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Behavioral Approach System (BAS)-Relevant Cognitive Styles in Individuals with High vs. Moderate BAS Sensitivity: A Behavioral High-Risk Design

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Abstract

This study used a behavioral high-risk design to evaluate cognitive styles relevant to the Behavioral Approach System (BAS) among individuals at high (n = 171) versus low (n = 119) risk of first onset of bipolar disorder based on BAS sensitivity, a known risk factor for bipolar disorder. Cognitive styles in high-BAS participants paralleled those implicated in bipolar disorder. Linear regressions indicated that individuals with high BAS sensitivity exhibited greater levels of goal striving, positive overgeneralization, rumination on positive affect, depressive brooding, perfectionism, and hypomanic personality. Furthermore, of the cognitive styles, emotion-focused rumination on positive affect mediated the association between BAS sensitivity and current levels of hypomanic symptoms. These results provide evidence that individuals at risk for the development of bipolar disorder have higher levels of BAS-relevant cognitive styles and hypomanic personality than do individuals with lower risk, indicating that these styles are not simply markers of prior (hypo)manic episodes.

Keywords

Behavioral Approach System; hypomania; bipolar disorder; cognitive style; goal-striving

Bipolar disorder (BD) can be a severe and chronic mood disorder that is characterized by periods of depression and mood elevation or irritability, as well as impairment in many areas of functioning (Angst, Stassen, Clayton, & Angst, 2002; Goodwin & Jamison, 2007; Grant et al., 2004; Nusslock, Alloy, Abramson, Harmon-Jones, & Hogan, 2008). BDs form a spectrum of severity from the milder cyclothymic disorder to bipolar II disorder to full-blown bipolar I disorder, and the milder forms sometimes progress to more severe BDs (e.g., Akiskal, Djenderedjian, Rosenthal, & Khani, 1977; Alloy et al., in press-a; Birmaher et al., 2009). The first onset of the adult form of bipolar mood episodes typically occurs in adolescence between ages 15-19 (Alloy, Abramson, Walshaw, Keyser, & Gerstein, 2006a; Kennedy et al., 2005; Kessler, Rubinow, Holmes, Abelson, & Zhao, 1997; Weissman et al., 1996), with an earlier onset indicating greater severity of illness, greater likelihood of progression to bipolar I disorder, and poorer functional outcomes (Alloy et al., in press-a; Perlis et al., 2004). It is therefore important to identify individuals at risk for developing

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bipolar spectrum disorders during this critical adolescent period of onset, as identification might allow for early intervention or prevention strategies to impede the development of these maladaptive outcomes.

The Behavioral Approach System and Bipolar Spectrum Disorders

One theory that has been implicated recently in bipolar disorder is the Behavioral Approach System (BAS) hypersensitivity model (Alloy & Abramson, 2010; Alloy, Abramson, Urosevic, Bender & Wagner, 2009a; Depue, Krauss & Spoont, 1987; Depue & Iacono, 1989; Johnson, 2005; Urosevic, Abramson, Harmon-Jones, & Alloy, 2008). The BAS is a motivational system linked to goal-striving and approach to rewards (Gray, 1991) that is hypothesized to be comprised of specific psychosocial factors and neurobiological systems that may be relevant to bipolar disorder. Individuals with BD are hypothesized to have an overly sensitive BAS that leads to the development of hypomanic/manic symptoms when the BAS is activated and depressive symptoms when the BAS is deactivated. Activation of the BAS is likely to occur in response to events involving goal-striving or attainment, and extreme or prolonged activation may lead to symptoms of mood elevation and potentially to hypomanic or manic episodes (Depue & Iacono, 1989; Fowles, 1993; Urosevic et al., 2008). Deactivation of the BAS may occur in response to failures or non-attainment of goals, which may lead to depressive symptoms such as sadness, anhedonia, lack of energy, and hopelessness (Depue et al., 1987; Fowles, 1988, 1993; Urosevic et al., 2008). Thus, individuals with BAS hypersensitivity are prone to experiencing mood elevation in response to BAS-activating events, and to experiencing depressed mood in response to BAS-deactivating events, fluctuations in mood that are characteristic of BD. In a broader context, the BAS hypersensitivity model suggests a framework for understanding the development of BD through interactions with the environment. Research to understand this underlying system is growing and implicates neurobiological processes that underpin the BAS such as greater left prefrontal cortical activity (e.g., Harmon-Jones et al., 2002) and heightened ventral striatal/orbitofrontal cortex activity in response to reward anticipation (e.g., Nusslock et al., 2011), yet the role of other individual factors that may contribute to this sensitivity is unclear.

Research on the BAS in BD largely has been consistent with the BAS hypersensitivity model. Alloy et al. (2006b) found that individuals high in BAS sensitivity were six times more likely to have a lifetime bipolar spectrum disorder diagnosis than were individuals with moderate BAS sensitivity. Among individuals with BD, BAS hypersensitivity prospectively predicted a shorter time to onset of hypomanic and manic episodes across an average of 33 months of follow-up (Alloy et al., 2008). Additionally, Alloy et al. (in press-a) found that higher BAS sensitivity prospectively predicted progression from diagnosis of cyclothymic disorder to bipolar II disorder, and from cyclothymia or bipolar II to bipolar I disorder. Finally, Alloy et al. (in press-b) found that BAS hypersensitivity also predicted first onset of bipolar spectrum disorders. Together, these findings provide strong support for the BAS hypersensitivity model of bipolar disorder.

