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Behavioral activation, inhibition and mood symptoms in early-onset bipolar disorder

Adrine Biuckians[a,*], **David J. Miklowitz**[a], and **Eunice Y. Kim**[b]

a *University of Colorado at Boulder, USA*

b *University of California, Los Angeles, USA*

Abstract

Background—Hypomania/mania and depression are hypothesized to correspond to high and low expressions of behavioral activation system (BAS) activity, respectively, in bipolar individuals. In contrast, behavioral inhibition system (BIS) activity is hypothesized to regulate anxiety. The aim of the present study was to examine whether self-reported levels of BAS functioning in bipolar adolescents corresponded with levels of concurrent manic and depressive symptomatology. The secondary aim was to investigate whether self-reported BIS levels were associated with self-reported anxiety symptoms.

Methods—Twenty-five adolescents diagnosed with bipolar I, II or not otherwise specified were recruited from a treatment-development study. Adolescents were interviewed using the Depression and Mania Rating Scales of the Kiddie Schedule for Affective Disorders and Schizophrenia and given the Self-Report for Childhood Anxiety Related Disorders. Next, they completed the Behavioral Inhibition/Activation Scales.

Results—Contrary to hypotheses, adolescents with higher BAS levels exhibited less severe concurrent mania symptoms. Furthermore, levels of BAS sensitivity were not associated with concurrent levels of depression. As predicted, BIS scores correlated positively with self-reported anxiety scores. Adolescents reporting higher levels of the motor activity symptoms of mania also reported higher levels of anxiety symptoms.

Limitations—The conclusions are based upon cross-sectional analyses in a small sample.

Conclusions—In bipolar adolescents, mania and depression appear to be independent of self-reported behavioral activation levels. However, mood symptoms in adolescent patients are closely tied to components of anxiety, which may lead to diminished approach behaviors.

Keywords

BAS; BIS; Bipolar disorder; Mania; Anxiety

Over the past several years, considerable research efforts have concentrated on identifying biopsychosocial markers for bipolar disorder in youth. Studies on neurobiology (Chang et al., 2004), pharmacotherapy (Kowatch et al., 2005), psychosocial factors (Craney and Geller, 2003) and psychosocial interventions (Miklowitz et al., 2004) indicate that biological and psychosocial factors conjointly influence the etiology and course of the disorder.

One specific model that integrates biological and environmental factors is the behavioral activation/inhibition system (BIS/BAS) model, developed independently by Depue and Iacono

* Corresponding author. Department of Psychology Campus Box 345 University of Colorado, Boulder, CO 80309-0345, USA. Tel.: +1 303 735 1394; fax: +1 303 492 2967. E-mail address: Adrine.Biuckians@colorado.edu (A. Biuckians)..

(1989) and Gray (1981, 1994). The Behavioral Activation System (BAS) controls appetitive motivation. It is sensitive to cues of reward and the avoidance of punishment and is thought to generate approach-related affect such as desire (Davidson et al., 2000). The system associated with withdrawal behaviors and negative affect is referred to as the Behavioral Inhibition System (BIS). The BIS inhibits behaviors that could lead to punishment or hinder one's motivation to move toward goals and is believed to generate withdrawal-related negative emotions, such as disgust, fear and anxiety.

Depue and Iacono (1989) view depressive and hypomanic/manic phases as extreme and opposite manifestations of BAS activity. Depression is conceptualized as the result of an inactive BAS that fails to produce positive affect or incentive–reward motivation. In contrast, mania is thought to be the outcome of an overactive BAS that produces excessive motor behaviors, reward motivations and heightened levels of affect. Relatively few studies have examined this model directly. Low self-reported BAS levels have been found to correlate with greater concurrent depression severity, and predict poor 8-month outcomes in unipolar depressed samples (Kasch et al., 2002). The link between low BAS levels and depression may be mediated by a lack of positive experiences and expectancies (Beevers and Meyer, 2002). In bipolar I adults, significant relationships have been reported between self-reported BAS scores and manic symptom intensification over time (Meyer et al., 2001).

