct attention away from neutral stimuli and towards positive stimuli (e.g., Price, Greven, Siegle, Koster, & de Raedt, 2016). Therefore, the approach of these ABM paradigms is to train participants to direct their attention towards stimuli that are relevant in the context of current task goals (i.e., toward neutral or positive stimuli). Findings from the current study suggest that attentional control processes are particularly nuanced, and so the therapeutic target of ABM's should precisely and directly match the specific components of attentional control that contribute to biased attention. Given that findings from the current study did *not* find evidence for difficulty directing attention to meet current task goals (e.g., no difference in time to first fixation for the target location or behavioral accuracy), it may be the case that focusing on this specific component of attentional control may not be the most relevant therapeutic target of ABM. Instead, ABM paradigms should train participants to inhibit prepotent tendencies to automatically orient towards salient emotional stimuli that are irrelevant or inappropriate in the context of current goals or demands. Such an approach would more precisely target and train the exact component of attentional control processes that is more closely associated with symptoms of psychopathology, such as general distress and physiological hyperarousal. In line with the approach to train inhibition of prepotent attentional responses, some of the aforementioned studies have employed reward and punishment contingencies to shape attentional control in the context of non-emotional information (e.g., Hardin et al., 2007; Jazbec et al., 2005).

Limitations and Future Directions

The current study had several limitations, which should also inform future directions for this important area of research. First, the current study operationalized constructs of the Tripartite Model, namely general distress, anhedonia, and physiological hyperarousal, by drawing upon specific items from self-report questionnaires assessing symptoms of depression (e.g., CDI, CES-DC) and anxiety (e.g., MASC, PSWQ-C). The current study selected scale items based on theory (e.g., Watson et al., 1995), as well as previous empirical studies (e.g., Chorpita et al., 1998, March et al., 1997). Although items from these self-report questionnaires were specifically designed to assess symptom dimensions of these disorders, there are some challenges in assigning symptom scale items to constructs of the Tripartite Model. For instance, items such as, “I felt lonely, like I didn't have any friends” from the CES-DC could have been assigned to the general distress construct, due to the mention of negative affect. Alternatively, this item could have been assigned to the anhedonia construct because it overlaps conceptually with social withdrawal. Future studies would benefit from utilizing scales that more closely index the three factors of the Tripartite Model, such as the Mood and Anxiety Symptom Questionnaire (Watson et al., 1995), the Positive and Negative Affectivity Scale for Children (Laurent et al., 1999), as well as scales of physiological hyperarousal (E.g. Laurent, Catanzaro, & Joiner, 1995). These scales were designed to precisely index constructs of negative and positive affectivity, as well as physiological hyperarousal, and therefore could strengthen future studies that assess the factors of the Tripartite Model.

Second, the current study examined continuous symptom domains in a general community sample of youth and young adults, as the preponderance of research to date has used case-control designs comparing healthy controls to participants with DSM-defined depression or anxiety disorders. It is possible, however, that low mean levels and variability in symptom severity in our unselected community sample might have limited the ability to detect effects between attentional processing and internalizing symptoms.

Third, the current study indexed attentional control processes only in the context of angry and neutral facial stimuli. Angry faces were chosen based on well-established theoretical associations of bias for indicators of social threat (i.e., anger) that cut across multiple forms of psychopathology, including depression and anxiety (Thayer, Åhs, Fredrikson, Sollers, & Wager, 2012). However, the current study was part of a larger study that required participants to complete laboratory tasks and questionnaires for five hours, and so only one emotional stimulus was chosen so as to limit the number of experimental trials and reduce undue burden on participants. Future studies would benefit from using multiple emotions, such as happiness, sadness, or fear, to determine how deficits in attentional control might vary across different types of emotions. This methodological approach would further strengthen observations regarding attentional control deficits in the context of various emotions and what is shared and unique across forms of internalizing psychopathology.

