Nonsuicidal Self-Injury: Relationship to Behavioral and Self-Rating Measures of Impulsivity and Self-Aggression

Michael S. McCloskey, PhD, Amy E. Look, MA, Eunice Y. Chen, PhD, Golnaz Pajoumand, PhD, and Mitchell E. Berman, PhD

Previous research using self-report measures has shown an association between nonsuicidal self-injurious behavior (NSSI) and impulsive tendencies. However, self-injurers have not been shown to be different from comparison groups on laboratory tasks putatively assessing impulsive behavior. One explanation for these contradictory findings is that self-report and laboratory measures of impulsive behavior tap into distinct but related constructs. Moreover, performance on laboratory measures of impulsive behavior can be influenced by myriad contextual and affective factors not present during past self-reported NSSI events. Accordingly, a relationship between behavioral tasks of impulsivity and self-injurious behavior could emerge if both are assessed relatively close in time under controlled laboratory conditions. To test this possibility, both self-ratings and laboratory task measures of self-injurious and impulsive behavior were employed in the current study. This multi-modal assessment approach revealed that self-rated impulsivity was associated with both self-report and behavioral measures of self-injurious behavior. Moreover, behavioral measures of impulsivity were associated with self-injurious behavior, but not NSSI history. These results provide support for the notion that a multi-modal approach to assessing self-injurious behavior is important for better understanding the correlates of nonsuicidal self-injury.

Although suicide has long been recognized as a serious public health concern (World Health Organization [WHO], 1992), less attention has been given to nonsuicidal self-injurious (NSSI) behavior. Defined as nonfatal acts of self-harm (e.g., cutting, burning, stabbing, hitting) that result in bodily injury without the intent to die (O’Carroll et al., 1996), NSSI appears to reflect psychopathology that is distinct from suicidal behavior. There are distinct differences between the two behaviors in terms of the reactions they evoke from others, the cognitions reported during the act, the aftermath, the demographics, and the prevalence rates (Muehlenkamp, 2005; Muehlenkamp & Gutierrez, 2004). Further, it is becoming increasingly evident that NSSI is both prevalent and associated with significant negative sequelae. Given these factors, there is a movement toward conceptualizing NSSI as a distinct syndrome in the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM; Muehlenkamp, 2005; Muehlenkamp & Gutierrez, 2004). Prevalence estimates of
NSSI in clinical populations range from approximately 20% to over 30% (Briere & Gil, 1998; Chowanec, Josephson, Coleman, & Davis, 1991), and are estimated to be as high as over 60% for adolescent inpatient samples (DiClemente, Ponton, & Hartley, 1991). NSSI also occurs in approximately 4% to 17% of nonclinical populations, with higher incidents reported among adolescents and young adults (Favazza, 2007; Klonsky, 2011; Klonsky, Olmanns, & Turkheimer, 2003; Whitlock, Eckenrode, & Silverman, 2006). Further, although NSSI is most often linked to borderline personality disorder (BPD), with upwards of 80% of BPD patients reporting a history of self-injurious behavior (Shearer, Peters, Quaytman, & Wadman, 1988), associations have also been found with several other clinical diagnoses, including substance abuse disorders, eating disorders, anxiety disorders, and mood disorders (Haw, Hawton, Houston, & Townsend, 2001; Zlotnick, Matta, & Zimmerman, 1999).

Impulsive tendencies, broadly defined, have long been thought to be associated with self-injurious behavior (Herpertz, Sass, & Favazza, 1997; Stanley, Gameroff, Michalsen, & Mann, 2001). Clinical populations known to engage in NSSI, such as those with BPD, also report higher levels of impulsivity and show increased levels of impulsivity on laboratory tasks (Dowson et al., 2004; McCloskey et al., 2009; Rentrop et al., 2008). Looking specifically at NSSI, individuals who self-injure score higher on self-ratings of impulsivity (Glenn & Klonsky, 2010; Janis & Nock, 2009). However, in contrast to BPD and other clinical populations, there is limited research on the relationship between NSSI and responses on laboratory measures of impulsivity. The few studies that specifically compare NSSI and non-NSSI groups on behavioral impulsivity tasks found no group differences on laboratory measures of behavioral disinhibition or risky decision making (Glenn & Klonsky, 2010; Janis & Nock, 2009).

