A profile approach to impulsivity in bipolar disorder: the key role of strong emotions

Muhtadie L, Johnson SL, Carver CS, Gotlib IH, Ketter TA. A profile approach to impulsivity in bipolar disorder: the key role of strong emotions.

Objective: Bipolar disorder has been associated with elevated impulsivity – a complex construct subsuming multiple facets. We aimed to compare specific facets of impulsivity in bipolar disorder, including those related to key psychological correlates of the illness: reward sensitivity and strong emotion.
Method: Ninety-one individuals diagnosed with bipolar I disorder (inter-episode period) and 80 controls completed several well-validated impulsivity measures, including those relevant to reward (Fun-seeking subscale of the Behavioral Activation System scale) and emotion (Positive Urgency and Negative Urgency scales).
Results: Bipolar participants reported higher impulsivity scores than did controls on all of the impulsivity measures, except the Fun-seeking subscale of the Behavioral Activation System scale. Positive Urgency – a measure assessing the tendency to act impulsively when experiencing strong positive emotion – yielded the largest group differences: $F_{(1,170)} = 78.69$, $P < 0.001$, partial $\eta^2 = 0.316$. Positive Urgency was also associated with poorer psychosocial functioning in the bipolar group: $\Delta R^2 = 0.24$, $b = -0.45$, $P < 0.001$.
Conclusion: Individuals with bipolar I disorder appear to be at particular risk of behaving impulsively when experiencing strong positive emotions. Findings provide an important first step toward developing a more refined understanding of impulsivity in bipolar disorder with the potential to inform targeted interventions.

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Significant outcomes

- Participants diagnosed with bipolar I disorder reported substantially higher Positive Urgency scores than did controls. Within the bipolar group, higher Positive Urgency scores were associated with poorer psychosocial functioning.

Limitations

- Cross-sectional design.
- Reliance on self-report measures of impulsivity.
- Psychosocial functioning assessed using the Global Assessment of Functioning scale.

Introduction

Bipolar I disorder is an episodic illness characterized by extreme shifts in mood, energy, and functioning. It is associated with high rates of suicide (1) and is the sixth leading cause of disability worldwide (2). Frequent episode recurrence remains common even with the best available medications (3), underscoring the need for more effective adjunctive psychosocial treatments. A better understanding of the psychological risk factors and concomitants of this illness is essential to developing such treatments and improving wellbeing.

Impulsivity is a feature of many psychiatric disorders and influences a number of important outcomes, including social adjustment (4), occupational functioning (5), and quality of life (6). There are several reasons to think that impulsivity is especially relevant to bipolar I disorder. First, impulsivity is one of the criteria for diagnosing a manic episode (i.e., 'excessive involvement in pleasurable activities that have a high potential for painful consequences' (7, p. 362)) and gives rise to some of the most disruptive behaviors that can occur during manic episodes, such as unrestrained spending, sexual indiscretions, and embarking on risky financial ventures. Second, impulsivity is strongly related to manic symptom severity (8–10). Finally, research suggests that elevated impulsivity predicts the onset of bipolar disorder (11, 12) and is associated with a more severe illness course (13, 14).

Several authors have highlighted that impulsivity is not a unitary construct, but subsumes multiple, statistically distinguishable facets (15, 16). For example, the three higher-order subscales of the widely used Barrett Impulsiveness Scales assess the overlapping but separable facets of Attentional, Motor, and Non-planning impulsivity (17). Similarly, the Fun-seeking subscale of the Behavioral Activation Scale (18) is highly correlated with other measures of impulsivity, but has specificity for measuring trait-like tendencies to pursue novelty and reward with little regard for potentially painful consequences (19–22). More recently, two factor analytically derived scales were developed to measure trait-like tendencies to act impulsively when experiencing strong emotion: the Positive Urgency (23) and Negative Urgency (16) scales assess tendencies to act impulsively when experiencing strong positive and strong negative emotions, respectively. These forms of impulsivity also have differential predictive validity for a range of important behavioral and psychiatric outcomes (23–26).