Future studies should examine whether attentional processing of emotional information is related to downstream cognitive emotion regulation processes, such as rumination or cognitive reappraisal. Gross' (2002) process model of emotion regulation maintains that attention exerts a relatively early impact on an unfolding emotional response. However, it is important to investigate the cognitive processes that may mediate or moderate the association between attentional processing of emotional information and the resulting emotional response. For example, Hilt, Leitzke, & Pollak (2016) found that greater dwell time on emotional faces in a modified visual probe task was associated with higher levels of rumination in a nonclinical sample of youth. Furthermore, Vanderhasselt, Koster, Goubert, and de Raedt (2012), found that reduced attentional control in the context of social threat interacted with life stress to predict prospective changes in rumination over a period of six weeks. Taken together, these studies provide some early evidence that deficits in attentional control may also be related to maladaptive downstream cognitive processes, especially rumination, which is a well-established and potentially more proximal cognitive mechanism of internalizing psychopathology.

Chapter Five: Summary

In conclusion, the current study makes an important contribution to the extant literature surrounding attentional processing of negative emotional information and internalizing psychopathology. More specifically, the results of the current study found that deficits inhibiting a reflexive prosaccade towards negative emotional stimuli, especially when it is irrelevant or inappropriate, is associated with what is shared across depression and anxiety, namely symptoms of general distress, as well as symptoms of physiological hyperarousal in anxiety.

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Appendix

Table 1 Questionnaire items for tripartite symptom constructs

Questionnaire Item	General Distress	Anhedonia	Physiological Hyperarousal
	Correlated Item Total Correlation on Constructs		
MASC			
I feel tense or upset	.532		
I feel restless or on edge	.513		
PSWQ-C			
My worries really bother me	.589		
I don’t really worry about things*	.503		
Many things make me worry	.699		
I know I shouldn’t worry about things, but I just can’t help it	.763		
When I’m under pressure, I worry a lot	.634		
I am always worrying about something	.721		
I find it easy to stop worrying when I want*	.566		
When I finish one thing, I start to worry about everything else	.625		
I never worry about anything*	.548		
I’ve been a worrier all my life	.581		
I notice that I have been worrying about things	.651		
Once I start worrying, I can’t stop	.616		
I worry all the time	.754		
I worry about things until they are all done	.439		
CDI			
I am sad all of the time	.515		
Nothing will ever work out for me	.496		
I do everything wrong	.535		
I think about bad things happening to me once in a while	.437		
I hate myself	.427		
All bad things are my fault	.466		
I want to kill myself	.395		
I feel like crying everyday	.461		

Things bother me all the time	.606	
I cannot make up my mind about things	.481	
I look ugly	.499	
I have trouble sleeping every night	.493	
I am tired all the time	.456	
Most days I don’t feel like eating	.390	
I can never be as good as other kids	.387	
CES-DC		
I was bothered by things that usually don’t bother me	.644	
I did not feel like eating, I wasn’t very hungry	.513	
I felt like I was just as good as other kids*	.448	
I felt down and unhappy	.718	
I felt like I was too tired to do things	.530	
I felt scared	.580	
I didn't sleep as well as I usually	.480	
I felt like crying	.652	
I felt sad	.470	
CDI		
Nothing is fun at all		.727
I do not want to be with people at all		.448
I have to push myself all the time to do schoolwork		.395
I feel alone all the time		.682
I never have fun at school		.378
I do not have any friends		.574
Nobody really loves me		.359
CES-DC		
I wasn't able to feel happy, even when family or friends tried to help me feel better		.655
I felt like something good was going to happen*		.535
I was happy*		.586
I felt lonely, like I didn't have any friends		.696
I felt like kids I know were not friendly or that they didn't want to be with me		.649
I had a good time*		.669
I felt people didn't like me		.689
It was hard to get started doing things		.463