One potential explanation for the finding that self-report, but not behavioral, measures of impulsivity are associated with NSSI is that the assessment tools do not measure the same construct. Impulsivity is a broad, heterogeneous construct used to describe behaviors and processes as diverse as sensation-seeking, lack of planning, lack of persistence, inability to delay gratification, insensitivity to delayed consequences, alteration in the perception of time, urgency, and risk-taking (Reynolds, Ortengren, Richards, & de Wit, 2006; Smith et al., 2007; Whiteside & Lynam, 2003; de Wit, Enggasser, & Richards, 2002). This assertion is partially supported by the modest correlations between behavioral and self-report assessments of impulsivity (Cyders & Coskunpinar, 2011; Mitchell, 1999; Reynolds et al., 2006; Richards, Zhang, Mitchell, & de Wit, 1999). Further, in the aforementioned studies on NSSI and impulsivity, self-reported impulsivity did not correlate with behavioral impulsivity measures of either risky decision making or behavioral disinhibition (Glenn & Klonsky, 2010; Janis & Nock, 2009).

Self-report measures of impulsivity typically assess a participant’s self-perceived tendency to engage in various behaviors that are termed impulsive (e.g., the tendency to act quickly without much thought), whereas behavioral measures offer a brief snapshot of a participant’s decision-making behavior during a specific time and within a specific set of task demands (including one’s current emotional state). This distinction may also help to explain why individuals with a history of intentional self-injury report greater impulsivity overall but are not more impulsive on behavioral tasks. That is, a history of engaging in self-injurious behaviors could reasonably be expected to be associated with the perception that one tends to engage in impulsive behaviors in general. In contrast, behavioral laboratory measures of decision processes thought to be impulsive may not adequately capture the complex nature of engaging in self-injurious behaviors and one’s associated perceptions of impulsive tendencies.

Studies to date on the relationship between both self- and behavioral impulsivity and NSSI have relied on retrospective accounts of self-injurious behavior. A stronger
test of this relationship would be to determine whether either self- or behavioral impulsivity measures also predict self-injurious behavior prospectively observed under controlled laboratory conditions. A behavioral analog of self-aggression, the Self-Aggression Paradigm (SAP), has been developed in which participants self-administer electric shocks of varying intensities. In this task, the more general term self-aggression is used rather than self-injurious because the task is associated with both NSSI and suicidality (Berman & Walley, 2003; McCloskey & Berman, 2003).

In this study, we examined the relationship between both self-ratings and behavioral measures of impulsivity and self-injurious behavior. In contrast to previous studies, we examined this relationship using both self-reported past NSSI and a validated prospective laboratory measure of self-injurious behavior. We predicted that both NSSI and self-aggressive behavior in the laboratory would be related to impulsive behavior. Consistent with previous research, we expected this relationship to emerge for self-ratings of impulsive disposition. Moreover, exploratory analyses were conducted to determine whether a relationship between behavioral measures of impulsivity and self-injurious behavior exists when both are assessed in close temporal proximity under controlled, laboratory conditions.

**METHOD**

**Participants**

Participants consisted of 33 men and 46 women aged 18–65 (M = 36.68; SD = 12.57) recruited via advertisements for healthy volunteers (HV) and individuals with emotional problems at The University of Chicago. Participants were excluded if they had a lifetime diagnosis of psychosis or bipolar disorder, organic brain syndrome, mental retardation, or a current diagnosis of substance dependence or major depressive disorder. Additional exclusion criteria included current suicidal or homicidal ideation, or current use of psychotropic medication. The University of Chicago institutional review board approved the protocol, and all participants provided written informed consent prior to enrollment in the study.

The 79 participants were categorized into three diagnostic groups. Participants in the HV group (n = 26) denied any lifetime Axis I or Axis II psychopathology as well as any history of self-injurious or suicidal behavior. Individuals in the no-NSSI group (NSSI−; n = 29) met DSM criteria for a lifetime Axis I or Axis II disorder, but denied any acts of self-injurious or suicidal behavior. Finally, individuals in the self-injurers group (NSSI+; n = 24) met DSM criteria for a lifetime Axis I or Axis II disorder and reported at least three acts of self-injurious behavior (M = 16.25, SD = 10.59). Group assignment was based on the results of a psychiatric interview and the Deliberate Self-Harm Inventory (DSHI; Gratz, 2001). The DSHI consists of 68 questions that assess the presence, frequency, onset, and most recent occurrence of 17 types of NSSI. It has high internal consistency (α = .82), test–retest reliability (r = .92), and construct validity (Gratz, 2001).