A considerable number of studies have assessed impulsivity in bipolar disorder during both symptomatic and euthymic phases of the illness (9, 10, 27, 28). Taken together, these studies suggest that impulsivity is consistently elevated during mania. Findings during inter-episode periods are more mixed, however, leaving open the possibility that impulsivity is not relegated to symptomatic periods, but remains elevated during euthymia.

Bipolar disorder has been robustly linked to reward sensitivity (29–32) and to intense emotional experiences (33, 34), as well as difficulties regulating emotion (35, 36). Early results from studies in analog samples suggest reward and strong emotion may also represent important preconditions for impulsivity in bipolar disorder. Specifically, elevated scores on the Behavioral Activation System (BAS) Fun-seeking scale have been reported among people at putative risk for bipolar disorder (37) and among those diagnosed with bipolar spectrum disorder (11, 31, 38). People at high risk for mania also endorse experiencing heightened impulsivity when in the throes of strong emotion (39). Based on these preliminary findings, we hypothesized that individuals diagnosed with bipolar I disorder would show elevations in facets of impulsivity associated with reward and strong emotion, and that these forms of impulsivity would most strongly impair psychosocial functioning within this diagnostic group.

Developing a more refined understanding of the forms of impulsivity that remain stably elevated across symptomatic and euthymic phases of bipolar I disorder and are most strongly associated with psychosocial functioning represents an important first step toward developing targeted interventions aimed at preventing some of the most disruptive behaviors characterizing this illness.

Aims of the study

The present study had three aims: first, to compare specific facets of impulsivity hypothesized to be elevated among individuals diagnosed with bipolar I disorder compared with controls during the inter-episode period; second, to test whether psychiatric comorbidity explains any observed elevations in impulsivity within the bipolar group; and third, to assess which specific facets of impulsivity are most strongly associated with psychosocial functioning in the bipolar group.

Material and methods

Participants

Participants were 92 people who met criteria for bipolar I disorder recruited in Palo Alto, CA, and Miami, FL (ns = 32 and 60, respectively) and 80 controls with no past or current mood disorder (ns = 41 and 39 at Palo Alto and Miami, respectively). Diagnostic status was ascertained using the Structured Clinical Interview for DSM-IV Axis I disorders [SCID (40)]. Participants were recruited through advertisements placed on the Internet, in newspapers and flyers, and at public transportations sites, as well as through local outpatient clinics within the Palo Alto, California, and Miami, Florida communities. To be able to examine the role of key comorbid conditions, recruitment was

stratified such that approximately half of the participants with bipolar disorder met criteria for lifetime substance-related conditions and half for anxiety disorders. To recruit control participants with anxiety and lifetime substance use diagnoses, advertisements were placed in community centers and on Internet sites that serve individuals with these disorders. Participants completed verbal consent procedures before the telephone-screening interview and written informed consent procedures before taking part in study procedures. Participants were given monetary compensation for their participation, and all procedures were in compliance with the Institutional Review Boards at Stanford University and the University of Miami.

Procedures

Potential participants completed an initial phone interview to establish that they were fluent English speakers, were between the ages of 18 and 65, and met preliminary screening criteria for Bipolar I Disorder (bipolar group) or for no past or current mood disorder (control group). Potentially eligible persons were invited to participate in a more extensive in-person diagnostic interview. Participants in the bipolar group completed the impulsivity battery only when they were not in episode. If participants with bipolar disorder reported elevated scores on depression or mania symptom interviews [7 or higher on both the Modified Hamilton Rating Scale for Depression (MHRSD) and the Bech Rafaelsen Mania Scale (BRMS)], they were scheduled for monthly telephone interviews to track symptom remission. Because residual symptoms in bipolar disorder are normative (41), participants who continued to report mildly elevated subsyndromal symptoms after several follow-up interviews were asked to complete the impulsivity measures once their symptoms had stabilized to a level they considered to be their typical baseline state. These data were collected as part of a larger study that included other measures not described here. Previous reports have focused on ambitious goal setting (42) and quality of life (6), but no previous reports overlap with the analyses examined here.

