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Conceptualizing impulsivity and risk taking in bipolar disorder: importance of history of alcohol abuse

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Abstract

Background—Elevated levels of impulsivity and increased risk taking are thought to be core features of both bipolar disorder (BD) and addictive disorders. Given the high rates of comorbid alcohol abuse in BD, alcohol addiction may exacerbate impulsive behavior and risk-taking propensity in BD. Here we examine multiple dimensions of impulsivity and risk taking, using cognitive tasks and self-report measures, in BD patients with and without a history of alcohol abuse.

Methods—Thirty-one BD subjects with a prior history of alcohol abuse or dependence (BD-A), 24 BD subjects with no history of alcohol abuse / dependence (BD-N), and 25 healthy control subjects (HC) were assessed with the Barratt Impulsiveness Scale (BIS) and the computerized Balloon Analogue Risk Task (BART).

Results—Both BD groups scored significantly higher than controls on the BIS. In contrast, only the BD-A group showed impaired performance on the BART. BD-A subjects popped significantly more balloons than the BD-N and HC groups. In addition, subjects in the BD-A group failed to adjust their performance after popping balloons. Severity of mood symptomatology was not associated with performance on either task.

Discussion—The current study supports a primary role of prior alcohol abuse in risk-taking propensity among patients with bipolar disorder. In addition, findings suggest that impulsivity and

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risky behavior, as operationalized by self-report and experimental cognitive probes, respectively, are separable constructs that tap distinct aspects of the bipolar phenotype.

Keywords

alcohol abuse; bipolar disorder; impulsivity; risk taking

Individuals with bipolar disorder (BD) tend to be impulsive and engage in risky behaviors—pleasurable activities with high potential for negative consequences. Indeed, increased risk taking is one of several diagnostic criteria for a manic episode (1). Impulsivity can be conceptualized as a personality trait, characterized by acting quickly and without planning in order to satisfy a desire (2). As such, impulsivity is a complex, multifaceted construct that includes cognitive components, personality / motivational dimensions, and behavioral components; related traits and behaviors include risk taking, sensation seeking, and behavioral disinhibition (3, 4). Among the most popular self-report indices of impulsivity is the Barratt Impulsiveness Scale (BIS) (5), which incorporates three dimensions of impulsivity: attentional, motor, and non-planning. Based on research with this instrument, there is growing evidence that impulsivity is a stable trait characteristic of BD (6) and appears to represent a core feature of the illness (7). Elevated levels of impulsivity have been found in BD patients during manic (8, 9), depressive (10), and euthymic (9, 10) periods. Additionally, increased impulsivity has been linked to a more severe suicide attempt history in BD (11).

Impulsivity and risk-taking propensity are thought to be highly correlated, yet not synonymous, constructs. Elevated levels of impulsivity are often present among those psychiatric disorders characterized by risk-taking behavior (e.g., bipolar disorder, personality disorders, and substance use disorders) (12). In general, impulsivity refers to a predisposition and an overall pattern of behavior, whereas risk taking encompasses specific, situationally determined behaviors that may or may not result from a deficit in impulse control (2). Although risk taking is often part of the clinical presentation of BD, very few studies have formally assessed risk-taking propensity in BD patients. A better understanding of the relationship between impulsivity and risk-taking behavior in BD has implications for the development of appropriate treatment strategies.

Impulsivity and risk taking are also constructs of central importance for addictive disorders. For example, higher levels of impulsivity are seen in early-onset versus late-onset alcoholics (13). Increased impulsivity has also been associated with early experimentation with illicit substances and a high susceptibility to developing substance use disorders (14). One commonly used behavioral measure of risk taking in research related to addictive disorders is the computerized Balloon Analogue Risk Task (BART) (15). Numerous studies have found performance on the BART to be related to self-report of substance use and other risk behaviors (15–19). To our knowledge, this is the first study to apply this task in patients with BD.

An estimated 56% of patients with bipolar I disorder experience alcohol abuse and 38% experience alcohol dependence during their lifetimes (20). There is increasing evidence that alcoholism phenomenologically changes illness presentation in bipolar disorder and can lead

to increased chronicity and symptom severity [see (21) for a review]. Because problems with alcohol use are so common in BD, any conceptualization of impulsivity and risk taking in BD must include an understanding of the effect of comorbid alcohol use disorders. In the current study, we used the BIS and the BART to better conceptualize impulsivity and risk propensity, respectively, in patients with BD with and without a history of alcohol use disorders. Based on the existing literature, we predicted that patients with BD overall would have elevated levels of both impulsivity and risk taking compared to demographically matched healthy control (HC) subjects. Additionally, we expected patients with BD with a history of alcohol abuse or dependence (BD-A) to have exaggerated levels of impulsivity and risk taking compared to their counterparts without a history of alcohol abuse or dependence (BD-N). Further, consistent with the notion that these measures reflect trait dimensions of BD, we predicted that performance would not be related to clinical symptoms.

