ATTENTION BIASES ASSOCIATED WITH VULNERABILITY TO BIPOLAR DISORDER

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Bipolar disorder is associated with significant social and occupational impairments, as well as increased risk for substance abuse and suicide. More research is needed to identify potential mechanisms associated with vulnerability to the disorder. Previous research has identified altered processing of emotional information in bipolar and bipolar-prone individuals, including attentional biases which appear to differ based on the current affective state of the individual. The current study applied a sensitive measure of attention (i.e., eye-tracking) to assess whether vulnerability to bipolar disorder, as indexed by hypomanic personality traits, would be correlated with biases in attention to emotional facial stimuli, independent of mood state. Hypomanic personality traits were hypothesized to be associated with greater attention to happy and angry faces, as indexed by faster initial orientation, more frequent gazes, and longer gaze duration for these stimuli. Participants completed self-report measures assessing current mood symptoms, positive and negative affect, and hypomanic personality traits. They then completed two tasks assessing attention for emotional faces. The first was an eye-tracking task, which measured latency to first fixation, total gaze duration and total number of gazes for each emotional face category. The second was a spatial cueing task which assessed both attentional engagement with emotional faces, and ability to disengage attention from this material. Hypomanic personality traits were significantly negatively correlated with latency to orient attention to happy faces. A trend toward decreased latency to orient to angry faces with higher hypomanic personality traits was also demonstrated. Hypomanic traits were not correlated with attention to sad faces. Furthermore, hypomanic traits were associated only with differences in initial orientation of attention, not with continued engagement or disengagement. The results of

this study suggest that individuals with higher levels of hypomanic personality traits, who are hypothesized to be at greater risk of developing bipolar disorder, are characterized by differences in their initial orientation of attention to positive emotional stimuli, independent of their current mood state. This finding is indicative of biased information processing in individuals with vulnerability to bipolar disorder. Such a bias may have important clinical implications for individuals with a vulnerability to bipolar disorder, as it may represent a mechanism by which vulnerability leads to increased, and at times problematic, engagement with rewarding stimuli.

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CHAPTER 1

INTRODUCTION

Bipolar Disorder: Criteria, Prevalence and Costs

Bipolar disorder (BD) is characterized by fluctuations in mood state. The diagnosis encompasses a number of subdisorders, with consequences ranging from mild enhancements in functioning to severe functional impairment. Consistent across all bipolar diagnoses are problematic mood state transitions, most often including both periods of depression and periods of mania or hypomania (American Psychiatric Association, 2000). The *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV-TR*; APA, 2000) identifies four specific bipolar disorder types: Bipolar I disorder is diagnosed in individuals who have experienced a full manic or mixed episode, defined by the presence of persistently and abnormally elevated or irritable mood accompanied by at least three of five symptoms (i.e., inflated self-esteem, pressured speech, decreased need for sleep, racing thoughts, distractibility, or increased involvement in activities likely to lead to negative consequences). Individuals with Bipolar I disorder typically experience several manic episodes and several depressive episodes over the course of their lifespan (Keck, Jr. et al., 1995; Goldberg, Harrow, & Grossman, 1995).

Not all individuals with bipolar disorder experience full manic episodes. In Bipolar II disorder, major depressive episodes are interspersed with hypomanic episodes. The *DSM-IV-TR* defines a hypomanic episode as a period of at least 4 days during which an individual experiences persistently elevated or irritable mood coupled with at least three of the five manic symptoms outlined above (APA, 2000). Hypomanic episodes are distinguished from manic episodes by shorter duration and the absence of significant impairment in social or occupational functioning. Cyclothymia is characterized by a fluctuation between hypomanic episodes and periods of depressed mood which are of insufficient severity to be considered major depressive episodes. Finally, Bipolar disorder NOS is a diagnosis given to individuals having a number of symptoms consistent with a bipolar diagnosis but not meeting full criteria for any of the three disorders described above.

Lifetime prevalence estimates of bipolar spectrum disorders range from about 1% for Bipolar I disorder, to 1.1% for Bipolar II disorder, and 2.4% for sub-threshold bipolar symptoms in a nationally representative US sample (Merikangas et al., 2011). The costs associated with these disorders are significant. Bipolar disorder is the most costly mental health disorder in terms of lost work productivity (Goetzel, Hawkins, Ozminkowski & Wang, 2003), and estimates place the yearly economic burden of bipolar spectrum disorders at approximately $45 billion (Sajatovic, 2005). In addition, bipolar disorder is associated with costs due to early mortality, as rates of suicide in individuals with affective disorders is up to four times the rate in non-affectively disordered individuals (Bostwick & Pankratz, 2000). Disorders in the bipolar spectrum are costly not only because of morbidity and early mortality, but also because of indirect costs such as impairment in health quality and burden on family members (Kleinman et al., 2003). Furthermore, comorbidity with other psychiatric diagnoses is highly prevalent in bipolar populations, compounding the difficulties experienced by these individuals (Merikangas et al., 2011).

The prevalence and high costs associated with bipolar spectrum disorders underscore the need to better understand the etiology of these conditions. In recent years, research has increasingly supported models of BD etiology that emphasize abnormal functioning in neurochemical systems which impairs mood regulation (Reynolds & Reynolds, 2011; Yildiz-Yesiloglu & Ankerst, 2006), as well as psychosocial factors (e.g., Johnson & Kizer, 2002). A broad, psychobiological model of bipolar disorder that emphasizes dysregulation of an approach system called the behavioral activation system (BAS) attempts to integrate and explain these findings (see Johnson, 2005, or Urosevic et al., 2008, for reviews of the model).

The present work discusses evidence for biased attentional processes in individuals with bipolar disorder, and suggests a model by which to understand how these biases may be related to development of bipolar symptoms. Individuals with high levels of hypomanic personality traits have been shown to be at heightened risk of developing bipolar disorder (Kwapil et al., 2000). The identification of attentional biases associated with such personality traits is important for a number of reasons. First, such biases might represent cognitive endophenotypes of bipolar disorder. Second, such processes may represent a novel intervention target. In fact, similar work in depression has led to the development of new treatments as well as to a better understanding of the underlying biology of these disorders.

Given the precedent for studying attention in unipolar depression, the present work begins with a review of cognitive models of unipolar depression and the role that attention plays in them. This is followed by a review of studies examining attentional biases in samples of bipolar individuals and individuals with high vulnerability to bipolar disorder. Finally, a potential explanatory model which may be related to observed biases is briefly discussed.

Attention in Unipolar Depression: Cognitive Models, Implications, and Evidence

Cognitive Models of Depression

Cognitive models have proposed that vulnerability to depression and maintenance of dysphoric mood states may be tied to cognitive distortions and altered patterns of information processing. One of the first and most influential cognitive models of depression was proposed by Beck (1967). According to this model, individuals vulnerable to depression have negative underlying schemas which affect the manner by which they perceive stimuli, as well as how they interpret and remember what they have perceived. Vulnerable individuals are thought to have a negative bias in attention that is activated by psychosocial stressors and deepens existing depressive symptoms. Ingram (1984) later applied an information-processing model to depression. In this model, the development of a particular affective state affects cognitive associative networks related to that affective state. In the case of depression, the activation of the neural structure responsible for sadness simultaneously activates cognitive networks related to depression, and influences the manner by which an individual processes and encodes information. This activation is hypothesized to lead to increased attention to and memory for mood-congruent information.

