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Impaired Decision-Making in Adolescent Suicide Attempters

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Abstract

Objective—Decision-making deficits have been linked to suicidal behavior in adults. However, it remains unclear whether impaired decision-making plays a role in the etiopathogenesis of youth suicidal behavior. The purpose of this study was to examine decision-making processes in adolescent suicide attempters and never-suicidal comparison subjects.

Method—Using the Iowa Gambling Task, the authors examined decision-making in 40 adolescent suicide attempters, ages 13–18, and 40 never-suicidal, demographically-matched psychiatric comparison subjects.

Results—Overall, suicide attempters performed significantly worse on the Iowa Gambling Task than comparison subjects. This difference in overall task performance between the groups persisted in an exact conditional logistic regression analysis that controlled for affective disorder, current psychotropic medication use, impulsivity, and hostility (adjusted odds ratio=0.96, 95% confidence interval=0.90–0.99, $p<.05$). A two-way repeated-measures analysis of variance revealed a significant group-by-block interaction, demonstrating that attempters failed to learn during the task, picking approximately the same proportion of disadvantageous cards in the first and final blocks of the task. In contrast, comparison subjects picked proportionately fewer cards from the disadvantageous decks as the task progressed. Within the attempter group, overall task performance did not correlate with any characteristic of the index attempt or with the personality dimensions of impulsivity, hostility, and emotional lability.

Conclusions—Similar to findings in adults, impaired decision-making is associated with suicidal behavior in adolescents. Longitudinal studies are needed to elucidate the temporal relationship between decision-making processes and suicidal behavior and help frame potential

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targets for early identification and preventive interventions to reduce youth suicide and suicidal behavior.

Introduction

The single most potent predictor of youth suicide is a previous suicide attempt, elevating the risk 10–60 fold.^{1–3} In 2009, 6.3% of adolescents in the United States attempted suicide, with 1.9% of those attempts requiring medical treatment.⁴ Identifying risk factors for suicidal behavior can facilitate early detection and the targeting of effective interventions for youth most likely to complete suicide. Several factors are associated with an increased risk of adolescent suicidal behavior, including depression,^{5–7} impulsive/aggressive traits,⁸ family history of suicidal behavior,⁹ and poor problem-solving skills.^{10, 11}

One of the components of problem-solving is decision-making, the process of forming preferences, selecting and executing actions, and evaluating outcomes.¹² The “Somatic Marker Hypothesis” was proposed in order to provide a neural and cognitive framework for decision making and the influence on it by emotion.¹³ Briefly, the Somatic Marker Hypothesis posits that affective signals of reward and punishment play a crucial role in decision-making.¹³ From a neurocognitive perspective, decision-making is associated with activation of the ventromedial prefrontal cortex (VmpFC), which includes the orbitofrontal sector of the prefrontal cortex.^{12, 14} Individuals with damage to the VmpFC tend to make highly impaired decisions in real life and exhibit decision-making deficits on laboratory tasks, such as the Iowa Gambling Task (IGT), and other betting tasks,¹⁵ that simulate real life decision-making under conditions of uncertainty.^{13, 16, 17}

Accumulating evidence from studies of adults suggests dysfunctional decision-making may be a relevant vulnerability marker for suicidal behavior.^{18–21} Jollant et al.¹⁸ reported that decision-making, as measured by the IGT,¹⁷ was impaired in adult suicide attempters; violent, but not non-violent, attempters in this sample exhibited decision-making deficits similar to patients with an orbitofrontal cortex lesion.^{13, 16} In a subsequent sample using functional neuroimaging, Jollant and colleagues²² replicated the association between impaired decision-making and suicidal behavior and found decreased activation of left lateral orbitofrontal and occipital cortices among the suicide attempters while making high-risk decisions. As attempters in both studies were euthymic at time of assessment,^{18, 22} the authors concluded that the decision-making impairment most likely represented a vulnerability trait, rather than a state-dependent risk factor for suicidal behavior.²³

