UNIVERSITY OF CINCINNATI

Date: July 31, 2008

I, Elizabeth A. Long**,**

hereby submit this work as part of the requirements for the degree of:

Master of Arts

in:

Psychology

It is entitled:

Facial Affect Recognition and Interpretation in Adolescents with Bipolar Disorder

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Facial Affect Recognition and Interpretation in Adolescents with Bipolar Disorder

A thesis submitted to the

Graduate School

of the University of Cincinnati

In partial fulfillment of the

requirements for the degree of

MASTER OF ARTS

In the Department of Psychology

of the McMicken College of Arts and Sciences

2008

by

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B.S., Neuroscience and Psychology
Muskingum College, New Concord, OH 2003

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Abstract

This study sought to replicate the finding that adolescents with bipolar disorder (BPD) have facial affect processing deficits as well as to examine the relationship between these labeling deficits and social choices based on affective information. Participants with bipolar disorder were compared with healthy adolescents on tasks of facial affect recognition, facial recognition, attention, and facial affect interpretation. These results suggest that adolescents with BPD have mild reductions in their ability to label emotions relative to healthy adolescents. Additionally, response speed was shown to be quicker for those with bipolar disorder when making social judgments about happy, angry and neutral faces. No significant differences were found between groups when making social judgments with respect to accuracy. Finally, groups did not differ with respect to response speed when labeling or making forced choice judgments about affect.

Acknowledgements

This project was supported by the Ohio Department of Mental Health (07.1225) and a Seeman/Frakes award from the University of Cincinnati Department of Psychology.

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Chapter 1

Introduction

I. Bipolar Disorder: Prevalence, Diagnostic Features

Prevalence

Bipolar disorder (BPD) is a psychiatric illness that is characterized by severe abnormalities in a person's mood and everyday functioning (American Psychiatric Association, 2000). This disorder affects approximately 1.5% of the population and may have its onset during childhood or adolescence as well as in adulthood (American Psychiatric Association, 2000). It has been estimated that the prevalence of bipolar disorders in community samples of older adolescents is similar to adults, at approximately 1% (Lewinsohn, 1995; Bland 1997).

Diagnostic Features

The hallmark feature of BPD is a deficiency in regulating emotion (American Psychiatric Association, 2000), as this disorder is characterized the presence of at least one manic episode that lasts for at least one week or that requires hospitalization. During mania, individuals experience elevated or irritable mood as well as at least three (four if irritable mood only) other symptoms such as racing thoughts, grandiosity, pressured speech, flight of ideas, a decreased need for sleep, poor judgment or excessive involvement in activities with high potential for painful consequences, impulsivity, distractibility, or increased involvement in goal directed activities (American Psychiatric Association). In addition, this disturbance must cause severe impairment in social or occupational functioning and cannot be due psychotic features, medication, drugs of abuse, toxin exposure or a medical condition (American Psychiatric Association). Thus, the severity and unpredictability of the characteristic affective instability cause much disruption in the lives of individuals with BPD.

In addition to the presence of at least one manic episode, individuals with BPD may experience depressive episodes (American Psychiatric Association, 2000). These episodes are characterized by sad mood, feelings of hopelessness, guilt, worthlessness, anhedonia, decreased energy, fatigue, decreased concentration, motor slowing, restlessness, irritability, insomnia, changes in appetite and thoughts of death or suicide (American Psychiatric Association). Frequently, symptoms of mania and depression are simultaneously present, which is referred to as a mixed episode (American Psychiatric Association, 2000). Performance during mixed episodes will be the emphasis of the present study.

Features Specific to Childhood and Adolescent Bipolar Disorder

Many symptoms of bipolar disorder present differently in children and adolescents as compared to adults. First, children and adolescents appear to be more likely to have mixed episodes than adults. Therefore, to understand features of adolescent bipolar disorder, it is important to examine patients in a mixed mood state. Chronic irritability is especially common in children and adolescents (Leibenluft, 2006; Rich, 2006). It has also been shown that the manifestation of symptoms such as grandiosity and involvement in pleasurable activities varies as a function of both age and developmental level (Geller, Zimerman, et al., 2002). Thus, careful consideration of symptoms, considering developmental level, is necessary for accurate diagnosis.

Research suggests that those with a prepubertal onset of their illness, as compared to adolescent onset, show higher levels of dysphoric mania, irritability, and aggression. Some researchers have described episodes that are shorter in duration than those of adults and remit less completely (Carlson, 1995; Gellar et al., 1995), whereas, others report that only a subset of children and adolescents have such episodes (Leibenluft, 2003). One hypothesis about this differential pattern in prepubertal and later onset is that the disorder not only affects the brain at the time of onset, but also affects future development. At puberty, important limbic-frontal lobe synapses are forming, and a disorder at this point could potentially interrupt such development (Bhangoo, 2002). This idea of interrupted development has been used to explain epidemiological finding that 17 year-old children with pre-pubertal or early adolescent onset were more severely ill than typical 27-year olds with late-teenage/adult onset mania (Carlson, 1995).

Finally, juvenile and adolescent onset is associated with a more chronic pattern as compared to adults, specifically exhibiting significant morbidity and mortality (Carlson et al., 2002; Geller et al 2002b; Geller et al., 2004). A recent retrospective study found that bipolar participants with an onset prior to age 13 were at risk of a more severe course, meaning greater suicidality, violence, and number of episodes. They also experienced greater co-morbidity and recurrence; whereas those with onset between 13 and 18 years showed an intermediate level of impairment between the juvenile onset and adult onset (Perlis et al., 2004). Biederman et al. (2005) found that childhood and adolescent onset are characterized by a chronic course, irritable mood, and comorbidity with disruptive behavior disorders and anxiety disorders. They also showed that ADHD and ODD are more frequent in younger bipolar children than in adolescents.

Social Functioning

Social functioning is an area of particular concern for children and adolescents with bipolar disorder. Children with mood disorders experience more peer rejection and social difficulty than healthy children (Luby, Todd, & Geller, 1996). It has been estimated that there are several areas of significant impairment that adolescents with bipolar disorder experience. Specifically, according to Lewinsohn, in their population, 66.7% of adolescents with bipolar experienced problems with social functioning, 55.6% experienced difficulties with family functioning, and 83.3% experienced problems with school functioning (2003). Adolescents with bipolar disorder, as well as those showing symptoms but not meeting full criteria, also had significant functional impairment in young adulthood and were significantly less likely to graduate from college, therefore suggesting compounding sources of difficulties for these individuals (Lewinsohn). Finally, people with mood and anxiety disorders often experience social dysfunction, such as frequent interpersonal conflicts, inadequate social problem solving styles, deficient conflict negotiation, mood dysregulation and peer rejection (Rudolph, 1994; McClure, 2003).

Emotional Processing in Bipolar Disorder

Given the affective instability and social functioning deficits, emotional processing is an important area to examine. Despite this, little is known about the emotional processing and cognitive effects that these individuals experience (Doyle, 2005). One cognitive domain of particular interest is emotional regulation as it relates to the perception of others' emotional states.

One aspect of emotional processing is affect processing. This is of interest because of its potential connection to the social and emotional regulation difficulties that such individuals encounter (Perlis, 2004, Biederman, 2005). In healthy individuals, mood is inferred from others' affect, which they transmit through facial expression and the prosody and the frequency of speech (Kolb & Wishaw, 2003). By considering not only the expression of these affective behaviors via facial expressions, but the interpretation of them in others, it is possible to gain information about affective processing, and ultimately begin to infer where weaknesses or deficits exist.

