Notice of correction 11/9/2011: *Odds ratios in Table 3 have been corrected. Age = 0.98, Sex = 0.48, Race = 0.95, Mood type = 3.11, Psychosis = 0.04, Trauma history = 0.28, BIS-II total score = 0.99, Aggression Questionnaire = 0.99, RFL total score = 0.98, HDRS-17 = 0.90, CARS-M = 1.02, and WRAT-III = 0.93. The online version has been corrected.*

Clinical and Cognitive Correlates of Suicide Attempts in Bipolar Disorder: Is Suicide Predictable?

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Objective: We conducted a retrospective investigation of potential clinical, demographic, and neuropsychological risk factors for suicide attempts in patients diagnosed with bipolar disorder.

Method: Participants included 67 adult inpatients and outpatients aged 18–60 years meeting *DSM-IV* criteria for bipolar disorder (bipolar I and II disorders, bipolar disorder not otherwise specified). We assessed demographic factors, mood symptoms, psychosis, trauma history, trait impulsivity, trait aggression, and reasons for living. The primary outcome measures were the Barratt Impulsiveness Scale-version II, Aggression Questionnaire, and 10 cognitive outcome variables. The cognitive outcome variables assessed cognitive performance across several domains, including processing speed, attention, verbal learning, and executive function. Another aspect of cognitive function, decision making, was assessed using the Iowa Gambling Task. The study was conducted from July 2007–July 2009.

Results: We found that nonattempters reported significantly higher trait impulsivity scores on the Barratt Impulsiveness Scale compared to attempters ($t_{57} = 2.2$, $P = .03$) and that, among attempters, lower trait impulsivity score was associated with higher scores of lethality of prior attempts ($r_{25} = -0.53$, $P = .01$). Analyses revealed no other group differences on demographic, clinical, or neurocognitive variables when comparing attempters versus nonattempters. Regression models failed to identify any significant predictors of past suicide attempt.

Conclusions: The largely negative results of our study are particularly important in highlighting the clinical dilemma faced by many clinicians when trying to predict which patients will make serious suicide attempts and which patients are at a lower risk for acting on suicidal thoughts. A limitation of our work is that we examined stable trait measures of impulsivity among a euthymic sample rather than mood state or the impact of mood state on traits. Overall, we conclude that suicidal behavior is extremely difficult to predict, even when comprehensive clinical and neurocognitive information is available.

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Bipolar disorder is a chronic and debilitating mood disorder associated with substantial morbidity and mortality.[1,2] Data from the Epidemiologic Catchment Area study[3] demonstrated suicide to be more prevalent among patients with bipolar disorder than any other psychiatric group, including patients with major depressive disorder (MDD). Indeed, the odds ratio for suicide attempts is 6.2 for bipolar disorder patients and 3.1 for MDD patients.[3] A recent review found that 15%–19% of bipolar disorder patients die by suicide.[4] Clearly, suicidality among bipolar disorder patients is a significant public health concern worthy of extensive examination; however, prior studies that have assessed potential clinical and neuropsychological correlates of suicidal behavior[5] are limited and have not specifically focused on bipolar disorder cohorts.

Clinical and Demographic Correlates of Suicidal Behavior

Investigations of clinical predictors of suicide attempts have assessed impulsivity-related traits,[6] with increased self-reported impulsivity reported among attempters versus nonattempters in some studies,[7,8] yet others have failed to find group differences.[9,10] Research on suicide has also focused on history of trauma as a potential risk factor. Findings from the Stanley Foundation suggest that almost a quarter of attempters report a history of physical and sexual abuse.[11] Others have found that a higher percentage of bipolar disorder patients with a prior attempt report a history of abuse than those patients who have never made an attempt; however, abuse is not an effective predictor of suicide attempt.[12] Bipolar subtype may also contribute to suicidal behavior. Recent work found that bipolar I disorder patients were more likely to attempt suicide compared to bipolar II disorder and MDD patients.[13] However, this finding is limited by the reliability of bipolar disorder diagnoses, especially the detection of hypomanic/manic episodes among MDD patients.[14] Other research has suggested that demographic factors such as sex may be an important predictor of suicide attempt. For example, in one study,[11] women were found to be at greater risk for suicide attempts, while another similar study[15] failed to show a sex difference. The complexity of suicidality, including individual, clinical, illness-related and stress-related risk factors, may account for the overall lack of consistent outcomes across studies that assess these clinical and demographic variables.[4] In the current study, we attempted to resolve inconsistencies in the literature by reexamining relevant clinical and demographic variables in a large sample of comprehensively characterized euthymic bipolar disorder patients.