Additional studies have found support for a relationship between suicidal behavior and faulty decision-making in adults. Malloy-Diniz et al.,¹⁹ in a sample of adults with bipolar disorder, found that patients with a history of suicide attempt performed worse on the IGT than non-attempters. Martino et al.²⁰ reported a significant relationship between impaired decision-making and suicidal behavior among a sample of euthymic bipolar patients, a pattern that held after controlling for number of previous hypomanic/manic episodes, gender, and exposure to antipsychotic medications. Dombrovski et al.,²¹ in a sample of depressed elders, found that a deficit in probabilistic reversal learning, a component of decision-making that taps into cognitive flexibility,²⁴ was associated with attempted suicide but not suicidal ideation. The accumulation of these findings complement those of post-mortem studies and functional neuroimaging studies by implicating altered functioning in the VmpFC to risk of suicide and suicidal behavior.^{25,26}

Better understanding of the relationship between decision-making and suicidal behavior in adolescents may serve to inform suicide prevention efforts with this population. To our knowledge, no study to date has examined the role of decision-making in the

etiopathogenesis of adolescent suicidal behavior. A prior study²⁷ found no deficit in decision-making on the IGT in adolescents who engaged in deliberate self-harm (i.e., self-injurious acts with or without intent to die). Nevertheless, youth who engage in non-suicidal self-injury may demonstrate a risk profile distinct from those who attempt suicide.²⁸ Thus, the purpose of this study was to investigate decision-making in youths who had previously attempted suicide. We hypothesized that suicide attempters would display decision-making deficits on the IGT compared to youths who have psychiatric symptoms but have never been suicidal. We expected these differences to persist even after controlling for group differences in psychiatric risk factors for suicidal behavior (e.g., depression) and personality traits (i.e., impulsivity, aggression, emotional lability) associated with the prefrontal cortex and suicidal behavior.^{5, 25, 29} Among suicide attempters, we explored whether decision-making performance was correlated with age at first attempt, time since last attempt, number of previous attempts, suicidal intent, violent vs. non-violent means of the index attempt,¹⁸ lethality of suicidal behavior, and the presence and severity of current suicidal ideation, as has been reported for adult suicide attempters.³⁰

Method

Sample

The sample comprised 40 youths, 13–18 years of age, who had attempted suicide and 40 youths, matched on age (± 1 year), sex, and race, who had never engaged in suicidal behavior nor had suicidal ideation. To be considered for the study, both groups had to have at least one parent or legal guardian who was available for direct interview and willing to participate in the study. The suicide attempters were a convenience sample recruited from local community behavioral health services and the emergency department of a large metropolitan children's hospital. Suicide attempt was defined as self-injurious behavior with stated or inferred intent to die, within one year of the recruitment date. Youths with other types of self-injurious behavior without the intent to die were excluded. Exclusion criteria for both groups included: IQ<70, non-English-speaking, and out of home placement.

Eligible youth suicide attempters (N=67) were identified from a pool of 154 patients who had agreed to be contacted about potential research opportunities. The overall study participation rate was 60% (N=40/67). Exclusion was due mainly to our inability to contact families (N=11, 16.4%) and to families not attending scheduled appointments (N=16, 23.9%). There were no significant differences in age, gender, or race between the attempters who participated in the study and those who agreed to participate but failed to show for appointments. Comparison subjects were recruited from an original pool of 296 youth receiving treatment for psychiatric concerns at the same treatment sites as attempters. Forty-nine eligible youth consented to the study and of these 82% (N=40) participated in the study; all nine non-participants had failed to attend scheduled appointments. No differences were found between participants and non-participants with respect to age, race, and gender.

The study was approved by the Institutional Review Board of The Research Institute at Nationwide Children's Hospital. Informed consent and assent were obtained from all participants and their parents (if the participant was under age 18).

