Laboratory Measured Behavioral Impulsivity Relates to Suicide Attempt History

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The purpose of this study was to examine the relationship between laboratory behavioral measured impulsivity (using the Immediate and Delayed Memory Tasks) and suicidal attempt histories. Three groups of adults were recruited, those with either: no previous suicide attempts (Control, \( n = 20 \)), only a single suicide attempt (Single, \( n = 20 \)), or multiple suicidal attempts (Multiple, \( n = 10 \)). As hypothesized, impulsive responses increased with the number of suicide attempts (Control \(<\) Single \(<\) Multiple). This study helps to demonstrate how laboratory behavioral measures of impulsivity can be used to discriminate groups based on suicidal histories among samples not currently exhibiting significant suicidal behaviors.

Research focusing on risk factors for suicidal behaviors is a major initiative in suicide prevention. Impulsivity is one significant underlying risk factor that has emerged from this research. Specifically impulsivity, which has been defined as “a predisposition toward rapid unplanned reactions to internal or external stimuli without regard to the negative consequences of these reactions to them-
are cost effectiveness, well-established psychometric properties, and face validity; however, because of the limitations, there is increasing interest in using laboratory behavioral impulsivity methods to augment the information gathered from self-report measures. Laboratory behavioral methods provide a more objective measure of impulsive behavior, and, in part, circumvent some of the problems related to self-report measures. Various types of laboratory measures can be used to relate specific types of impulsive responses (e.g., rapid-decision, reward-directed, and punishment and/or extinction paradigms) to specific patterns of behavior to account for variance that is unique from self-report methods (Dougherty, Mathias, & Marsh, 2003).

While there are a number of categorically distinct behavioral measures of impulsivity, some of the most popular measures are rapid-decision paradigms (see Dougherty, Mathias, & Marsh, 2003 for a review), which include continuous performance tests (CPT). The CPT typically requires a participant to identify a target stimulus among a series of ongoing stimuli that are presented briefly and rapidly. Commission errors, or responses incorrectly identifying a stimulus as a target (typically stimuli that resemble the target stimulus), are considered to be indicators of impulsivity (Halperin, Wolf, Greenblatt, & Young, 1991; Halperin et al., 1988; Sostek, Buchsbaum, & Rapoport, 1980; Sykes, Douglas, & Morganstern, 1973; Wohlberg & Kornetsky, 1973). Most researchers interpret commission errors as impulsive responses because they are thought to be rapid responses made prior to the complete processing of a stimulus. These measures are sensitive to state-dependent changes in impulsivity produced by drug administration and can discriminate between impulsive and non-impulsive populations. Support for this has been provided by a number of validity studies that have: (1) related the frequency of commission errors to self-report measures of impulsivity (Dougherty, Bjork, Huckabee, Moeller, & Swann, 1999; Marsh, Dougherty, Mathias, Moeller, & Hicks, 2002); (2) found that commission errors are elevated among populations thought to be impulsive (e.g., ADHD, conduct disorder; Dougherty, Marsh, Moeller, Chokshi, & Rosen, 2000; Dougherty, Bjork, Marsh, & Moeller, 2000; Dougherty, Mathias, et al., 2003; Halperin et al., 1988, 1991; Sostek et al., 1980; Sykes, Douglas, Weiss, & Minde, 1971); and (3) found increases in commission errors after the administration of drugs believed to increase impulsive behavior (Dougherty, Marsh et al., 2000; Dougherty, Moeller et al., 1999; Rohrbaugh et al., 1988; Smith, Kendrick, & Maben, 1992).

To date, only a single study has reported the use of a behavioral impulsivity measure among suicidal individuals. In this study, suicide attempters emitted more commission errors than non-attempters on a CPT (Horesh, 2001). However, commission error rates and self-report ratings (i.e., Child Suicide Potential Scale) of suicidal behavior severity were not significantly related. This may be due to the ease of the CPT (i.e., Test of Variables of Attention) because very few commission errors were made on the particular task used, which may have resulted in a floor effect. The suicide attempters in that study emitted only 3.8 percent commission errors on average. Researchers have criticized the measurement and interpretation of CPT performance where adults experience floor effects (Riccio, Reynolds, & Lowe, 2001). The current study was designed to extend previous CPT research with suicidal samples by using a more difficult version of the CPT which would more likely result in higher rates of impulsive-type responses (thereby avoiding potential floor effects).