Measures

SCID. Trained interviewers administered the SCID during the first session of the study to participants who were tentatively deemed eligible based on the telephone screen interview. The SCID is a widely used and well-validated clinical interview for psychiatric diagnosis based on DSM-IV criteria. All interviewers were graduate-level students in clinical psychology who received extensive didactic and role-play training in SCID procedures and who had previous experience administering structured clinical interviews to psychiatric populations. Inter-rater reliability was assessed using conjoint ratings of 10 randomly selected audio interviews across the two study sites. The intraclass correlation coefficients for mania and depression were both 1.0. Participants in the bipolar group met SCID diagnostic criteria for Bipolar I Disorder, and those in the control group did not meet past or current criteria for any Axis I mood disorder (i.e., bipolar I disorder, bipolar II disorder, bipolar disorder not otherwise specified, cyclothymia, dysthymia, or major depressive disorder). Participants were excluded if they reported severe head trauma, a general medical condition of the central nervous system, vascular disease, a degenerative disorder, alcohol or substance abuse or dependence within the past year, symptoms of a primary psychotic disorder, or if they had recently undergone electroconvulsive therapy. Given evidence that first-generation antipsychotics blunt reward sensitivity and positive affect (43), participants taking these medications were also excluded. Recruitment was stratified according to history of anxiety and substance use disorders in both groups to improve our ability to account for the influence of these conditions on both impulsivity and outcome measures. We computed dichotomous scores for the presence (or absence) of any anxiety disorder (panic disorder, agoraphobia, specific phobia, social phobia, obsessive–compulsive disorder, post-traumatic stress disorder, and generalized anxiety disorder); any impulse control disorder (intermittent explosive disorder, kleptomania, pathological gambling, and pyromania); and lifetime history of alcohol abuse, alcohol dependence, drug abuse, and drug dependence.

Global Assessment of Functioning. The Global Assessment of Functioning (GAF) is one of the five axes included in the DSM-IV-TR diagnostic system and was designed to provide an index of overall functioning. At the end of each SCID, interviewers assigned participants a GAF score ranging from 0 to 100 based on information obtained during the SCID.

Somatotherapy index. Levels of six classes of psychotropic medications (lithium, antipsychotics, anticonvulsants, lamotrigine, antidepressants, and anxiolytics) were coded using the Somatotherapy Index (44), an interview-based rating system that incorporates information on prescribed dosages and adherence rates to estimate dose equivalence.

Based on this coding system, all second-generation antipsychotics were converted to a dose equivalency for risperidone; all antidepressants were converted to a dose equivalency for imipramine; and all anxiolytics were converted to a dose equivalency for benzodiazepine. Final dosages for the medications in all six classes were computed by multiplying the prescribed dosage (or dose equivalency) of each drug with the reported adherence rate.

Bech Rafaelsen Mania Scale. Manic symptoms were assessed with the interview-based BRMS (45). This 11-item measure has strong psychometric properties, is widely used to differentiate between persons with and without current mania, and is highly correlated with other measures of mania (46). Responses are scored on a rating scale from 0 to 4, with higher scores indicating greater symptom severity. We used a set of standardized probes and obtained high inter-rater reliability (intraclass correlation = 0.84 based on review of 14 recordings) and acceptable internal consistency (alpha = 0.77).

Modified Hamilton Rating Scale for Depression. Depressive symptoms were assessed using the MHRSD (47). This 17-item version of the HRSD is strongly correlated with the original, but includes standardized probes and behavioral anchors to enable paraprofessionals to make valid and reliable ratings. The MHRSD is sensitive to changes in clinical status and is highly correlated with other measures of depression. The scale has excellent inter-rater reliability (intraclass correlation = 0.93 among our research team members based on a review of 14 recordings) and strong internal consistency (alpha = 0.82 in the present sample).