Behavioral Approach System-Relevant Cognitive Styles and Bipolar Disorder

Given the empirical support the BAS hypersensitivity model has received in predicting bipolar symptoms and mood episodes, it is important to better understand the characteristics of people with high BAS sensitivity. According to the BAS theory, certain types of cognitive and personality styles may develop as a result of a highly BAS-sensitive temperament (Alloy et al., 2009a, Urosevic et al., 2008), and there is evidence that BAS-

relevant cognitive styles mediate the association between BAS sensitivity and mood episodes in BD (Alloy et al., 2009b).

Recent research has found evidence for cognitive styles characterized by overly-ambitious goal-striving in individuals with BD, consistent with the BAS hypersensitivity model (e.g., Alloy et al., 2009b; Carver & Johnson, 2009; Johnson et al., 2005; Johnson & Carver, 2006; Johnson, Eisner, & Carver, 2009; for a review, see Johnson, 2005). BD individuals also experience increases in confidence after small successes (Eisner, Johnson, & Carver, 2008) and interpret their high moods as a sign that they can accomplish more (Jones et al., 2006), referred to as "positive overgeneralization." Furthermore, BD and risk for BD is associated with the goal attainment-related traits of perfectionism and a need to achieve (Lam, Wright, & Smith, 2004). Finally, previous studies have found higher levels of self-criticism and autonomy, two other BAS-relevant cognitive styles, in individuals with BD compared to healthy controls (Alloy et al., 2009b; Rosenfarb, Becker, Khan, & Mintz, 1988). Cognitive styles characterized by ambitious goal-striving, perfectionism, self-criticism, and autonomy have been shown to prospectively predict increases in manic symptoms in individuals with BD (Francis-Raniere, Alloy, & Abramson, 2006; Lozano & Johnson, 2001), and ambitious goal-striving predicted first onset of bipolar spectrum disorder (Alloy et al., in press-b). Thus, BAS-relevant cognitive styles appear to be highly relevant in predicting the course of illness in individuals with BD.

In sum, previous studies have provided much empirical support for the BAS hypersensitivity theory of BD, but with the exception of Alloy et al. (in press-b), prior studies have either evaluated the theory in samples putatively at risk for BD or in individuals who have already experienced a manic or hypomanic episode. Thus, it is possible that prior work evaluating the BAS theory in samples with BD is not generalizable to individuals who have not yet experienced a manic/hypomanic episode, as having a mood episode might modify people's cognitive styles and/or their behavioral patterns of goal-striving and reward responsivity. Evidence of the association between BAS sensitivity and BAS-relevant cognitive styles in individuals without, but at risk for, BD would allow investigators to identify these styles as potential predictors of first onset of mood episodes, rather than simply as markers of a previous episode.

The Present Investigation

The current study used a behavioral high-risk design to evaluate cross-sectional associations between BAS sensitivity and cognitive and personality styles that were relevant or irrelevant to the BAS. We hypothesized that individuals with high BAS sensitivity, previously shown to be at risk for BD (Alloy et al., in press-b), would report higher scores on BAS-relevant cognitive and personality styles (positive overgeneralization, ambitious goal-striving, rumination on positive affect, self-criticism, autonomy, perfectionism, and hypomanic personality) but not on BAS-irrelevant cognitive styles (rumination on negative affect, sociotropy, dependency, and concerns about others' approval), than individuals with moderate BAS sensitivity. We also hypothesized that these BAS-relevant cognitive styles would mediate the association between BAS status and current levels of hypomanic symptoms. If so, this would suggest that these cognitive styles may help to explain how the BAS impacts mood elevation.

Method

Participants and Procedure

Participants were selected based on a two-phase screening procedure. In Phase I, 9,991 14-19 year olds from the Philadelphia area completed the Behavioral Inhibition System/

Behavioral Activation System (BIS/BAS) Scales (Carver & White, 1994) and the Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ; Torrubia, Avila, Molto, & Caseras, 2001). Participants who scored in the top 15th percentile on *both* the BAS-Total (BAS-T) of the BIS/BAS Scales and the Sensitivity to Reward Scale (SR) of the SPSRQ were classified as the high BAS (HBAS) group, whereas those who scored between the 40th and 60th percentiles on both of these measures were classified as the moderate BAS (MBAS) group.

A random subset of HBAS and MBAS participants were invited to participate in the Phase II screening. Parental consent and adolescent assent were obtained for participants aged < 18, whereas participants > 18 provided their own written consent. At Phase II, 390 participants were administered the mood and psychosis sections of an expanded Schedule for Affective Disorders and Schizophrenia—Lifetime (exp-SADS–L; Endicott & Spitzer, 1978) diagnostic interview by interviewers blind to participants' BAS risk group status. Participants also completed the Beck Depression Inventory (BDI; Beck, Steer, & Garbin, 1988) to assess depressive symptoms and the Altman Self-Rating Mania Scale (ASRM; Altman, Hedeker, Peterson, & Davis, 1997, 2001) to assess hypomanic/manic symptoms.