In the current study we administered a modified CPT, the Immediate and Delayed Memory Tasks (IMT/DMT; Dougherty, 1999; Dougherty, Marsh, & Mathias, 2002), to three groups of adults reporting different histories of suicidal behavior: (1) multiple suicide attempts [Multiple], (2) single suicide attempt [Single], and (3) no suicide attempt [Control].
sized that the frequency of commission errors emitted would be related to the number of previous suicide attempts, since those who have multiple suicide attempt episodes experience a broader range, longer duration, and generally more severe symptoms of psychological distress (Mazza, Herting, Pike, & Eggert, 2003; Rudd, Joiner, & Rajab, 1996), suicidal crises (Joiner, Rudd, Rouleau, & Wagner, 2000), and externalizing behaviors (Stein, Apter, Ratzoni, Har-Even, & Avidan, 1998) than those with single attempt histories. Specifically, we hypothesized that suicide attempters with repeated attempts would emit more commission errors than those with only a single suicide attempt, and that those with only a single attempt would emit more commission errors than individuals with no suicide attempt history (Multiple > Single > Control).

METHOD

Participants

Fifty adults were recruited from the community using newspaper advertisements for paid research volunteers (no reference to suicide was included in the advertisement). Respondents completed a brief telephone screening interview during which demographic and general physical and mental health information was gathered, as well as preliminary information about any suicide attempt and/or psychiatric history. Respondents were not considered for participation if they reported current medication or recent drug use or any significant medical history or DSM-IV Axis I disorder. Additionally, for the Single or Multiple groups, a diagnosis of a depressive disorder was not exclusionary as long as there was no evidence of a depressive episode within the past 2 years; those who were previously treated or diagnosed with any other psychiatric illness (e.g., bipolar disorder) did not qualify for a more in-depth on-site interview.

Respondents who appeared to meet criteria for the study were invited for an on-site screening interview. This interview included a number of questionnaires and structured interviews to determine current and past drug/alcohol use, medical history, socioeconomic status, and psychiatric history/status. These screening measures included: the Beck Anxiety Inventory (BAI; Beck, Epstein, Brown, & Steer, 1988), the Beck Depression Inventory (BDI; Beck & Steer, 1993); the Structured Clinical Interview for the DSM-IV (SCID-I/P for Axis I Disorders; First, Spitzer, Gibbon, & Williams, 1996), and the Structured Clinical Interview II modules for antisocial and borderline personality disorders (SCID-II; First, Gibbon, Spitzer, Williams, & Benjamin, 1996). Exclusionary criteria included any significant medical condition, a major depressive episode that occurred within 2 years of participation, any current Axis I disorder other than substance abuse, or antisocial or borderline personality disorder.

Those who qualified were invited to participate in the study, which lasted from 8:00 AM to 4:30 PM. Prior to participation written informed consent was obtained from the subjects. This study was approved by the university’s Institutional Review and was performed in accordance with the ethical standards of the 1964 Declaration of Helsinki. All subjects provided a urine sample for drug testing (Syva RapidTest d.a.u. TM 4, assay; Cupertino, CA) and an expired-air sample for alcohol intoxication testing (Intoximeter, model 3000-II; St. Louis, MO). Across the day, subjects completed the laboratory behavioral impulsivity measure (IMT/DMT, described below) along with a number of self-report measures of mood, impulsivity, and aggression. Subjects earned approximately $60.00 for their participation.

Group Classification

Subjects were classified into one of three groups based on their history of suicide attempts reported on the Lifetime Parasuicide Count-2: healthy volunteers with no history of suicide attempts (Control; n = 20), those with one suicide attempt (Single, n =
20), and those with more than one suicide attempt (Multiple, \( n = 10 \)).