A more recent cognitive model of depression is Beevers' (2005) dual process model, which proposes that there are two pathways by which individuals process information. The first is an associative process, which is considered to be automatic, and requires little mental effort (i.e. does not significantly contribute to cognitive load). The second pathway by which information is processed is reflective, or explicit, processing. This is a slower route which is guided by rule-based knowledge and operates sequentially, rather than simultaneously. Beevers' (2005) model of cognitive vulnerability to depression focuses on the interplay of associative and reflective processing. Negative self-referent automatic processing is viewed as the heart of vulnerability. That is, individuals at increased risk for developing depression are those whose automatically accessed thoughts when processing information related to the self are negatively biased. However, biased associative processing does not provide a complete explanation. Reflective processing could potentially repair the negative mood states induced by negatively-biased automatic processing, but in individuals with vulnerability to depression, this reparative function of reflection is not realized. In these individuals, negatively-biased self-referent automatic processing and dysphoric mood exert bidirectional influences which are exacerbated by the lack of effective reflective processing.

Beevers (2005) proposed three reasons why negative automatic cognitions may go unchecked by reflective processes. First, an individual may have had their expectations violated by automatic processing, but may lack the cognitive resources to engage in more effortful processing. Second, negatively-biased automatic processing may be consistent with an individual's expectancies, and therefore the need for reflective processing is not realized. There is evidence of this process in depressed individuals, who are less likely to perceive a discrepancy between their mood state and an incongruent statement about the self (Sheppard & Teasdale, 2000). Finally, reflective processing may be activated but may fail to produce an adaptive change in mood. For example, depression-vulnerable individuals may engage in a type of reflective processing known as rumination, in which they turn focus inward and reflect on the causes and consequences of their depressive thoughts and other symptoms (Nolen-Hoeksema, 1991). This processing, rather than repairing a negative mood state, is thought to deepen the individual's dysphoria.

Finally, Harmer (2008) has proposed a model of depression vulnerability which integrates neuropsychological and cognitive aspects of the disorder based on response to psychopharmacological and cognitive interventions. Concordantly with Beevers' (2005) model, Harmer's model identifies two modes of processing which are altered in depression, a top-down frontal-cortical pathway (akin to Beevers' reflective pathway) and a bottom-up limbic pathway involving increased activation of the amygdala in response to negative stimuli (akin to Beevers' associative pathway). Neuroimaging studies support the existence of these distinct neural pathways, whose functioning in depressed and anxious individuals differs from that in non-depressed, non-anxiety-disordered individuals.

Implications of Depression Models

The preceding models have implications for the attentional patterns of individuals with depression. Specifically, it would be expected that individuals with depression would be more reactive to mood-congruent material, including dysphoric images and sad faces. In addition, it would be expected that attention to negative material would be maintained more strongly in depressed individuals than in non-depressed individuals, as negative materials activated neural networks that promote greater attention to these mood-congruent stimuli, and reflective processes which would typically shift attention away from negative information may be impaired. Furthermore, it may be hypothesized that individuals who are not currently depressed, but who evidence the same pattern of enhanced attention to negative information, may be at greater risk for developing depression.

Evidence of Biased Attention in Unipolar Depression

A number of research paradigms have been employed to investigate the nature of attention biases in dysphoria and unipolar depression, including the emotional Stroop task, dot-probe tasks, and more recently, tracking of gaze. In a review of studies on attention biases in depression, the emotional Stroop produced evidence of a marginally significant bias for negative information in dysphoric individuals (Cohen's $d = 0.17$, $p = .06$), while a moderate bias was found in studies employing the dot-probe paradigm (Cohen's $d = 0.52$, $p < .001$; Peckham, McHugh & Otto, 2010). In addition to a negative bias, depressed and dysphoric individuals also exhibited significantly less bias toward positive information than non-depressed groups (Cohen's $d = -0.23$). This meta-analysis of early attention bias studies found no significant difference in attention for verbal versus nonverbal stimuli in the dot-probe task, nor for stimuli presented for either 500 or 1000 ms. Patient status was also found to be non-significant; that is, patients with clinical depression and non-patients with induced negative mood exhibited similar attention biases.

More consistent evidence for an attention bias in dysphoria has been obtained in studies employing the more sensitive measure of eye tracking to measure attention. The first study to use eye tracking to examine attention biases in depressed participants was conducted by Eizenman et al. (2003), who simultaneously presented four images and measured total fixation time and average glance duration for each stimulus category. Each presentation included one neutral image, one sad image, one threat-related image, and one image related to interpersonal relationships. Researchers found that depressed participants had significantly greater average glance duration for dysphoric stimuli than non-depressed participants, and that they had a significantly greater total fixation time for dysphoric stimuli (Cohen's $d = 1.66$). In a more recent study, Caseras, Garner, Bradley, and Mogg (2007) presented pairs of images, with a neutral image appearing in each presentation with either a negative or a positive image. They found that dysphoric college students maintained their gaze on negative images significantly longer than non-dysphoric students (Cohen's $d = .55$). In a similar study, Kellough, Beevers, Ellis and Wells (2008) measured differential attention to simultaneously presented neutral, happy, threat-related and sad images. Depressed college students spent a significantly greater percentage of time looking at sad images than never-depressed students (Cohen's $d = .84$), and exhibited a greater number of fixations on dysphoric stimuli than never-depressed students (Cohen's $d = 0.82$). These studies provide strong evidence that a reliable bias for negative stimuli exists in depressed and dysphoric individuals.

The depression-related attention bias found in these studies has been variably hypothesized as reflecting greater tendency to attend to mood-congruent stimuli and impairment in the disengagement of attention from mood-congruent stimuli once attended. In an explicit investigation of the disengagement hypothesis, Sears and colleagues (2010) utilized simultaneous presentation of sad, threat-related, positive and neutral images, and sequential presentation of these stimuli with an endogenous cueing paradigm. In the simultaneous presentation condition, eye tracking was used to measure initial fixation, total number of fixations and average length of fixation to each stimulus category, and length of fixation on the first fixated image. Depressed participants exhibited a significantly lower number of fixations and a shorter average length of fixation to positive images than non-depressed participants. In the sequential presentation condition, disengagement of attention was measured by the length of time before an individual experienced a saccade (a rapid, simultaneous movement of both eyes) away from the currently fixated image following the appearance of the probe. Depressed participants showed significantly slower disengagement of attention from dysphoric stimuli than non-depressed participants, but did not differ in length to disengagement for the remaining stimulus categories. These results support the hypothesis that dysphoric individuals are impaired in their ability to shift attention away from mood-congruent stimuli.

Importantly, attention biases in depression do not appear to be simply a correlate of depressed mood, but rather represent a marker of cognitive vulnerability to the disorder. These biases have been shown to be present in never-depressed individuals with vulnerability to depression. For example, never-depressed daughters of depressed mothers exhibited selective attention for sad faces in an emotional-face dot-probe task (Joormann, Talbot, & Gotlib, 2007). Furthermore, attention toward negative information in college students has been shown to be predictive of subsequent dysphoria, when combined with intervening stressors occurring in the students' lives (Beevers & Carver, 2003). Together, this evidence suggests that negative processing biases may be causally related to the development of depressive symptoms. Supporting this hypothesis, a number of researchers have developed training procedures to manipulate attention biases in depressed individuals. In these procedures, the ratio of valid to invalid probes is manipulated such that neutral images correctly signal the presence of probes more often than dysphoric images, resulting in a training of visual attention away from dysphoric images. These cognitive bias modification procedures have been effective in reducing depressive symptoms in mildly depressed college students (Wells & Beevers, 2010), though their efficacy for more severe depression has been questioned (Baert, De Raedt, Schacht, & Koster, 2010).

Further evidence of a causal role of attention biases in the development of depression comes from Harmer (2008), who found that serotonergic drug treatment has been shown to increase attention to positive stimuli in depressed and dysphoric individuals. Complementary studies investigating the effects of tryptophan depletion on attention biases have demonstrated an increase in bias toward negative stimuli following depletion. Harmer's model of depression treatment proposes that the mechanism of action of antidepressant drugs is the alteration of attentional biases, which creates a more positive environment for the depressed individual and potentiates improvements in depressive symptomatology over time.