Methods

Participants

Fifty-five subjects with BD (31 BD-A and 24 BD-N) and 25 HC subjects were recruited. Before participating in the study, all subjects gave written informed consent on forms approved by the University of Texas Health Science Center at San Antonio. Patient diagnoses were established using the Structured Clinical Interview for the DSM-IV-TR Axis I Disorders, Patient Edition (SCID-I / P) (22) by clinical research staff trained to high reliability (intraclass correlation coefficient > 0.90) on this measure. The inclusion criterion for patients was a diagnosis of bipolar disorder (type I, n = 48; type II, n = 7). Exclusion criteria for patients included current alcohol or substance abuse or dependence (in the past six months), history of any medical or neurological condition that might affect cognitive functioning, and / or mental retardation.

Healthy control subjects were free of any Axis I psychopathology as determined by the SCID-I, Non-patient Edition (SCID-I /NP) (23). Control subjects satisfied the same exclusion criteria as patients and were additionally excluded for history of alcohol or other substance abuse or dependence. Demographic characteristics for patients and healthy control subjects can be found in Table 1.

In the BD-A group, 8 subjects (25.8%) were medication free, 3 (9.7%) were taking one medication, and 20 (64.5%) were taking a combination of medications. In the BD-N group, 6 subjects (25%) were medication free, 4 (16.7%) were taking only one medication, and 14 (58.3%) were taking a combination of medications. Further information regarding mood state, medication status, and clinical course for bipolar patients can be found in Table 1.

Assessment procedures

Barratt Impulsiveness Scale—The BIS is a 30-item self-report measure of impulsivity which includes three subscales: Attentional (problems related to concentrating / paying attention), Motor (fast reactions and / or restlessness), and Non-planning (orientation toward the present rather than to the future). The BIS has excellent psychometric properties (5).

Additionally, being one of the most commonly used measures of impulsivity, its use facilitates comparison with other research.

Balloon Analogue Risk Task—The BART is a computerized measure of risk taking. During each of 30 trials, subjects pump up a balloon, earning one point for each pump, but losing all collected points if the balloon pops. Subjects receive the following instructions:

> You will be shown some balloons. Your job is to blow up each balloon, taking care not to pop it. Touch the word 'pump' to fill the balloon. Each time you pump up the balloon, you get a point. You can pump up the balloon as much as you want, but at some point it will pop. If the balloon pops you don't get to keep the points you earned for that balloon. At any point, you can touch the word 'stop' and receive all of the points from that balloon and start another one.

There are no practice trials; subjects do not have the opportunity to evaluate risk (propensity for popping) before the task begins. Outcome measures include the total number of times a balloon was popped during the task and the total number of times balloons were pumped on trials where the balloon did not pop (adjusted pumps). In young adult samples, performance on the BART is associated with self-report of real-world risk behaviors, including alcohol and other substance use, cigarette smoking, number of different sex partners in the past year, and stealing (15, 18, 24).

Patients were classified as remitted, depressed or (hypo)manic based on symptom ratings from the Hamilton Depression Rating Scale [HAM-D (25); remitted, score < 10] and the Young Mania Rating Scale [YMRS (26); (hypo)mania, score ≥20; remitted, score < 10] based on previously published cutoff scores (27).

Statistical analyses

Statistical analyses were conducted using SAS 9.1 (SAS Institute, Cary, NC, USA) and Statistical Package for Social Sciences 14.0 (SPSS, Inc., Chicago, IL, USA), in order to examine group differences on the BART and BIS between BD patients and HC subjects. Prior to analyses, all variables were found to conform to normality (Shapiro-Wilk test, $p < 0.01$). BIS data were analyzed with a 3 × 3 MANOVA, testing main and interactive effects of diagnostic group (BD-A, BD-N, HC) and impulsivity scales (Non-planning, Motor, and Attentional). Significant main effects or interactions ($\alpha < 0.05$, two tailed) were decomposed with single degree of freedom between group contrasts.