**Lifetime Parasuicide Count-2.** Information about an individual’s history of suicide attempts was obtained using the Lifetime Parasuicide Count-2 (LPC-2; Linehan & Comtois, 1996). The LPC-2 is a 16-item interview assessing frequency and degree of suicidal behaviors and nonsuicidal self-harm by 11 different methods (e.g., “cut self,” “burned self,” “swallowed poison;” Linehan & Comtois, 1996). Frequency count is obtained for the number of suicide episodes with: (1) intent to die, (2) ambivalence about intent to die, (3) no intent to die, and (4) number of episodes requiring medical attention. A suicide attempt was defined as a self-harm behavior with a definite intent to die. Self-harm behaviors where there was no intent, or ambivalence about intent, to die were not considered suicide attempts and participants reporting these ambiguous episodes were excluded from participation. The LPC-2 was developed for use with adolescents with borderline personality disorder. There is no published reliability data. Validity is indicated by elevated suicidal behavior counts among outpatient adolescents with anxiety disorders, major depression, and borderline personality disorder (Velting & Miller, 1998).

**Physical Apparatus**

Participants completed behavioral testing in a 1.8 \( \times \) 1.8 m sound-insulated chamber, equipped with an IBM-compatible monitor, a 2-button computer mouse, and a ventilation fan providing masking noise. Software programs controlled experimental sessions for each of the computer tasks, which were run on an IBM computer located in an adjacent room. Self-report questionnaires were completed in a private interview room.

**Immediate and Delayed Memory Tasks**

The IMT/DMT is a modified continuous performance test (CPT; Beck, Bransome, Mirsky, Rosvold, & Sarason, 1956; Cornblatt, Risch, Faris, Friedman, & Erleman-Kimling, 1988) designed specifically for measuring impulsive response characteristics in high functioning populations (Dougherty, Mathias, & Marsh, 2003). This computerized measure has two task components (IMT and DMT) that alternate in 5-minute testing blocks, with the IMT always presented first (i.e., IMT/DMT/IMT/DMT). A 30-second rest period between the testing blocks resulted in a session that lasted 21.5 minutes. The IMT/DMT yields three primary data: correct detections, commission errors, and response latencies.

**Immediate Memory Task:** In the IMT, a series of five-digit numbers (2.0 cm wide by 3.3 cm high) are presented on the monitor for 0.5 seconds and are separated by a 0.5-second inter-trial interval where the monitor is blank. Participants are instructed to “click the mouse button when the number you see in the middle of the screen is identical to the one you saw just before it.... Your performance will be monitored and you will earn points based on how accurately you perform” (Dougherty & Marsh, 2003, p. 43). There are three primary types of stimuli: target, catch, and filler. A target stimulus is a 5-digit identical match to the preceding stimulus and responses to these stimuli are correct detections. A catch stimulus is similar to the preceding stimulus (differing by a single digit, with placement and value determined randomly), and responses to these similar stimuli are commission errors. Commission errors are the primary variable of interest because these types of errors, as discussed above, have been found to be elevated in impulsive populations. These types of errors are thought to be the result of an inability to refrain from responding before completely processing a stimulus (Dougherty, Marsh, et al., 2000). A filler stimulus is a randomly generated non-matching number and responses to these stimuli are called filler errors (typically occurring infrequently; < 2%). A filler stimulus was always presented following target or catch stimulus pairs. Trials following a filler stimulus were set at presentation rates of 33% for target, 33% for catch, and 34% for filler stimuli.
**Delayed Memory Task.** The DMT is similar to the IMT, but the participant must retain and compare stimuli spanning a longer period of time. Successive stimuli to be compared (i.e., 5-digit numbers) are separated by a 3.5-second period where the repetitive stimulus (always “12345”) is presented three times at the same rate and duration as the other stimuli (0.5 seconds on and off). For example, a target sequence would be: 82037 ... 12345 ... 12345 ... 12345 ... 82037.

**Self-Report Instruments**

Three self-report instruments were completed to better characterize the groups and to contrast these more traditional methods of assessment (i.e., retrospective self-reported impulsivity and aggression toward self and/or others) with our objective laboratory measure of impulsivity (IMT/DMT).

**Barratt Impulsiveness Scale (BIS).** The BIS (Patton, Stanford, & Barratt, 1995) is a questionnaire on which participants rate their frequency of several common impulsive (e.g., “I do things without thinking”) or nonimpulsive (“I am self-controlled”) behaviors/traits on a scale from 1 (rarely/never) to 4 (almost always/always). The 11th version of the BIS used in this study consists of 30 questions shown to have validity in a factor structure analysis (Patton, Stanford, & Barratt, 1995); scores can range from 30 to 120, with higher scores indicating greater impulsivity. This self-report instrument has been extensively tested for reliability and validity (Stein, Hollander, Simeon, & Cohen, 1994; Wiehe, 1987).