**Diagnostic Interviews**

**Structured Clinical Interview for the DSM-IV.** The Structured Clinical Interview for the DSM-IV (SCID) is a semistructured clinical interview used to diagnose DSM-IV Axis I disorders. It has adequate interrater reliability with kappa values for modules reported to be between .70 and 1.00 (Spitzer, Williams, Gibbon, & First, 1995). In our sample, the interclass correlation for existence of a current Axis I disorder was .92.

**Structured Interview for DSM-IV Personality.** The Structured Interview for DSM-IV Personality (SID-P) was used to diagnose DSM-IV personality disorders (Pfohl, Blum, & Zimmerman, 1995). Estimates of interrater reliability for the SID-P are reported to be adequate to strong with intraclass correlation coefficients (ICC) as
high as .88–.99 (Damen, De Jong, & Van der Kroft, 2004). In our sample, intraclass correlations for BPD were .83, and for any personality disorder .89.

**Global Assessment of Functioning.** The Global Assessment of Functioning (GAF) is a 0–100 score that reflects the extent to which psychological problems have impaired social and occupational functioning (American Psychiatric Association, 2000). Lower scores reflect greater psychosocial impairment. Estimates of interrater reliability for the GAF are satisfactory, with ICC values reported to be .81 in psychiatric outpatient clinics (Soderberg, Tungstrom, & Armelius, 2005).

**Self-Reported Impulsive Behavior**

**Barratt Impulsiveness Scale–11.** The Barratt Impulsiveness Scale–11 (BIS) is a 34-item questionnaire that assesses motor (acting without thinking), cognitive (hasty decisions), and nonplanning (failure to plan ahead) impulsiveness. Each item is rated on a four-point scale ranging from rarely/never to almost always/always. The BIS is an internally consistent ($\alpha = .79–.83$) and valid measure of impulsivity (Patton, Stanford, & Barratt, 1995). In our sample, the internal consistency of the BIS scales was fair to good ($\alpha = .68–.75$).

**Laboratory Measures of Impulsive Behavior**

**Immediate Memory Task.** The Immediate Memory Task (IMT) is a modified Continuous Performance Task that measures response initiation (a.k.a. motor) impulsivity (Dougherty & Marsh, 2003). During the IMT, subjects are shown a series of briefly presented five-digit numbers on a computer monitor. The sequence of numbers is randomly generated and each number appears for 500 ms at a rate of one per second. Subjects are instructed to click a mouse button when the five-digit number they see is identical to the one that preceded it. On one third of the trials, the stimulus is a number that differs from the preceding number by only one digit (its position and value determined randomly). Responses to catch stimuli are recorded as commission errors, which are believed to reflect motor impulsivity in this task. The remainder of the trials are equally divided between target and filler stimuli. A target stimulus is a five-digit number that is identical to the preceding number. The participant is instructed to respond to these numbers and these responses are recorded as correct detections. A filler stimulus is a random five-digit number that appears whenever a target or catch trial is not scheduled to appear. The proportion of commission errors to correct detections, known as the IMT ratio, is the primary dependent measure of impulsivity for this task (Dougherty, Marsh-Richard, Hatzis, Nouvion, & Mathias, 2008).

**Go/No-Go Task.** The Go/No-Go Task assesses an individual’s ability to inhibit inappropriate responses (Newman & Kosson, 1986). In this task, participants are presented with eight numbers, of which four are designated as “correct” and four as “incorrect.” They are instructed to respond only to the correct numbers. They are rewarded for correct responses (+10 cents) and penalized for incorrect responses (–10 cents). The outcome measures are errors of omission (i.e., withholding a response when a “correct” stimulus is presented) and errors of commission/false alarms (i.e., responding to an “incorrect” stimulus). Participants received the total amount of money earned at the end of the session. The measure of impulsive behavior in this task was the number of errors of commission relative to total errors, which indicates an inability to inhibit inappropriate responses.