No studies have examined the roles of BAS or BIS sensitivity in pediatric bipolar samples. We hypothesized that, among bipolar adolescents, high BAS scores would relate to concurrent manic symptomatology, whereas low BAS scores would relate to concurrent depressive symptomatology. In addition, because the function of the BIS is to avoid punishment and harm, we hypothesized that adolescents with high BIS scores would report higher levels of concurrent anxiety symptoms. We examined these hypotheses in a cross-sectional study of bipolar adolescents (n = 25) who were recruited from an ongoing treatment development study.

1. Methods

1.1. Participants

Adolescents were enrolled in a treatment development study of family-focused psychoeducational treatment (FFT) for early-onset bipolar disorder (PI, Miklowitz; MH62555; see Miklowitz et al., 2004). Patients in this study were assigned following an acute episode to open trial FFT (n = 3, study phase I) or randomized to FFT (n = 12, study phase II) or a brief psychoeducational comparison group (n = 10, study phase II). As a part of this larger study, participants were maintained on pharmacotherapy by a study-affiliated psychiatrist. Study selection criteria for this treatment study included a diagnosis of bipolar disorder (I, II or not otherwise specified [NOS]), the occurrence of a manic, hypomanic, depressed or mixed episode within the 3months prior to study entry, and age between 13years, 0month and 17years, 11months. Diagnoses were based on the Kiddie Schedule for Affective Disorders and Schizophrenia, Present and Lifetime Version (K-SADS; Chambers et al., 1985; Kaufman et al., 1997). Bipolar NOS was defined as a distinct period of abnormally elevated, expansive or irritable mood plus two (three if irritable mood only) accompanying DSM-IV symptoms of mania that caused a change in functioning, lasted for at least 1day, and were present for a total of at least 4days in the patient's lifetime (Birmaher et al., 2006). Adolescents were excluded if they met criteria for substance abuse or dependence within the past 3months, had central nervous system diseases or had pervasive developmental disorders. Interrater reliability between 14 raters at the Colorado (N=10) and Pittsburgh (N=4) sites was 81% for item-for-item agreement on the K-SADS depression scale and 76% for the K-SADS mania scale.

Of the 25 participants, 13 (53%) were male (mean age = 14.7+1.5years); 9 (36%) were co-diagnosed with an anxiety disorder, 13 (53%) with attention deficit hyperactivity disorder and 17 (68%) with oppositional defiant disorder.

1.2. Procedures

Adolescents from the treatment study were recruited for participation in an ancillary study of life stress, behavioral activation and mood symptoms. Interested individuals and their parents completed written informed consent documents approved by the University of Colorado's Human Research Committee. The participants completed the assessments at various points during their tenure in the larger treatment study. The mean length of time between entry into the treatment study and participation in the present study was 25.9weeks (S.D. = 23.7). For the present study, self-report measures of BIS/BAS sensitivity were administered once during an in-person interview. The mean length of time between the closest assessment of mood and anxiety symptom measures and the assessment of the BIS/BAS measure was 2.3weeks (S.D. = 4.9).

1.3. Measures

1.3.1. The Depression and Mania Rating Scales of the K-SADS (K-SADS-DRS/MRS)—All adolescents were interviewed using the Depression and Mania Rating Scales of the Schedule for Affective Disorders and Schizophrenia for School-Age Children-Present and Lifetime Version (KSADS-DRS/MRS; Axelson et al., 2003; Kaufman et al., 1997). Interviewers administered the DRS and MRS to each adolescent and one parent in separate interviews. The interviews were used to assess mood symptoms experienced in the prior 3months. In this study, agreement on KSADS-DRS and-MRS ratings among raters was 0.89 and 0.97, respectively (intraclass correlation coefficient).