MASC	
I have trouble getting my breath	.552
I get shaky or jittery	.709
I get dizzy or faint feelings	.591
I'm jumpy	.603
I have pains in my chest	.558
I feel strange, weird, or unreal	.594
My heart races or skips beats	.641
I feel sick to my stomach	.651
My hands shake	.662
My hands feel sweaty or cold	.446

CDI Children's Depression Inventory; *CES-DC* Center for Epidemiologic Studies-Depression Scale for Children *MASC* Multidimensional Anxiety Scale for Children; *PSWQ-C* Penn State Worry Questionnaire for Children; * Item is reverse scored

Table 2 Means, standard deviations, and inter-correlations between all variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. CDI	-														
2. CES-DC	.873**	-													
3. MASC	.684**	.686**	-												
4. PSWQ-C	.528**	.543**	.546**	-											
5. GEN DISTRESS	.800**	.803**	.685**	.887**	-										
6. ANHEDONIA	.894**	.935**	.654**	.423**	.676**	-									
7. PH AROUSAL	.583**	.617**	.869**	.537**	.646**	.542**	-								
8. ACC PS	-.047	-.128	.027	-.052	-.030	-.145	.062	-							
9. ACC AS	-.001	-.006	-.007	-.004	.026	.037	.010	.478**	-						
10. PROP ERR	.057	.093	.119	.009	.071	.053	.069	-.058	.028	-					
11. T1STFIX PRO	.056	.042	.119	.035	.091	.088	.098	-.481**	-.030	-.029	-				
12. T1STFIX FACE	-.193	-.179	-.294**	-.211	-.258*	-.185	-.321**	.024	.016	-.173	-.023	-			
13. T1STFIX TAR	.112	.123	-.079	.177	.177	.088	-.135	-.329**	-.079	.003	.039	.034	-		
14. AGE	-.082	-.080	-.190	.143	.081	-.059	-.179	.072	.315**	-.056	-.047	.114	.011	-	
15. GENDER	.240*	.173	.154	.488**	.462**	.083	.161	.046	-.020	-.051	-.020	-.018	.097	.131	-

Mean	7.83	12.66	29.91	17.59	29.75	7.05	8.25	.990	.930	.003	-.059	-.026	.014	16.76	1.57
SD	7.74	10.55	15.38	9.64	17.13	6.66	6.08	.020	.077	.100	.591	.895	.947	2.39	.500

** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)
CDI Children's Depression Inventory; *CES-DC* Center for Epidemiologic Studies-Depression Scale for Children *MASC* Multidimensional Anxiety Scale for Children; *PSWQ-C* Penn State Worry Questionnaire for Children; *GEN DISTRESS* Symptoms of general distress; *ANHEDONIA* Symptoms of anhedonia; *PH AROUSAL* Symptoms of physiological hyperarousal; *ACC PS* Proportion of correct responses in the prosaccade condition; *ACC AS* Proportion of correct responses in the antisaccade condition; *PROP ERR* Proportion of incorrect reflexive saccades in the antisaccade condition; *T1STFIX PRO* Time to first fixation for the facial cue in the prosaccade condition; *T1STFIX FACE* Time to first fixation for the facial cue in the antisaccade condition; *T1STFIX TAR* Time to first fixation for the target location in the antisaccade condition; *AGE* Age; *GENDER* Gender (1=Male; 2=Female)

Table 3 Summary of hierarchical regression analysis for proportion of correct responses in the prosaccade condition (ACC PS)