**Bechara Gambling Task.** The Bechara Gambling Task (BGT) is a computerized version of the original game developed by Bechara and colleagues (Bechara, Damasio, Damasio, & Anderson, 1994; Bechara, Damasio, Tranel, & Damasio, 1997). In this task, the participants sat in front of a computer screen and were presented with four decks of cards—A, B, C, and D—displayed face down. Participants were instructed to
turn over cards from the decks (by clicking on the computer mouse) to maximize gain over time. As each card was turned over, the computer provided feedback with regard to the net gain or loss associated with that selection. Decks A and B were designed to produce higher rewards (average reward = $125), but at unpredictable points these decks also produced even higher losses (average loss = $187.50). Thus, overall selection from decks A and B was disadvantageous and resulted in net losses. Decks C and D provided relatively smaller rewards (average reward = $62.50), but also had even smaller losses (average loss = $31.25). Selection from these decks resulted in advantageous net gains over time. The frequency of loss was comparable for the disadvantageous [loss f(A) + loss f(B)/2] and the advantageous decks [loss f(C) + loss f(D)/2]. Participants made 100 deck selections during the task. The primary impulsivity outcome measure on the BGT was the number of disadvantageous deck selections (decks A or B) that occurred within each 25-trial block (four blocks).

Laboratory Measure of Self-Injury

The Self-Aggression Paradigm. The SAP is a laboratory analog of self-aggression disguised as a reaction-time task against a fictitious opponent (Berman & Walley, 2003; McCloskey & Berman, 2003). Specifically, subjects are told they will be conducting a study on the “the effect of personality on psychomotor performance.” During the SAP, the participant completes 32 reaction-time trials, presented as two blocks of 16 trials with a 30-second rest between the blocks. The frequency of wins and losses was predetermined by the experimenter. During the first (low frustration) block, the participant “lost” six of the 16 trials. During the second (high frustration) block, the participant “lost” 12 of the 16 trials. Each participant was asked to select a shock level ranging from 0 through 10, and 20, for each trial that was “lost.” It was explained that the 10 option corresponded to each participant’s upper threshold, with options 9 (95%) through 1 (55%) representing a decreasing percentage of this maximum. The 0 option resulted in no shock. Subjects were also informed that selecting the 20 option would cause “a painful shock, twice that of what you judged very unpleasant.” In actuality, the 20 option delivered the same amount of shock as the 10 option. For each block, average self-shock was computed. Validity for the inferences that can be drawn from an individual’s behavior during the SAP are supported by the positive associations between shock intensity and self-ratings of self-aggressive (i.e., NSSI and suicidal) disposition, along with other variables related to extra-laboratory self-injurious behaviors (Berman, Jones, & McCloskey, 2005; Berman & Walley, 2003; McCloskey & Berman, 2003; McCloskey, Gollan, & Berman, 2008).

Procedure

On visit 1, participants completed a 3- to 4-hour diagnostic interview conducted by trained graduate-level diagnosticians who were not informed about the study hypotheses. Axis I diagnoses were assigned using the SCID. Axis II disorders were assessed using the SID-P. History of NSSI was assessed using the DSHI (Gratz, 2001). Diagnosticians also assigned a GAF score based on the information obtained during the interview. All diagnoses and GAF scores were confirmed using a best estimate procedure in which the diagnostic report was reviewed by a committee of psychiatrists, psychologists, and diagnosticians (Klein, Ouimette, Kelly, Ferro, & Riso, 1994).

On visit 2, participants completed a urine drug test and an alcohol breathalyzer test prior to the SAP. To prepare for the SAP, fingertip electrodes were attached to two of the participant’s fingers before the experimenter left the room to prepare the “other subject” for the experiment. After a short delay, an upper shock pain threshold was determined by administering increasingly intense shocks at 100-μA intervals until the participant reported that the shock was painful. To increase the
creadibility of the experimental situation, this procedure was repeated with the “other subject” (an audiotape of a confederate), and overheard by the participant.