When considering affect processing, valence of emotion is also important. This is because of the social implications that different types of affect carry (Lang, 1995). Emotions serve an adaptive function by motivating an organism to perform behaviors that promote survival and propagation of the species, for example organizing and mobilizing resources. Specifically, negative emotions such as fear or anger warn of danger, motivating the organism to withdraw from or avoid a situation; in other words, negative emotions prompt an individual to draw on external resources. Alternatively, emotions such as happiness propel the organism to approach a situation, thereby promoting prosocial behavior (Lang, 1995). Because these emotions serve different roles, it is possible that healthy individuals process different emotions (positive and negative) separately. Further, the interpretation of positive and negative emotional valences is different in healthy individuals and so an individual could be impaired when confronted with certain valences of emotions but not others.

The primary method that emotional processing has been studied is by considering facial expression. Facial expressions provide a large amount of information including identity, mood and intention (Kolb & Wishaw), and therefore are clearly important in social interactions. Facial affect labeling research is conducted by presenting a participant with the image of face showing a particular emotional expression and asking a person to label the emotion (Ekman, 1999). One such set of faces is the Ekman Pictures of Facial Affect (Ekman, 1976). These images have been used to address questions of differences in ability to judge emotions in various populations (Ekman, 1976). From such a method, questions as to what emotions are able to be labeled, the reliability of these judgments, and the importance of context have been asked (Ekman, 1999). Control items such as asking whether the person is male or female, or matching tasks are also often used to control for visual spatial functioning and to provide baseline imaging from simply looking at faces. FMRI is often used in conjunction with this behavioral method to then provide information about group differences in various brain structures (Ekman, 1999).

Facial affect recognition studies of adults and adolescents with bipolar disorder have shown that they are less able than psychiatrically healthy individuals to label the emotion that another person is displaying through his or her facial expressions (Addington & Addington, 1998; Getz, Shear & Strakowski, 2003a, McClure, 2005, McClure, 2003). Specifically, in adolescents, using facial affect recognition methodology, McClure et al., (2003 & 2005) have shown that individuals with bipolar disorder are deficient in their ability to correctly label facial expressions and to judge socially appropriate language. First, in a population of 11 individuals with bipolar disorder, 10 with anxiety disorders, and 25 healthy individuals, they examined affect recognition using high and low intensity images of happy, sad, angry and fearful adult and children's faces (McClure et al., 2003). These results showed that groups differed in recognition of emotional faces of children, but not adult faces. Overall, the participants with bipolar disorder made more errors than the other two groups. They most commonly mislabeled angry faces (McClure et al., 2003). In another study of 40 individuals with bipolar disorder, affect recognition was again examined, in addition to spoken language in social situations (McClure et al., 2005). Here, individuals with bipolar disorder scored lower on a pragmatic language judgment test, and made more errors on a facial affect recognition test. Additionally, this pattern has been examined in individuals who were non-syndromal. Specifically, Foster showed that euthymic adolescents with bipolar disorder were more likely to be mildly impaired overall on a battery of tests requiring facial and vocal affect recognition. In contrast, the ability to recognize faces on tasks that did not require affective processing was intact (Foster, 2007)

These findings are consistent with the adult literature. Manic adults with bipolar disorder are deficient in their ability to identify other people's emotions (Addington & Addington, 1998; Getz, Shear & Strakowski, 2003a). Specifically, Addington and Addington examined the performance of individuals with schizophrenia (n = 40), individuals with bipolar disorder, (n = 40), and healthy individuals on visual attention, facial recognition and affect recognition (identification and discrimination). Their results indicated that individuals with bipolar disorder score better than those with schizophrenia, but more poorly than healthy individuals when asked to discriminate between two faces showing emotions. Further, data from our laboratory has shown that in adults there is a disproportionate difficulty labeling negative (anger and fear) emotions (Getz, Shear & Strakowski, 2003b) during mania compared to healthy individuals. Finally, Lembke & Ketter (2002) also showed that adults in a manic state showed impairment in labeling fear and disgust. Lembke & Ketter also examined performance in euthymic patients and found them to be significantly less impaired than individuals in a manic state, and similar in performance ability to healthy individuals.

Because adolescents with bipolar disorder often experience mixed episodes, it is important to also consider the impact of depressive symptoms. Only one study of facial affect labeling has been conducted in adults with bipolar disorder, depressed state (Chen, 2006). This fMRI study showed that depressed and manic patients exhibited abnormal responses to fearful faces and to facial expressions that were incongruent with the patients' own mood (e.g., depressed subjects had difficulty identifying happiness in others). Previous studies have demonstrated that depressed bipolar and unipolar patients show greater accuracy in perceiving negatively valenced stimuli (Lyon et al., 1999; Gur et al., 1992; Murphy et al., 1999; and Hale, 1998). In contrast, according to Chen, 2006, a depressed state arising in the context of bipolar disorder may have different neurobiological determinants than a depressed state arising in the context of a unipolar disorder. This study suggests that though both individuals are depressed, the anatomical structures involved in each are different, due to a differential pattern of development of the two disorders. Specifically, Chen (2006) showed that a depressed group exhibited overactivity in fronto-striato-thalamic systems in response to happy faces and a manic group exhibited overactivity in the fusiform gyrus in response to sad faces. This difference in anatomy suggests that it would be reasonable to expect a potentially different pattern of symptoms and behaviors with each mood state.

The existing literature focuses primarily on the verbal labeling of emotional facial expressions, but it has not yet been clearly shown that the inability to label an emotion equates to an inability to correctly perceive the emotion, or to act on the basis of the perceived emotional valence of the stimuli. For this reason, one of the aims of the present study is to delineate these two phenomena through interpretive questions relating to emotion.

Finally, it is plausible that the social dysfunction that occurs in bipolar disorder may be related in part to a deficit in affective cognition. Therefore, by examining the relationship between scores on the naming and interpretation of emotions and social function in everyday life, a relationship can begin to be better understood. The present study seeks to address these issues through the interpretation of affective processing in adolescents with bipolar disorder who are experiencing a mixed episode. Ultimately, as has been tried with patients with schizophrenia (Frommann, 2003; Wolwer et al., 2005), this could lead to the development of psychosocial treatments to help those with bipolar disorder.

Neuroanatomy of Bipolar Disorder and Emotional Processing: Imaging Results

In addition to behavioral studies, significant efforts have been made to understand the anatomical substrates of bipolar disorder as well the underpinnings of the cognitive skills required for emotional processing. Two primary structures that modulate mood regulation have been hypothesized to be involved in the pathophysiology of bipolar disorder. Specifically, according to Soares and Mann, two overlapping circuits are involved. First, the limbic (amygdala)-thalamic-prefrontal cortical circuit, and second a limbic-striatal-pallidal-thalamic circuit. Other brain areas hypothesized to be involved are the insular gyrus, fusiform gyrus, and anterior cingulate. It is known that the amygdala is a key structure in emotional processing and memory, and has been studied extensively in bipolar disorder. The nature of such structural involvement in bipolar disorder is not yet clear; for example studies in adults have shown increased or unchanged amygdala volume (Strakowski et al., 1999; Altschuler et al, 2000; Brambillia, 2003). Similar studies with adolescent populations consistently document decreased amygdala volume (Dickstein et al., 2005; Blumberg et al. 2003; DelBello et al., 2004; Chang, 2005; Chen, 2004). Thus, in adults, the implication of the size of the amygdala is unclear; however, in adolescents, reductions in amygdala volume is clear.

With respect to facial affect processing, research has shown that in healthy individuals, multiple systems, both cortical and subcortical, are involved (Kolb & Wishaw, 2003). Historically, emotional processing has been attributed to the amygdala and prefrontal cortex in primates (Papez, 1930; LeDoux, 2000).