1.3.2. Self-Report for Childhood Anxiety Related Disorders (SCARED)—All adolescents completed the 41-item SCARED questionnaire (Birmaher et al., 1997) at the time of the mood interview. In this study, the internal consistency of the SCARED was 0.75.

1.3.3. The Behavioral Inhibition/Activation Scales (BIS/BAS)—Upon completing the mood interview and SCARED, adolescents were interviewed using the UCLA Life Stress Interview (Hammen et al., 1989). At the end of this interview, interviewers administered the self-report BIS/BAS scales (Carver and White, 1994), the primary measures of interest for the present study. The BIS scale is composed of seven items and the BAS scale consists of 13 items in total, but within the BAS scale are three subscales: fun seeking (BAS-fun, four items), drive (BAS-drive, four items) and reward responsiveness (BAS-RR, five items). In the present study, the internal consistencies of the subscales ranged from 0.69 (BAS-drive) to 0.83 (BAS total). The three BAS subscales were moderately intercorrelated (*r*'s = 0.45–0.78).

1.4. Statistical analyses

Our primary hypotheses were that scores on the BAS scales, primarily BAS-RR, would correlate positively with mania symptomatology and negatively with depressive symptomatology, as measured by the K-SADS MRS and DRS. Furthermore, we hypothesized that BIS scores would correlate positively with measures of anxiety (SCARED scores). First, we conducted principal component analyses to reduce the number of K-SADS MRS and DRS rating scale items to factor scores. We then conducted bivariate correlations of BIS/BAS scores and these mood symptom factor scores. We also conducted partial correlations of BAS scores with mood symptom scores, controlling for anxiety symptom scores. All tests were conducted using a two-tailed *p*-value of 0.05.

2. Results

2.1. Preliminary analyses

Given that over half of the sample (60%) was not assessed at the time of their immediate involvement in the larger treatment study, mean mania and depressive symptomatology scores were usually subsyndromal, lacking the duration and/or severity criteria required to meet the diagnostic criteria for mania or depression (see Table 1). However, based on these mean symptomatology scores, approximately 28% of sample participants had average elevations above 3 on the KSADS-MRS and 28% had average elevations above 3 on the KSADS-DRS at the time the BIS and BAS measures were administered. Because adolescent bipolar disorder is often characterized by rapid-cycling and mixed episodes (Biederman et al., 2004;Geller et al., 2004), the high correlation between manic and depressive symptomatology ($r = 0.78$, $p<0.001$) in this sample is not surprising.

2.2. Principal component analyses

Our principal component analyses of the K-SADS-MRS, and all subsequent tests using the components, were conducted using data from 22 participants (data were missing for three participants). The first two components displayed eigenvalues greater than one, and the results of the scree test suggested that the first two components were meaningful. We retained only the first two components for rotation. Components 1 and 2 accounted for 68% of the total variance. In interpreting the rotated factor pattern, components with factor loadings of 0.40 or greater were considered to load on a given component. Four items, which illustrated aspects of psychosis, were found to load on the first component, which was subsequently labeled the psychosis component. Three motor activity items loaded on the second factor, which was labeled the mania motor activity component.

On the K-SADS-DRS, the first two components displayed eigenvalues greater than one and scree test results suggested that the first two components were meaningful. Components 1 and 2 accounted for 64% of the total variance. Six items primarily related to internalizing depressive symptoms were found to load on the first component, which was subsequently labeled the depression internalizing component. Three items assessing for suicidality loaded on the second component. Next, we computed factor-based scores for use as our outcome variables. (Means and standard deviations of the factor-based scores are reported in Table 1.)

2.3. Relations between BIS/BAS scores and symptom scores

Correlations of the BIS and BAS scales with K-SADS mania and depression factor-based scores and SCARED scores are presented in Table 2. Contrary to our hypotheses, scores on the BAS-RR correlated *negatively* with the mania motor activity component ($r = -0.54$, $p<0.01$), as did scores on BAS-drive ($r = -0.45$, $p<0.05$). The negative correlation between BAS total scores and mania motor activity component scores approached significance ($r = -0.41$, $p = 0.06$). The BAS subscales were not correlated significantly with either of the K-SADS depression components.