Based on the Phase II screening, participants were excluded from the final sample if they met Diagnostic and Statistical Manual of Mental Disorders 4th ed. (DSM–IV-TR; APA, 2000) and/or Research Diagnostic Criteria (RDC; Spitzer, Endicott, & Robins, 1978) criteria for any bipolar spectrum diagnosis or a hypomanic or manic episode prior to the date of participation in Phase I of the study. Participants with a lifetime history of any psychotic disorder or who did not speak or read English fluently also were excluded. Twenty-two participants were excluded on the basis of meeting criteria for bipolar spectrum disorder or hypomanic episode(s) prior to completing Phase I, 7 were excluded due to history of psychotic disorder, and 5 were excluded due to poor English ability. An additional 66 eligible participants did not respond to invitations to complete their baseline assessments. The final sample for the present analyses consisted of 171 HBAS and 119 MBAS participants who completed the Time 1 baseline assessment.

At Time 1, participants completed the remainder of the SADS-L, as well as several behavioral tasks and a battery of self-report measures described below. The HBAS and MBAS groups did not differ on the basis of age, gender, or ethnicity (see Table 1). By definition, the HBAS group scored higher than the MBAS group on BAS and SR scores. However, the groups did not differ on BIS scores. Finally, the two groups did not differ on initial BDI scores. Mean BIS/BAS, SPSRQ, BDI and ASRM scores by group are presented in Table 1.

Measures

BAS sensitivity measures—The BIS/BAS Scales (Carver & White, 1994) and SPSRQ (Torrubia et al., 2001) were used to select the HBAS and MBAS groups. The BIS/BAS measure is widely used to assess individual differences in trait sensitivity to threats and rewards. It consists of 20 items on 4-point Likert scales (1 = strongly disagree, 4 = strongly agree), which comprise three BAS subscales and one BIS subscale. The BAS-Total (BAS-T) score, which we used to select the HBAS and MBAS groups, is the sum of all the BAS items. Internal consistencies (α's = .66-.76) and test-retest reliabilities (r's = .59-.69) for the subscales have been found to be satisfactory (Carver & White, 1994). In the present study, internal consistencies of the BAS-T and BIS scales in the Phase I screening sample were α's = .80 and .72, respectively.

The SPSRQ was also used to assess sensitivity to punishment and reward. In contrast to the BIS/BAS items, which focus on generalized sensitivity to punishment and reward, the

SPSRQ includes items focused on sensitivity to specific types of rewards and punishments. The measure is composed of 2 subscales, Sensitivity to Reward (SR) and Sensitivity to Punishment (SP), designed to assess BAS and BIS sensitivity, respectively. Each subscale has 24 "yes" or "no" items. Both subscales have demonstrated good internal consistency, with α's ranging from .75 to .83 and test-retest reliabilities of .87 for the SR scale and .89 for the SP scale (Torrubia et al., 2001). In the present study, α's for the SR and SP scales were .76 and .84, respectively. Numerous studies support the construct validity of the BIS/BAS and SPSRQ measures, including their relation to prefrontal cortical activity (Harmon-Jones & Allen, 1997; Sutton & Davidson, 1997), affect (Heponiemi, Keltikangas-Jarvinen, Kettunen, Puttonen, & Ravaja, 2004; Zinbarg & Mohlman, 1998), and performance on BAS and BIS relevant tasks involving incentives (Kambouropoulos & Staiger, 2004; Colder & O'Connor, 2004). BAS-T and SR scores were correlated (r = .40) in our Phase I sample.

Self-report symptom measures—Depressive symptoms were measured with the Beck Depression Inventory (BDI; Beck et al., 1988) during Phase II screening. The BDI is a 21-item self-report questionnaire that assesses the severity of affective, motivational, cognitive, and somatic symptoms of depression. The BDI has been validated in student samples and has been found to have good internal consistency (α's = .81-.86) and test–retest reliability (r's = .48-.86) in both clinical and nonclinical samples (Beck, Steer, & Garbin, 1988). In the present study's Phase II sample, α = .88.

Symptoms of hypomania/mania were assessed with the Altman Self-Rating Mania Scale (ASRM; Altman et al., 1997) at Phase II. The ASRM is a 5-item self-report measure that assesses inflated self-confidence, talkativeness, elation, reduced need for sleep, and excessive activity. Items are rated on 5-point Likert scales. In a factor analysis, ASRM items loaded onto a single factor (Altman et al., 1997). ASRM scores have been found to highly correlate with both clinical interviews and other measures of mania (Altman, Hedeker, Peterson, & Davis, 2001). In the present study's Phase II sample, α = .75 for the ASRM.