The aforementioned line of research has established a precedent for the study of attention biases as potential vulnerability markers and targets of intervention for psychological disorders. A similar line of research has been produced in the literature on anxiety disorders (Beard, 2011), but far less work has explored the role of attention in bipolar spectrum disorders. Existing models and literature are reviewed next.

Attention in Bipolar Disorder: Evidence of Biases and a Potential Explanatory Model

Biased Attention in Bipolar Disorder

While the existence of a bias toward mood-congruent information in unipolar depression has been thoroughly studied and documented, there have been relatively fewer studies investigating the attentional correlates of bipolar disorder. Because the course of bipolar disorder appears to be influenced by psychosocial and cognitive factors, it is important to determine whether attention biases exist in the disorder, and whether they may be causally related to the development of depressive and/or manic episodes. Addressing this question may be complicated by the characteristic transience of mood states in bipolar disorder. The findings of existing studies on attention in bipolar and bipolar-vulnerable samples in depressed, euthymic, and manic states will be summarized below.

Attention in depressed individuals with bipolar disorder appears to be distinct from the attentional patterns associated with unipolar depression. While a problem with attentional disengagement in unipolar depression tends to be present at late stages of attentive processing and only for mood-congruent stimuli, Leyman, De Raedt and Koster (2009) found that disengagement in depressed individuals with bipolar disorder was impaired only at an earlier stage of processing and for threat-related and positive social stimuli. Further evidence of differences in attentive processing in bipolar and unipolar depression was provided by Jongen et al. (2007) in their comparison of attention biases in depressed and euthymic bipolar individuals and in controls. In a dot-probe task incorporating a spatial cueing paradigm, these researchers found that depressed bipolar individuals had greater difficulty with attentional disengagement from the words which were used as cues, regardless of the valence of the words. Researchers also found a negative correlation between level of depressed mood and attention to negative words, with stronger negative affect predicting greater bias away from negative words. This finding is inconsistent with findings in dysphoric and depressed individuals (Mathews & McLeod, 2005) and does not correspond to the mood-congruency hypothesis of attention in depression (Beck, 1967). Notably, in both the euthymic and depressed bipolar groups in this study, a bias away from positive words was evident, suggesting that an avoidance of positive stimuli may be a trait characteristic of bipolar disorder, while bias away from negative information is likely state-dependent. Jongen and colleagues (2007) suggested that their findings may indicate that patterns of attentional processing may predict the transition of mood states in bipolar individuals, with avoidance of all emotional information predicting transition from a depressed to a euthymic state, and bias toward negative and away from positive information predicting a transition from the euthymic state to a depressed state.

Evidence of altered patterns of attentional processing in manic individuals with bipolar disorder has been obtained primarily in neurophysiological studies examining the brain's response to images of facial emotions. In a study incorporating both behavioral and neurophysiological measures of attention to pictures of facial affect, Lennox et al. (2004) found that manic individuals' brain activation patterns were marked by attenuated response to sad affect, and these individuals also rated pictures of sad affect as less intense than did control subjects. In other words, they showed a mood-congruent negative bias for negative information. However, they showed no difference from healthy controls in their behavioral or neurophysiological response to happy faces. Consistent with the behavioral findings mentioned above, the depressed bipolar individuals in this study exhibited enhanced recognition of mood-congruent faces, i.e. sad faces.

If attentional biases represent a cognitive marker of vulnerability to development of bipolar disorder, then they should be present not only in individuals with a bipolar diagnosis, but also in individuals with heightened proneness to the disorder. Attention and memory biases have been investigated in groups of individuals considered to be at risk of developing bipolar disorder, including offspring of bipolar parents and adolescents with hypomanic personality traits. In a study of children of adults with bipolar disorder (Gotlib et al., 2005), participants were induced into a negative affective state and then asked to indicate whether words presented to them were self-descriptive. The participants were then given an incidental recall task to remember as many words as possible in 3 minutes, regardless of whether the words had been identified as self-descriptive. Forty words were presented, including 20 positive adjectives and 20 negative adjectives. Compared to a control group of children with never-disordered parents, offspring of individuals with bipolar disorder were more likely to remember negative words. These children also exhibited an attentional bias toward social-threat and manic-irritable (but not for neutral, depressotypic, physically threatening or manic-euphoric) words in an emotional Stroop task. Gotlib et al. (2005) suggested that these findings indicate a pathogenic cognitive processing scheme which is activated by negative mood in children with biological predisposition to affective disorders.

A very different set of findings emerged in a study of euthymic adolescents with the bipolar phenotype, as measured with the Mood Disorders Questionnaire, a self-report measure of mood elevations that is used as a screening tool for bipolar spectrum disorders (MDQ; Hirschfeld, Williams, Spitzer, et al., 2000). In a facial expression recognition task, high-MDQ adolescents showed enhanced processing of surprised and neutral expressions, but not happy, fearful, disgusted or angry faces (Rock, Goodwin & Harmer, 2010). These adolescents were not more likely to endorse or to remember either positive or negative personality trait words presented for emotional categorization, but exhibited decreased latency to identify positive words in a recognition task. In an emotion-potentiated startle task, high-MDQ adolescents showed lower startle in response to negative and neutral images than low-MDQ adolescents. Finally, these adolescents exhibited no attentional bias for positive or negative words in a dot-probe task. Rock, Goodwin and Harmer interpreted these findings as an indication that bipolar-vulnerable adolescents have a bias toward enhanced processing of positive information. This finding stands in stark contrast to the findings of Gotlib et al. (2005) in their bipolar-risk group, highlighting the importance of current affect on the pattern of information processing of bipolar-vulnerable individuals.

In summary, the studies on attention biases in bipolar and bipolar-vulnerable groups are inconsistent. While bipolar-prone children induced into negative affect showed a depressogenic cognitive style similar to that observed in unipolar depression, bipolar adults with naturally occurring depression tended to have enhanced attention to all emotional material, rather than to mood-congruent material alone. In particular, difficulty with disengagement from social threat faces and happy faces has been found in depressed adults with bipolar disorder. In euthymic and depressed individuals with bipolar disorder, researchers have found a bias away from positive information. A simultaneous bias against mood-congruent material in depressed individuals with bipolar disorder has also been found.

Euthymic adolescents with vulnerability to bipolar disorder, contrary to the findings in euthymic adults with the disorder, appear to have a bias toward enhanced processing of positive information. Finally, adults with bipolar disorder in a manic state show attenuated neurophysiological and self-reported reactivity to sad faces, but evidence no difference from healthy adults in their response to happy faces.

While the findings in studies of attentional processing of positive and negative information have been inconsistent, one conclusion seems clear: that the biases implicated in the development and maintenance of unipolar depression appear to be qualitatively distinct from biases present in bipolar and bipolar-vulnerable samples.

BAS Dysregulation Model of Bipolar Disorder

A number of models involving the interaction of biological and environmental influences on the development and course of bipolar disorder have been proposed (see Jones & Bentall, 2008, for a review of three common models). One such model which has strong experimental support involves the behavioral activation system (BAS), a biopsychological system which governs approach behaviors in the presence of cues of potential reward (such as food or sex) or goal attainment (Gray, 1987). Depue and Iacono (1989) outlined a model of bipolar disorder which emphasized overactivity of the BAS. Specifically, the authors described the depressive and manic phases of the disorder as extreme forms of engagement with the environment of appetitive stimuli. In the manic state, individuals with bipolar disorder are overly involved in goal-striving approach behaviors. In the depressive state, these individuals exhibit deficient motor, motivational and affective reactivity to appetitive stimuli, or underactivity of the BAS. Several studies have supported the BAS dysregulation model of bipolar disorder (Alloy et al., 2006; Johnson, 2005; Meyer, Johnson, & Winters, 2001).