	General Distress					Anhedonia					Physiological Hyperarousal				
Variable	B *(SE)*	β	t	p	ΔR^2	B *(SE)*	β	t	p	ΔR^2	B *(SE)*	β	t	p	ΔR^2
Step 1					.212					.005					.044
Gender	.913 *(.218)*	.452	4.19	.001		.121 *(213)*	.070	.569	.571		.215 *(.217)*	.116	.993	.324	
Age	.017 *(.047)*	.039	.358	.721		-.015 *(.045)*	-.040	-.327	.745		-.076 *(.046)*	-.192	-1.65	.103	
Step 2					.001					.026					.005
Gender	.916 *(.220)*	.453	4.17	.001		.146 *(.213)*	.084	.685	.496		.207 *(.218)*	.111	.951	.345	
Age	.017 *(.047)*	.039	.364	.717		-.013 *(.045)*	-.034	-.278	.782		-.078 *(.047)*	-.198	-1.69	.096	
ACC PS	-1.87 *(5.37)*	-.037	-.348	.729		-6.73 *(5.08)*	-.169	-1.32	.190		3.36 *(5.31)*	.074	.633	.529	

Table 4 Summary of hierarchical regression analysis for time to first fixation for the facial cue in the prosaccade condition (T1STFIX PRO)

	General Distress					Anhedonia					Physiological Hyperarousal				
Variable	B *(SE)*	*β*	*t*	*p*	**Δ***R*²	B *(SE)*	*β*	*t*	*p*	**Δ***R*²	B *(SE)*	*β*	*t*	*p*	**Δ***R*²
Step 1					.205					.009					.065
Gender	.916 *(.216)*	.451	4.25	.001		.147 *(.222)*	.079	.662	.510		.374 *(.229)*	.184	1.63	.106	
Age	.004 *(.045)*	.010	.090	.928		-.025 *(.046)*	-.064	-.538	.592		-.084 *(.047)*	-.200	-1.78	.079	
Step 2					.014					.010					.009
Gender	.926 *(.215)*	.456	4.30	.001		.158 *(.223)*	.085	.710	.480		.378 *(.229)*	.186	1.65	.103	
Age	.006 *(.044)*	.014	.135	.893		-.023 *(.046)*	-.060	-.500	.619		-.082 *(.048)*	-.195	-1.73	.088	
T1stFix Pro	.205 *(.182)*	.119	1.13	.263		.157 *(.189)*	.098	.829	.410		.158 *(.190)*	.093	.832	.408	

Table 5 Summary of hierarchical regression analysis for proportion of incorrect reflexive saccades in the antisaccade condition (PROP ERR)

	General Distress					Anhedonia					Physiological Hyperarousal				
Variable	B *(SE)*	*β*	*t*	*p*	ΔR^2	B *(SE)*	*β*	*t*	*p*	ΔR^2	B *(SE)*	*β*	*t*	*p*	ΔR^2
Step 1					.208					.010					.065
Gender	.915 *(.212)*	.454	4.306	.001		.159 *(.219)*	.086	.725	.471		.372 *(.226)*	.184	1.65	.103	
Age	.004 *(.044)*	.009	.089	.929		-.024 *(.045)*	-.062	-.523	.603		-.084 *(.047)*	-.201	-1.80	.076	
Step 2					.013					.004					.005
Gender	.938 *(.213)*	.466	4.403	.001		.172 *(.221)*	.093	.093	.777	.440	.378 *(.227)*	.187	1.67	.099	
Age	.003 *(.044)*	.007	.070	.944		-.024 *(.046)*	-.062	-.523	.602		-.083 *(.047)*	-.197	-1.76	.083	
Prop Err	.120 *(.107)*	.117	1.120	.267		.063 *(.111)*	.068	.570	.570		.067 *(.111)*	.067	.604	.548	

Table 6 Summary of hierarchical regression analysis for time to first fixation for the facial cue in the antisaccade condition (T1STFIX FACE)