Assessments

Demographic information was elicited from all subjects and parents using the General Information Sheet.³¹ Pubertal development was assessed using the Petersen Pubertal Development Scale,³² a self-report questionnaire with adequate reliability and validity against physical examination. IQ was assessed by the Kaufman Brief Intelligence Test (2nd Edition).³³

Lifetime history of suicide attempts was assessed using the Columbia University Suicide History Form.³⁴ Administered to both subjects and parents as a semi-structured interview, we inquired about number of suicide attempts, methods, medical lethality, and triggering events. The Pierce Suicide Intent Scale,³⁵ administered when a history of suicide attempt was reported, assesses all relevant behavioral and circumstantial aspects surrounding the suicide attempt, including plans, preparation, and lethality. Suicide methods involving a firearm, hanging, asphyxiation, deep cutting, jumping from a height, or drowning were considered as violent attempts, whereas superficial cutting, drug overdose and gas inhalation were considered non-violent means, per the criteria of Asberg et al.³⁶

Psychiatric problems in youths were established using the DSM-oriented scales of the Child Behavior Checklist;^{37, 38} the borderline cut-point (T score ≥ 65) was used to indicate the presence of a DSM disorder.³⁷ Severity of depression was assessed by using the Beck Depression Inventory Fast-Screen for Medical Patients;³⁹ participants were considered to be euthymic if their total score was < 4 , indicating a normal mood state. The frequency of alcohol or substance use was assessed by the Drug Use Screening Inventory.⁴⁰ Family history of suicidal behavior was assessed from a series of questions adapted from the Family History Screen.⁴¹ Psychotropic medication history was assessed by the Services Assessment for Children and Adolescents.⁴²

Aggression was rated using the Buss-Perry Aggression Questionnaire-Short Form.⁴³ Impulsivity was assessed using the Barratt Impulsiveness Scale-Adolescent version,⁴⁴ a downward extension of the widely used adult Barratt Impulsivity Scale.⁴⁵ In this study, only the total score was calculated as it has been recommended as the most appropriate index of impulsivity for research with adolescents.⁴⁴ Emotional lability was assessed with the Children's Affective Lability Scale, a parent report measure of child mood lability with two subscales (angry/depressed, disinhibited/impersistent) that tap distinct aspects of affect regulation.⁴⁶

Iowa Gambling Task (IGT)—Decision-making was tested using the computerized version of the IGT, which simulates real-life decision making.^{13, 16, 17} The IGT has been used in numerous research studies of adolescents, and it has been shown to be a highly sensitive measure of impaired decision-making in a variety of psychiatric conditions in youths.^{47–49} However, to our knowledge, there has been no formal validation study of this task in adolescents. During the IGT, participants start with \$2000 and are told the goal is to win as much money as possible by selecting one card at a time from four decks of cards (labeled A', B', C', and D') displayed on the screen. All subjects picked 100 cards but were not told beforehand how many card selections would be made. Subjects were informed that some decks were worse than others and that they were free to switch from one deck to another at any time, and as often as they wished. After each card selection, the subject won money but occasionally also lost money. Unknown to the subjects, the schedule of monetary gain (reward) and loss (punishment) was preset such that every card selection from deck A' or B' resulted in a \$100 win on average and every card selection from deck C' or D' resulted in a \$50 win; however, the punishment was set to be higher in decks A' and B' and lower in decks C' and D'. In decks A' and B' the subject encountered a total loss of \$1250 in every 10 cards. In decks C' and D' the subject encountered a total loss of \$250 in every 10 cards. In the long run, choosing mainly from the disadvantageous decks A' and B' resulted in a net loss, whereas choosing from the advantageous decks C' and D' resulted in an overall net gain.