The participant then completed a series of 32 SAP reaction-time trials. Each trial consisted of the following specific events: (1) a signal to depress the reaction-time key; (2) a signal to release the reaction-time key as fast as possible; (3) feedback as to whether the subject won or lost the trial; (4) for losing trials, the selection of a self-shock level; (5) for losing trials, the presence of a 1-second shock; and (6) a 5-second intertrial interval. Shock-setting options for the participant were displayed on the screen as 0 through 10, and 20. Immediately after the SAP, subjects completed a short posttask questionnaire to confirm that the social conditions of the task had been accepted and to assess acute NSSI and suicidal ideation (four subjects who reported believing the SAP was assessing self-harm were not included in this manuscript). Next, subjects completed the IMT, Go/No-Go, and BGT tasks in randomized order. After completing all study procedures, participants were debriefed and given the opportunity to ask questions.

RESULTS

All analyses were conducted 2-tailed at the .05 level of significance. Significant inter-
actions were analyzed using simple effects. Post hoc group comparisons were made using Tukey’s HSD test ($p < .05$) for between-subject effects and Bonferroni-corrected pairwise comparisons for within-subject effects. Effect sizes are provided using partial eta-squared ($\eta^2_p$) for analyses of variance. For $\eta^2_p$, .01, .06, and .14 are considered small, medium, and large effect sizes (Cohen, 1988).

Preliminary Analyses

Demographic Variables. Healthy volunteers, NSSI−, and NSSI+ groups did not differ with respect to age, $F(2, 76) = 1.40$, $p = .25$; race, $\chi^2(4, N = 79) = 1.20$, $p = .88$; or gender, $\chi^2(2, N = 79) = 1.05$, $p = .59$. See Table 1 for means and percentages. Because the groups did not differ in gender distribution and analyses revealed no significant gender by group effects for any outcome measure, gender was not included in the analyses.

Psychopathology. There was a significant effect of group on psychosocial functioning, $F(2, 76) = 123.54$, $p < .001$. Post hoc analyses showed that HV subjects ($M = 88.73$, $SD = 5.20$) had higher GAF scores than NSSI− subjects ($M = 62.90$, $SD = 9.85$), who in turn had higher GAF scores than NSSI+ subjects ($M = 49.54$, $SD = 7.27$). All NSSI− and NSSI+ subjects had a lifetime DSM Axis I disorder. As

<table>
<thead>
<tr>
<th>Table 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographic Variables by Diagnostic Group</strong></td>
</tr>
<tr>
<td>Variable</td>
</tr>
<tr>
<td>Age (SD)</td>
</tr>
<tr>
<td>Gender (%)</td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td>Race (%)</td>
</tr>
<tr>
<td>Caucasian</td>
</tr>
</tbody>
</table>

HV, healthy volunteers; NSSI, nonsuicidal self-injurious behavior.
shown in Table 2, NSSI+ subjects endorsed a higher prevalence of lifetime mood disorders and anxiety disorders and showed a trend toward a higher prevalence of lifetime substance dependence \((p = .05)\). Additionally, all NSSI+ subjects received a personality disorder diagnosis, with two thirds of the NSSI+ subjects endorsing BPD; this proportion was higher than that of the NSSI− subjects. To ensure that the differences between NSSI+ and NSSI− groups in the primary analyses below were not a function of increased psychopathology in the NSSI+ groups, we reran the primary analyses as ANCOVAs with number of Axis I disorders and number of Axis II disorders as covariates, and NSSI+ versus NSSI− as the independent variable. The inclusion of comorbid psychopathology as covariates did not alter the pattern of results between NSSI− and NSSI+ groups. All previously significant results remained significant.

**NSSI Group, Impulsivity, and Laboratory Self-Aggression**

**Behavioral Impulsivity.** One-way (group) ANOVAs on IMT ratio and Go/No-Go ratio both failed to show a main effect of group. A 3 (group) × 4 (card quartile) mixed-design ANOVA on the disadvantageous BGT deck selections revealed a significant effect of quartile, \(F(3, 195) = 6.35, p < .001\).

Post hoc analyses showed that subjects made more disadvantageous deck selections during the first quartile \((M = 13.56, SD = 4.98)\) than during the second \((M = 11.56, SD = 4.78)\), third \((M = 10.32, SD = 5.99)\), or fourth \((M = 10.63, SD = 6.95)\) quartiles. Neither the main effect of group, \(F(2, 65) = 1.12, p = .33\), nor the group × card quartile interaction, \(F(6, 195) = 0.28, p = .94\), was significant. Exploratory ANOVAs confirmed the lack of a group effect at any quartile (see Table 3).