**Buss-Perry Aggression Questionnaire (BPAQ).** The BPAQ (Buss & Perry, 1992) is one of the best known and most frequently used self-report inventories for assessing hostility and aggression. Scores can range from 29 to 145 on this 29-item questionnaire where higher scores indicate higher aggressive behavior. This questionnaire contains brief statements (e.g., “once in a while I can’t control my urge to strike another person”) to which a rater assigns a number, from 1 to 5 where 1 = Not like me at all to 5 = A lot like me.

**Life History of Aggression (LHA).** The LHA includes 11-items pertaining to the frequency counts of aggressive, antisocial acts, and violent episodes in the participant’s past (Coccaro, Berman, & Kavoussi, 1997). Items are scored by type (e.g., physical fighting, verbal fighting, assaults on self, etc.) and frequency of aggressive acts (i.e., 0 to 10 or more assessed on a 5-point scale). Scores can range from 0 to 55, where higher total scores indicate a more aggressive history. Review of suicide literature indicates a moderate correlation between aggression and suicide, a relationship moderated by impulsivity, among other factors (Plutchik & van Praag, 1997).

**Data Analysis**

We hypothesized that the degree of impulsive responding would be expressed in an increasing order of magnitude according to the number of previous suicide attempts (Controls < Single < Multiple). An increased level of impulsivity would be demonstrated by greater rates of commission errors on the IMT and DMT.

Data were initially analyzed with $3 \times 2$ (Group × Testing Block) between-within ANOVAs for each dependent variable (i.e., correct detections, commission errors, and latencies) of the IMT and DMT tasks to determine whether there were performance differences across time (i.e., between blocks). No main effects or interactions of Testing Block were found and all data were collapsed across the two blocks and re-analyzed with one-way between-groups ANOVAs. Because all hypotheses included specific directional predictions, follow-up comparisons were made with one-tailed, paired-comparison $t$-tests. Significance criterion for all comparisons was set at $p < .05$. To compare the magnitude of group differences for the impulsivity variables of interest, estimates of effect sizes were calculated as Cohen’s $f$ (Cohen, 1988).

**RESULTS**

A summary of the group characteristics appears in Table 1. There were no significant
TABLE 1
Demographic Characteristics for the Three Experimental Groups

<table>
<thead>
<tr>
<th>Demographic Characteristics</th>
<th>Control</th>
<th>Single</th>
<th>Multiple</th>
</tr>
</thead>
<tbody>
<tr>
<td>n = 20</td>
<td>n = 20</td>
<td>n = 10</td>
<td>p</td>
</tr>
<tr>
<td>Age</td>
<td>28.30 (6.1)</td>
<td>31.15 (6.9)</td>
<td>28.00 (5.0)</td>
</tr>
<tr>
<td>Education Level</td>
<td>12.95 (1.4)</td>
<td>12.08 (2.0)</td>
<td>11.20 (1.7)</td>
</tr>
<tr>
<td>Gender</td>
<td>1.000‡</td>
<td>Female</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Male</td>
<td>8</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>.282‡</td>
<td>African American</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Caucasian</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hispanic</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Asian</td>
<td>0</td>
</tr>
</tbody>
</table>

a M(SD)
b Frequency count
c Univariate Analysis of Variance, follow-up comparisons with pair-wise t-tests
‡ Kruskal-Wallis test.

Differences between the groups in terms of age, gender, or ethnicity; however, the Multiple group reported slightly fewer years of completed education than the Control group (mean difference = 1.75 years). To confirm group classification, an analysis was performed confirming a statistically significant difference between the groups for number of suicide attempts, $F(2,47) = 486.45, p < .001$; Multiple, $M = 2.2$ attempts.

Seventy potential participants were invited to the laboratory for an in-depth screening interview prior to being invited to participate in the study. Of these, 20 were excluded: ten for mood disorders (major depressive disorder: Control = 1, Single = 1, Multiple = 6; generalized anxiety disorder: Control = 1; Multiple = 1), one for alcohol dependence (Multiple = 1), six for failed drug test (Control = 4; Single = 1, Multiple = 1), and one for personality disorder (antisocial personality disorder, Control = 1).