Impulsivity measures. For all impulsivity measures, participants with bipolar disorder were instructed to consider their tendencies during periods of wellness, when they were not experiencing symptoms of mania or depression.

Behavioral Activation System Fun-seeking. Of the three subscales comprising Carver and White's BAS Scales, BAS Fun-seeking has been found to be most highly correlated with other measures of trait impulsivity (19–22). BAS Fun-seeking assesses the willingness to approach novel and potentially rewarding stimuli. Respondents are asked to indicate how true each of four items is for them using a 1–4 Likert scale. BAS Fun-seeking has shown good test–retest reliability ($r = 0.69$)

and has been widely used in studies of depression and mania (48). Internal consistency for BAS Fun-seeking was 0.71 in the present sample.

Positive urgency. The Positive Urgency scale is a single-factor measure that assesses the tendency to act impulsively when experiencing strong positive emotion. Respondents are asked to indicate the extent to which they agree with each of 14 statements using a 1–4 Likert scale. Scores on this measure have been found to correlate with externalizing behaviors, such as problem drinking and gambling (23), and to predict longitudinal increases in drug use and risky sexual behavior among college students (26). Positive Urgency scores have also been found to be elevated among people at high risk for bipolar disorder (37), as assessed by the Hypomanic Personality Scale (49). Internal consistency for the Positive Urgency scale was 0.97 in the present sample.

Negative urgency. The Negative Urgency scale assesses the tendency to act impulsively when experiencing strong negative emotion. Respondents are asked to indicate the extent to which they agree with each of 13 statements using a 1–4 Likert scale. Negative Urgency has achieved strong factor-analytic support and has been linked to outcomes such as aggression, alcohol abuse, and disordered eating (24, 25). Internal consistency for Negative Urgency was 0.93 in the present sample.

Barratt Impulsiveness Scale, version 11. The Barratt Impulsiveness Scale, version 11 (BIS-11) is the most widely used measure of impulsivity in both the individual differences and bipolar disorder literatures. The BIS-11 comprises three higher-order factor analytically derived subscales: i) Attentional Impulsiveness, which assesses both the ability to focus on a task at hand and the tendency to shift attention quickly; ii) Motor Impulsiveness, which assesses the tendency to act without forethought as well as perseverance; and iii) Non-planning Impulsiveness, which assesses a present orientation or failure to consider the future. Respondents are asked to rate the frequency of the behaviors described in each item using a 1–4 Likert scale. Internal consistencies for BIS-11 Attentional, Motor, and Non-planning subscales were 0.77, 0.76, and 0.73, respectively, in the present sample.

Results

Preliminary analyses indicated that all dependent variables were normally distributed (skewness and kurtosis estimates $< |2|$). As shown in Table 1,

Table 1. Descriptive data by diagnostic group

Demographic and clinical variables	Bipolar I (N = 91) Mean (SD)	Control (N = 80) Mean (SD)
Age	37.8 (11.6)	35.0 (12.1)
Percent female	60	52
Years education	14.8 (2.0)	14.5 (2.1)
Percent employed*	48	65
Percent with anxiety disorder**	52	26
Percent with past substance use disorder**	54	26
Percent with impulse control disorder**	36	9
Manic symptom level (BRMS)	2.7 (3.0)	1.9 (2.8)
Depressive symptom level (MHRSD)	3.3 (4.3)	1.9 (3.1)
Global assessment of functioning**	67.2 (12.0)	83.3 (10.4)
Age of first manic episode	22.0 (9.1)	
Number of previous manic episodes	9.4 (10.2)	
Previous hospitalizations for mania	1.7 (3.1)	
Age of first depressive episode	18.2 (8.7)	
Number of previous MDEs	12.0 (12.0)	
Previous hospitalizations for MDE	1.2 (2.3)	