**Self-Ratings of Impulsivity.** A one-way (group) MANOVA on the motor, cognitive, and nonplanning subscales of the BIS revealed multivariate group effects, Wilks’ \(F(6, 148) = 7.61, p < .001, \eta^2_p = .24\). Univariate analysis revealed a significant effect of group for all three BIS subscales, and post hoc analyses showed an identical significance pattern of \(\text{NSSI}+ > \text{NSSI}− > \text{HV}\) for each subscale (Table 3).

**Behavioral Self-Aggression.** A 3 (group) × 2 (frustration) mixed ANOVA on mean self-shock revealed a significant effect of group. Post hoc tests showed that NSSI+ subjects set higher mean shock levels than HV subjects \((p < .01)\), but did not set higher mean shocks than NSSI− subjects \((p = .08)\). NSSI− and HV subjects did not differ on mean shock level. There was no group × frustration interaction, \(F(2, 76) = 1.41, p = .25\) (Table 3).

**TABLE 2**

*Lifetime Psychopathology by Diagnostic Group*

<table>
<thead>
<tr>
<th>Measure</th>
<th>NSSI− ((n = 29))</th>
<th>NSSI+ ((n = 24))</th>
<th>(\chi^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axis I psychopathology (% subjects)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any current Axis I disorder</td>
<td>14 (48.3%)</td>
<td>16 (66.7%)</td>
<td>1.80</td>
</tr>
<tr>
<td>Lifetime mood disorder</td>
<td>16 (55.2%)</td>
<td>20 (83.3%)</td>
<td>4.78*</td>
</tr>
<tr>
<td>Lifetime anxiety disorders</td>
<td>9 (31.0%)</td>
<td>15 (62.5%)</td>
<td>5.25*</td>
</tr>
<tr>
<td>Lifetime substance dependence</td>
<td>6 (20.7%)</td>
<td>11 (45.8%)</td>
<td>3.81</td>
</tr>
<tr>
<td>Lifetime eating disorder</td>
<td>2 (6.9%)</td>
<td>6 (25.0%)</td>
<td>3.36</td>
</tr>
<tr>
<td>Axis II psychopathology (% subjects)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any personality disorder</td>
<td>18 (62.1%)</td>
<td>24 (100.0%)</td>
<td>11.49***</td>
</tr>
</tbody>
</table>

NSSI, nonsuicidal self-injurious behavior.

*p < .05, ***p < .001.*
Correlations Between Self- and Laboratory Measures of Impulsive and Self-Injurious Behavior

The three subscales of the BIS were significantly intercorrelated, and all related to both self-rated (DSHI) and behavioral self-injurious behavior assessed by the SAP (see Table 4). In contrast, the behavioral impulsivity measures were not significantly associated with each other, nor were they associated with any of the BIS subscales. SAP mean shock was correlated with the IMT ratio and Go/no-go ratio. BGT total bad deck selections were not associated with any measures.