Most recently, strides have been taken to bring together lines of research on facial affect processing and structural studies of patients with bipolar disorder. Abnormalities in the amygdala-striatal-ventral prefrontal cortex circuit that is believed to control emotional processing and regulation potentially affects both emotional behavior and perception (McClure, 2005; Rich, 2006). Research with adults with bipolar disorder consistently implicates the amygdala and the ventral prefrontal cortex in the functions of facial processing and emotional regulation (Monk et al., 2003, McClure et al., 2004, Adolphs & Tranel, 2003, & Phillips et al 2003). The ventral prefrontal cortex and other prefrontal areas contribute to complex inhibitory functions (Chen et al., 2004). Inhibitory functions are essential to the regulation a wide range of abilities such as behavior, attention and emotion. Thus, given findings of structural and functional anomalies in the prefrontal cortex and amygdala in bipolar disorder (Blair, 2004, Adolphs & Tranel, 2003; Rolls, 1996; Phillips et al., 2003; Davidson et al., 2000), and the importance of such structures in facial affect processing, a deficiency in processing or using this information is not surprising.

III. General Neuropsychological Deficits in BPD

Emotional processing deficits in bipolar disorder occur within a constellation of other cognitive deficits. Though not individually diagnostic, there are a range of cognitive symptoms associated with this disorder. These symptoms are particularly relevant to the present study because they also have the potential to contribute to emotional processing. Because the existing cognitive literature on adolescents with bipolar disorder is so small, however, reference is made here to both the child and adult literature. IQ has been shown to be mildly reduced as compared to healthy controls (Doyle A.E. et al., 2005, Olvera et al., 2005) particularly Performance IQ (McCarthy J., et al 2004). Deficits have also been identified in executive functions (Bearden et al., 2007; Shear, DelBello, Rosenberg & Strakowski, 2002; Pavuluri, MN et al., 2006, Olvera, R.L. et al., 2005, Dickstein, D.P. et al., 2004, Warner et al., 2005, McDonough-Ryan, P., 2001; Myer S.E. et al., 2004; Dixon, 2004), attention (Fleck, 2005; Doyle, A.E. et al., 2005; Olvera, R.L. et al., 2005; McCarthy, J. et al., 2004, Dickstein et al., 2004, Castillo M., 2000) and visual and verbal memory (Fleck et al., 2003; Shear et al., 1999, Doyle A.E., 2005; Olvera et al., 2005; McClure, et al., 2005; Glahn et al., 2005).

Because cognitive symptoms vary across different mood states, it is important to contrast multiple mood states in order to separate symptoms that are related to a particular mood state, and which are deficits that are broadly related to bipolar disorder (McClure, 2005). In contrast to the studies described above, other studies have specifically considered symptoms in individuals with depression. With depression, the most pronounced symptoms are reduced processing speed (Hartlage et al., 1993) and memory (Miallet et al., 1996; Austin, et al., 1999; Richards & Ruff, 1989; and Pelosi et al., 2000). Also, there are impairments in executive functioning (Rogers et al, 2004; Austin et al., 2001).

IV. Aims and Hypotheses

The present study examined affective processing in adolescents with bipolar disorder who were in mixed (i.e., both manic and depressive symptoms are present simultaneously) mood states, relative to healthy controls. The mixed patients were selected because they provided information about symptoms of both mania and depression and because mixed mood states are common in adolescence. It is possible that the well documented social difficulties that patients with bipolar disorder experience may be related, in part, to a deficit in affective cognition; however, little is known about this domain of functioning in adolescents with BPD. For this reason, this study was designed to examine both labeling and social judgment. Labeling was examined by asking participants to apply verbal labels to facial expressions. The first hypothesis was that adolescents with bipolar disorder would perform more poorly than healthy participants on tasks of facial affect labeling, which is the most common method used in the literature to assess affective processing. A novel aspect of the present study is that adolescents were also asked to make social judgments based on their perceptions of facial affect. The second hypothesis was that adolescents with bipolar disorder would be less successful than healthy controls at making appropriate social judgments on the basis of facial affect.

Chapter 2

Methods

Participants

Participants were adolescents (n= 12) with BPD, current episode mixed, and healthy volunteers (n=12). Groups were equated with regard to age, sex, and race. Participants with BPD were recruited from ongoing research protocols within the Division of Bipolar Disorders Research (DBDR) at the University of Cincinnati, College of Medicine. Healthy volunteers were recruited from the community and from ongoing research protocols in the DBDR.

Prospective participants in both groups were required to be between the ages of 12-17 years and to have a Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999) Full Scale IQ greater than 80. They were excluded if they had a history of serious closed head injury or other serious neurological illness or injury, current psychotic episode, or a history of lifetime substance dependence or abuse within three months of participation. Participants were also excluded if they were not fluent in English. All participants' legal guardians gave written informed consent, and participants provided written assent for participation in this research project. All aspects of this project were approved by the University of Cincinnati Institutional Review Board.

Inclusion criteria for participants with bipolar disorder in a mixed mood state included a Washington University at Saint Louis Kiddie Schedule for Affective Disorders and Schizophrenia (WASH-U-KSADS) (WASH-U-KSADS; Geller et al., 1998) confirmed diagnosis of bipolar disorder, current stated mixed, a rating of greater than or equal to 12 on the Young Mania Rating Scale (YMRS; Young et al., 1978), and a rating of greater than or equal to 28 on the Childhood Depression Rating Scale (CDRS; Poznanski, Cook & Carroll, 1979). Four participants had comorbid Attention Deficit Hyperactivity Disorder (ADHD), Combined Type.

Healthy adolescents had a WASH-U-KSADS confirmation of no mood or psychotic disorder or ADHD, as well as no first-degree relative with a mood or psychotic disorder or ADHD.

Diagnostic and Psychological Assessment

All research participants were diagnostic and symptom severity measures. Before administering the diagnostic and symptom measures in this battery, the principal investigator and co-investigators completed training with a research psychiatrist and demonstrated a high degree of inter-rater reliability (kappa > .90).

Diagnostic Instrument

First, a semi-structured interview, the WASH-U-KSADS was conducted to determine diagnostic eligibility by establishing the presence of bipolar I disorder, current state mixed, or by confirming that control participants were psychiatrically healthy. The WASH-U-KSADS has good reliability and has been validated against parent and teacher reports (Geller et al., 1998a, 2001b). It has been has been used successfully to establish thresholds for boundaries between bipolar disorder subtypes (BP-I, BP-II, cyclothymia), which is important for defining phenotypically homogeneous samples (NIMH Roundtable, 2001). Family history of psychotic disorder or mood disorder was obtained through parent report.

Symptom Rating Instruments

The Young Mania Rating Scale (YMRS; Young et al., 1978) and the Childhood Depression Rating Scale-revised version (CDRS-R; Poznanski, Cook, & Carroll, 1979) were also administered to evaluate symptom severity. The YMRS is an 11-item clinician-administered assessment of mania severity over the past week, with possible scores ranging from 0 to 60 and higher scores indicating more pronounced symptomatology. The reliability and validity of this instrument are acceptable (Fristad, Weller, & Weller, 1995; Young et al., 1978).

The CDRS is a clinician-rated scale of the severity of depressive symptoms that have occurred, consisting of 17 clinically relevant domains. Ratings are based on the participant's responses about his or her current behavior or functioning over the previous week. The reliability and validity of this instrument are acceptable (Poznanski et al., 1979).

Additionally, the Scale of Positive Symptoms was administered to rule out the presence of psychosis (SAPS; Andreasen, 1984). This is a brief, clinician-administered assessment used to rate the presence and severity positive symptoms such as hallucinations, delusions, and other aspects of thought disorder over the previous week. The reliability and validity of this instrument are considered to be satisfactory (Andreasen, 1984).

Neuropsychological Assessment

All research participants were administered several well normed measures that were not included in the primary analyses but were intended to control for other cognitive processes that could have impacted performance on the affect processing tasks. For example, individuals with low intelligence, poor attention, or poor visual-spatial abilities (particularly related to the processing of faces), may answer items incorrectly as a result of a fundamental difference in information processing, rather than due to a broader deficiency in social or emotional awareness. All measures are standardized tests of neuropsychological performance that have been validated through normative procedures. For all neuropsychological measures, the principal investigator completed training with a psychologist.