Cognitive style and personality measures—The Willingly Approached Set of Statistically Unlikely Pursuits (WASSUP; Johnson & Carver, 2006) is a 30-item self-report measure designed to assess the cognitive tendency to set highly ambitious, unrealistic, or grandiose life goals. For each item, participants rate their expectations for setting these goals (1 = *no chance I will set this goal for myself*; 5 = *definitely WILL set this goal for myself*). The measure is comprised of 7 factor-analytically derived subscales covering a range of goal domains: Popular fame, idealized relationships with friends, positively impacting world well-being, political influence, idealized family relationships, financial success, creative output and fulfillment of creative goals. Elevated scores on the WASSUP, particularly subscales measuring extrinsically-motivated goals such as desire for popular fame, political influence or wealth, have been correlated with risk for mania and diagnoses of BD (Alloy et al., in press-b; Gruber & Johnson, 2009). Internal consistencies have been acceptable (subscale α's = .58 [Fulfillment] to .88 [Popular Fame]; Johnson & Carver, 2006). In the current study, internal consistencies ranged from α = .58 (fulfillment subscale) to α = .90 (popular fame subscale), and each subscale was considered BAS-relevant.

The Positive Overgeneralization scale (POG; Eisner et al., 2008) assesses the tendency to over-generalize from a given successful experience to broader aspects of life. The scale is composed of three subscales: Lateral generalization from a good outcome in one domain to positive outcomes in other areas of life; Upward generalization to more lofty goals in the same domain; and Social generalization. Possible responses range from 1= *I disagree with the statement a lot* to 4 = *I agree with the statement a lot*. Prior research suggests that the POG, particularly upward generalization, is associated with risk for mania (Eisner et al., 2008), and predicts prospective increases in hypomanic symptoms among individuals with

high BAS sensitivity (Stange et al., in press). Internal consistencies for the subscales in a previous study ranged from α = .51 (social generalization) to .82 (lateral generalization; Eisner et al., 2008). In the current study, α's = .71 for each of the three POG subscales, and each subscale was considered BAS-relevant.

The Dysfunctional Attitudes Scale (DAS; Weissman & Beck, 1978), a 40-item self-report questionnaire, was used to assess dysfunctional beliefs regarding concerns about others' approval and performance expectations. Items are scored on 7-point Likert scales ranging from *totally agree* to *totally disagree.* Two extracted factors (Cane, Olinger, Gotlib, & Kuiper, 1986), Approval by Others (AO) and Performance Evaluation/Perfectionism (PE) were of particular interest in the current study. Consistent with previous research findings (e.g., Alloy et al., 2009b), we considered PE to be a BAS-relevant dimension of dysfunctional attitudes, whereas AO was not considered to be relevant to BAS sensitivity. The DAS as a whole, as well as the PE and AO scales, have demonstrated good construct validity (Alloy et al., 2000; Francis-Raniere et al., 2006). In the current sample, α's for the PE and AO subscales were .89 and .55, respectively.

The Sociotropy-Autonomy Scale (SAS; Beck, Epstein, Harrison, & Emery, 1983) is a 60-item questionnaire designed to assess Beck's (1987) depressive personality modes, Sociotropy and Autonomy. Each item is rated on a 5-point scale (0%, 25%, 50%, 75%, and 100%). Consistent with prior research (Alloy et al., 2009b), we considered autonomy to be BAS relevant, as it assesses value placed on achievement, mobility, and freedom from control. In contrast, as sociotropy measures value placed on attachment and fears of rejection and abandonment, it is not considered to be BAS relevant. The Sociotropy and Autonomy scales have evidenced good internal consistency (α's = .90 and .93, respectively) and high retest reliability (Beck et al., 1983; Zuroff, Mongrain, & Santor, 2004). In the present sample, α's for Sociotropy and Autonomy were .90 and .84, respectively.

The Depressive Experiences Questionnaire (DEQ; Blatt, D'Aflitti, & Quinlan, 1976) is composed of 66 items, rated on 7-point scales (from *strongly disagree* to *strongly agree*), used to measure depressive personality styles hypothesized by Blatt et al. (1976): Dependency, Self-Criticism, and Efficacy. We used only Self-Criticism and Dependency subscales in this study, as the former was found to be BAS relevant, whereas the latter was not (Alloy et al., 2009b). The DEQ has high internal and retest reliability (Blatt et al., 1976; Zuroff, Moskowitz, Wielgus, Powers, & Franko, 1983) and the factors have evidenced good construct validity. In the present sample, α's for Dependency and Self-Criticism were α = . 74 and .80, respectively.

The Responses to Positive Affect Scale (RPAS; Feldman, Joormann, & Johnson, 2008) is a 17-item self-report measure designed to examine ruminative responses to positive affective states. The measure contains three factor-analytically derived scales: Emotion-Focused Rumination, Self-Focused Positive Rumination, and Dampening. The Emotion-Focused and Self-Focused Rumination subscales assess the tendency to intensify positive affect, whereas the Dampening subscale measures the tendency to diminish positive affect. Items were rated on 4-point Likert scales, ranging from *I almost never respond in this way* to *I almost always respond in this way*. All three scales demonstrated acceptable internal consistency (α's ranged from .72-.76; Feldman et al., 2008). Both the emotion-focused and self-focused positive rumination subscales were positively correlated with vulnerability to hypomania in the validation studies (Feldman et al., 2008), and in the present study, both were considered BAS-relevant. In another study, emotion-focused rumination was elevated among persons with a diagnosis of bipolar spectrum disorder, but not depression, whereas the Dampening scale correlated with a history of depression (Johnson, McKenzie, & McMurrich, 2008). In

the present study, all three subscales demonstrated good internal consistency (α's ranged from .76 to .83).