As predicted, the BIS scores were related to SCARED scores ($r = 0.68$, $p<0.001$). BIS scores were also significantly related to the suicidality component of the K-SADS-DRS ($r = 0.54$, $p<0.01$), but not the depression internalizing components or the K-SADS-MRS mania motor components (for both, $p>0.10$).

2.4. Mania motor activity component and anxiety

We reasoned that the negative correlations between the BAS scales (BAS-RR and BAS-drive) and the K-SADS-MRS mania motor activity component might reflect a common association between BAS Scales, K-SADS factor-based scores and anxiety. Higher levels of the K-SADS

mania motor activity component were significantly related to SCARED scores ($r = 0.43$, $p<0.05$). A partial correlation of BAS-RR and the mania motor activity component, when controlling for SCARED scores, was significant and remained negative ($r(19) = -0.59$, $p = 0.005$). Likewise, a partial correlation of BAS-drive and the mania motor activity component, when controlling for SCARED scores, was significant ($r(19) = -0.57$, $p = 0.008$). Finally, a partial correlation of BAS total scores and mania motor activity scores, when controlling for SCARED scores, was significant ($r(19) = -0.51$, $p = 0.02$). Thus, behavioral activation scores were associated with low levels of mania symptoms, even after levels of self-reported anxiety were covaried.

3. Discussion

This study examined the relationships between a self-report measure of the behavioral activation system and concurrent manic and depressive symptoms, and between a measure of the behavioral inhibition system and anxiety symptoms in a small sample ($n = 25$) of bipolar adolescents. We hypothesized that high and low BAS scores would correlate with manic and depressive symptomatology, respectively. We also expected that higher BIS scores would be associated with higher self-reported anxiety symptoms.

Contrary to our hypotheses, we found evidence of high BAS functioning in adolescents with lower mania symptom severity scores. Bipolar adolescents who obtained higher scores on the BAS reward responsiveness and drive subscales had lower severity ratings on the motor-activity-based mania factor scores. These data are inconsistent with findings reported by other investigators (e.g. Meyer et al., 2001) who found that high BAS sensitivity levels predicted an escalation of manic symptoms over time. In addition, we found no evidence for a link between BAS sensitivity and depressive symptomatology in this sample. This, again, is inconsistent with prior research which indicated that low BAS strength is associated with depressed states (Beevers and Meyer, 2002; Kasch et al., 2002).

Our analyses of BIS and anxiety symptomatology supported Quay's (1993) theorized link between BIS and anxiety in adolescents. In this study, bipolar adolescents who obtained high scores on the BIS scale reported higher levels of anxiety symptoms on the SCARED. These data replicate work that has found high levels of BIS sensitivity in individuals reporting high levels of anxiety (Carver and White, 1994; Gray, 1981). They also support the clinical observation that bipolar adolescents are often highly anxious (Birmaher et al., 2002; Masi et al., 2004).

Secondarily, we found that adolescents reporting higher levels of the motor activity symptoms of mania obtained higher scores on the anxiety symptom scale. This link supports previous work that has found high rates of comorbidity between bipolar and anxiety disorders in adult and pediatric samples (Freeman et al., 2002; Masi et al., 2001). Our results may also indicate that mania and anxiety are not truly independent clinical states in juvenile-onset populations. Adolescents with manic symptoms may exhibit symptoms typically associated with anxiety, such as physical agitation and avoidance, more so than classic mania symptoms, such as elation. Likewise, highly anxious bipolar patients may experience racing thoughts, rumination and restlessness, symptoms which may overlap with or be mistaken for mania.