BRMS, Bech Rafaelsen Mania Scale; MHRSD, Modified Hamilton Rating Scale for Depression; MDE, Major Depressive Episode.
*$P < 0.05$, **$P < 0.01$.

participants in the bipolar and control groups were well matched on age, gender, and years of education. Analyses also indicated that procedures for following participants with bipolar disorder until remission were effective: there were no differences between the bipolar and control groups on manic or depressive symptoms, and mean scores for both groups were well below the clinical cutoffs for mania and depression. As shown in Table 1, the bipolar I group reported a fairly severe illness history. Compared with controls, participants in the bipolar group were less likely to be employed and more likely to meet criteria for current anxiety, impulse control, and lifetime substance use disorder. They also had significantly lower GAF scores.

The median correlation among impulsivity measures was 0.46, suggesting that the scales cover separable aspects of impulsivity. Negative Urgency and BIS-11 Attentional Impulsiveness were correlated most strongly, $r = 0.64$, $P < 0.001$. Positive Urgency and BAS Fun-seeking were correlated most weakly, $r = 0.12$, ns. Gender was not significantly correlated with any of the impulsivity measures in the full sample: all rs < |0.15|, all ps > 0.06. Within the bipolar group, impulsivity scores were not associated with mood symptoms (BRMS, MHRSD scores) or medications (Somatotherapy Index scores): all rs < |0.17|, all ps > 0.11.

Which facets of impulsivity differentiate the bipolar group from the control group?

Because impulsivity measures were moderately intercorrelated, a multivariate analytic strategy

was used. To examine group differences in the set of self-reported impulsivity measures, a one-way multivariate analysis of variance (MANOVA) was conducted with group (bipolar vs. control) as the sole predictor (50). The bipolar and control groups differed significantly in impulsivity, Wilks' $\lambda = 0.64$, $F(6,165) = 15.58$, $P < 0.001$, partial $n^2 = 0.362$.

To determine which specific facets of impulsivity contributed to the omnibus group difference, six parallel one-way ANOVAs (Bonferroni corrected, $P < 0.008$) were conducted with diagnosis (bipolar, control) as the independent variable and each of the self-reported impulsivity variables as the dependent variable. As shown in Table 2, these one-way ANOVAs yielded significant group differences for five of the six impulsivity variables (all except BAS Fun-seeking), with Positive Urgency yielding the largest effect size among the impulsivity variables. Effect sizes for the Positive Urgency and Negative Urgency scales were statistically indistinguishable, but only Positive Urgency yielded a significantly larger effect size than the remaining non emotion-related impulsivity measures.

Are the elevated impulsivity scores observed in bipolar disorder explained by psychiatric comorbidity?

To determine whether group differences in comorbid anxiety, impulse control, and lifetime substance use disorders drove the group differences observed for Positive Urgency, Negative Urgency, and BIS-11 Attentional, Motor, and Non-planning Impulsiveness, a parallel series of forward selection multiple regressions was conducted to predict each of the impulsivity measures, with dichotomous variables for anxiety disorders; impulse control disorders; and lifetime history of alcohol abuse, alcohol dependence, substance abuse, and substance dependence entered in block 1 and diagnostic group (bipolar vs. control) entered in block 2 as independent variables. As shown in Table 3, the mean differences observed between the bipolar and

Table 2. Univariate ANOVA tests of group differences in impulsivity (df = 1, 170)

Impulsivity scale	Bipolar mean (SD)	Control mean (SD)	F	P	Partial η^2
Positive Urgency	33.74 (10.89)	21.00 (7.29)	78.69	<0.001	0.316
Negative Urgency	3.64 (0.65)	2.92 (0.69)	49.67	<0.001	0.226
BIS-11 Attentional	18.51 (4.25)	15.44 (4.07)	23.25	<0.001	0.120
BIS-11 Motor	20.61 (4.63)	17.49 (4.38)	20.46	<0.001	0.107
BIS-11 Non-planning	26.85 (5.05)	22.81 (5.02)	27.50	<0.001	0.139
BAS Fun-seeking	12.79 (2.49)	12.13 (2.36)	3.24	0.074	0.019

F tests are shown for the main effect of group.
BIS, Barratt Impulsivity Scale; BAS scale, Behavioral Activation System Scale.