Dysregulation of the BAS systems in bipolar disorder may have implications for attention processes. Specifically, the BAS model predicts that individuals with bipolar disorder may experience dysregulation of the BAS in response to cues such as happy faces, which represent potentially rewarding stimuli, and threatening faces, which represent non-reward or punishment. With respect to attention, the BAS dysregulation model suggests that individuals with bipolar disorder may be more likely to have their attention engaged with BAS-activating cues than non-BAS-related cues. Individuals with BAS hypersensitivity could potentially experience greater difficulty disengaging their attention from such cues than from cues which do not signal potential reward. Regarding sad stimuli, the BAS model predicts that individuals with vulnerability to bipolar disorder will show no differences in attentional engagement or disengagement.

Present Study

There are several limitations in the current literature on attention biases in bipolar disorder. Principal among these is the use of measures, such as the dot-probe task and the emotional Stroop task, which are not highly sensitive to differences in attention. Existing studies also tend to be characterized by small sample sizes, decreasing the likelihood of detecting variability in attention across groups. Finally, several previous studies have used less powerful group designs with “high-low” cutoffs as opposed to continuous measures of vulnerability, which may decrease power to detect attention biases. The present study seeks to overcome some of these limitations by using the more reliable and powerful eye tracking method of assessing attention, by recruiting a large enough sample to detect smaller effects, and by using a continuous measure of bipolar risk, as opposed to a group design.

The current study will seek to elucidate the nature of attention biases associated with risk for bipolar disorder. This will be accomplished by examining the correlations between several attention outcomes and levels of hypomanic personality traits as measured with the Hypomanic Personality Scale (HPS; Eckblad & Chapman, 1986), a measure meant to identify individuals at risk of developing manic or hypomanic episodes. The innovation of the current study is the introduction of eye-tracking, a more sensitive measure of visual attention, to assess attention to happy, sad, angry and fearful faces in this sample, the use of a larger sample, and the assessment of risk along a continuous dimension.

Research Questions and Hypotheses

Research Question 1: *Are individuals' self-reported levels of hypomanic personality traits correlated with their attentional engagement with happy, sad, angry and neutral faces?*

Hypotheses: Because the Hypomanic Personality Scale represents a measure of BAS dysregulation, it is expected that scores on the HPS will be significantly correlated with measures of attentional engagement with the BAS-relevant cues of happy and angry faces. Specifically, a positive relationship between HPS scores and engagement scores is expected. It is further expected that attentional engagement with sad and neutral faces will not be significantly correlated with HPS scores. The preceding relationships are expected to hold even after controlling for current affect and mood symptoms.

Research Question 2: Are individuals' self-reported levels of hypomanic personality traits correlated with their ability to disengage attention from happy, sad, angry and neutral faces?

Hypotheses: Consistent with predictions based on the BAS dysregulation model of bipolar disorder, it is expected that HPS scores will be associated with impaired disengagement from happy and angry faces relative to disengagement from neutral faces. It is further expected that latency to disengagement from sad faces will not differ from the latency to disengagement from neutral faces. The preceding relationships are expected to hold even after controlling for current affect and mood symptoms.

Exploratory Research Question: Does BAS hypersensitivity mediate the relationship between hpomanic personality scores and biased attention?

Hypothesis: BAS hypersensitivity, as measured by the BIS/BAS scales, will mediate significant associations between HPS scores and attentional engagement scores, as well as attentional disengagement scores.

CHAPTER 2

METHODS

Participants

Participants were recruited from the undergraduate population at the University of North Texas (UNT) through Sona Systems, an online subject pool management system for students taking psychology courses. Students received experimental credit for their psychology courses in exchange for their participation in the study.

Procedures

Written informed consent was obtained prior to beginning the experiment. Participants then completed paper versions of the Hypomanic Personality Scale (HPS), Behavioral Inhibition System/Behavioral Activation System Scale (BIS/BAS), Inventory of Depression and Anxiety Symptoms – Second Version (IDAS-II), and Positive and Negative Affect Schedule (PANAS). After completing the questionnaires, participants were seated at a desk facing a computer screen, with their eyes approximately 24” from the screen. They then completed two eye-tracking tasks designed to measure attention allocation as well as attentional disengagement (see below).

Self-Report Measures

Hypomanic Personality Scale

The Hypomanic Personality Scale (HPS) is a self-report measure consisting of 48 statements rated “true” or “false” by the respondent. The measure was developed by Eckblad and Chapman (1986) to identify premorbid hypomanic personality characteristics which indicate vulnerability to bipolar disorder. High scores on the HPS have been found to predict the occurrence of bipolar disorder in a 13-year longitudinal study (Kwapil et al., 2000), as well as psychosocial impairment and substance use disorders in a large community sample of adolescents (Klein, Lewinsohn, & Seeley, 1996). In the standardization sample, the test-retest reliability of the measure was 0.81, and the Cronbach's α was 0.87 (Eckblad & Chapman, 1986). Furthermore, the HPS has been found to correlate highly with the BAS scale of the BIS/BAS scales, and was demonstrated to be a better predictor of the mood dysregulation predicted by the BAS hypersensitivity model of bipolar disorder than the BAS scale (Meyer & Hoffman, 2005). The HPS had adequate internal consistency in the present sample (Cronbach's $\alpha = 0.78$).

BIS/BAS Scales

Carver and White (1994) developed the BIS/BAS scales to measure behavioral inhibition and behavioral activation, working from Gray's (1987) theory of motivational systems. The measure presents 24 numbered statements for which the respondent must indicate his or her level of agreement on a 4-point Likert scale. The BIS/BAS scales produce a unified score representing behavioral inhibition, and three separate scores representing separate dimensions of behavioral activation, as well as a general BAS score. The BAS dimensions assessed are fun seeking, reward responsiveness, and drive. The scales have demonstrated adequate validity and reliability, achieving Cronbach's α of 0.76 for the BIS scale and 0.83 for the general BAS scale (Jorm et al., 1998). Internal consistency of the subscales of the BAS have demonstrated lower but adequate reliability, with Cronbach's α of 0.65 for reward responsiveness, .80 for drive, and 0.70 for fun seeking. In the present study, the internal consistency of the general scales was adequate (Cronbach's $\alpha = 0.82$ for BAS and 0.81 for BIS). The internal consistency of the subscales ranged from questionable (Cronbach's $\alpha = 0.69$ for reward responsiveness) to acceptable (Cronbach's $\alpha = 0.74$ for drive and 0.76 for fun seeking).

Positive and Negative Affect Schedule

The Positive and Negative Affect Schedule (PANAS) is a 20-item self-report measure that was created by Watson, Clark, and Tellegen (1988) for the assessment of positive and negative affect. Negative affect is defined by the presence of subjective feelings of distress and unpleasurable engagement with the environment, with low scores indicating an absence of such feelings. Positive affect is defined by pleasurable engagement with the environment, as indicated by subjective feelings such as excitement or alertness, with low scores representing the lack of these feelings. The PANAS has been used in several studies examining the influence of current affect on cognitive processes, and has exhibited satisfactory internal consistency reliability for both the positive affect (PA) scale (Cronbach's $\alpha = 0.89$) and the negative affect (NA) scale (Cronbach's $\alpha = 0.85$) (Crawford & Henry, 2004). Both the PA scale and the NA scale demonstrated adequate internal consistency reliability in the present sample (Cronbach's $\alpha = 0.93$ and 0.81, respectively).