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Clinical Points

- The study's inability to find reliable neuropsychological predictors confirms the difficulty faced by clinicians in identifying which patients are at greatest risk for suicide attempt.
- Despite the failure to find reliable predictors of suicidal behavior, thorough clinical assessment of suicide risk by health care professionals continues to be essential.

Neuropsychological Correlates of Suicidal Behavior

Neuropsychological studies suggest that suicidality among patients with mood disorders may be associated with executive dysfunction, particularly when highly lethal attempts are made. For example, it has been found that currently depressed individuals with a history of making high lethality suicide attempts perform significantly worse on measures of executive functioning compared to nonpatients, depressed patients with no past history of attempts, and patients with a history of making low lethality suicide attempts.[16] A related investigation[17] found that a group of nondepressed (Hamilton Depression Rating Scale score > 10) patients diagnosed with psychiatric disorders, including mood disorders (MDD, bipolar disorder), eating disorders, anxiety disorders, or substance abuse, who engaged in violent suicide attempts performed significantly worse on the Iowa Gambling Task, a measure of decision making, when compared to patients who did not have a history of suicide attempt. Cognitive function did not differ between patients who engaged in nonviolent suicide attempts versus patients without a history of suicide attempts. Cognitive function did not differ between patients with violent versus nonviolent suicide attempts.[17]

Surprisingly few studies have focused on patients with bipolar disorder and, more specifically, examined potential cognitive disturbances that may reflect deficits in executive function among suicide attempters. This shortage of material exists despite a growing literature indicating trait-like impairment in euthymic bipolar disorder patients in this domain.[18] One study[19] examined a sample of currently mildly depressed, mildly hypomanic, mixed, and euthymic bipolar disorder patients and assessed a variety of cognitive factors and demonstrated deficits in decision making on the Iowa Gambling Task in bipolar I disorder attempters versus nonattempters. Impaired performance on the Iowa Gambling Task was significantly associated with number of suicide attempts.[19] In this study,[19] interference scores on the Stroop Test were also significantly correlated with an increased number of suicide attempts, suggesting that difficulties with response inhibition are associated with an increased rate of suicide attempts. It was found that a sample of euthymic, manic, depressed, and mixed-episode bipolar disorder patients who have attempted suicide also have more impulsive responses on an immediate response task when compared to bipolar disorder patients who do not have a history of suicide attempt.[20] Research examining depressed bipolar I disorder and bipolar II disorder attempters and healthy controls revealed that both groups of bipolar disorder patients exhibit impairments on cognitive tasks assessing working memory, psychomotor speed, and impulsivity compared to healthy controls.[21] Other work[22] has shown that visual processing impairment on Trail Making Test-Part A and verbal memory deficits on the California Verbal Learning Test are associated with an increased number of suicide attempts among a sample of bipolar I disorder and bipolar II disorder patients in manic, depressed, mixed, and euthymic states. The current work aimed to add to this small set of studies by identifying a homogenous group of euthymic bipolar disorder patients and examining differences between attempters and nonattempters on cognitive tasks as well as cognitive predictors of suicide attempts in this bipolar disorder sample.

In summary, the clinical, demographic, and cognitive predictors of suicidality among bipolar disorder patients remain to be fully elucidated.[4] The current study supplements prior work by examining a set of trait and state clinical measures, demographic characteristics, and neurocognitive tasks thought to be relevant to bipolar disorder and suicide. In an effort to identify which patients are at greatest risk for actualized suicide attempts, we first assessed potential differences among attempters and nonattempters, with the secondary aim of developing a multivariate model to predict suicide attempts in bipolar disorder patients.