The Reflection and Brooding subscales of the Ruminative Responses Scale (RRS; Treynor, Gonzalez, & Nolen-Hoeksema, 2003) were used to assess the extent to which participants engage in neutrally-focused introspection and "moody pondering," respectively, in response to depressed mood. The measure consists of 5 Reflection and 5 Brooding items scored on 4-point Likert scales (1= *almost never*, 4 = *almost always)*. Brooding has been found to better predict depressive symptoms over time than Reflection (Treynor et al., 2003). Both the Reflection and Brooding subscales have demonstrated good internal consistency (α's = .72, .77) and one-year retest reliability (*r*'s = .60, .62; Treynor et al., 2003). In the present study, the Brooding (α = .78) and Reflection (α = .75) subscales also demonstrated good internal consistency.

The Hypomanic Personality Scale (HPS; Eckblad & Chapman, 1986), a self-report questionnaire, contains 48 true/false items designed to capture an overactive, upbeat, gregarious personality style. In the initial validation study, 78% of individuals who scored two standard deviations above the mean were found to meet diagnostic criteria for bipolar spectrum disorder, whereas no individuals with low scores on the HPS met criteria for bipolar spectrum disorders. The HPS has high internal consistency (α = .87) and good retest reliability over fifteen weeks (*r* = .81; Eckblad & Chapman, 1986). In the present study, HPS showed moderate internal consistency (α = .70), and was considered BAS-relevant.

Diagnostic interview—The exp-SADS–L (Endicott & Spitzer, 1978), a semi-structured diagnostic interview, was used to assess current and lifetime history of Axis I disorders. We expanded the original SADS-L to allow for greater accuracy and reliability in the diagnosis of bipolar spectrum disorders in several ways: 1) additional probes were included to allow for both *DSM-IV* and RDC diagnoses; 2) questions were added to allow for a better understanding of the nuances of episodes as well as the frequency and duration of symptoms of depression, hypomania, mania, and cyclothymia; 3) the order of the questions was altered to maximize the interview's efficiency and comprehension; and 4) sections were appended to assess eating disorders, ADHD, and acute stress disorder; additional probes were added to the anxiety disorder section; and organic rule-out and medical history sections were included. An inter-rater reliability study based on 105 jointly-rated exp-SADS-L interviews yielded κ's > .96 for bipolar spectrum diagnoses. Interviews in the present study were conducted by extensively trained research assistants who were blind to Phase I BAS status. Training consisted of approximately 200 hours of reading and didactic instruction, watching videotaped interviews, role playing, discussing case vignettes, and extensive practice conducting live interviews with supervision and feedback. Consensus *DSM-IV* and RDC diagnoses were determined by a three-tiered standardized diagnostic review procedure involving senior diagnosticians (see Alloy et al., 2008, in press-b for more details).

Statistical Analysis

To compare cognitive styles and personality of the HBAS and MBAS groups, we conducted separate linear regressions with BAS risk group as the predictor variable and each cognitive style and personality as the outcome variables. We then conducted mediation analyses in which each cognitive style or personality that differed between BAS groups was tested individually as a mediator of the relationship between BAS risk group and hypomanic symptoms. Next, we conducted a combined mediation analysis in which all cognitive and personality styles that were significant mediators of this relationship individually were analyzed as mediators in the same model simultaneously. Finally, we evaluated an

alternative hypothesis that hypomanic symptoms would mediate the relationships between BAS risk group and each cognitive style or personality.

Mediation analyses employed a bootstrapping approach (with N = 5000 bootstrap resamples and a 95% confidence interval) to assess the indirect effects (see Preacher & Hayes, 2008). Bootstrapping is a nonparametric resampling procedure that generates an approximation of the sampling distribution of a statistic from the available data. Sampling distributions of indirect effects are generated by taking a sample (with replacement) of size N from the full data set and calculating the indirect effects in the resamples.

To protect against familywise alpha inflation, we used a threshold of $\alpha = .01$ for reporting significant results from the primary analyses.

Results

BAS risk group status significantly predicted symptom scores on the ASRM ($\beta = .13$, $p = .03$, $f^2 = .02$), but not on the BDI ($\beta = .06$, $p = .31$, $f^2 < .01$), such that the HBAS group exhibited higher levels of hypomanic symptoms than the MBAS group.

BAS Risk Group Differences in BAS-Relevant Cognitive Styles

BAS risk group differences in BAS-relevant cognitive styles are presented in Table 2. Overall, results were consistent with our hypotheses. Compared to the MBAS group, the HBAS group exhibited significantly greater levels of Hypomanic Personality, WASSUP Popular Fame, Political Influence, and Financial Success, POG Lateral Generalization, Upward Generalization, and Social Generalization, RPAS Emotion-Focused and Self-Focused Rumination, and DAS Performance Evaluation.[1] These differences were consistent with small-to-medium effect sizes. The BAS risk groups did not differ significantly on SAS Autonomy, DEQ Self-Criticism, and four of the WASSUP subscales including Idealized Family Relationships, Idealized Relationships with Friends, World Well-Being, and Creative Output and Self-Actualization, consistent with previous literature utilizing the WASSUP in individuals at risk for BD (e.g., Gruber & Johnson, 2009; Johnson & Carver, 2006).