Two separate BART indices were examined: the total number of pops and the number of adjusted pumps (number of pumps on balloons that did not pop). Each of these variables was modeled in a 3 × 1 ANOVA where significant main effects were examined with between-group *F*-tests. To examine the extent to which an individual altered his or her behavior after negative feedback (i.e., degree of learning), the average number of adjusted pumps after unpopped and popped balloons was examined with a 3 × 2 repeated-measures MANOVA. Learning was demonstrated by an adjustment in behavior (pumping less) after popped balloons. Performance on the first trial was eliminated from this analysis because it was not possible to evaluate learning behavior for this trial.

Pearson correlations were conducted to examine the relationship between depressive (HAM-D) and manic (YMRS) symptomatology and performance on the BIS and the BART. Additionally, patients were grouped categorically [e.g., euthymic, depressed, and (hypo)manic / mixed] to determine whether mood state was associated with degree of risk taking or impulsivity. Finally, Pearson's correlations were calculated to evaluate the relationship between the three subscales of the BIS and performance on the BART.

Results

The BD-A, BD-N, and HC groups did not differ in terms of age ($p = 0.36$), full-scale IQ ($p = 0.33$), or race ($p = 0.25$) (see Table 1). Consistent with epidemiological research (28), females were over-represented in the BD-N group ($p = 0.06$). Therefore, all analyses were run with and without gender as a covariate. As has been reported previously (29), control subjects had slightly higher levels of education ($p = 0.05$) than either patient group. However, because IQ was similar between groups and education was not significantly correlated with BIS or BART performance (all $p > 0.2$), education level was not introduced as a covariate. HAM-D, YMRS, and Global Assessment of Functioning (GAF) scores did not differ between BD-A and BD-N patient groups (see Table 1). Similarly, the distribution of medication usage between patient groups did not significantly differ.

Impulsivity

Between-group differences were found for all three subscales of the BIS: Non-planning ($F = 21.31$, $p < 0.0001$), Motor ($F = 32.49$, $p < 0.0001$), and Attentional ($F = 20.12$, $p < 0.0001$). Post hoc analysis revealed that both BD groups scored higher than the HC group on all three subscales. Although the BD groups did not differ from each other on the Non-planning and Attentional subscales, the BD-A group scored higher than the BD-N group on the Motor subscale ($F = 4.58$, $p = 0.04$). (See Table 2)

Risk taking

Between-group differences were found in the number of pops on the BART ($F = 4.48$, $p = 0.01$), suggesting group differences in risk-taking behavior. Post hoc analysis revealed that the BD-A group popped significantly more balloons than both the HC ($F = 5.92$, $p = 0.02$) and the BD-N groups ($F = 6.96$, $p = 0.01$). In contrast, there were no differences between the BD-N and HC groups for number of balloons popped ($F = 0.05$, $p = 0.83$). (See Table 2)

There were no significant between-group differences on the number of adjusted pumps on the BART ($F = 1.36$, $p = 0.26$). However, there was evidence for a learning effect on BART-adjusted pumps, with a main effect for previous pop ($F = 41.75$, $p < 0.0001$). Although there was not a significant main effect of diagnostic group ($F = 2.06$, $p = 0.13$), there was a diagnostic group by previous pop interaction ($F = 3.58$, $p = 0.008$). Within-subject subtraction scores (no previous pop – yes previous pop), which index changes in behavior after a pop trial, differed between groups. Specifically, the BD-A group did not exhibit learning behavior, pumping the same amount when the previous balloon popped as when it did not pop [mean subtraction score (SD) = 0.88 (4.2), $t = 1.15$, $p = 0.26$]. In contrast, the BD-N and HC groups adjusted their behavior and pumped less on trials

preceded by a popped balloon [BD-N: 3.50 (3.7), $t = 4.62$, p = 0.001; HC: 3.12 (3.8), $t = 4.05$, p = 0.0005]. (See Table 2 and Fig. 1)

Association with mood state

For the most part, the affective symptomatology ratings and the impulsivity and risk-taking measures were not correlated. An exception is the Attentional subscale of the BIS, which was correlated with the HAM-D ($r = 0.31$; p = 0.02) and correlated at a trend level with the YMRS ($r = 0.26$; p = 0.06). However, when corrections for multiple comparisons were applied (Bonferroni), these correlations were no longer significant. In addition, when the bipolar sample was divided into euthymic, depressed, and (hypo)manic subgroups, groups did not differ in scores on the BIS subscales or performance on the BART (p = 0.10 to 0.91).