Inventory of Depression and Anxiety Symptoms – Second Version (IDAS-II)

The IDAS is a 64-item self-report measure of symptoms of anxiety and depression which was developed by Watson and colleagues (2007). Each item provides a statement about a symptom, and respondents are asked to rate how much that statement is consistent with their experiences in the past 2 weeks. Ratings are made on a 5-point Likert scale, with a rating of 1 indicating *not at all* and a rating of 5 indicating *extremely*. The measure provides scores on 12 scales, which include 10 specific symptom scales (panic, social anxiety, traumatic intrusion, suicidality, insomnia, lassitude, well-being, appetite loss, appetite gain, and ill temper) and 2 more general scales (general depression and dysphoria). The current study will use the IDAS-II, an extended 99-item version of the IDAS which allows for computation of scores on measures of angry/irritable mood, manic mood symptoms, and anxious mood. The IDAS has demonstrated adequate internal consistency reliability; in the initial validation study, 94.4% of the obtained α-coefficients were 0.80 or higher (Watson et al., 2007). In the present study, only the general depression and mania scales were utilized in analyses. The general depression scale demonstrated adequate internal consistency reliability (Cronbach's $\alpha = 0.89$), as did the mania scale (Cronbach's $\alpha = 0.80$).

Attention Tasks

Participants completed two tasks measuring attention, each described below. The first was a naturalistic viewing task in which each participant's line of visual gaze was tracked as he or she was presented simultaneously with several images. A naturalistic approach allowed researchers to examine differences in the overall allocation and maintenance of gaze to emotional (happy, sad, and angry) and neutral facial stimuli. The second task was a measure of attentional disengagement which utilized a spatial cueing procedure. This paradigm allowed researchers to examine differences in attentional engagement with and disengagement from emotional and neutral stimuli.

Naturalistic Viewing Task

In the naturalistic viewing task, participants viewed four images of facial affect simultaneously (see Figure 1). Images of facial affect were drawn from the Radboud faces database, an experimentally validated database of facial images which was created for research on cognition and emotion (Langner et al., 2010). The emotional expressions exhibited by each of the actors in the database were based on prototypes drawn from the *Investigator's Guide for the Facial Action Coding System* (Ekman, Friesen, & Hager, 2002), a manual with detailed categorization of facial expressions based on the muscle groups which are used to produce each expression.

Participants were instructed to view the images freely, in any way that they pleased. The procedure consisted of three trial stimulus presentations, followed by 36 test presentations. Preceding onset of facial stimuli in each trial, participants were presented with a black screen with a central fixation cross. One neutral, one sad, one angry and one positive face then appeared during each trial, with one image in each quadrant of the screen. Images remained on the screen for 10 seconds. Image locations were randomly varied from trial to trial, so that images of each emotional face category appeared with equal probability in each of the four locations over the course of the task.

While viewing these images, the location and duration of participants' gaze was measured using the Tobii x50 eye tracker. The Tobii uses near-infrared illuminators to create reflection patterns on the cornea of an individual's eye, which are used to create an image of the eye. This image is used to detect the exact position of the individual's pupil and to process the reflections from the illuminators, determining their exact location. Participants were seated with their faces approximately 24" from the computer screen. Prior to stimulus presentation, the Tobii x50 was calibrated to each participant's gaze. If the software failed to adequately calibrate to the participant's gaze after two attempts, the participant was excluded from further participation in the study.

Attentional Disengagement Task

Attentional disengagement was measured using a spatial cueing procedure. In this task, participants were initially presented with a black screen, two white squares (one on the left side of the screen, one on the right) and a central fixation cross (see Figure 2). This fixation screen was presented for 500 ms. A face then appeared in the center of one of the two white squares, and remained for 1500 ms. Facial stimuli were drawn from the Radboud database as before, and included angry, happy, sad and neutral facial expressions. The face then disappeared, and both squares remained empty for 50 ms. Finally, a target in the form of a small black square appeared in the center of one of the two white squares. Participants were required to press a key indicating the location of the probe. Latency to key press was then used to infer attention engagement and disengagement from different faces (Leyman, de Raedt, & Koster, 2009).

Participants completed a practice block of 12 trials, followed by the test block of 144 trials. In 50% of trials, the target appeared in the same location as the facial cue; these trials were “valid” trials. In the remaining trials, the target appeared in the box on the opposite side of the screen from the cue; these trials were “invalid” trials. Targets appeared with equal probability on either side of the screen. Pictures of each emotional valence occurred with equal probability on the left and the right sides and were valid in 50% of trials and invalid in 50% of trials.

Attentional engagement with images of each emotional valence was operationalized as the difference between the average response time for valid neutral cues and the average response time for valid emotional cues. Attentional disengagement was operationalized as the difference between the average response time for invalid neutral cues and the average response time for invalid emotional cues. Finally, cue validity was operationalized as the difference between the average response time for valid cues and the average response time for invalid cues.

CHAPTER 3

RESULTS

Data Cleaning Results

Prior to conducting primary analyses, data for the attention outcomes were calculated and cleaned. Three primary outcomes were calculated for the eye-tracking data (i.e., total visit duration, fixation count, and latency to first fixation) and were downloaded with Tobii Studio Version 2.1.14. Participants for whom the Tobii software recorded less than 30% of their gaze over the course of the task or for whom there was clear aberration in gaze capture were excluded from further analysis. Nineteen of 157 cases (12.1%) did not meet this threshold and were excluded from analysis of their eye-tracking data. Mean visit duration, latency to first fixation, and number of fixations for each emotional face category for each remaining participant were computed by averaging values for all slides.

Next, scores on the HPS and depression and mania scores on the IDAS-II were screened for univariate and multivariate outliers, normality, and other primary test assumptions. Six participants had scores higher than 2 standard deviations from the mean on one or more of these measures. In order to avoid restriction of range in the primary predictor, and because no scores fell outside of the expected range, all cases were retained. Data were also screened for univariate outliers on demographic variables. Three participants whose ages were more than 2 standard deviations from the mean age of participants were removed from further analysis, as age differences were considered to be an a priori confound based on previous research (e.g. Isaacowitz, Wadlinger, Goren, & Wilson, 2006).

With the exception of negative affect, all predictor and outcome variables approximated a normal curve, with acceptable values of skew and kurtosis. Negative affect demonstrated unacceptable positive skewness and kurtosis (skewness = 2.43, kurtosis = 6.39). A $\log_{10}$ transformation was conducted to normalize the distribution of negative affect scores, resulting in acceptable skewness (1.72) and kurtosis (2.56). The log of negative affect was used in all analyses. Visual inspection of residual scatterplots did not suggest violation of the assumption of homogeneity of variance.

Sample Characteristics

The final sample consisted of 135 undergraduate students at a large public university in the southern United States. The sample was 58.8% female, and had an average age of 20.2 years. Of the final sample, 66.4% of participants self-identified as Caucasian, 24.8% as African American, 8% as Asian, and 0.8% as Native American or Alaskan Native.

Sample-wide Trends in Attention

Prior to conducting analyses, general trends in attention were first assessed for the sample as a whole. Table 1 reports the outcomes for the entire sample with respect to attentional engagement and disengagement scores from the spatial cueing task and mean latency to first fixation, visit duration and fixation count for each category of valenced stimuli in the naturalistic viewing task. A series of repeated measures ANOVAs was conducted to identify differences in these outcomes. Because data violated the assumption of sphericity, Greenhouse-Geisser corrected F-statistics were interpreted for all comparisons. Comparisons of latency to first fixation, visit duration, and fixation count for angry, happy, neutral and sad faces were significant. As seen in Table 1, participants were characterized by a positive information processing bias in that they on average looked longer at happy faces than other valenced faces. In addition, they fixated on happy faces more quickly and more often than sad, angry or neutral faces.

