Published in final edited form as:

Curr Dir Psychol Sci. 2010 June 1; 19(3): 189–194. doi:10.1177/0963721410370292.

The Role of the Behavioral Approach System (BAS) in Bipolar Spectrum Disorders

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Abstract

Bipolar spectrum disorders are characterized by highs and lows of mood, energy, motivation, cognition, and activity. The behavioral approach system (BAS) dysregulation theory provides an integrated model for understanding psychosocial and biological features of bipolar disorders. The theory emphasizes the role that sensitivity to rewards and goals plays in bipolar disorder. We review theory and evidence for the BAS-dysregulation model of bipolar disorders. We consider whether high BAS sensitivity is a correlate of, vulnerability factor for, and predictor of the course of bipolar spectrum disorders. We also discuss BAS-relevant life events as triggers of bipolar mood episodes. Finally, we address the implications of the BAS model for treatment and prevention of bipolar disorders and suggest directions for further research.

Keywords

bipolar disorder; behavioral approach system; hypomania; mania; depression

Bipolar disorder is both puzzling and fascinating because extreme contrasts in mood and behavior occur within the same individual. At some times, people with bipolar disorder exhibit euphoria, supercharged energy, and excessive goal striving, but on other occasions, they are sad, lethargic, and hopeless. Bipolar disorders form a spectrum of severity (Fig. 1) from the milder Cyclothymia to Bipolar II to full-blown Bipolar I disorder (at least one manic episode; Goodwin & Jamison, 2007). What explains the rollercoaster of highs and lows of mood, energy, interest, and confidence in individuals with bipolar spectrum disorders?

The hypothesized functions of neurobiological systems provide a way to conceptualize associations between personality traits, behaviors, and various forms of psychopathology. One such system, the behavioral approach system (BAS), is thought to underlie incentive motivation and approach behavior (Gray, 1994). Gray posited that the BAS is mediated by a set of interacting brain structures in the central nervous system that process and respond to stimuli associated with reward. Thus, the BAS is hypothesized to be a psychobiological system that integrates approach motivation, personality traits, and behavioral tendencies involved in goal-seeking and reward responsiveness.

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Declaration of Conflicting Interests

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

We suggest that a hypersensitive BAS characterizes individuals with bipolar disorder. We hypothesize that in bipolar disorder, the BAS becomes dysregulated easily and thus is vulnerable to extreme fluctuations in activation and deactivation. Such excessive BAS activation and deactivation results in (hypo)manic and depressive symptoms, respectively.

The BAS: Structure and Function

The BAS regulates approach motivation and goal-directed behavior to attain rewards. It is activated by rewards or goal-relevant cues, which can be either external (presence of a desired goal) or internal (expectancies of goal attainment). BAS activation is implicated in the generation of positive goal-striving emotions such as happiness (Gray, 1994). Recent work also documents an association between anger and BAS activation when goal striving is frustrated (Carver, 2004). The BAS has been linked to a reward-sensitive neural network, which involves dopamine neurons that project between several emotion- and reward-relevant limbic and cortical brain systems (Depue & Iacono, 1989).

According to the BAS-dysregulation model, vulnerability to bipolar disorder is reflected in an overly sensitive BAS that is hyperreactive to relevant cues. Such trait BAS hypersensitivity leads individuals to experience variability in their state levels of BAS activation across situations and over time. When vulnerable individuals experience events involving rewards or goal striving and attainment, we hypothesize that their hypersensitive BAS becomes excessively activated. This leads to (hypo)manic symptoms, such as excessive goal-directed behavior, increased energy, decreased need for sleep, optimism, and euphoria. Alternatively, we hypothesize that, in response to events involving definite failures, losses, or nonattainment of goals, a hypersensitive BAS becomes excessively deactivated, leading to a shutdown of behavioral approach. Consequently, depressive symptoms such as decreased goal-directed activity, decreased energy, loss of interest, hopelessness, and sadness result (Depue & Iacono, 1989; Urosevic, Abramson, Harmon-Jones, & Alloy, 2008). Thus, the BAS-dysregulation theory is a vulnerability–stress model. A hypersensitive BAS is the vulnerability that combines with the experience of BAS-activation or BAS-deactivation life events (the stress), leading to excessive activation or deactivation of approach motivation, respectively. In turn, the excessive BAS activation or deactivation results in (hypo)manic or depressive symptoms (Fig. 2).

Bas-Dysregulation Theory of Bipolar Disorder: Evidence

Are Bipolar Spectrum Disorders Associated With High BAS Sensitivity and Activation?