BAS Risk Group Differences in Non-BAS-Relevant Cognitive Styles

Next, to evaluate the hypothesis that the BAS risk groups would not differ on cognitive styles hypothesized not to be relevant to the BAS, HBAS and MBAS groups were compared using the same strategy. In general, results were consistent with our hypotheses (Table 2). HBAS and MBAS groups did not differ on RRS Reflective Pondering, SAS Sociotropy, or DEQ Dependency. However, compared to the MBAS group, HBAS participants had significantly greater levels of RRS Brooding.

Mediation of the Association between BAS Risk Group and Hypomanic Symptoms

First, we investigated which of the cognitive styles and personality measures that differed between BAS risk groups mediated the relationship between BAS group and hypomanic symptoms (Table 3). Bootstrapping mediation analyses (Preacher & Hayes, 2008) indicated that Hypomanic Personality, POG Upward Generalization, POG Social Generalization, and RPAS Emotion-Focused Rumination on positive affect each mediated the relationship between BAS group and hypomanic symptoms, suggesting that these cognitive and personality styles might explain the higher level of hypomanic symptoms in the HBAS

[1]Of note, all of these BAS group differences remained statistically significant when controlling for hypomanic symptoms, as well as when controlling for demographic characteristics associated with the cognitive or personality styles.

group relative to the MBAS group. Next, to evaluate which of these four styles best explained the relationship between BAS group and hypomanic symptoms, we entered these styles into another mediation analysis simultaneously. Because Hypomanic Personality is conceptualized as a personality style rather than a cognitive style and shares conceptual overlap with hypomanic symptoms, we report results excluding HPS from this combined mediation analysis. Of the three remaining cognitive styles, RPAS Emotion-Focused Rumination was the only significant mediator of the relationship between BAS group and hypomanic symptoms in the combined analysis.[2]

To test the alternative hypothesis that BAS risk group differences in cognitive and personality styles were due to elevated state levels of hypomanic symptoms, we also tested whether hypomanic symptoms would mediate the relationships between BAS risk group and each cognitive or personality style. Hypomanic symptoms did not significantly mediate any of these relationships, providing evidence that BAS group differences in cognitive and personality styles were not attributable to concurrent hypomanic symptoms (see Table 3).

Discussion

The results of the present study are largely consistent with study hypotheses, and add to the growing body of literature suggesting relationships between BAS sensitivity, BAS-relevant cognitive styles and personality, and bipolar symptomatology. These results suggest that BAS hypersensitivity is related to a distinct set of cognitive and personality characteristics that may confer risk for bipolar symptoms, even in individuals without a history of mania or hypomania. Some of these styles, particularly positive overgeneralization, emotion-focused rumination on positive affect, and hypomanic personality, also explained the relationship between BAS sensitivity and hypomanic symptoms.

As hypothesized, BAS sensitivity was significantly associated with BAS-relevant cognitive styles. Participants in the HBAS group were significantly more likely to exhibit cognitive features consistent with themes of hypomanic personality traits, overly-ambitious goal-striving related to popular fame, political influence, and financial success, positive overgeneralization from success, rumination in response to positive affect, and perfectionism. Importantly, these results indicate that higher BAS sensitivity is associated with these styles prior to the onset of clinically significant hypomanic or manic symptoms, suggesting that they are not simply aftereffects of significant past or current bipolar symptoms.

Study hypotheses regarding mediation were also generally supported. Specifically, the association between BAS risk group status and hypomanic symptoms was mediated by upward positive overgeneralization, social positive overgeneralization, emotion-focused rumination on positive affect, and hypomanic personality. When these cognitive styles (excluding hypomanic personality) were entered into the mediation analysis simultaneously, emotion-focused rumination on positive affect was the only cognitive style that independently mediated this relationship. These styles may drive risk for the development of hypomanic symptoms among individuals with BAS hypersensitivity. This would be consistent with a previous study that found that BAS-relevant cognitive styles mediated the relationship between BAS sensitivity and hypomanic episodes (Alloy et al., 2009b) as well as with a previous study that found that upward positive overgeneralization predicted prospective increases in hypomanic symptoms among HBAS individuals (Stange et al., in press). Importantly, we did not find support for an alternative hypothesis that hypomanic

[2]When HPS was included in the combined mediation analysis with the cognitive styles, it was the only significant mediator of the relationship between BAS risk group and hypomanic symptoms.

symptoms would mediate the relationships between BAS risk group and cognitive and personality styles. This provides further evidence that these cognitive and personality styles may be elevated in individuals at risk for BD, and that these elevations are not simply due to concurrent symptoms of hypomania. Although interesting, these assertions must be tested prospectively before any firm conclusions can be drawn about the temporal sequence of these variables.