	General Distress					Anhedonia					Physiological Hyperarousal				
Variable	B *(SE)*	*β*	*t*	*p*	ΔR^2	B *(SE)*	*β*	*t*	*p*	ΔR^2	B *(SE)*	*β*	*t*	*p*	ΔR^2
Step 1					.218					.009					.060
Gender	.929 *(.212)*	.460	4.37	.001		.170 *(.220)*	.092	.773	.442		.391 *(.226)*	.195	1.73	.087	
Age	.016 *(.045)*	.036	.345	.731		-.015 *(.047)*	-.039	-.325	.746		-.072 *(.048)*	-.167	-1.49	.141	
Step 2					.068					.034					.089
Gender	.904 *(.205)*	.448	4.42	.001		.150 *(.218)*	.081	.687	.495		.363 *(.216)*	.181	1.68	.098	
Age	.031 *(.044)*	.072	.705	.483		-.006 *(.047)*	-.015	-.129	.898		-.057 *(.046)*	-.134	-1.24	.220	
T1stFix Face	-.287 *(.110)*	-.264	-2.61	.011		-.185 *(.118)*	-.185	-1.57	.121		-.335 *(.120)*	-.302	-2.80	.007	

Table 7 Summary of hierarchical regression analysis for proportion of correct responses in the antisaccade condition (ACC AS)

	General Distress					Anhedonia					Physiological Hyperarousal				
Variable	B *(SE)*	*β*	*t*	*p*	**Δ***R*²	B *(SE)*	*β*	*t*	*p*	**Δ***R*²	B *(SE)*	*β*	*t*	*p*	**Δ***R*²
Step 1					.212					.005					.044
Gender	.913 *(.218)*	.452	4.19	.001		.121 *(.213)*	.070	.569	.571		.215 *(.217)*	.116	.993	.324	
Age	.017 *(.047)*	.039	.358	.721		-.015 *(.045)*	-.040	-.327	.745		-.076 *(.046)*	-.192	-1.65	.103	
Step 2					.003					.002					.006
Gender	.925 *(.220)*	.458	4.20	.001		.127 *(.215)*	.073	.588	.588		.228 *(.218)*	.123	1.05	.299	
Age	.009 *(.049)*	.021	.183	.855		-.020 *(.048)*	-.054	-.416	.679		-.087 *(.049)*	-.218	-1.78	.080	
ACC AS	.758 *(1.15)*	.056	.502	.617		.528 *(1.51)*	.045	.351	.727		1.02 *(1.50)*	.083	.685	.496	

Table 8 Summary of hierarchical regression analysis for time to first fixation for the target location in the antisaccade condition (T1STFIX TAR)

	General Distress					Anhedonia					Physiological Hyperarousal				
Variable	B *(SE)*	*β*	*t*	*p*	ΔR^2	B *(SE)*	*β*	*t*	*p*	ΔR^2	B *(SE)*	*β*	*t*	*p*	ΔR^2
Step 1					.186					.010					.065
Gender	.915 *(.212)*	.454	4.31	.001		.159 *(.219)*	.086	.725	.471		.372 *(.226)*	.184	1.65	.103	
Age	.004 *(.044)*	.009	.089	.929		-.024 *(.045)*	-.062	-.523	.603		-.084 *(.047)*	-.210	-1.80	.076	
Step 2					.007					.011					.023
Gender	.891 *(.212)*	.443	4.19	.001		.151 *(.220)*	.082	.687	.495		.390 *(.225)*	.193	1.74	.087	
Age	.002 *(.044)*	.005	.049	.961		-.024	.045	-.063	-.532	.596	-.087 *(.047)*	-.206	-1.85	.068	
T1stFix Tar	.139 *(.110)*	.132	1.27	.209		.111 *(.121)*	.108	.920	.361		-.169 *(.123)*	-.151	-1.37	.175	