BAS trait sensitivity and state activation levels have been assessed in three main ways: (a) with self-report questionnaires (e.g., Behavioral Inhibition System/Behavioral Activation System [BIS/BAS] Scales; Carver & White, 1994); (b) with behavioral tasks involving rewards; and (c) with relative left- versus right-sided activation of the prefrontal cortex, as measured by electroencephalography (EEG) in the resting state and in response to rewards. Greater relative left-frontal cortical activation on EEG has been found to reflect higher BAS sensitivity and activation (Coan & Allen, 2004).

Self-report and Behavioral Task Studies—Consistent with the BAS-dysregulation model, individuals with bipolar spectrum disorders or who are prone to (hypo)manic symptoms exhibit significantly higher levels of self-reported BAS sensitivity, as well as greater reward responsiveness on behavioral tasks, than do individuals without mood disorders or not prone to (hypo)mania. Studies of bipolar individuals in a euthymic mood state—a normal mood that is neither depressed nor (hypo)manic—are interesting because they assess BAS sensitivity independently of potential mood state-related biases. Such studies also showed that euthymic individuals with bipolar disorder exhibited heightened

self-reported BAS sensitivity and responsiveness to rewards on a behavioral task. Moreover, BAS sensitivity remains stable across fluctuations in mood state in individuals with bipolar spectrum disorders (Alloy, Abramson, Urosevic, Bender, & Wagner, 2009a; Urosevic et al., 2008).

Cognitive Style Studies—Much research has attempted to identify maladaptive cognitive styles associated with bipolar disorder. Cognitive styles are people's typical patterns of perceiving, interpreting, and reacting to events in their lives. From a BAS-model perspective, individuals with bipolar disorder should exhibit cognitive styles specific to the themes of high drive and incentive motivation associated with high BAS sensitivity. Consistent with this prediction, individuals with bipolar spectrum disorders exhibit cognitive styles as negative as those of unipolar depressed persons, but with unique BAS-relevant characteristics (Alloy et al., 2009b). Specifically, controlling for mood symptoms, euthymic individuals with bipolar disorder showed higher levels of the BAS-related styles of autonomy, perfectionism, goal striving, and self-criticism compared to normal controls. They did not exhibit maladaptive attachment, dependency, and approval-seeking styles typically observed in unipolar depression. Also, controlling for symptom levels, individuals prone to (hypo)mania exhibit overly ambitious goal striving and goal setting, as well as greater cognitive reactivity and positive generalization in response to success experiences (Johnson, 2005).

EEG Studies—EEG studies of resting frontal cortical asymmetry show that bipolar depression is associated with increased relative right frontal activity, whereas mania is associated with increased relative left frontal activity. In the euthymic state, individuals with bipolar disorder typically exhibit increased relative left frontal activity. Consistent with the BAS-dysregulation model, individuals with bipolar spectrum disorders exhibited greater relative left frontal activation to a challenging goal-striving task (unscrambling difficult anagrams) involving rewards, compared with normal individuals (Harmon-Jones et al., 2008).

Is High BAS Sensitivity a Vulnerability for Bipolar Spectrum Disorders?

A powerful way to test whether high BAS sensitivity actually increases vulnerability to bipolar disorder is to use a behavioral high-risk research design. In this design, participants are selected to be at high versus low risk for bipolar disorder based on high versus moderate levels of BAS sensitivity. Then, one can compare the high and moderate BAS groups on their likelihood of exhibiting bipolar spectrum disorders in their lifetimes or in the future. Using this design, high-BAS participants were significantly more likely than moderate-BAS participants to meet diagnostic criteria for bipolar spectrum disorders in their lifetime (50% vs. 8.3%; Alloy et al., 2006). Moreover, among those with no prior history of bipolar disorder, high-BAS individuals were significantly more likely than moderate-BAS individuals to develop bipolar spectrum disorder in the future (15.4% vs. 4.4%; Alloy & Abramson, 2009). This latter finding provides especially strong support for high BAS sensitivity as a vulnerability to bipolar disorder, because it is a truly prospective test, uncontaminated by prior history of bipolar disorder.

Does BAS Sensitivity Affect the Course of Bipolar Spectrum Disorders?