There were also noteworthy results that were somewhat unexpected given the hypotheses of the present study. One example is the lack of a significant difference in the severity of depressive symptoms between the High BAS and Moderate BAS groups. This is puzzling to some degree, given that BAS hypersensitivity is thought to confer risk not only to mood elevation, but also to the emergence of depressive symptoms. For example, BAS sensitivity (as measured by the BIS/BAS scales) has been found to predict sadness after frustrative non-reward (Carver, 2004) and initial onset of major depressive episodes among individuals with Cyclothymia or Bipolar NOS (Alloy et al., in press-a). It is possible that differences in depressive symptoms between BAS groups will emerge when the BAS is evaluated in the context of BAS-deactivating life events (Urosevic et al., 2008), which were not assessed in this cross-sectional report.

Another relatively unexpected finding was the significant association between BAS sensitivity and brooding. In the present study, the High BAS group exhibited significantly higher levels of brooding than did the Moderate BAS group. Although brooding – and rumination in response to negative affect more generally – is typically associated with depressive symptoms, previous research indicates that individuals with BD engage in brooding as well (Gruber, Eidelman, Johnson, Smith, & Harvey, 2011), and that negative rumination in these samples can be explained in terms of the depressive symptoms seen in BD (e.g., Johnson et al., 2008). Given that the BAS hypersensitivity model asserts that high BAS sensitivity is associated with increased risk for both (hypo)mania and depression (Urosevic et al., 2008), this result is certainly consistent with the overarching model.

Although the present study exhibits significant methodological strengths in using a behavioral high-risk design, well-validated measures, and a large and diverse sample, there are also several limitations of note. The associations reported here are cross-sectional in nature; thus, the present results do not speak to the prospective relationship between BAS sensitivity, BAS-relevant cognitive styles, and the emergence of bipolar symptoms. Similarly, the present analyses are limited in that the mediational relationships described above are also based on cross-sectional data, and as such, do not represent true temporal mediation analyses. Although hypomanic symptoms did not mediate the relationships between BAS risk group and cognitive and personality styles, future studies could evaluate these relationships with greater clarity by matching participants in each BAS group based on concurrent mood symptoms. An additional limitation of this study relates to the potentially restricted range of scores on measures of cognitive style, many of which were associated with BAS sensitivity, the distribution of which was likely artificially truncated due to the desire to select a group at high risk for BD.

Despite these limitations, these results indicate that BAS hypersensitivity is associated with several specific BAS-relevant cognitive styles prior to the onset of BD, suggesting that many of these cognitive styles are not simply psychological remnants or “scars” related to an individual’s prior experience of hypomanic or manic symptoms. Future research will benefit greatly by testing BAS-relevant cognitive styles as prospective predictors of the onset of BDs. In conducting prospective analyses, the nature of the complex relationships between BAS sensitivity, BAS-relevant cognitive styles, and the emergence of bipolar symptomatology will be further elucidated, and the temporal relationship between these

variables will also be clarified. To that end, the present study is part of an ongoing longitudinal investigation, and participants are being followed closely so that true prospective tests will ultimately be possible.

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Table 1

Demographic Characteristics of the Study Sample

	High BAS (N = 171)	**Moderate BAS (N = 131)**
Age	18.18 (1.40)	17.92 (1.59)
Sex	63.2% Female	71.0% Female
Race	58.8% Caucasian	55.1% Caucasian
	23.5% African American	29.9% African American
	11.2% Asian/Pacific Islanders	11.8% Asian/Pacific Islanders
	1.2% Biracial	1.6% Biracial
	5.3% Other	4.7% Other
Ethnicity	8.0% Hispanic/Latino	6.3% Hispanic/Latino
BIS	19.94 (4.08)	19.68 (3.17)
BAS-T	46.16 (2.68)	38.17 (1.32)
SP	10.59 (5.42)	11.13 (5.33)
SR	18.17 (1.90)	11.62 (1.95)
BDI	7.08 (6.44)	6.07 (6.73)
ASRM	6.23 (3.98)	5.27 (3.59)

Note. Standard deviations are in parentheses. BIS = Behavioral Inhibition System scores from the BIS/BAS Scales; BAS-T = Behavioral Approach System – Total scores from the BIS/BAS Scales; SP = Sensitivity to Punishment scores from the SPSRQ; SR = Sensitivity to Reward from the SPSRQ; BDI = Beck Depression Inventory; ASRM = Altman Self-Rating Mania Scale.

Table 2

BAS Risk Group Prediction of Cognitive Styles

Cognitive Style	ß	*F*	R^2	f^2
HPS	.24	17.98**	.06	.06
WASSUP				
Popular Fame	.22	14.49**	.05	.05
Family	.06	1.11	<.01	<.01
World Well-Being	.03	0.31	<.01	<.01
Political Influence	.17	8.80*	.03	.03
Friends	.08	1.99	<.01	<.01
Financial Success	.21	13.23**	.04	.04
Fulfillment	.07	1.33	<.01	<.01
POG				
Lateral Generalization	.20	11.96**	.04	.04
Upward Generalization	.22	14.81**	.05	.05
Social Generalization	.30	28.28**	.09	.10
RPAS				
Self-Focused	.16	7.52*	.02	.02
Emotion-Focused	.18	9.32*	.03	.03
Dampening	.12	4.24	.01	.01
RRS				
Brooding	.19	10.36**	.04	.04
Reflective Pondering	.06	0.98	<.01	<.01
DAS				
Approval by Others	.12	4.15	.01	.01
Performance Evaluation/ Perfectionism	.20	11.94**	.04	.04
DEQ				
Self-Criticism	.14	6.05	.02	.02
Dependency	.01	0.02	<.01	<.01
SAS				
Autonomy	.11	3.70	.01	.01
Sociotropy	.12	4.12	.01	.01

* $p < .01$.