Intelligence

This battery included a standardized estimate of intelligence, The Wechsler Abbreviated Scale of Intelligence [WASI (Wechsler, 1999)]. This scale is valid for individuals ages 6 years to 89 years and comprises four subtests: Vocabulary, Similarities, Block Design and Matrix Reasoning. The WASI was standardized on a stratified national sample (total N = 2245; child N =1100) on the basis of gender, race/ethnicity, educational level, and geographical region. Internal consistency reliabilities have been shown to be excellent for the four-subtest combination. Validity studies show that it has a high correlation with measures of intelligence ability and achievement. Thus, it is adequate for screening purposes.

Attention

Attentional abilities were assessed using the Ruff 2 & 7 Selective Attention Test (Ruff & Allen, 1996). This test requires the participant to scan a quasi-random series of numbers or numbers and letters and then mark the numbers 2 and 7 wherever they appear. Measures of commission, omission, and speed were gathered. This test has been shown to have high internal consistency and high split-half reliability. Validity studies measuring convergent and discriminant validity support that sustained attention is measured by the combination of the speed and accuracy scores. Thus, reliability and validity are felt to be adequate (Ruff & Allen, 1996).

Facial Recognition

Finally, the Benton Facial Recognition Test was administered to confirm that any obtained group differences in facial affect recognition are specific to emotion recognition rather than facial feature processing (Benton et al, 1978). The test required matching a target face with up to three pictures of the same person presented in a six-stimulus array of faces; however, most importantly, the task has no affective processing component, in contrast to measures below, and so all performance was based on the facial recognition only. In this way, it provided an excellent control, ensuring that all participants were able to correctly perceive faces. Finally, the test was developed with normative studies in adults, children and a wide range of cultural, clinical groups (Benton, Sivan, Hamsher, Varney & Spreen, 1994). It has been shown to have adequate reliability and validity (Benton, 1978). Although average scores are known for children ages 6-14, standard deviations are not published, and so it is not possible to convert raw scores to any type of standard score. Therefore, raw scores will be evaluated for this measure. Clinical classifications or cut scores for the adult data will be used for adolescents older than age 13, as the means for adolescents overlap with the adult means starting at this age. For adolescents who are 12 years of age, the mean score for overlaps with the low average range for adults, and so the clinical classification will be adjusted.

Facial Affect Recognition and Facial Affect Interpretation Tasks

The primary measures of interest in this study were drawn from three novel tasks including 1) Forced Choice Interpretation, 2) Line Scale Interpretation, and 3) Forced Choice Labeling, all of which were constructed from the Ekman Faces of Affect stimuli (Ekman, 1974). Ekman created this photo set using posers who were trained and instructed to contract or relax different facial muscles associated with particular facial expressions. On the basis of empirical studies, a set of 110 35-millimeter black and white pictures was created (Ekman), and two normative analyses were conducted to ensure reliability (Ekman, 1980). For this study, a subset of the images was selected for the high reliability with which raters in normative studies labeled the emotion that was displayed. Images then were edited to show only the faces, with hair and other external features masked. Equal numbers of male and female images were selected, and all stimuli for the present study depicted Happy, Angry, Fearful or Neutral facial expressions.

The tasks took place in a room where sunlight does not produce a reflection on the computer screen. Participants were seated approximately 22 inches from the screen. All images or pairs of images were shown centrally. Participants were instructed to left-click on the designated area to show their answer. They were also informed that they should respond as quickly and accurately as possible, and that once they responded they could not change their answer. Verbal instructions were given while the participant read along on the computer screen. Three practice trials were given before each task. For each practice item, feedback was given to ensure that the participant understood the task. Following the practice items, the investigator then repeated essential portions of the instructions, and answered any questions that the participant had.

Forced Choice Interpretation: First, in order to understand how adolescents with bipolar disorder in a mixed mood state make social judgments based on facial affect information, a forced choice component was presented. Participants were shown two photographs of the same person expressing different emotions and were asked to answer the question, *"If you are alone, and need help with something, which picture looks more like someone you would ask for help?"* Images were presented in pairs that included both a negative (Angry or Fearful) and a positive (Happy or Neutral) emotion. This method was used to ensure that there was a "correct answer" (i.e., the positive emotion) that would be selected by most healthy individuals and, thus, provide a way to score the responses. The two negative valences were crossed with the two positive ones to create four experimental conditions, which were presented in 4 blocks of 10 images, for a total of 40 trials. The items were presented in a quasi-random sequence, with the positions of the positive and negative valences counterbalanced on the left and right. Each item was scored for accuracy of response and reaction time.

Line Scale Interpretation: Next, in a line scale component, the participants were shown each of the 40 images that had been presented during the forced choice task individually, and they were asked, *"If you are alone and need help with something and this is the only person available, how likely are you to approach this person and ask for help?"* This task again looked at social judgment, but was designed to examine the possibility that a participant might decline to ask anyone for help or, alternatively, might ask all people for help. The participants responded by clicking on a line with the left labeled "Very likely" and the right labeled "Unlikely." Answers were measured in pixels starting at the left end of the continuum and ranged from 300 pixels ("Very Likely") to 700 pixels ("Unlikely"). Reaction time was also recorded.

Forced Choice Labeling: Finally, the participants completed an Affect Labeling task that again used the same faces as in the previous two tasks. The participants were presented with the same 40 stimuli on a computer and were required in a forced choice format to select the label (Fearful, Angry, Happy, or Neutral) that corresponded to the emotion expressed in the image by clicking on the corresponding word. Participants were instructed to click on the word that best matched the expressed emotion. Answers were measured in terms of percent correct as well as reaction time.

Statistical Analyses

Though sample sizes were small, data were found to be approximately normally distributed. For reaction time data, which had significantly skewed distributions, non-parametric tests were conducted. For normally distributed data, parametric tests were used to examine the data.

We first considered whether demographic variables (age, sex, race, family income level and handedness) were significantly different between the two groups. In addition, symptom severity was also compared between groups. T-tests were conducted to compare groups with respect to age. X^2 analyses were conducted to compare groups with respect to race, gender, handedness and socioeconomic status. Next, we examined the cognitive control variables to determine whether the two groups differed significantly in IQ, facial recognition, or sustained visual attention. Those control variables that were significant were included in subsequent statistical models.

Affect Labeling and Forced Choice Interpretation scores were converted to percentage correct. Mean responses for each group were then calculated. Finally, each individual's mean reaction time for each task was calculated. If a person did not give an answer that was acceptable, for example by clicking outside of the answer area, the next image did not advance. Instead the participant resubmitted their answer. Outside of the initial practice trials, this did not happen frequently (n=8). In instances where it did happen, the reaction times for the two responses were summed. In addition to averages for each task, data were considered with respect to the emotional valence of the stimuli.

Finally, for Affect Labeling valences were first compared separately and then also collapsed so that angry and fearful created a "negative" category, and happy and neutral created a contrasting "positive" category. When analyzed separately, it was found that angry and fearful were not significantly different from one another, and so it was felt that due the small sample size it was best to consider results comparing the valences grouped as "positive" and "negative."

Chapter 3

Results

Demographic Variables

See Table 1 for descriptive statistics of the demographic variables. There were no significant differences between the groups with respect to sex, race, age, or family income level.