The total net score on the IGT was calculated for each participant as the difference between the total number of card selections from advantageous decks (decks C' + D') and the total number of card selections from disadvantageous decks (decks A' + B').⁵⁰ Similarly, for

each block of 20 cards the block score was equal to $[(\text{decks C}' + \text{D}') - (\text{decks A}' + \text{B}')]$. The total net score can range from -100 to 100 ; the range for each block score is -20 to 20 . Positive total net scores and block scores indicate that decision-making performance was advantageous. Negative total net scores and block scores indicate that decision-making performance was disadvantageous.

Statistical Analysis

Demographic and clinical characteristics were compared between attempters and comparison subjects by using t tests, χ^2 , and Fisher's exact test, as appropriate. A Mann-Whitney U test was used to test for group differences in IGT total net scores and block scores because the Shapiro-Wilk normality test indicated significant deviation from a normal distribution. Because the two groups were matched one-to-one, we also examined decision-making using the Wilcoxon signed-rank tests for paired samples. Matched results were very similar to unmatched results and so results shown are unmatched, since these are easier to display. Group differences in the proportion of disadvantageous card selections in the final block relative to the first block of the IGT were examined using a two-way repeated-measure analysis of variance. Spearman rank correlations were computed to assess associations between the IGT total net score and variables that differed significantly between groups, and, among attempters, with scales measuring different personality dimensions. We used exact conditional logistic regression to assess whether the IGT total net score contributed independently to the prediction of suicide attempt status beyond the effect of other predictors, per the recommendations of Cohen⁵¹ and the approach of Nock et al.⁵² In this hierarchical analysis, clinical factors that significantly differentiated attempters and comparison subject were entered in the first step, and performance on the IGT was entered in the second step. All statistical tests were two-tailed, and p values < 0.05 were considered statistically significant. Statistical analyses were conducted with SPSS, version 19.0 (IBM SPSS Statistics, Somers, N.Y.) and LogXact-7 (Cytel Inc., Cambridge, MA).

Results

Demographic and Clinical Comparisons

The demographic and clinical characteristics of the subjects are presented in Table 1. The study sample was 75% female, 70% white non-Hispanic, and the mean (SD) age was 15.6 (1.3) at the index date. Suicide attempters made their first attempt around the age of fourteen years (mean $\pm$ SD, 14.4 $\pm$ 2.2 years). More than half made multiple suicide attempts (55%), with maximum self-reported suicidal intent in the moderate severity range (mean $\pm$ SD, 4.6 $\pm$ 1.8). On average, the last suicide attempt occurred 3.8 months before the assessment (range, 0–11). There were no significant differences between the groups in IQ, pubertal level, and household income. Suicide attempters and comparison subjects had similar rates of anxiety, somatic, and behavioral disorders, but attempters had significantly higher rates of affective disorders. Suicide attempters had higher rates of any current psychotropic medication use than comparison subjects.

Attempters had higher mean scores on the Barratt Impulsivity Scale (74.0 [SD=11.6] vs. 68.6 [SD=10.5], $t=2.18$, $df=78$, $p=0.033$) and on the Buss Perry Aggression Questionnaire-Short Form hostility subscale (7.4 [SD=3.9] vs. 4.9 [SD=3.4], $t=3.06$, $df=76$, $p=0.003$), indicating greater impulsivity and hostility in attempters than the comparison subjects. There were no group differences on any other aggression subscale or the total aggression score. As well, there were no differences on the overall parent-rated Children's Affective Liability Scale score or either subscale.