Analyses of self-report characteristics without suicide attempts, and there was an orderly increase in the percentage of commission errors across the Control, Single, and Multiple groups, respectively (see Fig. 1, bottom panels). There was a significant main effect of Group on both the IMT, $F(2,47) = .24, p = .787$, correct detections.

Correct Detections. As expected from this high-functioning sample, all groups correctly identified matching stimuli at high rates and there were no between-group differences. The percentage of correct detections for the IMT and DMT are shown in Figure 1 (top panels). The main effect of Group was not significant for the IMT, $F(2,47) = .04, p = .964$, or DMT, $F(2,47) = .24, p = .787$, correct detections.

Commission Errors. As hypothesized, there were more IMT and DMT commission errors committed by individuals with previous suicide attempts compared to those without suicide attempts, and there was an orderly increase in the percentage of commission errors across the Control, Single, and Multiple groups, respectively (see Fig. 1, bottom panels). There was a significant main effect of Group on both the IMT, $F(2,47) = .24, p = .787$, correct detections.
TABLE 2
Mean and Standard Deviation of the Self-Report Measures for the Three Experimental Groups

<table>
<thead>
<tr>
<th></th>
<th>Control n = 20</th>
<th>Single n = 20</th>
<th>Multiple n = 10</th>
<th>p*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beck Anxiety Inventory</td>
<td>2.71 (4.3)</td>
<td>10.47 (9.1)</td>
<td>14.20 (7.3)</td>
<td>&lt;.001 c,b &gt; a</td>
</tr>
<tr>
<td>Beck Depression Inventory</td>
<td>4.59 (7.3)</td>
<td>15.35 (10.6)</td>
<td>16.30 (19.6)</td>
<td>.020 c,b &gt; a</td>
</tr>
<tr>
<td>Barratt Impulsiveness Scale</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attentional</td>
<td>15.06 (3.6)</td>
<td>17.11 (3.1)</td>
<td>18.00 (4.9)</td>
<td>.116</td>
</tr>
<tr>
<td>Motor</td>
<td>21.24 (3.6)</td>
<td>24.79 (3.5)</td>
<td>28.67 (5.6)</td>
<td>&lt;.001 c,b &gt; a</td>
</tr>
<tr>
<td>Non-Planning</td>
<td>22.53 (5.0)</td>
<td>26.37 (4.2)</td>
<td>25.20 (6.2)</td>
<td>.082</td>
</tr>
<tr>
<td>Total</td>
<td>58.83 (9.9)</td>
<td>68.27 (9.3)</td>
<td>71.87 (20.6)</td>
<td>.061</td>
</tr>
<tr>
<td>Buss-Perry Aggression Questionnaire</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical</td>
<td>20.11 (8.6)</td>
<td>24.94 (9.5)</td>
<td>26.00 (9.2)</td>
<td>.159</td>
</tr>
<tr>
<td>Verbal</td>
<td>13.05 (6.0)</td>
<td>14.78 (4.5)</td>
<td>15.90 (3.6)</td>
<td>.317</td>
</tr>
<tr>
<td>Hostility</td>
<td>16.05 (3.6)</td>
<td>21.67 (10.0)</td>
<td>22.00 (8.3)</td>
<td>.054</td>
</tr>
<tr>
<td>Anger</td>
<td>17.89 (19.4)</td>
<td>19.50 (8.4)</td>
<td>20.00 (6.4)</td>
<td>.877</td>
</tr>
<tr>
<td>Total</td>
<td>67.11 (30.9)</td>
<td>80.89 (27.1)</td>
<td>84.40 (28.7)</td>
<td>.202</td>
</tr>
<tr>
<td>Lifetime History of Aggression</td>
<td>11.00 (8.0)</td>
<td>15.58 (11.4)</td>
<td>26.60 (10.5)</td>
<td>.001 c &gt; a,b</td>
</tr>
</tbody>
</table>

* = Univariate Analysis of Variance, follow-up comparisons with pair-wise t-tests