Table 3. Forward selection regression analyses examining effects of bipolar diagnosis on impulsivity, controlling for comorbid conditions

	Positive Urgency		Negative Urgency		BIS-11 Attention		BIS-11 Motor		BIS-11 Non-planning	
	ΔR^2	b	ΔR^2	b	ΔR^2	b	ΔR^2	b	ΔR^2	b
Block 1	0.15**		0.30**		0.19**		0.14**		0.26**	
Anxiety disorder				0.24*		0.18*				
Impulse control disorder		0.13		0.20*		0.22*		0.19*		0.26**
Lifetime alcohol abuse										0.17*
Lifetime alcohol dependence										
Lifetime substance abuse								0.19*		
Lifetime substance dependence		0.09		0.14*		0.09				0.18*
Block 2	0.20**		0.08**		0.04*		0.04*		0.03*	
Bipolar diagnosis		0.50**		0.31**		0.22*		0.22*		0.20*

βs are standardized. Dashed lines indicate variables excluded from the full model (per the forward criterion $P \leq 0.05$). All diagnoses were dichotomized (0 = no, 1 = yes).
*$P < 0.05$, **$P < 0.001$.

control groups on five of the impulsivity measures were not explained by any of the aforementioned forms of psychiatric comorbidity. Moreover, Positive Urgency was the only impulsivity variable that was not significantly related to comorbid anxiety, impulse control, or lifetime substance use disorder status in the full model.

Which facet(s) of impulsivity are the strongest correlates of psychosocial functioning?

To determine whether study site or any demographic, clinical, or treatment variables were potential confounds for GAF, a forward selection multiple regression analysis was conducted using site, demographic variables (age, gender, years of education), mood symptoms (BRMS and MHRSD), and medication (dose equivalency levels) as independent variables, and GAF as the criterion variable. In the final model, only site remained significant ($b = 12.67$, $t = 2.12$, $P = 0.04$); thus, site was controlled for in the subsequent regression.

To examine whether the self-rated impulsivity scales predicted GAF after controlling for study site and comorbid diagnoses, a hierarchical linear regression analysis was conducted with site in block 1, comorbid diagnoses (anxiety disorders, impulse control disorders, and lifetime alcohol abuse, alcohol dependence, substance use, and substance dependence) in block 2, the six impulsivity measures in block 3, and GAF as the dependent variable.

Site accounted for 14.4% of the variance in GAF, $\Delta F(1,87) = 14.63$, $P < 0.001$. After controlling for site, comorbid diagnoses accounted for an additional 3.9% of the variance in GAF, $\Delta F(6,81) = 0.64$, $P = 0.70$. Finally, after controlling for site and comorbid diagnoses, Positive Urgency accounted for 24.2% of the variance in GAF

scores, $b = -0.45$, $t(78) = -4.60$, $P < 0.001$. No other impulsivity variable accounted for significant variance in GAF. The full model was significant, $F(6,75) = 5.27$, $P < 0.001$, accounting for 42.5% of the variance in GAF scores.

Discussion

This is the first study to conjointly examine multiple facets of impulsivity, including those related to key motivational and emotional correlates of bipolar disorder, in a sample of individuals diagnosed with the illness. Our results indicate that during inter-episode periods, individuals with bipolar I disorder report pronounced elevations on all of the impulsivity measures examined, except BAS Fun-seeking, and these elevations are not explained by comorbid anxiety, impulse control, or lifetime substance use disorder status.