Potential Confounds

The role of potential confounds was considered next. Variables that were correlated with the primary predictor variables (i.e., HPS) were considered to be potential confounds, whereas variables that were only correlated with the outcomes were considered potential covariates. Self-reported mood state and demographics were considered to be the most likely confounds a priori. Demographics of age, race, and socioeconomic status were not related to the primary predictors and therefore were not considered to be confounds. HPS was positively correlated with depression ($r = 0.20$, $p < .05$) and mania ($r = 0.50$, $p < .01$). HPS was also positively correlated with positive affect ($r = 0.34$, $p < .01$), but was not significantly associated with negative affect. Subsequent analyses of hypotheses were performed with and without controlling for these mood symptoms and mood states.

Next, the relationship between current mood symptoms and outcomes was assessed (Table 2). Semipartial correlations between outcome measures in each valence category and mood symptoms and affective state were obtained, controlling for attention to neutral faces for each outcome. As can be seen in Table 2, depression scores were associated with fewer fixations on all emotional categories, though this association was significant only for fixation count on happy and angry faces. A trend toward greater attentional engagement with sad faces in individuals with more depressive symptoms was also found. Manic symptoms were not significantly correlated with any attention outcomes. A non-significant trend toward a higher number of fixations on happy faces was found to be associated with current positive affect. Finally, a positive correlation between negative affect and visit duration on happy faces approached significance.

Hypothesis 1

The first hypothesis was that higher HPS scores would be associated with greater attentional engagement with BAS-relevant cues (i.e., happy and angry faces). Mean visit duration, latency to first fixation, fixation count, and attentional engagement scores served as dependent measures in this analysis.

Naturalistic Viewing Task

Table 3 (column 1) reports the correlations between HPS scores and engagement with emotional faces in the naturalistic viewing task, controlling for neutral conditions. Columns 2 and 3 of Table 3 report the same associations, but also controlling for current depression and mania, respectively. As seen in the table, HPS scores were negatively correlated with time to first fixation of happy faces. In other words, higher HPS scores were associated with faster initial orientation to happy faces. The semipartial correlation between HPS scores and latency to fixate happy faces was significant after controlling for mania and depression, both independently and within the same model. A significant negative semipartial correlation (r = -0.19) between HPS scores and latency to fixation of angry faces was also found when controlling for symptoms of depression.

Spatial Cueing Task

Bivariate correlations were obtained to examine the association between HPS scores and attentional engagement with happy, sad and angry faces. Results are reported in Table 4. No significant correlations were found. Hierarchical linear regressions were additionally conducted to examine the relationship between HPS scores and attentional engagement, controlling for mood symptoms. Results indicate that manic symptoms may have suppressed a significant negative correlation between HPS scores and engagement with happy faces ($r = -0.20$). This finding was in contrast to predictions, and contrary to findings from the naturalistic viewing task.

Hypothesis 2

The second hypothesis stated that higher HPS scores would be associated with greater difficulty disengaging attention from BAS-relevant cues (i.e. angry and happy faces). To address a priori confounds, Table 5 reports the correlations between attentional disengagement scores and mood symptoms. Manic symptoms, positive affect and negative affect were not significantly associated with disengagement from any emotional face category. A trend toward facilitated disengagement from all emotional information with greater general depression scores was present. General depression scores were significantly negatively correlated with disengagement from happy faces, indicating that higher levels of depression may be associated with greater facility in disengaging attention from positive material.

Bivariate correlations between HPS scores and attentional disengagement scores for happy, sad and angry faces were obtained (Table 6). Hypomanic personality traits were not significantly correlated with disengagement scores for any emotional face category. Furthermore, the correlations remained nonsignificant when mood symptoms were controlled; symptoms did not significantly suppress associations between HPS and disengagement.

Exploratory Hypothesis

In the exploratory analyses, BAS hypersensitivity was hypothesized to mediate the significant associations between hypomanic personality traits and attention outcomes. However, BAS scores were not significantly associated with any attention outcome, and therefore mediation analyses were not conducted.

CHAPTER 4

DISCUSSION

Previous research has indicated that individuals with certain forms of psychopathology, including depression and anxiety, may exhibit biases in their attentional processes, and that these biases may be related to the development and maintenance of symptoms. Even in a non-clinical sample, attentional preference for sad information has been demonstrated to predict depressive symptoms over time (Beevers & Carver, 2003). Furthermore, biases in sustained attention to negative information have been identified in individuals considered to be at risk of depression (Joormann, Talbot, & Gotlib, 2007). While there is now ample literature examining attentional processes in individuals vulnerable to and diagnosed with unipolar depression, few researchers have examined whether similar differences are seen in individuals with bipolar disorder or individuals who may be at risk of developing the disorder. This study provided initial support for differences in attentional processes among those with varying levels of self-reported hypomanic personality traits, which are considered to be one marker of risk for development of bipolar disorder.

The current study sought to improve upon previous studies examining cognitive biases in bipolar disorder by utilizing eye tracking, a more sensitive measure of visual attention than those which have been used previously (e.g. dot-probe designs). Additionally, the current study included a larger sample than previous studies. Finally, in this study a continuous measure of risk was utilized, unlike the dichotomous grouping of “at-risk” and “not at-risk” which was utilized in previous studies (e.g. Rock, Goodwin, & Harmer, 2010). All of these differences from previous studies served to increase the power of the study to detect differences in attention.

Consistent with a priori hypotheses, differences in hypomanic personality traits predicted differences in the manner in which individuals attended to emotionally-valenced social information. In particular, social cues of reward (happy faces) were fixated more quickly by individuals with greater hypomanic personality traits, while hypomanic personality traits were not correlated with attention to sad faces. A trend toward faster fixation of social cues of non-reward (angry faces) in individuals with higher levels of hypomanic personality traits was also found. Hypomanic personality traits were not associated with differences in sustained attention nor with differences in number of fixations on emotional faces of any valence. This suggests that vulnerability to bipolar disorder may be associated with differences only in initial orientation of visual attention, characterized by fixating more quickly on information regarding social reward or non-reward. This significant correlation between hypomanic traits and faster orientation of attention to happy faces was found even after controlling for symptoms of depression and mania, as well as current affective state.

The findings of the current study are congruent with findings in euthymic adolescents with vulnerability to bipolar disorder (Rock, Goodwin, & Harmer, 2010), in that a bias toward positive information was found. In the current study the bias was present only within the initial orientation phase of attention, rather than in later stages reflecting prolonged processing. The presence of a bias for positive and threat-related images within the first milliseconds of stimulus presentation complements the findings of Leyman, De Raedt and Koster (2009), who found that depressed individuals with bipolar disorder are characterized by impaired disengagement from this material only with very brief (200 ms) stimulus presentation. However, this impaired disengagement may have reflected a correlate of depressed mood; it is unclear whether a similar impairment in disengagement from positive and threat-related stimuli may be present in the absence of depression symptoms. The current study did not support a link between hypomanic personality traits and differences in ability to disengage attention from emotional faces.

A bias in initial orientation of attention toward rewarding stimuli associated with hypomanic personality traits may have important clinical implications. Individuals with high levels of hypomanic personality traits are at heightened risk of manic episodes (Kwapil et al., 2000) and have been shown to have higher levels of consumption of alcohol and nicotine than low-scoring counterparts (Krumm-Merabet & Meyer, 2005). Additionally, a positive relationship between hypomanic personality traits and addictive tendencies has also been demonstrated (Meyer, Rahman, & Shepherd, 2007). Attentional biases may represent a mechanism by which a cognitive vulnerability toward engagement with rewarding stimuli is expressed in pleasure-seeking behaviors. Drugs and alcohol likely represent a much more powerful cue of reward than the stimuli utilized in this or other studies investigating attentional biases. The tendency to orient quickly to such strong cues of reward in the environment may convey risk toward greater behavioral engagement with such cues. Further research is needed to determine whether attentional biases may partially mediate the relationship between hypomanic personality traits and addictive tendencies. If such a mediating relationship exists, it may represent an important target for intervention.