Iowa Gambling Task (IGT) Performance

There was a significant difference between the attempters and comparison subjects for the mean overall net score on the IGT (-11.2 [$SD=23.1$] vs. 1.4 [18.2]; Mann Whitney $U=531.5$, $p=0.010$) (Table 2). Regarding intermediate scores, there were significant group differences for the third score (41st to 60th card choice; Mann Whitney $U=592.0$, $p=0.044$) and the last score (81st to 100th card choice; Mann Whitney $U=516.5$, $p=0.006$). As Figure 1 shows, both groups began by choosing mainly from the disadvantageous decks. Comparison subjects switched to a preference for the advantageous decks between draws 21 and 40 and maintained that preference for the remainder of the task, whereas attempters, on average, showed no evidence of improvement as the task progressed. To quantify how attempters and comparison subjects learned during the task, we calculated the proportion of disadvantageous card selections in the final block (81st to 100th trials) relative to the first block (1st to 20th trials). A two-way repeated-measures analysis of variance revealed a significant effect of group ($F=6.21$, $df=1,78$, $p=0.015$), a non-significant trend for block ($F=3.82$, $df=1,78$, $p=0.054$), and a significant interaction ($F=4.81$, $df=1,78$, $p=0.031$), indicating that the attempters picked approximately the same proportion of disadvantageous cards in the first and final blocks (0.57 [$SD=0.10$] vs. 0.58 [$SD=0.19$], $t=0.18$, $df=39$, $p=0.86$), whereas comparison subjects picked proportionately less from the disadvantageous decks in the final block as compared with the first block (0.56 [$SD=0.08$] vs. 0.48 [$SD=0.16$], $t=-2.83$, $df=39$, $p=0.007$).

The net score for the IGT was not correlated with IQ ($r_s=0.13$, $n=80$, $p=0.27$), current euthymia ($r_s=-0.03$, $n=80$, $p=0.77$), or any clinical variable that differed significantly between attempters and comparison subjects (Table 3).

Hierarchical Exact Conditional Logistic Regression

We conducted a hierarchical exact conditional logistic regression analysis to examine the multivariate association between decision-making and attempted suicide (Table 4). All clinical factors that significantly differentiated attempters and comparison subjects were entered in the first step of the analysis (model 1). Current psychotropic medication use was the only clinical variable that remained a significant predictor of suicide attempt status in model 1 (exact $p=0.01$). In the second step of the analysis (model 2), the IGT total net score was significantly associated with suicide attempt status (exact $p<0.05$) after controlling for affective disorder, current psychotropic medication use, impulsivity, and hostility.

Sensitivity Analysis

To assess the potential bias resulting from inclusion of suicide attempters with brain injury suffered during the index attempt, we identified only one attempter in our study whose attempt had the potential to result in cognitive impairment. We conducted an analysis excluding this one attempter who had made a highly lethal drug overdose. The difference in decision-making performance between groups remained statistically significant (Mann Whitney $U=515.5$, $p=0.009$) after excluding this attempter.

IGT Performance and Characteristics of the Suicide Attempters

Overall decision-making performance was not correlated with age at first attempt, lethality of most recent attempt, violent vs. non-violent means of the index attempt, number of previous attempts, time since most recent attempt, current suicidal ideation, or either of the Suicide Intent Scale subscales (all p -values >0.20). The net score on the IGT was not correlated with the personality dimensions of impulsivity, hostility, or emotional lability (all p -values >0.20).

Discussion

Our findings show a clear relationship between impaired decision-making and attempted suicide among adolescents. Suicide attempters made more overall disadvantageous choices on the IGT relative to never-suicidal psychiatric comparison subjects. Findings of impaired decision-making remained significant even after accounting for differences in affective disorder, psychotropic medication use, impulsivity, and hostility between attempters and comparison subjects. Attempters failed to learn an advantageous decision-making strategy during the task, and instead selected cards from the disadvantageous decks at about the same rate at the beginning and end of the task. In contrast, the first block served as a learning period for the comparison subjects, who shifted their selections to primarily advantageous cards as the task progressed.