Figure 1. Percentage of correct detections (top) and commission errors (bottom) for the Immediate and Delayed Memory Tasks. Error bars represent the SEM.
Dougherty et al. 10.74, $p < .001$, $f = .677$; ANCOVA (education): $p = .002$, and the DMT, $F(2,47) = 10.82$, $p < .001$, $f = .678$; ANCOVA (education): $p = .002$. (To account for possible group differences based on years of education, analyses of covariance were conducted for commission errors). Planned follow-up comparisons showed that commission error rates were elevated for the Multiple group compared to both the Single and Control groups [Single, IMT: $t(28) = 2.11; p = .011$; DMT: $t(28) = 2.39; p = .012$; Control, IMT: $t(28) = 4.44; p < .001$; DMT: $t(28) = 4.18; p = .001$], and the Single group also emitted more commission errors than the Control group [Control, IMT: $t(38) = 2.91; p = .003$; DMT: $t(38) = 2.37; p = .012$].

Response Latencies. Response latencies on both the IMT and DMT showed no group differences for either correct detections or commission errors (main effect of Group: $p > .13$).

DISCUSSION

Consistent with our hypothesis, performance on the laboratory behavioral measure of impulsivity varied as a function of suicide attempt histories. Specifically, there were significant differences between the three groups in terms of the proportion of impulsive-type responses on the Immediate and Delayed Memory Tasks, with the Multiple attempt group emitting the highest percentage of commission errors, followed by the Single, while the Control group had the lowest rate of impulsive responding.

This is the first study to report a relationship between behavioral impulsivity and the number of previous suicide attempts. The only other study to examine continuous performance test (CPT) performance among suicide attempters found a general increase in commission errors among those with attempts, although this was not related to severity of suicidal behaviors (Horesh, 2001).

In the current study, to relate the degree of previous suicidal behaviors to impulsivity, we sampled groups differing in number of suicide attempts. Previous research has noted that those with multiple attempts have higher ratings of distress than single attempters (e.g., Mazza et al., 2003; Rudd et al., 1996). Given the current findings, and previous studies comparing self-report measures between multiple and single suicide attempters, it appears that higher rates of suicidal behaviors are associated not only with psychological symptoms of distress but also with a general increase in impulsive behavior.

Another distinction between the current study and the one previous behavioral impulsivity study (Horesh, 2001) was the continuous performance test used. Horesh used the Test of Variables of Attention (TOVA), which is a CPT variant designed to diagnose ADHD in children, adolescents, and adults with attentional deficits. The TOVA used in the Horesh study resulted in low rates of commission errors (the suicide attempter group emitted only 3.8 percent commission errors on average, while non-attempters had only .38 percent commission errors). There are several limitations to using CPT variants that produce such low base rates and have a truncated range of impulsive performance. First, higher functioning samples like adults may experience a floor effect on these procedures (Riccio et al., 2001), obscuring any meaningful group differences. Second, a small range of commission error scores reduces the potential effect size thereby requiring a larger sample size to adequately test comparisons. Finally, even though Horesh suggests that CPTs may be potentially useful for demonstrating improvement following pharmacotherapy, a narrow range of commission errors allows little room for observing significant statistical change. Given these limitations and the curr-
rent findings, it appears that CPT versions like the IMT/DMT, which are sufficiently difficult to allow detection of orderly differences in impulsivity among higher functioning samples, may be particularly appropriate for the measurement of impulsivity among groups that vary in number of previous suicide attempts.

Despite the promise of the current findings, there were several limitations. First, the study resulted in unequal sample sizes. We found it difficult to recruit participants among the Multiple attempter group because many respondents with multiple suicide attempts were excluded from the study. This is not surprising since impulsive individuals are more likely to engage in behaviors that were exclusionary criteria and those with more frequent suicide attempts have higher rates of psychiatric disorders (Brent, Perper, Moritz, Baugher, & Allman, 1993) which were also exclusionary criteria in the current study. Besides unequal sample sizes, the exclusionary criteria may have inadvertently loaded the Multiple group with a relatively less impulsive sample than the general population of multiple suicide attempters. From this perspective, the current result may be a conservative estimate of population differences between those with and without suicide attempt histories. Another limitation is that there was a significant difference between the three groups in terms of years of education. The Control group was, on average, more educated than the Multiple group. Taking education into account with analyses of covariance, however, did not alter the statistical outcome of the between-group differences found for either the IMT or DMT task components.