In the current study, individuals with greater hypomanic personality traits also evidenced poorer engagement with cues of social reward in a spatial cueing task. This finding was not consistent with a priori predictions. However, a limitation of the spatial cueing task should be considered in interpreting this result. The modified emotional spatial cueing task did not account for potential response slowing effects of emotional information. Previous research has demonstrated that emotional information may exert a response slowing effect within the spatial cueing paradigm. This effect can be measured and controlled for by conducting a central cue task prior to spatial cueing (Mogg, Holmes, Garner, & Bradley, 2008). No such task was completed in the current study; therefore, results may not accurately reflect the effect of emotional cue type on attention orientation and disengagement processes assessed within the spatial cueing task.

The exploratory hypothesis that BAS dysregulation may mediate the relationship between hypomanic personality traits and attention outcomes was disconfirmed. BAS scores were not significantly associated with attentional outcomes for any emotional face category on the spatial cueing or the eye tracking task. Therefore, it appears that in the current sample, the observed attention differences could not be accounted for by dysregulation of the behavioral activation system in response to signs of reward and non-reward as proposed. However, it is important to note that the BIS/BAS scales were designed to measure stable individual differences in reactivity, rather than dysregulation in either of these behavioral systems. Meyer and Hoffman (2007) examined associations between scores on the HPS and self-reported mood state over the course of several days, as well as the association between BIS/BAS scores and self-reported mood. These researchers found that both measures only partly captured the dysregulation of BAS activity which Depue and Iacono (1989) identified as the heart of vulnerability.

Higher self-reported symptoms of depression were associated with longer duration of gaze on mood-congruent (i.e. sad) faces, and less frequent visits to mood-incongruent (i.e. happy and angry) faces in the current study. While these results are in keeping with prior findings regarding attention biases in depression, the effect sizes are notably smaller than in similar previous research (Caseras, Garner, Bradley, & Mogg, 2007; Eizenman et al., 2003). A number of factors should be considered in interpreting the differences in effect sizes between past studies and the current study. In previous research, group designs were utilized to compare average scores on measures of attention in controls to those of dysphoric or depressed individuals. In contrast, no grouping was performed in the current study; continuous depression scores were correlated with attention scores. Additionally, previous studies used more complex images than those utilized in the current study. The relative similarity of the images in the eye tracking task in the current study (i.e. the same individual in each quadrant, wearing the same shirt, the same placement of facial information across trials) may have diminished the positive and negative power of the images over the course of tasks. Finally, restriction in range of depression scores likely diminished the power of the study to detect differences in attention. Depressive symptoms in the present sample were at a sub-clinical level.

The current study had a number of limitations. Participants were drawn from a non-clinical sample of undergraduate students at a university. The incidence of hypomanic personality traits, as well as manic and depressive symptoms, was therefore low. Restriction of range in the primary predictor of hypomanic personality traits may have substantially decreased the power of the study. Future research into the visual gaze behaviors of individuals with hypomanic personality traits and mood symptoms may benefit from the use of a sample which includes individuals with clinically significant symptoms.

Additionally, as noted above, the stimuli utilized in the current study were relatively subtle compared to the myriad of potentially rewarding stimuli which may be available in the natural environment. It is promising that biased attentional processes were found even with subtle stimuli. However, it is possible that with stronger stimuli (e.g. stimuli suggesting more explicit reward), the bias may be more evident, and potentially more likely to be associated with differences in an individual’s behaviors within an environment presenting opportunity for reward. Future research with such stimuli which incorporates a behavioral component may be important in elucidating the importance of biases within a more naturalistic environment.

The existence of attentional biases in individuals with psychopathology may have important implications. In his dual process model of cognitive vulnerability to depression, Beevers (2005) suggested that the presence of biased cognitive processes in emotional disorders may lead to symptoms through a failure in of reflective processes to appropriately address information which is processed automatically. Following this model, one could address symptoms by adjusting attentional biases to align cognitive processes in those with emotional disorders more closely with those seen in non-disordered individuals. This approach has been utilized within the paradigm of cognitive bias modification (see Browning, Holmes, & Harmer, 2010, for a review). Cognitive bias modification procedures capitalize on experimental paradigms for assessing cognitive biases (i.e. spatial cueing tasks, dot probe tasks); manipulation of the parameters of the task are used to train attention, rather than simply to assess it. In this way, automatic, mood-congruent biases associated with emotional disorders are altered. Such procedures have demonstrated efficacy in decreasing symptoms in those with social anxiety (Beard, Weisberg, & Amir, 2011), and to a lesser extent in those with depression (Baert, De Raedt, Schacht, & Koster, 2010; Wells & Beevers, 2010). The applicability of the dual process model to bipolar depression, and further to bipolar mania, remains unclear. However, if similar processes contribute to symptoms in bipolar disorder, then the current study may contribute to the identification of attentional processes which represent targets of intervention within a cognitive bias modification paradigm.

An important caveat of the current research is the validity of extending the relationship between hypomanic personality traits and bipolar disorder to the current sample. Previous research has established a link between heightened risk of bipolar disorder and hypomanic personality traits (Kwapil et al., 2000). However, hypomanic personality traits were not considered as a continuous predictor of vulnerability in Kwapil and colleagues' study; rather, individuals scoring above a specific cutoff on the HPS were compared with control individuals. While utilizing a continuous measure of hypomanic personality in the current study represents a strength in that it increases statistical power, interpretation of the connection between attention biases and bipolar vulnerability must be undertaken with some caution, as research has not established the validity of scores on the HPS scale as continuous predictors of bipolar disorder risk. These results may, therefore, more accurately reflect patterns of attention associated with a certain personality style, characterized by extraversion, high levels of energy, impulsivity, high self-confidence and tendency toward excessive engagement with pleasurable stimuli, rather than a marker of vulnerability. Additional research examining the association between bipolar disorder development and hypomanic personality traits which uses a continuous measure of these traits is needed in order to further clarify the implications of these results.

Conclusions

In summary, hypomanic personality traits were found to be correlated with a bias toward rewarding social stimuli (happy faces) in the earliest stage of attention, but were not associated with sustained attention for or disengagement from these stimuli. This bias was independent of affective state and symptoms of depression and mania. Hypomanic personality traits were not significantly related to attention for sad faces or angry faces at any stage of attention. The results of the current study contribute to the growing literature addressing attentional biases associated with vulnerability to bipolar disorder.

Table 1

Sample-Wide Descriptive Statistics for Primary Attention Outcomes

	Angry Faces *M(SD)*	Happy Faces *M(SD)*	Sad Faces *M(SD)*	Neutral Faces *M(SD)*
Latency to First Fixation (s)	1.75(.55)	1.65(.57)	1.74(.59)	1.74(.55)
Visit Duration (s)	1.91(.45)	2.50(.76)	1.96(.44)	2.12(.49)
Fixation Count	2.28(.58)	2.46(.56)	2.31(.58)	2.39 (.61)
Attentional Engagement (ms)[§]	-1.96(21.77)	-.69(21.22)	-4.02(22.92)	--
Attentional Disengagement (ms)	3.65(29.06)	2.95(19.53)	7.80(21.49)	--

[§]Attentional engagement was reverse-scored such that higher scores indicate greater engagement with emotional information relative to neutral.