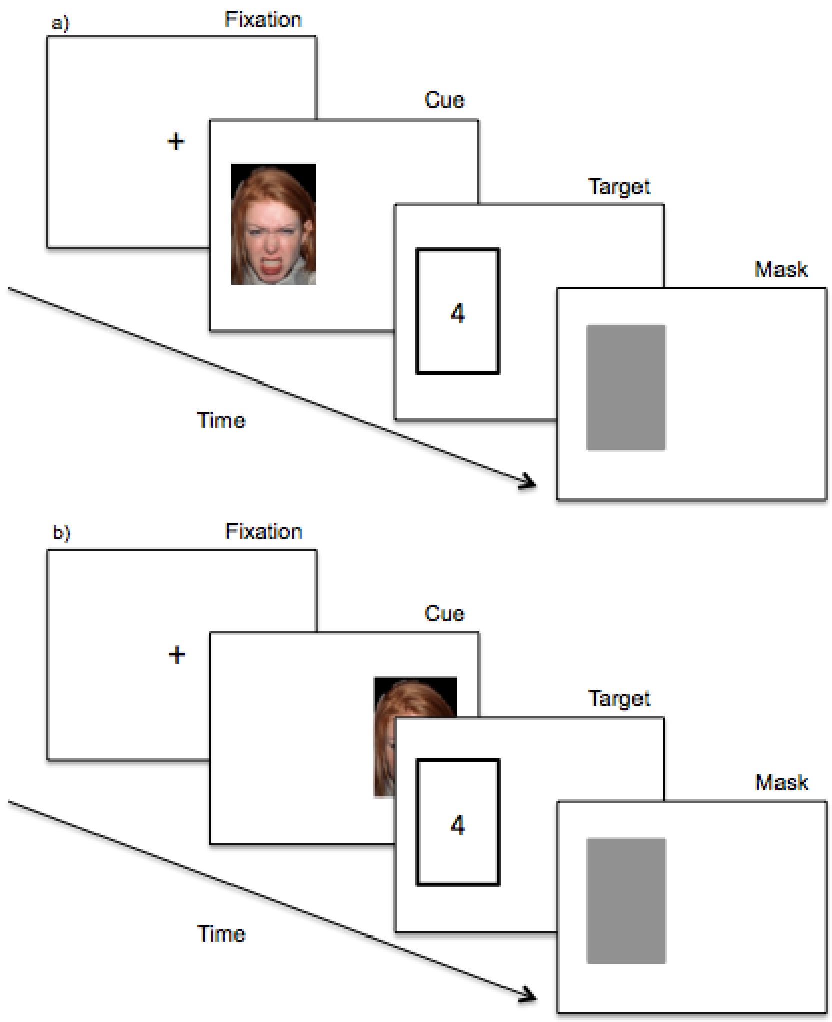

Figure 1 Schematic of a prosaccade (a) and antisaccade trial (b) of the emotional adaptation of the Antisaccade Task.