** $p < .001$.

Note. Each row in Table 2 represents a separate analysis. Positive ß values indicate higher levels of the cognitive or personality style in the HBAS group compared to the MBAS group. HPS = Hypomanic Personality Scale; WASSUP = Willingly Approached Set of Statistically Unlikely Pursuits; POG = Positive Overgeneralization Scale; RPAS = Responses to Positive Affect Scale; RRS = Ruminative Response Scale; DAS = Dysfunctional Attitudes Scale; DEQ = Depressive Experiences Questionnaire; SAS = Sociotropy-Autonomy Scale.

Table 3

Summary of mediation results (5000 bootstrap samples).

Model	Independent variable (*IV*)	Mediating variable (*M*)	Dependent variable (*DV*)	Effect of *IV* on *M* (*a*)	Effect of *M* on *DV* (*b*)	Direct effect of *IV* on *DV* (*c'*)	Indirect effect (*a* x *b*)	Total effect of IV on DV (*c*)
Cognitive/personality style mediation of BAS association with hypomanic symptoms								
1.	BAS Risk Group	HPS	ASRM	4.20	0.17	0.24	0.70**	0.94
2.	BAS Risk Group	WASSUP Popular Fame	ASRM	3.09	0.08	0.71	0.24	0.95
3.	BAS Risk Group	WASSUP Political Influence	ASRM	0.59	0.33	0.73	0.19	0.93
4.	BAS Risk Group	WASSUP Financial Success	ASRM	1.68	0.10	0.78	0.17	0.95
5.	BAS Risk Group	POG Lateral Generlization	ASRM	1.50	0.22	0.62	0.34	0.96
6.	BAS Risk Group	POG Upward Generlization	ASRM	1.88	0.25	0.58	0.47*	1.05
7.	BAS Risk Group	POG Social Generlization	ASRM	2.43	0.22	0.41	0.55*	0.96
8.	BAS Risk Group	RPAS Self-Focused	ASRM	0.88	0.42	0.62	0.37	0.99
9.	BAS Risk Group	RPAS Emotion-Focused	ASRM	1.13	0.40	0.53	0.46*	0.99
10.	BAS Risk Group	DAS Perform Eval/Perfectionism	ASRM	5.69	0.01	0.89	0.05	0.94
11.	BAS Risk Group	RRS Brooding	ASRM	1.34	0.01	0.95	0.01	0.96
12.	BAS Risk Group	POG Upward Generlization	ASRM	1.87	0.16	0.16	0.86	1.02
		POG Social Generlization		2.48	0.07		0.30	
		RPAS Emotion-Focused		1.15	0.34		0.17*	
Alternative mediation hypothesis - Hypomanic symptom mediation of BAS associations with cognitive/personality styles								
13.	BAS Risk Group	ASRM	HPS	0.94	0.81	3.44	0.76	4.20
14.	BAS Risk Group	ASRM	WASSUP Popular Fame	0.95	0.25	2.85	0.24	3.09
15.	BAS Risk Group	ASRM	WASSUP Political Influence	0.93	0.07	0.53	0.06	0.59
16.	BAS Risk Group	ASRM	WASSUP Financial Success	0.95	0.10	1.58	0.06	1.68
17.	BAS Risk Group	ASRM	POG Lateral Generlization	0.96	0.22	1.29	0.21	1.50
18.	BAS Risk Group	ASRM	POG Upward Generlization	1.05	0.30	1.56	0.32	1.88
19.	BAS Risk Group	ASRM	POG Social Generlization	0.96	0.23	2.21	0.14	2.43
20.	BAS Risk Group	ASRM	RPAS Self-Focused	0.99	0.23	0.65	0.23	0.88
21.	BAS Risk Group	ASRM	RPAS Emotion-Focused	0.99	0.28	0.86	0.27	1.13
22.	BAS Risk Group	ASRM	DAS Perform Eval/Perfectionism	0.94	0.12	5.58	0.12	5.69
23.	BAS Risk Group	ASRM	RRS Brooding	0.96	0.01	1.36	0.01	1.34

*Note. Significant indirect effects (mediation) indicated by: $p < .01$

**Note. Significant indirect effects (mediation) indicated by: $p < .001$.

Values in cells are unstandardized regression coefficients. ASRM = Altman Self-Rating Mania Scale; HPS = Hypomanic Personality Scale; WASSUP = Willingly Approached Set of Statistically Unlikely Pursuits; POG = Positive Overgeneralization Scale; RPAS = Responses to Positive Affect Scale; RRS = Ruminative Response Scale; DAS = Dysfunctional Attitudes Scale; Perform Eval = Performance Evaluation.