METHOD

Participants

Participants included 67 adult inpatients and outpatients aged 18–60 years at Zucker Hillside Hospital, a division of the North Shore Long Island Jewish Health System, meeting *DSM-IV* criteria (Structured Clinical Interview for *DSM-IV* Axis I Disorders, Research Version, Patient Edition[23]) for bipolar I disorder, bipolar II disorder, or bipolar disorder not otherwise specified (NOS). All participants were treated with mood stabilizers, antidepressants, antipsychotics, anticholinergics, anxiolytics, hypnotics, and/or benzodiazepines. Stimulants, dopamine agonists, and tricyclics were disallowed due to effects on cognition. See Table 2 for the pharmacologic profile of each group.

Exclusion criteria were substance abuse/dependence within 1 month of study participation, unstable or severe medical illness, and history of significant neurologic injury, mental retardation, or dementia. Patients had not received electroconvulsive therapy within 12 months of study participation.[24]

The North Shore Long Island Jewish Health System Institutional Review Board reviewed and approved all study procedures. All participants provided written informed consent prior to their participation. Data were collected from July 2007 to July 2009.

Assessments

Suicide attempts were determined using the Columbia Suicide History Form.[25] For primary analyses, we used a

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stringent definition of suicide attempters who reported at least 1 deliberate attempt. Deliberate attempts do not include ambiguous (self-injurious acts without intent to die), aborted (steps toward a suicidal act that are terminated before the act occurs), or interrupted attempts (self-injurious acts interrupted by outside circumstances). For secondary analyses, we classified individuals based on having made any kind of the above-described attempts. We also assessed current suicidal ideation with the Beck Scale for Suicidal Ideation.[26]

Clinical. The following symptom and mood ratings were administered to participants: 17-item Hamilton Depression Rating Scale (HDRS-17)[27] and Clinician-Administered Rating Scale for Mania (CARS-M).[28] Self-report measures included the Childhood Trauma Questionnaire,[29] Barratt Impulsiveness Scale-version II (BIS-II),[30] Aggression Questionnaire,[31] and Reasons for Living Inventory.[32]

Neuropsychological cognitive testing. Neuropsychological tasks administered were previously associated with suicidality and/or bipolar disorder.[33,34] We assessed the following cognitive domains: (1) attention (Wechsler Adult Intelligence Scale-Revised [WAIS-R]: Digit Span), (2) processing speed (WAIS-R Digit Symbol, Trail Making Test-Parts A and B, Letter Fluency, and Category Fluency), (3) verbal learning and memory (Hopkins Verbal Learning Test), and (4) executive function (Wisconsin Card Sorting Test, Stroop Color Word Test). Premorbid intellectual functioning (IQ) was assessed using the Wide Range Achievement Test reading subscale.

Decision making. A computerized version of the Iowa Gambling Task[35] was administered. The Iowa Gambling Task is a decision-making task thought to reflect emotional decision making. The goal of the Iowa Gambling Task is for participants to make choices that maximize monetary gain and minimize monetary loss. Participants choose a card from 1 of 4 decks; 2 decks (A, B) are disadvantageous (monetary loss), while 2 decks are advantageous (C, D) (monetary gain). The task consists of 100 trials.

Statistical Analyses

We examined clinical, demographic, and cognitive differences between attempters and nonattempters. We also tested for significant predictors of prior suicide attempts. Data were analyzed using SPSS 11.0 (IBM, Chicago, Illinois).

Clinical and demographic. First, we assessed group differences in clinical characteristics using a series of *t* tests. Measures included the following: mood disorder type (bipolar I disorder, bipolar II disorder, bipolar disorder NOS), history of psychosis (yes, no), trauma history (yes, no), trait impulsivity (BIS-II total score), aggression (Aggression Questionnaire total score), reasons for living (Reasons for Living Inventory total score), and current depressive (HDRS-17) and manic symptoms (CARS-M). Demographic variables included age, sex, and race (white, nonwhite). We submitted the same variables as predictors to a binary logistic regression analysis. Premorbid IQ was included in order to control for individual differences in cognitive function.