Table 1
Demographic Information by Variable and Group

Variable	BPD	HP
Sex (percentage male)	42%	42%
Race (percentage Caucasian)	75%	50%
Medication (percentage on psychotropic medication)	67%	0%
Medication (percentage on stimulants)	0%	0%
Age (Mean (SD))	14.33 (1.8)	14.00 (1.9)
Family Income Level: 5 Categories (Mean (SD))	3.70 (1.4)	4.00 (1.1)
YMRS (Mean (SD))	18.09 (6.5)	0.42 (0.7)
CDRS-R (Mean (SD))	32.91 (7.9)	17.25 (0.5)
SAPS (Mean (SD))	0.36 (0.8)	0.00 (0.0)

With respect to symptom severity ratings, as expected, the two groups differed significantly on both the YMRS ($t = 9.425$, $df = 21$, $p < 0.001$) and the CDRS ($t = 6.821$, $df = 21$, $p < 0.001$), with those with bipolar disorder experiencing greater manic and depressive symptoms than the healthy participants. Qualitative examination of the magnitude of the group means suggests that those with bipolar disorder were rated on average as demonstrating clinically significant levels of mania and depression. None of the participants in the healthy group had ever taken any psychotropic medications. At the time of assessment, in the group with bipolar disorder, 4 participants were not taking any medications. The 8 remaining were taking one or more of the following: quetiapine (n = 1), carbamazepine-extended release (n = 2), risperdol (n = 1), ziprasidone (n = 1), topiramate (n = 4), olanzapine (n = 4).

Non-parametric correlations within each group were conducted (see Table 3 for correlation coefficients and significance). For the group with bipolar disorder, minority status was associated with better facial recognition and female gender was associated with slower speed and better accuracy. For the healthy group, again, female gender was associated with better accuracy.

Control Variables

Descriptive statistics for the cognitive control variables can be found in Table 2. The groups did not differ significantly in their facial recognition ability (t = .262, df = 22, p = .398) or sustained attention (accuracy) (t = -1.236, df = 22, p = .115). The healthy group scored significantly better with respect to speed on a task of attention (t = -2.563, df = 22, p = .009), with scores in the patients falling into the mildly impaired range relative to normative data provided by the test publisher. There was a trend for the bipolar participants to score worse than healthy participants on the estimate of IQ (t = -1.544, df = 22, p = .07). However, inspection of the group means revealed that there is not a clinically meaningful difference between groups and that both groups have mean scores well within the average range of intelligence.

Table 2
Mean and Standard Deviation of Control Tasks by Variable and Group

Task		**Mean**	**SD**	**Median**	**Range**
Estimated IQ (SS)	BPD	100.10	8.80	98.00	92-119
	HP	104.55	10.89	109.00	84-119
Facial Recognition (Raw)	BPD	43.08	4.76	41.50	37-54
	HP	44.58	4.96	43.50	38-53
Attention: Total Accuracy (T-score)	BPD	45.25	8.66	46.50	29-60
	HP	50.00	10.12	54.00	22-61
Attention: Total Speed (T-Score)	BPD	37.67	6.01	38.50	29-47
	HP	49.33	14.58	49.00	25-74

Table 3.
Spearman’s Rho Correlations between demographic and control variables: BPD Group & Healthy (Italicized)

	Age	Race	Gender	YMRS	CDRS	SAPS	Est. IQ	Speed	Accuracy	Facial Recognition
Age		*-0.142*	*0.025*	*0.452*	*-0.057*		*-0.091*	*0.426*	*-0.395*	*0.128*
		0.661	*0.938*	*0.140*	*0.859*		*0.779*	*0.167*	*0.204*	*0.691*
Race	-0.115		***0.581***	*-0.011*	*0.090*		*-0.557*	*0.392*	*-0.062*	*0.267*
	0.721		***0.048***	*0.972*	*0.780*		*0.060*	*0.208*	*0.849*	*0.402*
Gender	**0.632**	0.098		*-0.383*	*-0.293*		*0.049*	***0.614***	*-0.300*	*0.074*
	0.027	0.763		*0.220*	*0.356*		*0.879*	***0.034***	*0.344*	*0.820*
YMRS	0.080	-0.197	-0.074		*-0.034*		*-0.316*	*-0.057*	*-0.195*	*0.011*
	0.805	0.540	0.819		*0.918*		*0.317*	*0.861*	*0.544*	*0.974*
CDRS	0.403	-0.089	0.157	0.571			*-0.394*	*-0.308*	*-0.199*	*-0.224*
	0.194	0.783	0.626	0.052			*0.205*	*0.331*	*0.535*	*0.484*
SAPS	0.077	-0.289	-0.043	0.376	0.203					
	0.823	0.389	0.900	0.254	0.549					
Est. IQ	-0.415	-0.251	-0.514	-0.324	-0.205	0.224		*-0.163*	*-0.103*	*0.204*
	0.179	0.432	0.087	0.304	0.522	0.509		*0.613*	*0.751*	*0.526*
Speed	0.358	-0.028	0.416	-0.331	-0.396	-0.447	-0.231		*0.098*	*0.299*
	0.254	0.931	0.178	0.293	0.203	0.168	0.471		*0.761*	*0.345*
Accuracy	0.455	0.362	**0.710**	-0.352	0.086	-0.373	-0.245	**0.650**		*0.057*
	0.137	0.247	**0.010**	0.262	0.791	0.259	0.443	**0.022**		*0.860*
Facial Recognition	0.325	**0.673**	0.369	-0.439	-0.293	-0.413	-0.492	0.510	0.538	

Facial Affect Recognition

Experimental Task Validity

As the facial affect tasks were novel measures, it is important to demonstrate that the instruments were working as expected. Examination of the mean scores and distributions of the labeling task, which are listed on Table 4, enabled us to consider the validity of this instrument.

Table 4
Mean and Standard Deviation of Affect Labeling by Diagnosis and Valence

	Neutral M (SD)	Happy M (SD)	Fearful M (SD)	Angry M (SD)	Positive M (SD)	Negative M (SD)
BPD	0.93 (0.04)	1.00 (0)	0.87 (.10)	0.83 (.19)	0.97 (.02)	0.85 (.12)
HP	0.93 (0.06)	0.99 (.03)	0.98 (.06)	0.88 (.11)	0.96 (.04)	0.93 (.05)

First, examination of group means show that healthy individuals are able to label the emotional expressions of others accurately, with percent correct ranging from 0.88 to 0.99 across emotional valences (See Table 4). Next we inspected their answers on the forced choice interpretation condition, and again it was evident that the healthy adolescents selected happy and neutral images over angry or fearful images (Table 5).

Table 5
Mean and Standard Deviation of Affect Interpretation (Forced- Choice) by Diagnosis and Valence

	Happy-Angry M (SD)	Happy-Fearful M (SD)	Neutral-Angry M (SD)	Neutral-Fearful M (SD)
BPD	0.95 (.07)	0.93 (.10)	0.88 (.09)	0.93 (.09)
HP	0.97(.05)	0.94 (.07)	0.89 (.07)	0.95 (.07)

Finally, the Line Scale Interpretation task served provided information about whether the participants would ever approach any of the individuals pictured in the images. Indeed, as all images were of Caucasian actors, were dated, and were black and white, it seemed possible that a participant could truly prefer never to associate with the person in the image. Visual inspection of the data revealed that none of the images were rated entirely unapproachable by any of the participants and that Happy and Neutral faces were rated as relatively more approachable (lower ratings on the line scale) than the negative faces (Table 6) in terms of the order of the mean values. Taken together, these qualitative analyses indicate that the overall the tasks were constructed in a way that allows us to answer the proposed research questions.