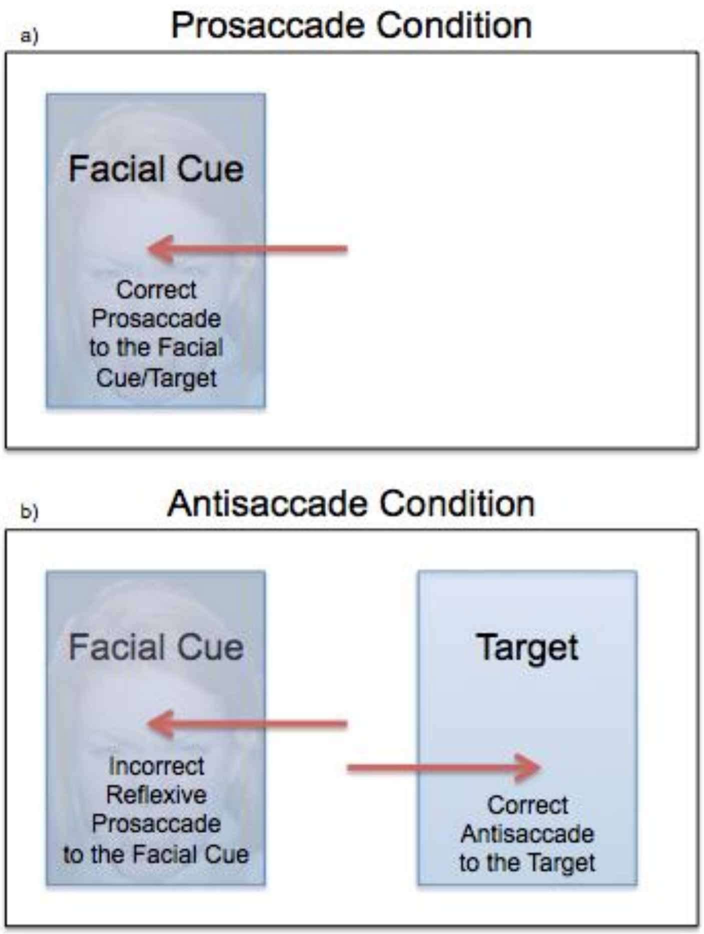

Figure 2 Schematic of areas of interest during the presentation of the facial stimuli cue in the prosaccade (a) and antisaccade (b) conditions.

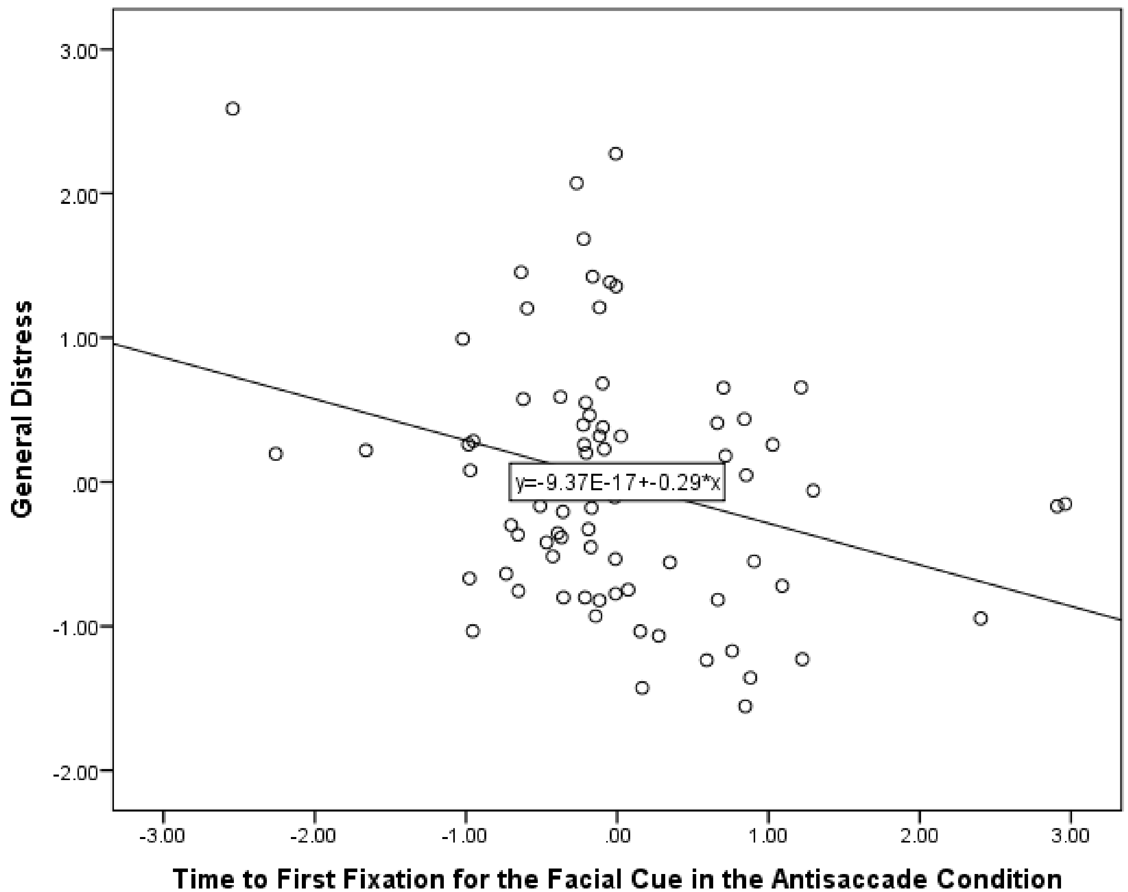

Figure 3 Time to first fixation for the facial cue in the antisaccade condition (T1STFIX FACE) is negatively correlated with General Distress (GEN DISTRESS).