We conducted follow-up analyses examining the association (Pearson correlation) between impulsivity (attention, motor, nonplanning, overall impulsiveness) and highest level of lethality from all prior attempts.[6–8]

Neuropsychological cognitive testing. In order to afford the advantage of statistically powering the study for fewer dependent measures, we entered neuropsychological tests into a principal components analysis. The principal components analysis was a factor analytic model using varimax rotation. Four factors were identified with eigenvalues greater than 1.0 and together explained 65% of the variance. Each of the 4 factors accounted for 28.5%, 14.5%, 12.2%, and 10.4% of the variance, respectively. The 4 factors were (1) processing speed (WAIS-R Digit Symbol, Trail Making Test-Parts A and B, Letter Fluency, and Category fluency), (2) executive function (Wisconsin Card Sorting Test, Stroop Color Word Test), (3) attention (WAIS-R Digit Span), and (4) verbal learning and memory (Hopkins Verbal Learning Test). Factor structure and loadings of the neuropsychological factors derived from the principal components analysis are reported as supplemental information (eTable 1 at PSYCHIATRIST.COM).

We used *t* tests to examine group differences in neuropsychological functioning. We assessed predictors of suicide attempt using a binary logistic regression with our 4 cognitive factors, premorbid IQ, age, and sex as predictor variables.

Decision making. We determined the proportion of cards chosen from disadvantageous decks (A, B) for 5 sets of 20 trials (T1–20, T21–40, T41–60, T61–80, and T81–100) and total monetary losses/gains.[36] The Iowa Gambling Task expectancy-valence model was enlisted using Matlab v. 7.3.0.298.[37,38] This model yields 3 scores: recency (effects of memory for the most recent outcome on task performance), attention to losses/gains (persistence in choosing from disadvantageous or advantageous decks), and consistency (reliability of decision making).[38] *t* Tests and Pearson correlations were used to assess outcomes.

RESULTS

Participants

The mean ± SD age of the final sample (N = 67) was 42.2 ± 11.5 years (range, 19.5–61.5), and 44.8% (n/N = 30/67) were female. The percentage of subjects who were white was 64.2% (n/N = 43/67), and 35.8% (n/N = 24/67) were nonwhite (Asian or Pacific Islander, black, Hispanic, other) (Table 1).

When using the stringent, deliberate definition of attempt, we found that 41.8% (n/N = 28/67; mean ± SD age, 43.7 ± 12.0) of our sample had made at least 1 prior suicide attempt ("attempters"), while the remaining 58.2% (n/N = 39/67) had never attempted suicide ("nonattempters"). Data from a subset of our attempter sample (n = 25) indicate that a mean (SD) of approximately 14 (12) years elapsed between the time of the study and the past suicide attempt. Lethality was defined according to the medical consequences and damage related to the suicidal act and ranges from 0 (no attempt) to 8 (death), with increasing scores indicating increasing medical consequences and damage.

For secondary analyses, using our broad definition of suicide attempt, which incorporated ambiguous (n = 1), aborted

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Table 1. Clinical and Demographic Characteristics of Attempters Versus Nonattempters

Variable	Attempter (n = 28)	Nonattempter (n = 39)	*P*
Demographic			
Age, mean (SD), y	43.7 (10.7)	41.1 (12.0)	NS
Female sex, % (n/n)	50 (14/28)	41 (16/39)	NS
White, % (n/n)	68 (19/28)	62 (24/39)	NS
Mood type			
Bipolar I disorder, % (n/n)	75 (21/28)	77 (30/39)	NS
Bipolar II disorder, % (n/n)	14 (4/28)	18 (7/39)	NS
Bipolar disorder NOS, % (n/n)	11 (3/28)	5 (2/39)	NS
Psychosis, % (n/n)	64 (18/28)	63 (24/38)	NS
Trauma history, % (n/n)	74 (20/27)	72 (28/39)	NS
BIS-II total score, mean (SD)	62.96 (8.84)	69.88 (15.16)	< .05
Aggression Questionnaire score, mean (SD)	68.8 (23.5)	72.6 (23.4)	NS
RFL total score, mean (SD)	204.66 (47.72)	211.48 (50.73)	NS
HDRS-17 score, mean (SD)	8.60 (7.51)	10.76 (6.92)	NS
CARS-M score, mean (SD)	4.29 (3.58)	5.24 (6.20)	NS

Abbreviations: BIS-II = Barratt Impulsiveness Scale-version II, CARS-M = Clinician-Administered Rating Scale for Mania, HDRS-17 = 17-item Hamilton Depression Rating Scale, NOS = not otherwise specified, NS = nonsignificant, RFL = Reasons for Living Inventory.