Table 2

Relationship between Current Mood Symptoms and Attention Outcomes (Controlling for Attention to Neutral Faces)

	General Depression	Mania	Positive Affect	Negative Affect
Angry Faces				
Latency to First Fixation	0.10	-0.06	-0.01	-0.01
Visit Duration	-0.10	-0.03	-0.03	-0.01
Fixation Count	-0.18*	-0.03	0.01	-0.10
Attentional Engagement§	-0.02	-0.15	-0.06	-0.03
Happy Faces				
Latency to First Fixation	0.02	-0.05	0.01	-0.11
Visit Duration	-0.02	-0.04	-0.01	0.16†
Fixation Count	-0.19*	-0.05	0.15†	0.12
Attentional Engagement	0.04	0.03	0.14	0.00
Sad Faces				
Latency to First Fixation	-0.04	-0.05	0.03	-0.12
Visit Duration	0.02	-0.02	-0.07	0.00
Fixation Count	-0.12	-0.09	0.00	-0.07
Attentional Engagement	0.16†	0.09	0.09	0.14

*Significant at $p < .05$. †Significant at $p < .10$. §Attentional engagement was reverse-scored such that higher scores indicate greater engagement.

Table 3

Associations between Hypomanic Personality Traits and Eye-Tracking Attention Outcomes

	Semipartial Correlation[1]	Semipartial Correlation[2]	Semipartial Correlation[3]	Semipartial Correlation[4]	Semipartial Correlation[5]
			HPS Score		
Angry Faces					
Latency to First Fixation	-0.16[†]	-0.19*	-0.16	-0.13	-0.14
Visit Duration	0.00	0.02	0.02	0.01	0.01
Fixation Count	0.06	0.10	0.09	0.06	0.07
Happy Faces					
Latency to First Fixation	-0.18*	-0.19*	-0.19*	-0.18*	-0.20*
Visit Duration	0.03	0.04	0.06	0.06	0.10
Fixation Count	0.12	0.15	0.16	0.14	0.11
Sad Faces					
Latency to First Fixation	-0.12	-0.11	-0.11	-0.11	-0.12
Visit Duration	-0.05	-0.05	-0.04	-0.03	-0.03
Fixation Count	0.06	0.08	0.12	0.11	0.09

*Significant at $p < .05$. [1]Controlling for attention to neutral faces. [2]Controlling for attention to neutral and IDAS-II general depression score. [3]Controlling for attention to neutral and IDAS-II mania score. [4]Controlling for attention to neutral, IDAS-II mania score and IDAS-II general depression score. [5]Controlling for attention to neutral, IDAS-II mania and general depression scores, and PANAS positive and negative affect scores. [†]Approaching significance (p<.10).

Table 4

Associations between Hypomanic Personality Traits and Attentional Engagement

	HPS	Semipartial Correlation[1]	Semipartial Correlation[2]	Semipartial Correlation[3]	Semipartial Correlation[4]
			HPS Score		
Angry[§]	-0.12	-0.17	-0.05	-0.04	-0.04
Happy	-0.16	-0.12	-0.20*	-0.20*	-0.25**
Sad	0.02	-0.01	-0.03	0.00	-0.03

[§]Attentional engagement scores were reverse-scored so that higher scores indicate greater engagement. *Significant at $p < .05$. **Significant at $p < .01$. [1]Controlling for IDAS-II general depression score. [3]Controlling for IDAS-II mania score. [4]Controlling for IDAS-II mania score and IDAS-II general depression score. [4]Controlling for IDAS-II mania and general depression scores and PANAS positive and negative affect scores.

Table 5

Associations between Mood Symptoms, Affective State and Attentional Disengagement

	General Depression	Mania	Positive Affect	Negative Affect
Angry[§]	-0.11	0.05	-0.04	-0.01
Happy	-0.20*	-0.06	-0.01	-0.08
Sad	-0.08	0.01	-0.03	0.01

*Significant at $p < .05$. [§]Attentional disengagement scores are calculated such that higher scores indicate poorer disengagement relative to disengagement from neutral faces. In contrast, lower scores indicate facilitated disengagement relative to neutral.

Table 6

Associations between Hypomanic Personality Traits and Attentional Disengagement

	HPS	Semipartial Correlation[1]	Semipartial Correlation[2]	Semipartial Correlation[3]	Semipartial Correlation[4]
			HPS Score		
Angry[§]	0.02	0.04	-0.01	-0.04	-0.02
Happy	0.04	0.08	0.08	0.04	0.06
Sad	-0.06	-0.04	-0.07	-0.09	-0.08

[§]Attentional disengagement scores are calculated such that higher scores indicate poorer disengagement relative to disengagement from neutral faces. In contrast, lower scores indicate facilitated disengagement relative to neutral. [1]Controlling for IDAS-II general depression score. [2]Controlling for IDAS-II mania score. [3]Controlling for IDAS-II mania score and IDAS-II general depression score. [4]Controlling for IDAS-II mania and general depression scores and PANAS positive and negative affect.

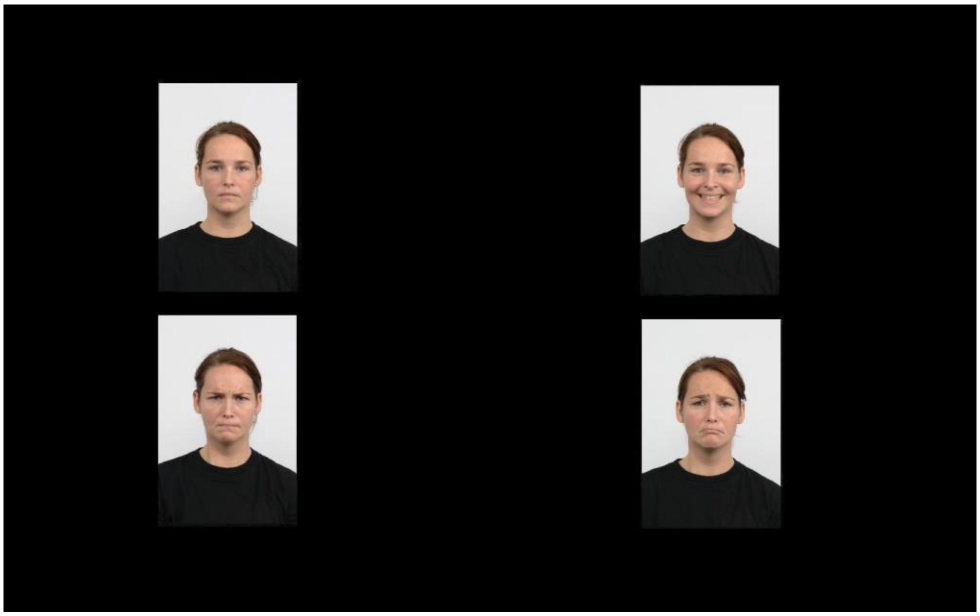

Figure 1. Stimulus for the naturalistic viewing task, with four images of the same actor displaying a variety of expressions.

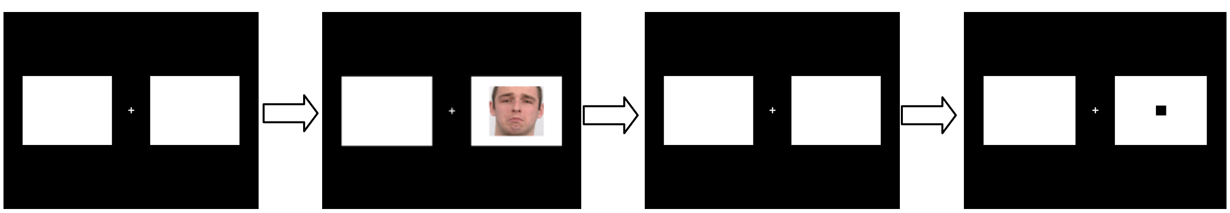

Figure 2. Order of stimulus presentation for one trial of the spatial cueing task. This trial is a valid trial, as the cue appears in the same location as the target.

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