The largest group difference (in terms of effect size) was observed for Positive Urgency, a facet of impulsivity that assesses the tendency to behave impulsively when experiencing strong positive emotions. This finding withstood control for comorbid anxiety disorders, impulse control disorders, and lifetime history of substance use disorders. In fact, Positive Urgency accounted for one-third of the variance in diagnosis of bipolar disorder and explained considerable variance in psychosocial functioning within the bipolar group.

Overall, these results suggest that strong positive emotions may represent an important precondition for impulsivity among individuals with bipolar I disorder. This finding is particularly notable when considered alongside a burgeoning literature suggesting that bipolar disorder is associated with context-insensitive elevations in positive emotion (cf. 34, 35): the type of emotion that people with bipolar disorder are most susceptible to experiencing also confers the greatest vulnerability to their

behaving in rash and ill-considered ways. This profile suggests two potential targets for therapeutic intervention in bipolar I disorder: i) developing effective emotion regulation strategies to maintain healthy levels of positive emotion and ii) implementing plans for preventing impulsive behavior when strong positive emotions do unfold.

At least one existing line of basic research shows early promise for an intervention that addresses these targets: setting implementation intentions *in advance* of strong emotional states (51). An implementation intention is a self-regulatory strategy in the form of a concrete if–then plan (i.e., 'If situation X arises, then I will do Y') that specifies when, where, and how the goal (in this case, keeping impulsive behavior at bay) will be achieved. Setting implementation intensions leads to a keener awareness of high-risk situations when they arise, enabling the chosen behavior to be performed more automatically. This strategy has been found to be effective both for regulating emotions (52, 53) and for overcoming the impact of emotions on various behaviors, including risk-taking (54–57).

The present study has several notable strengths. We recruited a large and well-characterized sample of people with bipolar I disorder during the inter-episode period and a demographically matched group of controls. Participants with bipolar disorder were followed longitudinally until they achieved symptom levels comparable to those of the control participants, reducing the likelihood that mood-state-dependent effects influenced the impulsivity findings. Finally, targeted sampling of the bipolar group allowed us to consider the potential influence of psychiatric comorbidity on impulsivity.

Several limitations are also apparent. First, the cross-sectional design of this study precludes us from being able to draw conclusions about the causal nature or underlying mechanisms of the observed relations among impulsivity, bipolar disorder, and psychosocial functioning. Second, this study relied on self-report measures of impulsivity, which are susceptible to response and self-presentational biases, as well as to shared method variance. Although the impulsivity measures we used have strong psychometric properties, and it has been argued that the degree of bias in self-ratings is relatively small (58), future studies would benefit from including behavioral measures of impulsivity in conjunction with experimental mood inductions or naturalistically occurring mood fluctuations to examine emotion-based impulsivity as it unfolds. Experience sampling methodology could also provide more direct information regarding the temporal dynamics of impulsive reactions to strong emotions in real-world contexts. Finally, the GAF scale yields a single score and thus only bluntly assesses psychosocial functioning. Future studies would benefit from using more refined indices that assess functioning in a range of life domains.

Although we took care to measure emotion-based impulsivity during the inter-episode period and explicitly instructed participants with bipolar disorder to reflect on periods of wellness when considering their impulsive tendencies, the current study does not help to decipher whether emotion-relevant impulsivity is more accurately conceptualized as a vulnerability factor or a 'scar' of bipolar disorder. Recent findings suggest that emotion-based impulsivity is elevated among individuals at putative risk for developing mania (37) and is related to a polymorphism marking variation in serotonergic function (59). Future research would thus benefit from integrating emotion-based measures of impulsivity with biological ones, including those related to serotonergic function.

In sum, our findings provide an important first step toward developing a more refined understanding of impulsivity in bipolar disorder and underscore the pivotal influence of strong positive emotion on impulsive behavior and functioning in this illness. Research corroborating these early self-report findings with multiple methods, including the kinds of laboratory-based and ecological measures outlined above, could lead to more fine-tuned interventions that help to stem self-destructive impulsive behaviors and improve the wellbeing of persons with bipolar disorder.

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