TABLE 3
Impulsivity and Self-Aggression Measures by NSSI Group

<table>
<thead>
<tr>
<th>Measure</th>
<th>HV</th>
<th>NSSI−</th>
<th>NSSI+</th>
<th>F</th>
<th>η²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Go/No-Go Task</td>
<td>(n = 23)</td>
<td>(n = 27)</td>
<td>(n = 24)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Go/No-Go Ratio</td>
<td>.43 (.23)</td>
<td>.51 (.20)</td>
<td>.43 (.24)</td>
<td>1.06</td>
<td>.03</td>
</tr>
<tr>
<td>Immediate Memory Task</td>
<td>(n = 23)</td>
<td>(n = 26)</td>
<td>(n = 20)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IMT ratio</td>
<td>.41 (.28)</td>
<td>.38 (.20)</td>
<td>.44 (.24)</td>
<td>0.39</td>
<td>.01</td>
</tr>
<tr>
<td>Bechara Gambling Task</td>
<td>(n = 23)</td>
<td>(n = 25)</td>
<td>(n = 20)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trials 1–25</td>
<td>13.78 (5.74)</td>
<td>14.44 (2.92)</td>
<td>12.20 (5.98)</td>
<td>1.16</td>
<td>.03</td>
</tr>
<tr>
<td>Trials 26–50</td>
<td>10.78 (4.77)</td>
<td>11.08 (4.42)</td>
<td>9.65 (5.31)</td>
<td>0.53</td>
<td>.02</td>
</tr>
<tr>
<td>Trials 51–75</td>
<td>9.70 (6.38)</td>
<td>11.48 (6.29)</td>
<td>9.90 (5.14)</td>
<td>0.73</td>
<td>.02</td>
</tr>
<tr>
<td>Trials 76–100</td>
<td>11.43 (7.54)</td>
<td>10.80 (7.45)</td>
<td>9.50 (5.67)</td>
<td>0.42</td>
<td>.01</td>
</tr>
<tr>
<td>Barratt Impulsiveness Scale</td>
<td>(n = 26)</td>
<td>(n = 29)</td>
<td>(n = 24)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor</td>
<td>17.27 (2.46)</td>
<td>20.38 (5.27)</td>
<td>24.67 (5.16)</td>
<td>16.93***</td>
<td>.31</td>
</tr>
<tr>
<td>Cognitive</td>
<td>13.69 (3.15)</td>
<td>16.62 (3.19)</td>
<td>19.83 (4.27)</td>
<td>18.80***</td>
<td>.33</td>
</tr>
<tr>
<td>Nonplanning</td>
<td>22.19 (3.78)</td>
<td>16.62 (3.19)</td>
<td>29.13 (6.01)</td>
<td>13.19***</td>
<td>.26</td>
</tr>
<tr>
<td>Self-Aggression Paradigm</td>
<td>(n = 26)</td>
<td>(n = 29)</td>
<td>(n = 24)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(mean shock)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low frustration</td>
<td>.97 (1.19)</td>
<td>1.90 (2.36)</td>
<td>3.40 (3.92)</td>
<td>5.22**</td>
<td>.12</td>
</tr>
<tr>
<td>High frustration</td>
<td>.93 (1.25)</td>
<td>2.18 (2.71)</td>
<td>2.31 (3.15%)</td>
<td>6.56**</td>
<td>.15</td>
</tr>
</tbody>
</table>

HV, healthy volunteers; NSSI, nonsuicidal self-injurious behavior.
**p < .01, ***p < .001.

Correlations Between Self- and Laboratory Measures of Impulsive and Self-Injurious Behavior

The three subscales of the BIS were significantly intercorrelated, and all related to both self-rated (DSHI) and behavioral self-injurious behavior assessed by the SAP (see Table 4). In contrast, the behavioral impulsivity measures were not significantly associated with each other, nor were they associated with any of the BIS subscales. SAP mean shock was correlated with the IMT ratio and Go/no-go ratio. BGT total bad deck selections were not associated with any measures.

TABLE 4
Bivariate Relationships Between Impulsive and Self-Injurious Behavior Measures

<table>
<thead>
<tr>
<th>Measure</th>
<th>BIS-C</th>
<th>BIS-N</th>
<th>IMT</th>
<th>Go/No-Go</th>
<th>BGT</th>
<th>DSHI</th>
<th>SAP M</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIS-M</td>
<td>.62***</td>
<td>.59***</td>
<td>.17</td>
<td>.21</td>
<td>.03</td>
<td>.45***</td>
<td>.28*</td>
</tr>
<tr>
<td>BIS-C</td>
<td></td>
<td>.55***</td>
<td>.07</td>
<td>.01</td>
<td>.08</td>
<td>.31**</td>
<td>.30**</td>
</tr>
<tr>
<td>BIS-N</td>
<td></td>
<td></td>
<td>.16</td>
<td>.18</td>
<td>.12</td>
<td>.35**</td>
<td>.30**</td>
</tr>
<tr>
<td>IMT</td>
<td></td>
<td></td>
<td></td>
<td>.22</td>
<td>.04</td>
<td>.15</td>
<td>.31**</td>
</tr>
<tr>
<td>Go/No-Go</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>−.09</td>
<td>.18</td>
<td>.26*</td>
</tr>
<tr>
<td>BGT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.04</td>
<td>.05</td>
<td>.05</td>
</tr>
<tr>
<td>DSHI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.49***</td>
<td></td>
</tr>
</tbody>
</table>