To our knowledge, this is the first report on the association between impaired decision-making and attempted suicide in adolescence. These findings are consistent with those in the adult literature demonstrating a link between impaired decision-making and attempted suicide.^{18–22} This deficit in decision-making seems to be related to youth suicidal behavior broadly and not to a specific subgroup, since we found no correlation between decision-making performance and any characteristic of the attempt. In two recent studies, no impairment in decision-making on the IGT was reported in adolescents with a history of deliberate self-harm (self-injury or self-poisoning)²⁷ or among youth engaging in non-suicidal self-injury,⁵³ defined as an act of deliberate destruction of one's own body tissue without intent to die.²⁸ These divergent findings from the present study may be explained by the differences between youth who engage in non-suicidal self-injury and those who engage in suicide attempts. In both of the studies, half or fewer of those who engaged in non-suicidal self-injury reported a history of a suicide attempt. Since the motivation of non-suicidal self-injury is usually emotion regulation without an intention to die, it is not surprising that our results differed from these two studies.

The converging evidence thus supports a strong link between impaired decision-making and attempted suicide in adolescents that is distinct from impulsivity and hostility, since both trait behaviors differed between the groups but were unrelated to decision-making performance in suicide attempters. However, our data cannot disentangle the exact mechanism by which decision-making deficits increase susceptibility to suicidal behavior, or if this is an enduring trait, or one that can be modified. Although we and others have found no association between IGT performance and depressed mood,¹⁸ other studies of adults have shown a deterioration in problem-solving during depressed mood induction in those depressed patients with a history of serious suicidal ideation or suicidal behavior.⁵⁴

These findings suggest that clinicians should pay particular attention to decision-making abilities in youths at risk for suicide because dysfunctional decision-making may increase vulnerability to suicidal behavior above and beyond that conferred by depression, impulsivity, or hostility. In addition, performance on the IGT involves several different cognitive functions, and some investigators have begun to deconstruct this task into component parts.^{48, 55} It will be important in the future to identify which components of the IGT show impairment associated with suicidal behavior. Such findings may be of use in screening adolescents for suicidal risk and in framing clear targets for intervention. Furthermore, preliminary studies suggest that decision-making, as measured by the IGT, can be modified with psychosocial⁵⁶ or pharmacological⁵⁷ interventions. Thus, the present findings also suggest that the IGT could be used as a treatment outcome variable in studies of preventive interventions among those at high risk for suicidal behavior.

This study has several potential limitations. First, all participants were seeking outpatient behavioral health treatment or emergency services at a single metropolitan children's hospital. Second, the sample of suicide attempters was drawn from a pool of patients who had agreed to be contacted about research opportunities and only 60% of eligible attempters were studied. These issues of sample selection may affect the generalizability of our findings and suggest that the effects observed in this study may underestimate the association between decision making and suicidal behavior in the general population. A further limitation was that our sample was primarily female, which, although consistent with the epidemiology of non-fatal suicidal behavior in youth,⁵⁸ requires that these results be confirmed in larger more representative samples of male suicide attempters. We did not conduct structured diagnostic interviews with participants but instead elicited information about youth psychiatric problems only by parent report. Although this methodology has been shown to have high reliability and validity,³⁸ research indicates that parents of adolescent suicide attempters underestimate major depression, anxiety disorders, and non-aggressive conduct symptoms, but demonstrate high agreement with youth informants on reports of alcohol/substance abuse and disruptive behavioral disorders.⁵⁹ It is therefore possible that the difference in rates of affective disorders between attempters and comparison subjects was even larger, and we may have failed to detect differences between the groups in anxiety disorders and conduct problems because of our reliance on parental informants. Another limitation is that the IGT has not been formally validated in adolescents and there are no normative data available in children or adolescents to allow more accurate interpretations regarding impaired performance on the IGT.⁵⁰ Finally, our study protocol would have ideally employed other neurocognitive tests that engage different brain regions to serve as comparator tasks to the IGT, as executive function, attention, and memory deficits have been linked to risk for suicidal behavior.⁶⁰

In conclusion, the results of this study add to a growing body of evidence that decision-making impairments may play an important role in increasing vulnerability to suicidal behavior. Future research should use the IGT in larger samples of youth suicide attempters, include more boys, and use longitudinal designs to disentangle possible mechanisms. Prospective cohort studies of at-risk youth are needed to test the predictive effects of the association between decision-making processes and suicidal behavior and help to frame potential targets for early identification and preventive interventions to reduce adolescent suicide and suicidal behavior.