(n = 15), and interrupted (n = 6) attempts (Table 2), we found that 50.7% (n/N = 34/67; mean ± SD age, 42.5 ± 11.0 years) of our sample were attempters, while the remaining 49.2% (n/N = 33/67) were nonattempters.

Clinical and Demographic Characteristics

Patients were stable at the time of assessment (HDRS-17 mean ± SD score = 9.8 ± 7.3 [range, 0–28]; CARS-M mean ± SD score = 5.0 ± 5.2 [range, 0–29]) (Table 1). Attempters did not differ significantly from nonattempters on depression ($t_{65} = 1.21$, $P = .23$) or mania ($t_{64} = 0.73$, $P = .47$). There were no group differences in Aggression Questionnaire scores ($t_{51} = 0.58$, $P = .56$), Reasons for Living Inventory scores ($t_{62} = 0.54$, $P = .59$), bipolar disorder subtype ($\chi^2_2 = 0.82$, $P = .66$), history of psychosis ($\chi^2_1 = 0.01$, $P = .93$), or Childhood Trauma Questionnaire scores ($\chi^2_1 = 0.04$, $P = .83$).

On the BIS-II, attempters reported lower trait impulsivity compared to nonattempters ($t_{57} = 2.2$, $P = .03$). Within the attempter group, we found a significant negative correlation between lethality and motor impulsiveness ($r_{26} = -0.40$, $P = .04$) as well as overall impulsiveness (motor, nonplanning, and attention) ($r_{25} = -0.53$, $P = .01$).

There were no significant differences between attempters and nonattempters on demographic variables: age ($t_{65} = -0.93$, $P = .35$), sex ($\chi^2_1 = 0.53$, $P = .47$), and race ($\chi^2_2 = 0.28$, $P = .56$).

Our regression model did not yield significant clinical and demographic predictors of suicide attempts among bipolar disorder patients (Table 3). In secondary analyses, we used a broader definition of suicide attempt that included individuals who engaged in less deliberate suicidal acts. A notable difference in our findings was that WRAT scores were a significant predictor of attempter group ($P = .04$, OR = .90). However, groups did not differ when directly compared using *t* tests ($t_{64} = 0.34$, $P = .74$: attempters, mean ± SD score = 98.9 ± 12.2; nonattempters, mean ± SD score = 99.8 ± 8.9). Also, when broadly defined, impulsivity did not differ significantly between attempters (BIS-II total mean ± SD score = 64.5 ± 10.1) and nonattempters (BIS-II total mean ± SD score = 69.3 ± 15.5) ($F = 2.0$, $P > .16$). All other subscales, including motor, attention, and nonplanning subscales, were nonsignificant (all *P* values > .16).

Table 2. Patient Characteristics

Variable	Yes	No	*P*
Columbia Suicide History Form			
Deliberate attempts, % (n/n)	41.8 (28/67)	58.2 (39/67)	
Aborted attempts, % (n/n)	39 (10/26)	14 (5/37)	NS
Interrupted attempts, % (n/n)	19 (5/26)	3 (1/37)	.03 ($\chi^2 = 4.84$)
Ambiguous attempts, % (n/n)	0 (0/26)	3 (1/37)	NS
Lethality rating for deliberate attempts, mean (SD)[a]	2.57 (1.89)	NA	
	Attempter	Nonattempter	*P*
Alcohol use, % (n/n)	52 (11/21)	39 (14/36)	NS
Drug use, % (n/n)	33 (7/21)	43 (15/35)	NS
Medications, % (n/n)			
Lithium	45 (5/11)	54 (6/11)	NS
Anticonvulsant	45 (9/20)	55 (11/20)	NS
Antipsychotic	42 (14/33)	57 (19/33)	NS
Antidepressant	60 (12/20)	40 (8/20)	NS

[a]Lethality is rated as the highest lethality rating among all attempts.
Abbreviations: NA = not applicable, NS = nonsignificant.