A final limitation of the study is that, overall, there were more women than men sampled. This could limit the generalizability of the current findings; however, there was not a statistically significant difference within or between the groups in terms of gender. While this initial investigation was not powered to test for gender differences, ongoing research in our laboratory is designed to address the role of gender in the relationship between impulsivity and suicidal behaviors.

**CONCLUSION**

This is the first study to find that laboratory behavioral impulsivity is related to the degree of previous suicidal behaviors (as indicated by number of suicide attempts) and the results are consistent with theory of suicidal behavior. Our findings, that relatively higher rates of impulsive responding are found among those with multiple suicide attempts, is consistent with the escape theory of suicide (Baumeister, 1990), which suggests that the final stage before a suicidal crisis involves cognitive disinhibition, or a loss of impulse control. Because Multiple attempters may be more impulsive in general, as indicated by our findings, their threshold for progressing through this final stage of cognitive disinhibition may be lower. This would result in more frequent suicidal episodes. Future research may further test this hypothesis by comparing laboratory behavioral performance both during an acute suicidal episode (at initial hospitalization) and later during periods of more stabilized functioning. Ongoing research is being conducted in our laboratory to explore this repeated type of testing using multiple measures of laboratory behavioral impulsivity.

While the performance differences noted here suggest that behavioral impulsivity is related to the degree of previous suicidal behaviors, we are left with broader questions regarding the meaning of this relationship. First, what is impulsivity and how is it similar to or different from other concepts like disinhibition or sensation seeking? Encompassing key elements of previous definitions (Dickman, 1993; Eysenck & Eysenck, 1977; Hinslie & Shatzky, 1940; Patton et al., 1995; Smith, 1952), impulsivity can be defined as “a predisposition toward rapid, unplanned reactions to internal or external stimuli without regard to the negative consequences of these reactions to themselves or others” (Moeller et al., 2001, p. 1784). While this definition shares some level of overlap with processes like sensation seeking, novelty seeking, openness to experience, disinhibition, and cognitive deconstruction, this definition may be
specifically relevant to suicidal behaviors because it incorporates concepts of an action tendency and a diminished awareness of consequences. Both action and aversion to consequences may be a necessary component to explaining suicidal behaviors (Baumeister, 1990). Second, are various measures of impulsivity differentially related to suicidal behaviors? Impulsive behaviors may result from different etiological sources and not all impulsivity tasks are equally sensitive to group differences (Dougherty, Mathias, & Marsh, 2003). Any single test may assess one component of impulsivity and different aspects of suicidality may be differentially related to impulsivity, therefore, no approach should be used in isolation for assessment of the construct of impulsivity. Finally, what information does a continuous performance test provide that is clinically useful? The primary tool used in the current study (i.e., IMT/DMT) is a modification of a research tool that has a long history. Initially developed to assess performance in brain-damaged individuals (Beck et al., 1956), CPTs in general have focused on relatively low functioning samples, like young children (e.g. Forbes, 1998; Halperin et al., 1995) or adults with schizophrenia (e.g., Buchsbaum et al., 1992; Ito, Kanno, Mori, & Niwa, 1997). In contrast, our laboratory has developed a tool that is scalable to the ability level of the sample of interest (Dougherty et al., 2002). The IMT/DMT has been found to be sensitive among various psychiatric samples (e.g., bipolar disorder, borderline personality disorder, and substance abuse; Dougherty, Bjork et al., 1999; Moeller et al., 2002; Swann, Anderson, Dougherty, & Moeller, 2001) and even with healthy adults following consumption of alcohol (Dougherty, Marsh et al., 2000; Dougherty, Moeller et al., 1999). The purpose of this validation has been to address more fundamental questions regarding the role of impulsivity in various psychiatric disorders, in assessing treatment efficacy, and perhaps, predicting response to therapeutic interventions targeted for underlying impulsive deficits relating to psychiatric disorder. While suicidality appears to be related to aspects of the impulsivity construct, continued efforts emphasizing multiple measures of impulsivity will be necessary to fully describe this relationship.

REFERENCES


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Manuscript Received: August 27, 2003
Revision Accepted: March 19, 2004