Several studies have examined whether BAS sensitivity, assessed by self-report, cognitive styles, or EEG, predict a worse course of bipolar disorder. Consistent with the BAS-dysregulation theory, controlling for initial bipolar symptoms, higher self-reported BAS sensitivity predicted greater manic symptoms, greater likelihood of relapse with a hypomanic or manic episode, and a shorter time to onset of a new hypomanic or manic episode among individuals with bipolar spectrum disorders over follow-up (see Alloy et al.,

2009a, for review). BAS-relevant cognitive styles of high achievement striving, autonomy, and self-criticism also predicted increases in manic symptoms and onsets of (hypo)manic and depressive episodes among bipolar spectrum individuals over follow-up, controlling for initial symptoms (Alloy et al., 2009b). Moreover, studies of prodromes, the early symptoms and signs that precede the acute clinical phase of an illness, suggest that increased goal-striving versus decreased pleasure/goal-directed activity are important immediate harbingers of impending manic versus depressive episodes, respectively (Alloy et al., 2009a).

Milder disorders in the bipolar spectrum sometimes worsen and progress to more severe disorders over time. Individuals who progressed from Cyclothymia to Bipolar II disorder and from Cyclothymia or Bipolar II to Bipolar I disorder had significantly higher initial self-reported BAS sensitivity than those who did not progress to a worse disorder (Alloy, Abramson, Urosevic, Nusslock, & Jager-Hyman, in press). In addition, Cyclothymic and Bipolar II individuals who progressed to Bipolar I disorder had initially greater resting relative left frontal activation on EEG than did individuals with bipolar spectrum disorders who did not progress to Bipolar I.

Do BAS-Relevant Life Events Trigger Bipolar Mood Episodes?

Environmental factors play an important role in the timing, frequency, and type of bipolar episodes. Negative life events precipitate bipolar depression, whereas both negative and positive events have triggered (hypo)mania. An advantage of the BAS-dysregulation theory is that it predicts the specific types of events that should trigger bipolar mood episodes. (Hypo)mania should be precipitated by BAS-activation events involving goal attainment, goal striving, or anger provocation, whereas depression should be triggered by BAS-deactivation events, such as failures or losses. Consistent with this hypothesis, life events involving attainment of or striving toward a desired goal predicted an increase in manic symptoms or onset of a new hypomanic episode among individuals with bipolar spectrum disorders over follow-up (Johnson et al., 2008; Nusslock, Abramson, Harmon-Jones, Alloy, & Hogan, 2007). Indeed, 42% of undergraduates with bipolar spectrum disorders engaged in goal striving (studying for final exams) developed a hypomanic episode during finals week compared to 4% of individuals with bipolar spectrum disorders not taking exams during the same week. Given that (hypo)mania sometimes presents with irritable mood, it is interesting that anger-inducing events that also activate the BAS, such as goal obstacles or insults, also predict (hypo)manic symptoms. Additionally, much evidence documents failures and losses as triggers of depression. Finally, BAS-activation and BAS-deactivation events combined with self-reported BAS sensitivity or BAS-relevant cognitive styles predict increases in hypomanic and depressive symptoms, respectively, among individuals with bipolar spectrum disorders over follow-up (Alloy et al., 2009a).

What Predicts Impairment Versus Success in Bipolar Spectrum Disorders?

Although bipolar disorder is associated with significant impairment in academic, work, and interpersonal functioning and high levels of substance abuse, paradoxically it is also associated with high levels of accomplishment (Johnson, 2005). Theoretically, high BAS sensitivity should contribute to both impairment and high achievement in bipolar disorder. Thus, consideration of factors that may combine with high BAS sensitivity to determine which outcome predominates is important for prediction and management of bipolar spectrum disorders. Impulsivity, defined as a tendency toward rash, unplanned behavior without reflection, is elevated in bipolar disorders and stable across mood episodes (Swann, Dougherty, Pazzaglia, Pham, & Moeller, 2004). High impulsivity is also associated with poorer adjustment and substance abuse among bipolar individuals (Alloy et al., 2009c). Consequently, we recently examined the additional role of impulsivity in predicting impairment versus success in individuals with bipolar spectrum disorders. Both high BAS

sensitivity and high impulsivity predicted greater substance abuse problems over follow-up in individuals with bipolar spectrum disorders, and both accounted for the association between bipolar disorder and substance abuse in the sample (Alloy et al., 2009c). In a study of academic achievement, we found that participants with bipolar spectrum disorders had significantly worse college grade point averages (GPAs) and more dropped classes and were more likely to withdraw from college than were control participants overall. However, participants with bipolar disorder who were high in BAS sensitivity but low in impulsivity had significantly higher GPAs than those with high BAS sensitivity and high impulsivity or those with low BAS sensitivity regardless of impulsivity levels (Nusslock, Alloy, Abramson, Harmon-Jones, & Hogan, 2008). Thus, when combined with low impulsivity, high BAS sensitivity was associated with higher academic achievement. Finally, high impulsivity also distinguished participants with bipolar spectrum disorders who progressed to Bipolar I disorder from those who did not (Alloy et al., in press).