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Figure 1.
Changes in Performance on the Five Blocks of the Iowa Gambling Task for Suicide Attempters and Never-Suicidal Comparison Subjects

TABLE 1
Demographic and Clinical Characteristics of Adolescent Suicide Attempters and Never-Suicidal Comparison Subjects

Characteristic	Suicide Attempters (N=40)		Comparison Subjects (N=40)		Analysis		
	Mean	SD	Mean	SD	Statistic	df	P
Age (years) ^a	15.5	1.4	15.6	1.4	t=-0.28	78	0.81
IQ	97.3	14.7	98.3	13.8	t=-0.29	78	0.77
Pubertal level, boys	3.4	0.5	3.3	0.6	t=0.58	18	0.57
Pubertal level, girls	3.5	0.4	3.6	0.3	t=-0.43	58	0.67
Suicide history							
Age at first attempt, yr.	14.4	2.2					
Lethality of most recent attempt	2.1	1.9					
Number of previous attempts	1.9	1.1					
Time since last suicide attempt, mo.	3.8	2.3					
Suicide intent scale, circumstances	3.5	2.5					
Suicide intent scale, self-report	4.6	1.8					
BIS-A total score	74.0	11.6	68.6	10.5	t=2.18	78	0.03
BPAQ-SF							
Physical Aggression	5.9	4.5	4.9	4.5	t=1.00	78	0.32
Verbal Aggression	6.6	4.7	6.7	3.9	t=-0.15	77	0.88
Anger	6.4	4.4	6.0	4.4	t=0.40	77	0.69
Hostility	7.4	3.9	4.9	3.4	t=3.06	76	0.003
Total Score	26.3	14.9	22.5	14.3	t=1.18	78	0.24
Children's Affective Liability Scale							
Disinhibited/Impersistent	6.7	4.4	6.1	6.6	MWU=634.5		0.11
Angry/Depressed	12.8	8.3	13.5	13.3	MWU=718.5		0.43
Total Score	18.6	11.1	19.1	19.0	MWU=696.0		0.32
Sex, % Female ^a	N	%	N	%			
	30	75.0	30	75.0			
Race/ethnicity ^a							
White, non-Hispanic	28	70.0	28	70.0			

Characteristic	Suicide Attempters (N=40)	Comparison Subjects (N=40)	Analysis
Black	10	25.0	10 25.0
Other race	1	2.5	1 2.5
Hispanic	1	2.5	1 2.5
Household income, >\$50,000/year	15	37.5	14 35.0 $\chi^2=0.1$ 1 0.82
CBCL DSM-Oriented Scales			
Affective disorders	28	70.0	16 40.0 $\chi^2=7.3$ 1 0.007
Anxiety disorders	14	35.0	14 35.0 $\chi^2=0.0$ 1 1.0
Somatic disorders	12	30.0	15 37.5 $\chi^2=0.5$ 1 0.48
Any behavioral disorder ^b	24	60.0	20 50.0 $\chi^2=0.8$ 1 0.37
Euthymic participants ^c	22	55.0	30 75.0 $\chi^2=3.5$ 1 0.06
Current psychotropic medication use ^d	30	75.0	13 32.5 $\chi^2=14.5$ 1 <0.001
Current alcohol or substance ^e use	16	40.0	15 37.5 $\chi^2=0.1$ 1 0.82
Family history of suicidal behavior	13	32.5	10 25.0 $\chi^2=0.5$ 1 0.46
Violent method of suicide attempt	8	20.0	
Any current suicidal ideation ^f	11	29.0	

^aComparison subjects were matched to suicide attempters on age ($\pm$ 1 year), sex, and race/ethnicity.