Table 6
Mean and Standard Deviation of Affect Interpretation (Line-Scale) by Diagnosis and Valence

	Neutral M (SD)	Fearful M (SD)	Happy M (SD)	Angry M (SD)
BPD	549.49 (56.48)	612.55 (26.97)	393.88 (27.97)	611.31 (33.61)
HP	513.24 (49.32)	590.64 (56.22)	405.37 (42.04)	588.73 (34.73)

Group Differences in Accuracy

Forced Choice Interpretation

We began by examining group differences with respect to accuracy on the Forced Choice Interpretation task (Table 5). One participant in the healthy group and one participant in the bipolar disorder group were found to be outliers and were excluded from analyses. A 4 (valence comparisons: Happy vs. Angry; Happy vs. Fearful; Neutral vs. Angry; and Neutral vs. Fearful) x 2 (groups) repeated measures ANOVA was conducted. This analysis showed a main effect for valence (F = 6.741, df = 18, p = .003). Post-hoc analyses revealed that participants in both groups had more difficulty selecting the positive face in the Neutral vs. Angry condition compared to the Happy vs. Angry condition (t = 5.095), df = 21, p <.001), the Happy vs. Fearful condition (t = 2.017, df = 21 p = .05) and the Neutral vs. Fearful condition (t = 2.318, df = 21, p =.03). No significant effect of diagnosis or interaction was found.

Line Scale Interpretation

Next, we examined group differences with respect to ratings on the Line Scale Interpretation task (Table 5). A 4 (valences: happy, neutral, angry, and fearful) x 2 (diagnostic groups) Repeated Measures ANOVA was conducted. This analysis showed a main effect for valence (F= 29.897, df = 20, p < .001). Post-hoc analyses revealed that both groups' ratings of Happy was significantly different from their rating of Fearful (t = 7.519, df = 23, p < .001), Angry (t = -8.132, df = 23, p <.001) and Neutral (t = 8.084, df = 23, p <.001). Both groups also rated Neutral as significantly different from Fearful (t = -3.385, df = 23, p = .003), and Angry (t = -3.766, df = 23, p = .001). Angry and Fearful were not significantly different from one another. No effect of diagnosis or interaction was found.

Labeling

The Affect Labeling task revealed significant group differences. Specifically, a 2 (positive and negative) x 2 (diagnostic group) repeated measures ANOVA was conducted, which showed a main effect for valence (F= 14.374, df = 22, p = .001). Post-hoc analyses showed participants in both groups had more difficulty labeling negative faces as compared to positive faces (t = -2.168, df = 23, p = .041). A significant group by valence interaction was also found (F = 7.47, df = 22, p = .012) (see Figure 1).

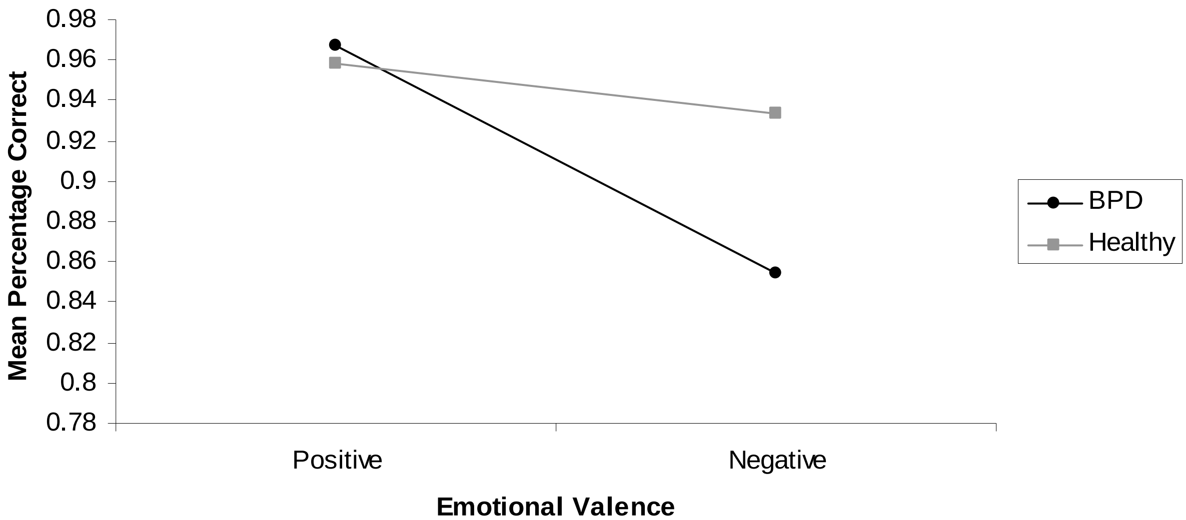

Figure 1. Labeling means by diagnosis and valence.

Post-hoc analyses revealed that patients, compared with controls, made more errors when labeling angry and fearful images (angry and fearful; t = 2.711, df = 22, p = 0.006). This group difference was not evident when viewing faces expressing positive emotions (happy and neutral; t = -.666, df = 22, p = .26). Additionally, healthy volunteers achieved approximately the same performance regardless of valence (positive or negative; t = .692, df = 11, p = .205). In contrast, individuals with bipolar disorder scored significantly worse when labeling negative images as compared to positive valences (positive and negative; t = -2.764, df = 11, p = .009).

Group Differences in Reaction Time

Labeling

Next, we considered reaction time for each task. A Mann-Whitney U test was conducted for each pair to compare groups' performance on labeling each of the four valences of images (see Table 7). The groups did not significantly differ in their speed of responding to any of the valences.

Table 7
Labeling Reaction Time Medians and Ranges by Diagnosis and Valence

	Neutral	Happy	Fearful	Angry
BPD	1554.06 (1043-2449)	1271.82 (1083-2169)	1908.68 (1184-2935)	1971.17 (1258-2712)
HP	1674.83 (1152-1786)	1331.89 (970-1632)	1930.19 (1406-2869)	1921.11 (1435-2964)

Forced Choice Interpretation

On the Forced-Choice Interpretation task, healthy individuals responded significantly more slowly than those with bipolar disorder when they were shown the happy-fearful pairing (see table 8; (U = 43.5, df = 23, p = .05)) or the happy-angry pairing (U = 49.5, df = 23, p = .09). However, the standard deviations for the happy-fearful pairing and the neutral fearful pairing were exceptionally large. Inspection of the individual data revealed that one participant was an extreme outlier. When the data was reanalyzed excluding this individual, groups did not differ on either of these valences. No other significant differences were found for other combinations of emotions shown.

Table 8
Forced-Choice Reaction Time Medians and Ranges by Diagnosis and Valence

	Happy-Angry	Neutral-Angry	Happy-Fearful	Neutral-Fearful
BPD	1326.48 (990-1523)	1222.65 (1287-2005)	1774.55 (959-1406)	2077.45 (1146-2609)
HP	1451.3 (1013-2339)	1817.55 (1142-2502)	1324.75 (1507-51559)	2132.5 (1385-26725)

Line Scale Interpretation

The healthy participants responded significantly more slowly than the group with bipolar disorder when rating happy faces (U = 39, df = 23, p = .03). They showed a similar trend when rating angry (U = 48, df = 23, p = .09) and neutral stimuli (U = 47, df = 23, p = .08).

Table 9
Line-Scale Interpretation Reaction Time Medians and Ranges by Diagnosis and Valence

	Neutral	**Happy**	**Fearful**	**Angry**
BPD	1726.4 (1173-2288)	1333.45 (830-1868)	1486.27 (1073-1798)	1366.83 (1063-1868)
HP	2091.75 (1184-3823)	1508 (938-3049)	1669.77 (9531-3167)	1652 (946-3188)

Examination of Confounding Factors

Correlations between Control, Demographic, Clinical Variables, and Affective Task Performance & Attention Covariates

Correlations were conducted to examine the relationship between cognitive measures, demographic variables and clinical measures. Looking at the group with bipolar disorder, race was positively related to facial recognition (r_s = .673, p = .017), with African American individuals scoring higher on facial recognition than Caucasian individuals. Gender was positively related to labeling accuracy (r_s = .710, p = .01), with female participants scoring higher on accuracy than male participants. Finally, female participants also performed more slowly than male participants on attentional speed (r_s = .650, p = .022).