Table 3. Logistic Regression Analyses of Clinical and Demographic Predictors of Suicide Attempt

Predictor	Odds Ratio	95% CI Lower	95% CI Upper	β	SE	*P*[a]
Age	0.98	0.90	1.06	−0.02	0.04	.58
Sex	0.48	0.42	10.41	0.74	0.82	.36
Race	0.95	0.13	6.65	−0.06	1.00	.96
Mood type	3.11	0.79	12.20	1.14	0.70	.10
Psychosis	0.04	0.00	1.52	−3.21	1.85	.08
Trauma history	0.28	0.04	2.11	−1.28	1.03	.22
BIS-II total score	0.99	0.93	1.06	−0.01	0.03	.83
Aggression Questionnaire	0.99	0.95	1.03	−0.01	0.02	.64
RFL total score	0.98	0.96	1.00	−0.02	0.01	.10
HDRS-17	0.90	0.79	1.03	−0.10	0.07	.12
CARS-M	1.02	0.86	1.20	0.02	0.09	.85
WRAT-III	0.93	0.84	1.03	−0.07	0.05	.16

[a]All *P* values are nonsignificant.
Abbreviations: BIS-II = Barratt Impulsiveness Scale-version II, CARS-M = Clinician-Administered Rating Scale for Mania, HDRS-17 = 17-item Hamilton Depression Rating Scale, RFL = Reason for Living Inventory, SE = standard error, WRAT-III = Wide Range Achievement Test reading subscale.

Neuropsychological Characteristics

Cognitive testing. There were no significant differences between attempters and nonattempters on processing speed, attention, verbal learning, or executive function (all t_{57} values > −1.04; all *P* values > .30) (Figure 1). We did not find evidence of premorbid IQ differences between attempters and nonattempters ($t_{64} = 0.74$, $P = .46$). Our regression revealed no significant cognitive predictors of suicide attempts (Table 4).

Decision making. Attempters and nonattempters did not differ on total monetary losses/gains or net scores ($t_{42} < 1.93$, all *P* values > .06) (Table 5). We did not find significant group differences using expectancy-valence model ($t_{42} > -0.69$, all *P* values > .49). Highest level of lethality was not significantly

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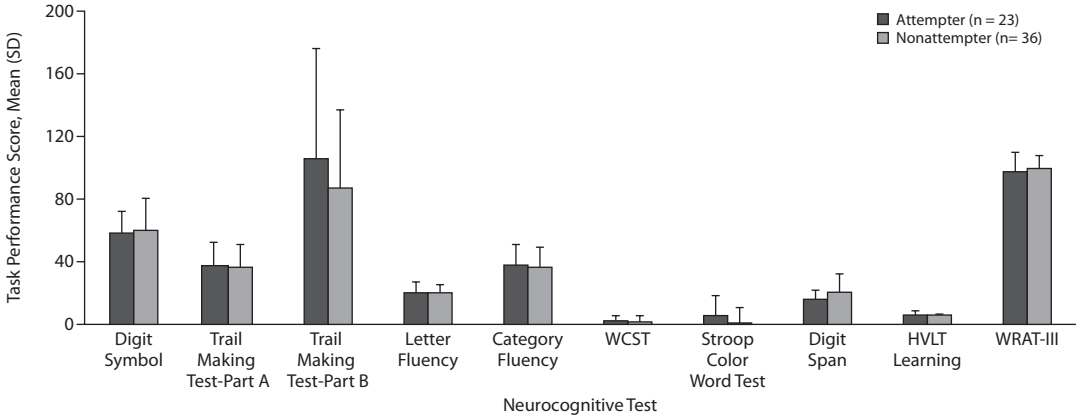
Figure 1. Neurocognitive Performance for Attempters Versus Nonattempters



Abbreviations: HVLT = Hopkins Verbal Learning Test, WCST = Wisconsin Card Sorting Test, WRAT-III = Wide Range Achievement Test reading subscale.