Relationship between impulsivity and risk taking

Only the Motor subscale of the BIS was significantly related to number of pops on the BART ($r = 0.41$, p = 0.001). BART pops were not significantly associated with the BIS Non-planning ($r = 0.20$, p = 0.09) or Attentional ($r = 0.15$, p = 0.19) subscales. Additionally, BART-adjusted pumps ($r = 0.27$, p = 0.02) were significantly related only to the Motor subscale, not the other BIS scales. Similar patterns were found for the ‘no previous pop’ and ‘yes previous pop’ adjusted pumps measures.

Discussion

The most striking finding of this study is that the behavioral measure of risk-taking propensity, the BART, was sensitive to prior history of alcohol use disorder among bipolar patients, whereas performance on the self-report measure of impulsivity, the BIS, was sensitive to bipolar disorder status alone. The notable exception is the Motor subscale of the BIS, which was sensitive to both diagnostic status and history of alcohol abuse. As this scale was the only dimension of the BIS that correlated with task performance on the BART, this pattern of findings suggests that motor impulsivity (i.e., impetuous responding) represents a distinct component of impulsivity that is particularly characteristic of bipolar patients who develop alcohol use disorders.

Another important finding is that the BD-A group uniquely failed to exhibit learning behavior on the risk-taking task. Unlike healthy controls and BD patients with no alcohol disorder history, the subjects in this group did not alter their behavior based on a negative consequence (popped balloon) on the previous trial. Although it is difficult to determine the temporal relationships between substance abuse and bipolar disorder (30), here the effects of substance abuse appeared related to past rather than current substance abuse, as none of the subjects in this study met criteria for a substance abuse disorder at the time of testing. Taken together, these results support previous research finding increased levels of impulsivity in patients with BD (6, 9) and further suggest that risk-taking propensity may be elevated only among patients with a history of alcohol use disorders.

Association with mood

Clinical presentation was not related to the Motor or Non-planning subscales of the BIS or performance on the BART. Additionally, patients in different mood states performed similarly on the impulsivity and risk-taking measures. Overall, these findings suggest that impulsivity is elevated in BD independent of symptom severity or mood state, and support previous research conceptualizing impulsivity as a stable feature of the illness (6). Additionally, the results do not support elevated risk taking as characteristic of bipolar patients in general. Here, risk-taking behavior was uniquely elevated in bipolar subjects with a history of alcohol abuse and was not related to mood state. These findings are consistent with a prior study (8) which found that performance on a laboratory-based measure of rapid-response impulsivity, the Immediate Memory–Delayed Memory task, was impaired in nonsymptomatic bipolar patients only if a history of substance abuse was present.

Bipolar disorder and substance use disorders

There is a growing body of literature addressing the relevance of co-occurring alcohol use to outcome in bipolar spectrum disorders. Comorbid alcohol abuse has been associated with increased symptom severity and suicidality, higher rates of mixed mania and rapid cycling, increased novelty seeking and aggression, treatment noncompliance, lower response rates to lithium, and higher rates of relapse (21, 31). Some investigators have proposed that impulsivity, as a prominent feature of both bipolar disorder and substance abuse, may have behavioral and biological substrates that contribute to the overlap between the two disorders (8). Our results suggest that laboratory measures of risk-taking propensity may be able to distinguish between bipolar patients with and without a past history of alcohol use disorder.

Clinical implications

The current study suggests that impulsivity is a core feature of bipolar disorder that is elevated regardless of mood state or alcohol abuse history. Impulsivity may be important to assess in clinical settings, as patients with high trait impulsivity are at increased risk for suicide attempts (11), and more impulsive individuals with bipolar disorder are likely to be more susceptible to substance abuse problems (32).

Elevated risk taking causes a number of problems for patients with BD. The finding that patients with comorbid alcohol abuse failed to adjust their behavior after negative feedback suggests that this patient group may be particularly likely to repeat behavior despite negative consequences. These patients may have an inaccurate perception of risk, and risk appraisal may be an appropriate treatment focus.

Limitations

Non-bipolar individuals with a history of alcohol abuse or dependence would constitute an important comparison group in order to better understand the unique and shared predictors of performance on these measures of impulsivity and risk-taking propensity. Additionally, the study would be strengthened by the inclusion of information regarding the severity and duration of alcohol use in the BD-A group. Unfortunately, that level of detailed information was not available for the majority of subjects in this sample. Although females were over-represented in the BD-N group, covarying for gender did not change any of the results.