Effect of Speed

As performance on the Ruff 2&7 Selective Attention Test indicated that the bipolar and healthy groups were significantly different with respect to speed, it was of interest to account for differences in reaction time in reaction time findings on novel interpretation tasks. In this way, it is possible to better understand emotional processing by separating simple attention speed from speed on tasks that require emotional processing. As such, reaction time data for the Line Scale task transformed to make it normally distributed and then reanalyzed using parametric tests.

For the Line-Scale task, A 4 (valences) x 2 (diagnostic group) Repeated Measures ANOVA was conducted, which revealed a main effect (F = 4.208, df = 3, p = .018). No significant interaction or effect of diagnosis was found. Post-hoc t-tests revealed that both groups were significantly slower at rating neutral than rating happy (t = 3.661, df = 23, p = .001), angry (t = 3.622, df = 23, p = .001) and fearful (t = -3.537, df = 23, p = .002). Next, the attention speed variable was added to the analysis and this revealed that that the main effect was no longer significant (F = 1.608, df = 19, p = .221).

Thus, while these results must be considered cautiously, as there are limits to using transformed data, and power is a realistic concern for this analysis, it appears that speed impacted the results of the reaction time comparisons for the line scale task. It is felt that speed for general attention rather than a difference in how this particular type of information is processed could have impacted these reaction time results to a degree. However, given the limitations of this analysis, the precise relationship is not clear.

Effect of Difficulties with Attention

Previous research has indicated that differences individuals with bipolar disorder have known differences in attention (Wilder-Willis et al., 2001). As such, overall attention abilities were measured, and groups did not differ, suggesting that both groups were similar in their overall ability to sustain attention.

Effect of Comorbid ADHD

It is important to consider the impact of those with comorbid attentional disorders. T-tests revealed that those with comorbid ADHD scored worse than other participants with bipolar disorder when labeling neutral (t = -1.83, df = 10, p = .045) and angry (t = 1.83, df = 10, p = .045) faces. They were not significantly different when labeling fearful faces (t = .44, df = 10, p = 0.34). Given the extremely small sample sizes, Mann-Whitney U tests were conducted to confirm the results, and the findings did not change. Individuals with comorbid ADHD scored significantly worse when labeling neutral (U = 8.0, p = .048) and angry faces (U = 8.0, p = .048), but not fearful faces (U = 15.5, p = 0.46). Both groups scored the same when labeling happy faces. A Repeated Measures ANOVA of performance on the labeling task was then conducted excluding the participants with comorbid ADHD. This revealed that the previously reported main effect of valence (F = 9.49, df = 18, p = .006) and interaction between diagnostic group and valence of the stimuli (F = 4.39, df = 18, p = .05) were still significant, suggesting that affect labeling deficits are present in adolescents without ADHD.

Mood

Correlations were conducted to examine the relationship between clinical measures accuracy and reaction time on novel tasks. For the bipolar patient group, higher CDRS scores were significantly related to faster response times for neutral faces on the Line Scale Task (r_s = -.788, p = .004) and higher YMRS scores were significantly related to faster response times for neutral faces on the labeling task (r_s = -.798, p = .003), though both groups scored similarly with respect to accuracy. There were no other significant correlations among the tasks and clinical measures.

Age

Though the two groups were similar in mean age, correlation showed that age was positively correlated with the neutral-angry condition on the Forced Choice Interpretation task (r_s = .370, p = .045)

Chapter 4

Discussion

This study investigated two components of facial affect processing in adolescents experiencing mixed mood states: labeling of facial expressions and social judgments made on the basis of facial expressions. The results indicate differences in both accuracy of labeling and interpretation response time between healthy and adolescents with bipolar disorder.

Labeling

Relative to healthy participants of comparable age and gender, adolescents with bipolar disorder were mildly deficient in their ability to label emotions in a forced choice format. This relative weakness was found in spite of normal intelligence and normal facial recognition. These results are consistent with previous reports of deficient facial affect recognition in adults (Getz et al., 2003a) and children (McClure et al., 2003; McClure, Treland, Snow, Schmajuk et al., 2005, McClure et al, 2005) with bipolar disorder, although this is the first study to demonstrate such a deficit in individuals experiencing mixed mood states. Further, we found that adolescents with bipolar disorder performed more poorly than controls when asked to label negative emotions (angry and fearful), but not when asked to label positive emotions (happy and neutral), a pattern that has been reported also in manic adults with the disorder (Getz et al., 2003b). There is, however, one conflicting report that euthymic adults have enhanced performance on a different negative emotion, disgust (Harmer, Grayson, & Goodwin, 2002), as such, the present findings may not generalize to all negative emotions.

Because all of the patients in the present sample were in the same mood state (mixed mood state), it is possible that the findings are reflective of a trait-related affective processing difficulty, a state related contribution of mania or depression, or a combination of both state and trait factors. We found that greater depression symptoms were related to faster response time on the Line Scale Task (neutral faces), and greater mania severity was related to faster response time on the Labeling Task (neutral faces), though both groups scored similarly with respect to accuracy. Overall, this would suggest that greater the severity of mood symptoms was associated with faster response time on particular tasks, when labeling or rating neutral faces, rather than a particular state related phenomenon. However, this is limited by the fact that all of the individuals were in a mixed mood state, and so had been experiencing both mood states recently. Previous research in adults can also help to parse apart the effect of mood state, as Getz showed this impairment in labeling in individuals in a manic state, suggesting that the deficits are not related only to depression. Additionally, Lembke & Ketter (2002) showed that adults in a manic state showed impairment in labeling fear and disgust relative to individuals who were euthymic and another group that were diagnosed with BP-II. The manic adults also scored significantly worse than individuals in a euthymic state, and individuals diagnosed with BP-II. This pattern suggests that the impairment is not broadly related to bipolar disorder, but may be related to the presence of mania. Ultimately, our results cannot be generalized to all adolescents with bipolar disorder, and can only be applied to those in a mixed mood state.

Additionally, it is possible that our results could be due in part to the effect of medication, as 8 participants were taking psychotropic medication at the time of assessment. Power was very poor due to the small sample size, however, it was felt it was important to examine this statistically in a cursory way. A t-test comparing the scores of those taking medication and those not taking medication showed that the non-medicated and medicated participants did not score significantly differently from each other (t = -.084, df = 10, p = .465).

Finally, it is possible that certain items were simply poor items and were artificially driving the data. Looking qualitatively at the data, 3 items were found to cause more difficulty for both groups of individuals. Stimuli 3 had 14 total errors, stimuli 5 had 15 total errors, and stimuli 29 had 15 total errors. Thus, 38%- 42% answered these items correctly. As such, it is felt that though these were clearly the most difficult items, they were also not so ambiguous that no one answered them correctly.

Interpretation

Facial affect labeling has been investigated in adults and adolescents with bipolar disorder, and deficiencies have been consistently shown. However, in order to relate this to the psychosocial impairments that such individuals experience it is important to understand how interpretation is impacted by disruptions in labeling. A novel aspect of the present study is the effort to examine interpretation of affective information. The present study did not reveal any significant group differences on either the Forced Choice Interpretive task or the Line-Scale Interpretive task in terms of accuracy, suggesting that the two groups were making similar judgments based on affective information. It is possible that a more difficult task, or a task with a shorter stimulus duration would mirror more closely what these adolescents are experiencing in real life and would be more sensitive to difficulties.

Another consideration is that we did find that overall, on the forced choice task, the most difficult condition for both groups was the neutral vs. angry condition. Though the stimuli are well normed, subjectively, some neutral faces were felt to be relatively poor choices of people to ask for help for reasons other than the valence of emotion they were showing. Thus, it is possible that individuals were rating on a characteristic different than emotion and this could have impacted our results. However, in addition the function of an interpretive task, the line scale task also served as a control measure to provide information about how individuals approached the tasks. The pattern of responses on the line scale task indicates that the tasks worked in the sense that individuals rated the images in a way that was ranked consistent with our expectations. Specifically, they rated happy faces most favorably, and angry faces least favorably. In this way, the line scale has helped to demonstrate that people did not completely dislike the neutral faces, and in general preferred them over angry faces.