^bIncludes attention deficit hyperactivity disorder, oppositional defiant disorder, and conduct disorder.

^cBased on Beck Depression Inventory-FastScreen total score <4, indicating minimal depressive symptoms.

^dIncludes antidepressants, antipsychotics, antianxiety agents, mood stabilizers, and stimulants.

^eIncludes marijuana, cocaine, amphetamine, lysergic acid diethylamide (LSD)/mescaline, tranquilizers, heroin/opiates, phenylcyclidine (PCP), or gases/fumes.

^fBased on score from the Beck Depression Inventory-FastScreen suicidal ideation item.

BIS-A indicates Barratt Impulsivity Scale-Adolescent version; BPAQ-SF, Buss Perry Aggression Questionnaire-Short Form; CBCL, Child Behavior Checklist; MWU, Mann-Whitney U test.

TABLE 2
Iowa Gambling Task Performance in Suicide Attempters and Never-Suicidal Comparison Subjects

Characteristic	Suicide Attempters (N=40)		Comparison Subjects (N=40)		Analysis	
	Mean	SD	Mean	SD	Statistic	P-Value
Iowa Gambling Task performance [†]						
Block Score 1: card selections 1–20	–3.0	3.9	–2.5	3.3	MWU=749.5	0.62
Block Score 2: card selections 21–40	–1.3	4.1	1.0	4.8	MWU=630.5	0.10
Block Score 3: card selections 41–60	–2.2	5.8	1.3	6.7	MWU=592.0	0.04
Block Score 4: card selections 61–80	–1.7	7.7	0.6	7.4	MWU=694.5	0.31
Block Score 5: card selections 81–100	–3.2	7.6	1.0	6.4	MWU=516.5	0.006
Total Net Score	–11.2	23.1	1.4	18.2	MWU=531.5	0.01

[†] Number of advantageous cards minus number of disadvantageous cards.

MWU indicates Mann-Whitney *U* test.

TABLE 3

Spearman Rank Correlations among Iowa Gambling Task Net Score and Measures that Differed Significantly Between Attempters and Never-Suicidal Comparison Subjects (N=80)

	1	2	3	4
1. Iowa Gambling Task net score	-			
2. Current affective disorder	-0.19	-		
3. Current psychotropic medication use ^a	-0.16	0.42**	-	
4. Barratt Impulsivity Scale – Adolescent version total score	-0.17	0.07	0.08	-
5. Buss Perry Aggression Questionnaire – Short form hostility subscale	-0.21	0.24*	0.11	0.49**

^aIncludes antidepressants, antipsychotics, antianxiety agents, mood stabilizers, and stimulants.

*
 $P < .05$;

**
 $P < .01$

Summary of Hierarchical Exact Conditional Logistic Regression Analysis Predicting Suicide Attempt Status

TABLE 4

Variable	b	SE	Adjusted Odds Ratio	95% Confidence Interval	Exact P-Value
Model 1					
BPAQ-SF Hostility Subscale	0.18	0.12	1.20	0.962–1.580	0.1185
BIS-A Total Score	0.02	0.04	1.02	0.944–1.105	0.6879
Current psychotropic medication use	1.85	0.78	6.38	1.337–59.66	0.0132
Affective disorder ^a	0.08	0.66	1.08	0.233–4.884	1.0000
Model 2 [†]					
Iowa Gambling Task Total Net Score	−0.04	0.02	0.96	0.904–0.999	0.0495

BPAQ-SF indicates Buss Perry Aggression Questionnaire-Short Form; BIS-A, Barratt Impulsivity Scale-Adolescent version;

^aBased on the Child Behavior Checklist (CBCL) DSM-IV-Oriented Scales (borderline cut-off score, 7≥65)

[†]Model 2 includes all variables in Model 1 + Iowa Gambling Task Total Net Score