Adolescents reporting higher levels of anxiety and behavioral inhibition also reported higher levels of suicidality in the three months prior to their assessments, as measured by a composite score of the number, medical lethality and seriousness of all reported suicide attempts/gestures reported on the K-SADS-DRS. Our findings extend research which has found that bipolar adults with high levels of anxiety are more likely to exhibit suicidal behavior (Young et al., 1993). They also support the findings of Akiskal et al. (2005) that among adults with unipolar

major depressive disorder, psycho-motor activation and racing thoughts independently predict suicidal ideation. Thus, mood episodes characterized by mixed symptoms may be a risk factor for suicidality among adults and adolescents.

This study did not address whether BIS/BAS levels are stale over time and over clinical state in bipolar adolescents. Our findings may have been compatible with hypothesized linkages between BIS/BAS levels and mood if a greater number of our participants had been in acute clinical states during the BIS/BAS assessments. It remains for future research to investigate whether the relationships we obtained reflect the influences of states versus traits in bipolar adolescents.

The cross-sectional design of this study also prohibited us from examining whether the type of treatment offered (family-focused or brief psychoeducation, both given with pharmacotherapy) differentially affected the associations between BAS levels and mania/depression outcomes. The recruitment for this study was unique in that the type of treatment adolescents received was controlled–they were assigned to a 3-session or 21-session psychosocial treatment protocol. Future research would benefit from taking treatment variables into account and examining whether baseline levels of BIS/BAS interact with treatment type in predicting the course of mood symptoms over time.

Our findings suggest that clinicians need to address symptoms of anxiety directly in their treatment approaches to bipolar teens, including a thorough assessment of whether the mood disorder is comorbid with an anxiety disorder. In addition to pharmacologic interventions, clinicians should consider incorporating traditional anxiety treatments, such as relaxation training, exposure or emotional distress tolerance techniques found in protocols such as dialectical behavior therapy (Linehan, 1993).

Despite the limitations of a cross-sectional design and a small sample size, our study suggests that BAS functioning is inversely related to mania symptomatology among bipolar adolescents. In addition, mood symptoms in adolescent populations may be closely tied to components of anxiety such that the more anxious adolescents report more severe manic symptoms. Taken together, these data suggest that the moods of bipolar adolescents include elements of anxiety which may lead to diminished approach behaviors. Future research should examine whether BIS and BAS functioning in bipolar adolescents represent vulnerability markers that place patients at higher risk for recurrences, and whether the effectiveness of interventions are moderated by baseline levels of BIS or BAS functioning.

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Table 1

Means and standard deviations of study variables

Scale	*M*	S.D.	Range
KSADS-DRS	2.14	0.72	0.90–3.70
KSADS-MRS	2.52	0.95	1.14–4.53
Psychosis component[1]	8.23	3.85	4–18
Mania motor activity component[1]	8.23	4.37	3–17
Depression internalizing component[1]	13.09	6.24	6–25
Depression suicidality component[1]	1.18	2.34	0–7
BIS	19.64	3.83	13–27
BAS total score	41.76	6.22	31–52
BAS-fun	13.40	2.16	9–16
BAS-drive	11.76	2.47	8–16
BAS-RR	16.60	2.60	12–20
SCARED	19.16	13.77	1–53

[1]Component scores represent computed factor-based scores.

Table 2

Correlations between the BIS/BAS scales and depression and mania components and anxiety symptomatology

Measure	BIS	BAS total	BAS-fun	BAS-drive	BAS-RR
Psychosis component	0.07	−0.06	0.04	−0.07	−0.11
Mania motor activity component	0.03	−0.41	−0.03	−0.44*	−0.54*
Depression internalizing component	0.11	−0.16	0.11	−0.26	−0.23
Depression suicidality component	0.54**	0.02	0.01	0.08	−0.05
SCARED	0.68***	0.08	0.17	0.10	−0.05

* $p<0.05$.

** $p<0.01$.

*** $p<0.001$.