Reaction Time

We also considered reaction time for each of the three facial affect recognition and interpretive tasks. Previous research has indicated that speed is an important factor to consider when measuring affect processing (Getz, 2003). Getz showed group differences with respect to response time. Specifically, this study revealed that manic patients may need more time to examine facial affect. Because of this, it was expected that individuals with bipolar disorder would respond more slowly than healthy individuals on all tasks.

Our findings were not consistent with this expectation, as we found that when making interpretive decisions on the line-scale and forced choice tasks, response time for individuals with bipolar disorder was quicker than for healthy individuals. Though these results are not consistent with our hypotheses, the group differences do suggest that individuals with bipolar disorder may process or organize information another way. Perhaps in an interpretive task, where they are not told explicitly to attend to affective information, they tend to act more impulsively.

Thus, even though they ultimately did not make significantly more errors than their healthy counterparts, individuals with bipolar disorder used an approach that was different, and possibly more impulsive. Though this is not consistent with previous findings, such faster response time could have implications for social interactions. Typically, social interactions are quite brief, and information is often conveyed subtly and often only available for fractions of a second (Rubin, Bukowski, & Parker, 2006). In addition, the interaction is often complicated, as information is embedded in long term relationships. Finally, in real life, successful emotional interpretation involves not only monitoring the others' emotion, but also an individual has to successfully monitor and interpret their own emotions (Rubin, Bukowski, & Parker).

Because the interactions are brief, and it is necessary to monitor such a large amount of information, speed and accuracy are felt to both be important components in social competence. Our results show that individuals have greater difficulty labeling negative emotions, and have a tendency to respond more rapidly when making social judgments. Socially, this pattern of difficulties could have serious consequences, such as misunderstandings, in real life situations.

Ultimately, it is known that children who are less competent socially experience rejection by peers, parents and teachers (Parker, 2006). Thus, our findings of group differences on reaction time for social judgments about happy, angry and neutral faces, taken together with research on social competence, suggest a potential contributor to the social dysfunction that such individuals experience.

Implications for Social and Emotional Regulation

Ultimately, these deficits are of interest because they are potentially relevant to the social and emotional regulation difficulties that individuals encounter in daily life (McClure, 2005). It is known that children with mood disorders experience more peer rejection and social difficulty than healthy children (Luby,Todd & Geller, 1996) and that in general, children who are less socially competent experience rejection by peers, parents and teachers (Parker, 2006).

Information from other clinical populations can help to formulate hypotheses about a connection between weaknesses in labeling and social competence. Yeates (2007) indicated that children with TBI display impairments in a number of social-emotional domains, including pragmatic language, understanding of emotions, and theory of mind tasks. Indeed, data from the present study and previous studies have described similar difficulties for individuals with bipolar disorder (Kerr, Dunbarr, & Bentall, 2003; McClure et al., 2005). By understanding the nature of how such affective information is interpreted, a stronger connection can be made to social impairments experienced in daily life. Reaction time data from our study shows a pattern where individuals with bipolar disorder respond more quickly than healthy participants when making social judgments. This suggests that there may be differences in the way that information is processed. Also, understanding the types of errors made when labeling emotions can also provide insight into the connection between labeling performance and social and emotional impairment. Qualitative analysis of our data revealed that often individuals tended to rate negative faces too positively. Indeed, errors such as this could have serious consequences with regard to interpersonal functioning. For example, it is known that social interactions are the building blocks for friendships and often give rise to long-term relationships (Yeates, 2007). A misinterpretation in a brief interaction could have the potential to lead a person to engage in a potentially detrimental relationship.

Design Considerations

This study population had several limitations. First, the participants were a sample of convenience as they were recruited from ongoing clinical trials. This raises the possibility of selection bias. In addition, all bipolar participants had at least one prior hospitalization. This selection bias may limit the generalization of the conclusions because the sample may represent a subgroup of more severely impaired subjects. Also, the number of subjects was relatively small.

A larger sample could have increased our power to find smaller effects as well as given us a more representative group of the population of adolescents with bipolar disorder. Most patients with bipolar disorder were receiving medication.

Additionally, the impact of the presence of comorbid ADHD on performance was also examined. For the labeling task, those with comorbid ADHD scored worse than other participants when labeling neutral and angry but not fearful or happy faces. These findings suggest the possibility that the presence of ADHD adds an additional level of impairment, although labeling deficits existed also in those without comorbid ADHD. Indeed, this notion of "additive" impairment is consistent with previous findings where individuals with bipolar disorder with comorbid ADHD showed executive dysfunction relative to individuals with bipolar disorder in isolation (Warner, 2005).

Another consideration is that presently there are no existing standardized measures of facial affect interpretation. Though the stimuli used have good normative properties with respect to labeling, such data do not exist for interpretation. Given that such measures have no normative backing, it is difficult to draw conclusive interpretations. In addition, these tasks were created from the perspective of adolescents' willingness to approach an individual. Existing literature indicates that social interactions may be characterized as involving actions that bring individuals together (prosocial behaviors), actions that move people against each other (aggression), and actions that isolate individuals (withdrawal) (Lang, 1995). While this task was grounded in this notion of prosocial behaviors, certainly, it is not the only way to capture such information. For example, it may be of interest to ask a question such as, "Could this person be asking for help?" Additionally, questions that relate to aggressive or withdrawal behaviors may also yield further information (Rubin, Bukowski, and Parker, 2006).

Additionally, as we only studied patients with bipolar disorder and health individuals, it is not possible from these data to determine whether our findings are specific to bipolar disorder or, rather, are common to a number of different psychiatric conditions. It is known that not all mental illnesses carry a deficit in affect labeling [e.g. McClure and colleagues have demonstrated that individuals with anxiety do not show deficits in facial affect recognition (McClure, 2003)]; nevertheless, affective processing deficits have been identified in those with schizophrenia and other disorders.

Finally, research on children's social interactions has shown that their behaviors vary depending on the individual with whom they are interacting (Parker et al., 2006). The images used in this study were drawn from an entirely Caucasian adult sample. It is possible that different results would have been obtained if adolescents were rating or interpreting emotion in individuals that were of similar age, rather than adults. Additionally, with respect to race, no individuals rated that they would not approach an individual at all, and the African American participants rated faces as more approachable than Caucasian participants. Further, both groups of participants were comprised of adolescents of varying races. Despite this, it is possible that what was measured relates, in part, to a broader response to the images, and that images that were of more racially diverse individuals and a comparison of adults and children would have yielded different results.

Future Directions

It is not possible to fully explain whether deficits in labeling and interpretation are related to state or trait features based on this data. For this reason, an important future step would be to contrast an additional control group of individuals in a depressed state, as well as adolescents with bipolar disorder who are in a euthymic state to clarify the answers to these questions.

Given deficits in affect labeling, further understanding of the interpretive aspect of emotional facial information is sought. In addition, a greater understanding of the relationship of this interpretation to social dysfunction is also of interest. Building on this study, a model of social competence that incorporates social interactions and social adjustment can help to further bridge the gap between the way that such individuals process affective information and their social outcomes (e.g. Yeates et al., 2007).

Finally, social relationships have been described as compounding or transactional, where people come to expect an adolescent to continue to behave in a certain way, and even in the event of improvement in these skills, global reversal of poor social interactions is difficult (Coie, 1990). For this reason, early intervention is essential. By gaining a better understanding of the nature of the dysfunction, useful and appropriate rehabilitation models or psychosocial treatments can be developed and applied, thereby improving social functioning and the overall quality of life for these individuals.

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