Table 4. Logistic Regression Analyses of Cognitive Predictors of Suicide Attempt

Predictor	Odds Ratio	95% CI Lower	95% CI Upper	β	SE	P[a]
Processing speed	1.01	0.55	1.85	0.01	0.31	.97
Executive function	1.19	0.66	2.14	0.17	0.30	.56
Attention	1.47	0.78	2.78	0.39	0.32	.23
Verbal learning	0.76	0.39	1.48	−0.27	0.34	.42
WRAT-III	0.97	0.91	1.03	−0.03	0.03	.33
Age	1.02	0.97	1.08	0.02	0.03	.36
Sex	0.96	0.29	3.12	−0.05	0.60	.94

[a]All *P* values are nonsignificant.
Abbreviations: SE = standard error, WRAT-III = Wide Range Achievement Test reading subscale.

Table 5. Decision Making Among Attempters Versus Nonattempters

Iowa Gambling Task	Attempter, Mean (SD)	Nonattempter, Mean (SD)	P
Total amount won, $	84.94 (8.59)	81.59 (5.70)	NS
Total amount lost, $	−99.23 (16.43)	−90.24 (14.48)	NS
Total no. of cards chosen from			
Deck A	21.27 (8.04)	21.18 (4.24)	NS
Deck B	32.36 (13.58)	28.09 (8.67)	NS
Deck C	21.36 (7.35)	21.00 (6.08)	NS
Deck D	25.00 (9.58)	29.73 (12.90)	NS
Net scores			
T1–T20	−3.00 (6.23)	−0.18 (4.78)	NS
T21–T40	−0.18 (4.97)	0.18 (4.32)	NS
T41–T60	−1.73 (7.54)	1.36 (7.21)	NS
T61–T80	−0.95 (8.19)	0.73 (8.13)	NS
T81–T100	−1.23 (6.80)	0.14 (7.00)	NS
Total net score (sum of net scores)	−7.09 (23.23)	2.22 (19.90)	NS
Expectancy-Valence Model			
Recency parameter	0.26 (0.35)	0.30 (0.41)	NS
Attention to losses and gains parameter	0.40 (0.37)	0.33 (0.36)	NS
Choice consistency parameter	2.77 (3.63)	2.61 (3.71)	NS

Abbreviation: NS = nonsignificant.

correlated with any of the Iowa Gambling Task outcome measures (net scores, recency, attention to losses/gains, and reliability) (all r_{22} values < 0.31; all *P* values > .16). As some of these data were skewed, we repeated these analyses using nonparametric tests and found that this did not change the results. These results are inconsistent with the few existing findings of deficits on the Iowa Gambling Task among bipolar disorder patients with past suicide attempts.[17,19]

Given the negative findings of this study and in light of prior positive results, we evaluated our power to detect differences that were reported in a related study that found significantly lower task scores on the Iowa Gambling Task among attempters versus nonattempters.[19] Specifically, a significant group difference ($P = .005$) was reported on trials 41–60, with an effect size equivalent to a small effect (Cohen $d = 0.16$: attempters, mean ± SD effect size = −2.56 ± 4.69, n = 17; nonattempters, mean ± SD effect size = 3.71 ± 8.72, n = 19). With the current sample size (n = 44), our power to detect the same effect size difference is > 90%, suggesting that we were powered to find even small, statistically significant effects if they were indeed present in our cohort.

DISCUSSION

We investigated clinical, demographic, and neuropsychological variables that may be important in predicting suicide attempts among bipolar disorder patients. Consistent with a subset of recent research, we failed to find significant factors that serve to predict group membership when comparing those patients who have made at least 1 serious suicide attempt to those patients who have never made an attempt.