Additionally, males and females did not perform differently on any of the outcome measures. Although education levels were lower in the patient groups relative to the healthy controls, education was not significantly correlated with BIS or BART performance (all $p > 0.2$). It is important to note that subjects were not excluded for disorders that may affect impulsivity and risk, such as attention-deficit hyperactivity disorder, impulse control disorders, and personality disorders. Analyses involving mood state should be interpreted with caution due to the small number of (hypo)manic patients in the current study.

Conclusions

The central goals of this study were to assess the complex relationship between impulsivity and risk-taking propensity in BD and the effect of a history of comorbid alcohol abuse on these constructs. This study supports a primary role of history of alcohol abuse in risky behavior among patients with BD, as we found elevated risk taking, as assessed by a laboratory measure of risk-taking propensity, only in bipolar patients with a history of alcohol abuse. Additionally, these subjects alone failed to learn from negative consequences of their behavior. In contrast, self-reported impulsivity was elevated for all bipolar patients, regardless of alcohol abuse history. Although preliminary, these results support the conceptualization of impulsivity and risk taking as distinct yet related constructs, each with a qualitatively different relationship to alcohol use disorder and BD. Further research with larger samples, a more comprehensive characterization of alcohol abuse history, and careful control of medication status is warranted. In addition, prospective longitudinal research will greatly advance our understanding of the temporal relationship between these often co-occurring illnesses, and lead toward the development of a better model of the complex inter-relationships between mood, alcohol use, impulsivity, and risk propensity.

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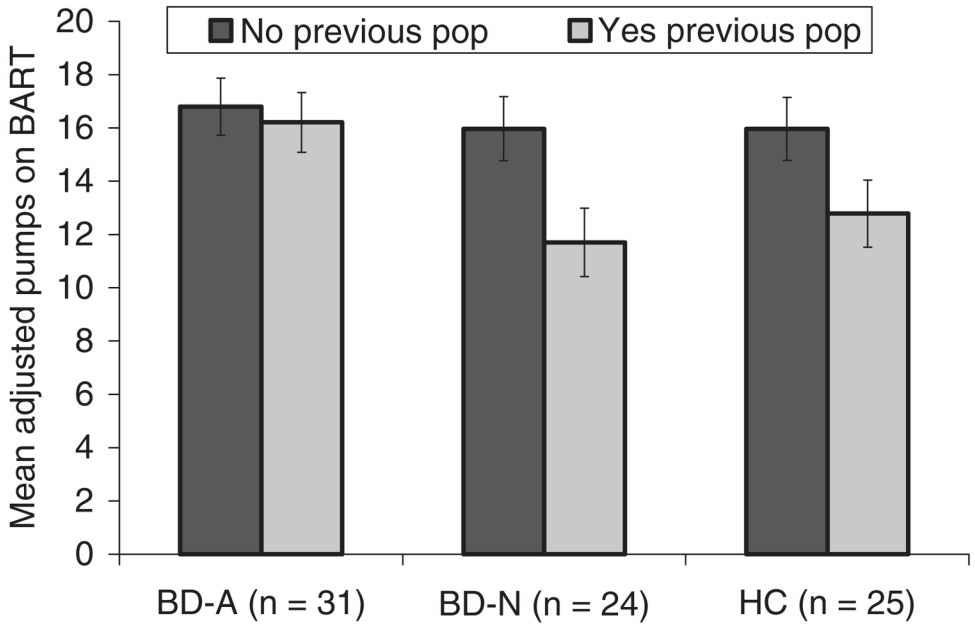

Fig. 1.

Learning effect for the Balloon Analogue Risk Task (BART): adjusted pumps when previous balloon did not pop (‘no previous pop’) and when previous balloon did pop (‘yes previous pop’). BD-A = bipolar disorder with history of alcohol abuse / dependence; BD-N = bipolar disorder with no history of alcohol abuse / dependence; HC = healthy controls.