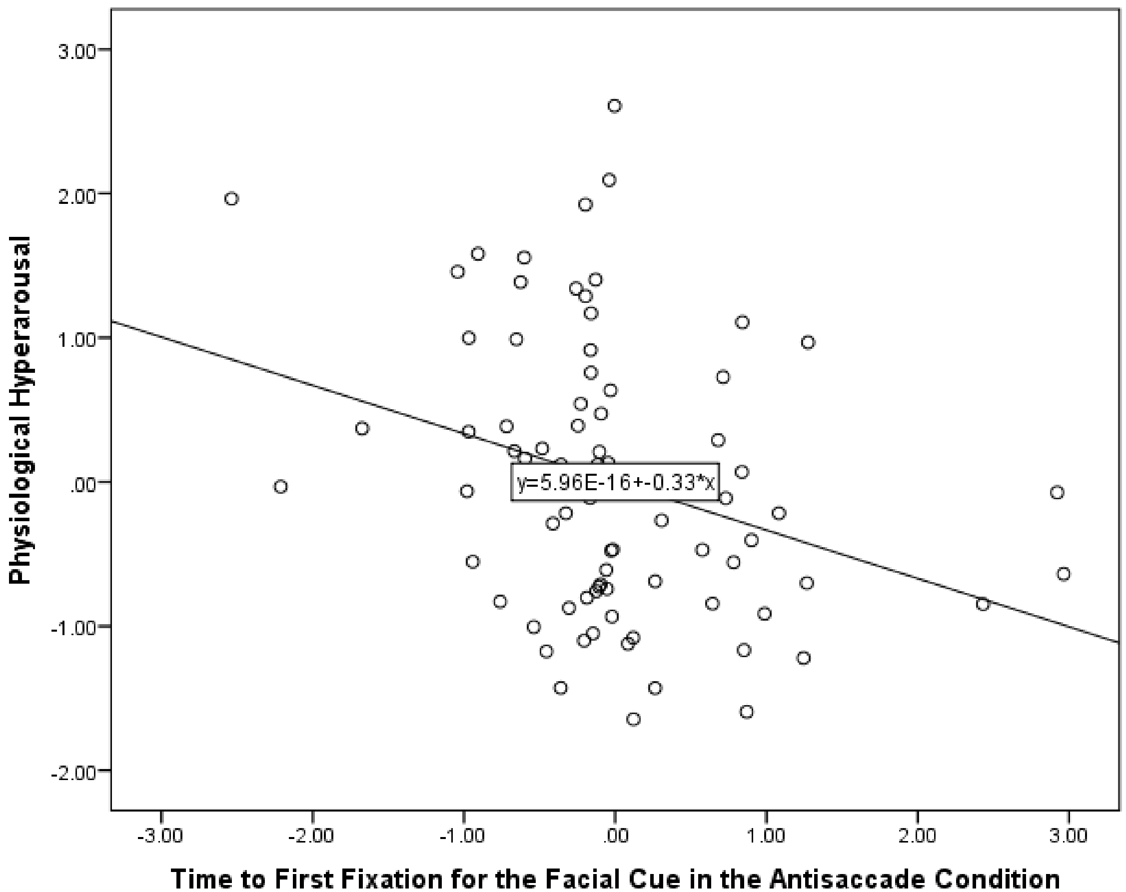

Figure 4 Time to first fixation for the facial cue in the antisaccade condition (T1STFIX FACE) is negatively correlated with Physiological Hyperarousal (PH AROUSAL).