Interestingly, we found that attempters in our sample were less impulsive than nonattempters by self-report on the BIS-II. Other work yields either equivocal results or statistically significant results in the opposite direction when compared to our findings.[7–10] One possible explanation is that we utilized the most stringent of definitions for an attempt, as defined by the Columbia Suicide History Form, while prior studies have used varying definitions. Specifically, an attempt on this scale is coded only if the act was deliberate with a clear intent to die. Indeed, when we examined the relationship between impulsivity and lethality, we found a significant negative correlation. We believe that the

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use of this stringent definition is a strength, supported by the fact that this scale has been specifically recommended by the US Food and Drug Administration for clinical trials because of its reliability as a suicide measure.[39]

Overall, our results and the results from a portion of related studies have failed to find reliable predictors of suicidal behavior, making it difficult for clinicians to prospectively predict which patients are at greatest risk. A significant consideration of this research is that our study examined stable trait measures as they relate to suicide attempt rather than measures of mood state or the interplay between trait measures and mood state as a predictor of suicide. A limitation of our study is that we did not assess for several factors that may have tracked with risk for suicidal behaviors, such as stressful life events, medication adherence, and mood state preceding suicide attempts. Indeed, prior research suggests that recent negative life events, lithium discontinuation, and mixed/depressed mood state may increase risk for suicide.[40,41–43]

Consistent with our inability to detect significant neuropsychological predictors of suicide attempt, the handful of existing studies has also yielded few significant results across cognitive domains.[8,19,21,22] Our null findings may have been masked by our principal components analysis approach; however, this is unlikely, since each measure was incorporated into 1 of the 4 cognitive factors (ie, no variable was unaccounted for). Furthermore, when we examined individual cognitive tests, we failed to find any measure that significantly distinguished our attempter and nonattempter groups ($P > .15$). Prior research has examined similar domains of functioning using a different set of neuropsychological tests (n-back test of working memory) and found a significant association with suicide attempts among bipolar disorder patients.[21] Negative results could also potentially result from a lack of statistical power. This does not seem to be the case since we demonstrate power > 90% to detect effect sizes in the range that has been previously reported in related research.

In conclusion, the results of our study strongly support the clinician's dilemma when faced with the task of predicting which patients will attempt suicide and which patients are at a lower risk for acting on suicidal thoughts. It should be highlighted that even when clinical factors and cognition are comprehensively measured using a 4-hour battery, suicidal behavior is highly unpredictable. This study was retrospective, thereby inherently limiting its predictive ability, and its negative findings should not discourage future studies designed to explore quantifiable risk factors for suicide attempts, particularly using prospective analyses. Indeed, a diagnosis of bipolar illness places an individual at among the highest risk for dying by suicide, making ongoing efforts in this research area extremely important and potentially lifesaving.

Drug names: lithium (Lithobid and others).

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Supplementary Material

Article Title: Clinical and Cognitive Correlates of Suicide Attempts in Bipolar Disorder: Is Suicide Predictable?

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List of Supplementary Material for the article

1. eTable 1 — Factor Loadings from the Unrotated Principal Components Analysis (Factor Analysis) of the Neurocognitive Variables

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eTable 1. Factor Loadings from the Unrotated Principal Components Analysis (Factor Analysis) of the Neurocognitive Variables.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.717	29.482	29.482	4.717	29.482	29.482
2	2.237	13.982	43.464	2.237	13.982	43.464
3	1.490	9.312	52.776	1.490	9.312	52.776
4	1.344	8.398	61.174	1.344	8.398	61.174
5	1.044	6.522	67.696	1.044	6.522	67.696

Extraction Method: Principal Component Analysis.

Component Matrix

Test	Component				
	1	2	3	4	5
ANT Alerting	.062	.417	.311	-.431	-.583
ANT Orienting	-.035	.713	.245	.434	-.123
ANT Conflict	-.133	.212	.617	-.415	.114
WRATReading	.520	.092	-.457	.422	-.333
Digit span	.175	.732	.256	.193	.097
Digit Symbol	.616	-.395	-.113	-.342	-.240
Stroop Word	.669	-.450	.298	.126	-.060
Stroop Color	.744	.015	.244	.009	.175
Stroop ColorWord	.806	.238	-.030	-.212	.285
Stroop Interference	.326	.489	-.400	-.303	.424
Trails A time	-.675	.108	-.167	.062	.118
Trails B time	-.749	-.145	.097	.055	.257
Letter fluency	.645	-.136	.263	.215	-.047
WCST Categories Completed	.642	.313	-.409	-.267	.005
Animal fluency	.484	-.372	.282	.136	.340
CVLT Delayed Recall	.422	.153	.054	.412	.067

Extraction Method: Principal Component Analysis: 5 components extracted with eigenvalues>1.