Clinical Implications of the Bas-Dysregulation Theory

The BAS-dysregulation model suggests directions for improving treatment and prevention of bipolar disorder (Nusslock, Abramson, Harmon-Jones, Alloy, & Coan, 2009). First, given that connections between limbic system and frontal cortex structures involving reward-sensitive dopamine neurons is hypothesized to underlie the BAS, development of new medications targeting the functioning of this neural network may be promising. Second, a BAS-dysregulation perspective may improve the effectiveness of cognitive behavioral therapy used as an adjunct to pharmacotherapy for bipolar spectrum disorders. The cognitive styles of individuals with bipolar spectrum disorders are characterized by perfectionism and extreme goal-striving tendencies, and the prodromes of (hypo)manic and depressive episodes involve increased and decreased goal-directed activity, respectively. Thus, cognitive-behavioral therapists could teach clients with bipolar disorder strategies for recognizing and challenging ambitious goal-setting and increased confidence, on the one hand, and decreased goal-striving and efficacy, on the other hand. This should reduce the likelihood and severity of manic and depressive episodes, respectively. Third, a BAS-dysregulation perspective might also enhance the effectiveness of interpersonal and social rhythm therapy for bipolar disorder. This approach focuses on managing interpersonal stressors that trigger disruption of daily schedules and circadian rhythms (e.g., sleep-wake cycle) and, in turn, mood episodes. Specifically, the BAS model suggests that targeting BAS-relevant events in the achievement domain may be beneficial because such events are also likely to precipitate social and circadian rhythm disruption in individuals with bipolar disorder. Future work might also address the development of strategies for directly reducing BAS hypersensitivity, the proposed vulnerability for bipolar disorder. Finally, it may be possible to identify youth at risk for bipolar disorders using self-report, behavioral, cognitive, and neurophysiological measures of BAS hypersensitivity. One could then intervene early with these at-risk youth to prevent onset or improve the course of an impending disorder (Alloy et al., 2009a).

Conclusions and Future Directions

The BAS-dysregulation theory makes novel predictions about the onset and course of bipolar spectrum disorders. For example, future research should examine whether BAS sensitivity and reactivity, as assessed by self-report, behavioral, cognitive, and neurophysiological indicators, combine with BAS-activation and BAS-deactivation events to predict first onset and recurrences of bipolar manic and depressive episodes, respectively. Other important questions to address are: Does the relative frequency of BAS-activation or BAS-deactivation events in a person's life predict the relative predominance of (hypo)mania versus depression in the course of their bipolar disorder? Does a person's level of BAS

activation prior to the occurrence of a BAS-relevant life event affect the magnitude of their dysregulated response to the event and, thus, the severity and duration of their mood symptoms? What are the neural underpinnings of BAS sensitivity and a dysregulated BAS response to environmental events? And how does high BAS sensitivity develop in childhood? In conclusion, the BAS-dysregulation model of bipolar disorder is promising and warrants further specification and testing.

Acknowledgments

Preparation of this article was supported by National Institute of Mental Health Grants MH52617, MH52662, and MH77908.

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Recommended Reading

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Cyclothymia	Bipolar II Disorder	Bipolar I Disorder
Recurrent Depressive and Hypomanic Symptoms	Major Depression and Hypomanic Episodes	Manic Episode
No Major Depression or Manic Episode	No Manic Episode	Major Depression Episode not necessary for diagnosis

Fig. 1.

The spectrum of bipolar disorders. Severity increases from Cyclothymia to Bipolar II disorder to Bipolar I disorder. Cyclothymia involves recurrent hypomanic and depressive episodes that do not meet diagnostic criteria for mania and major depression, respectively. Bipolar II involves hypomanic episodes and at least one major depressive episode. Bipolar I involves at least one manic episode.

Fig. 2.

The behavioral approach system (BAS) dysregulation model of bipolar disorder. High BAS sensitivity is the vulnerability factor that interacts with stress (BAS-activation-relevant or BAS-deactivation-relevant life events) to lead to excessive BAS activation or deactivation, respectively. Excessive BAS activation or deactivation lead, in turn, to hypomanic or manic or depressive episodes, respectively. In addition, (hypo)manic or depressive symptoms can also increase the likelihood of experiencing BAS-activation and BAS-deactivation life events in the stress-generation portion of the model (see Alloy et al., 2009; Urosevic et al., 2008).