Table 1

Demographic characteristics of the sample

	BD-A (n = 31)	BD-N (n = 24)	HC (n = 25)	Statistics
Demographics				
% Female	48.4%	79.2%	56.0%	$\chi^2 = 5.58$, p = 0.06
Age (years), mean (SD) [range]	42.4 (10.4) [21–59]	39.5 (12.4) [21–63]	38.3 (10.5) [21–60]	$F = 1.05$, p = 0.36
Years of education, mean (SD) [range]	14.0 (2.0) [9–19]	13.8 (3.0) [9–22]	15.4 (2.5) [11–21]	$F = 3.13$, p = 0.05[a]
Race, n (%)				$\chi^2 = 5.35$, p = 0.25
Hispanic / Latino	8 (25.8)	7 (29.2)	11 (44.0)	
Non-Hispanic White	21 (67.7)	12 (50.0)	11 (44.0)	
Other	2 (6.5)	5 (20.8)	3 (12.0)	
Full scale IQ, mean (SD) [range]	105.6 (9.5) [86–123]	102.1 (12.5) [80–123]	106.4 (10.4) [79–117]	$F = 1.11$, p = 0.33
BD type I, n (%)	29 (93.5%)	19 (79.2%)		$\chi^2 = 2.52$, p = 0.11[b]
Current symptomatology				
HAM-D score, mean (SD) [range]	13.2 (8.7) [2–28]	12.4 (8.4) [0–31]		$F = 0.02$, p = 0.88[b]
YMRS score, mean (SD) [range]	8.0 (7.3) [0–26]	6.7 (6.5) [1–22]		$F = 0.43$, p = 0.51[b]
GAF score, mean (SD) [range]	61.6 (15.8) [37–83]	60.7 (14.3) [35–87]	90.7 (4.0) [80–98]	$F = 48.3$, p < 0.001[c]
Mood state, n (%)				$\chi^2 = 0.26$, p = 0.88[b]
Remitted	14 (45.2)	10 (41.7)		
Depressed	15 (48.4)	13 (54.2)		
(Hypo)manic	2 (6.4)	1 (4.1)		
Medications, n (%)				
Antidepressant(s)	8 (25.8)	7 (29.2)		$\chi^2 = 0.19$, p = 0.66[b]
Mood stabilizer(s)	11 (35.5)	8 (33.3)		$\chi^2 = 0.75$, p = 0.39[b]
Antipsychotic(s)	16 (51.6)	12 (50.0)		$\chi^2 = 0.01$, p = 0.92[b]

BD-A = bipolar disorder with history of alcohol abuse / dependence; BD-N = bipolar disorder with no history of alcohol abuse / dependence; HC = healthy controls; HAM-D = Hamilton Rating Scale for Depression; YMRS = Young Mania Rating Scale; GAF = Global Assessment of Functioning.

[a] Note that similar numbers of subjects finished high school and college for each group.

[b] BD-A versus BD-N.

[c] HC > BD-A, BD-N.

Table 2

Raw data and statistics for the Barratt Impulsiveness Scale (BIS) and the Balloon Analogue Risk Task (BART)

	BD-A (n = 31)	BD-N (n = 24)	HC (n = 25)	Omnibus effects	Post hoc analysis
BIS Non-planning	30.90 (4.6) [21–40]	29.04 (4.6) [19–37]	23.32 (4.0) [16–32]	$F = 21.31$, $p < 0.0001$	BD-A, BD-N > HC ($p < 0.0001$)
BIS Motor	27.74 (4.9) [19–39]	25.3 (3.9) [17–36]	18.92 (3.3) [13–23]	$F = 32.49$, $p < 0.0001$	BD-A, BD-N > HC ($p < 0.0001$) BD-A > BD-N ($p = 0.04$)
BIS Attentional	21.74 (4.2) [13–32]	21.61 (3.1) [16–26]	16 (3.6) [10–25]	$F = 20.1$, $p < 0.0001$	BD-A, BD-N > HC ($p < 0.0001$)
BART pops	9.45 (3.3) [2–16]	7.33 (2.8) [1–13]	7.52 (2.5) [2–11]	$F = 4.48$, $p = 0.01$	BD-A > HC ($p = 0.02$) BD-A > BD-N ($p = 0.01$)
BART pumps	16.03 (6.8) [6–36]	13.47 (5.4) [5–30]	14.39 (5.0) [7–25]	$F = 1.36$, $p = 0.26$	
No previous pop	17.28 (6.6) [7–33]	15.50 (6.5) [7–37]	16.42 (5.7) [8–29]	$F = 0.54$, $p = 0.58$	
Yes previous pop	16.41 (7.5) [7–39]	12.00 (5.6) [5–27]	13.3 (5.3) [5–28]	$F = 3.54$, $p = 0.03$	BD-A > HC ($p = 0.07$) BD-A > BD-N ($p = 0.01$)

All values are indicated as mean (SD) [range].

BD-A = bipolar disorder with history of alcohol abuse / dependence; BD-N = bipolar disorder with no history of alcohol abuse / dependence; HC = healthy controls; pumps = average number of pumps from non-pop trials (adjusted pumps).