BIS, Barratt Impulsiveness Scale–11; BIS-M, BIS Motor Impulsivity Scale; BIS-C, BIS Cognitive Impulsivity Scale; BIS-N, BIS Nonplanning Scale; IMT, Immediate Memory Task ratio; Go/No-Go, Go/No-Go Task ratio; BGT, Bechara Gambling Task total bad deck selections; DSHI, Deliberate Self-Harm Inventory; SAP, Self-Aggression Paradigm; SAP M, mean self-shock.
*p < .05, **p < .01, ***p < .001.
DISCUSSION

The relationship between self-report and behavioral measures of self-aggression and impulsivity was examined by comparing self-injuring adults (NSSI+) to non–self-injuring psychiatric (NSSI−) and healthy volunteer (HV) control groups on measures of trait impulsivity (BIS), behavioral impulsivity (Go/no-go, IMT, BGT), and behavioral self-aggression (SAP). We predicted that NSSI+ subjects would report more impulsive tendencies and demonstrate more behavioral self-aggression on the SAP. This prediction was generally supported. NSSI+ participants did not differ from the comparison groups on behavioral measures of impulsivity, but did show higher levels of self-reported impulsivity and behavioral self-aggression.

The NSSI+ group did not differ from either comparison group on any of the three behavioral impulsivity tasks. This is consistent with previous research on self-injurious adolescents and adults (Glenn & Klonsky, 2010; Janis & Nock, 2009) and suggests that self-injurers do not invariably respond impulsively on behavioral tasks. However, self-injurious behavior observed using the SAP was associated with two of the three behavioral measures of impulsivity. These results provide qualified support for the notion that individuals who engage in self-injurious behavior may be more behaviorally impulsive under some but not all conditions and tasks when behavioral impulsivity is assessed close in time to self-injurious behavior.

The lack of a group difference in behavioral impulsivity was in contrast to the finding that the NSSI+ group self-reported higher levels of motor, attention, and nonplanning trait impulsivity on the BIS than the NSSI− group, who reported more overall impulsivity than HV participants. The fact that NSSI+ individuals reported greater impulsivity is consistent with previous research (Dougherty, Bjork, Huckabee, Moeller, & Swann, 1999; Glenn & Klonsky, 2010; Klonsky & May, 2010; Lynam, Miller, Miller, Bornovalova, & Lejuez, 2011; Paris et al., 2004; Whiteside & Lynam, 2001; Wilson et al., 2007) and suggests a disconnect between behavioral and self-report measures of impulsivity with respect to how they are associated with NSSI. We will explore several possible reasons for this relationship.

It could be argued that self-injurers over-report their impulsive tendencies. However, the association of NSSI with several other impulsive behaviors, including substance abuse (Zlotnick et al., 1999), impulsive aggression (McCloskey, Ben-Zeev, Lee, & Coccaro, 2008; Zlotnick et al., 1999), and risky sexual behavior (Brown, Houck, Grossman, Lescano, & Frenkel, 2008), suggests that the increased trait impulsivity reported by individuals with a history of NSSI is not solely a product of overresponding.

None of the BIS subscales were significantly correlated with any of the behavioral impulsivity measures. This could be taken as evidence suggesting that behavioral and self-report measures of impulsivity are measuring unrelated constructs. All of the self-report impulsivity subscales showed weak, nonsignificant positive relationships with all behavioral impulsivity measures, with somewhat stronger (though still nonsignificant) relationships appearing within the motor and nonplanning domains. This pattern suggests that behavioral tasks and self-report measures may be modestly associated, which is consistent with a recent meta-analysis that examined the relationship between self-report and laboratory tasks of impulsivity (Cyders & Coskunpinar, 2011). It may be that self-report and behavioral tasks measure different but comparably vital constructs, with the former tending to measure general response tendencies (traits), while the latter may be more influenced by fluctuating cognitive processes contributing to the in-the-life moment reactions (states; see Cyders & Coskunpinar, 2011 for a discussion of this state/trait distinction for self-report and behavioral measures of impulsivity). This notion is further supported in that although self-report measures have well-established psychometric properties, behavioral
Impulsivity tasks tend to have low test–retest reliability, apart from the Go/No-Go Task, which has reasonable temporal stability (Horn, Dolan, Elliott, Deakin, & Wooffruff, 2003; Kindlon, Mezzacappa, & Earls, 1995).

If self-injurers do have the capacity for normative inhibitory control and tend to be both behaviorally impulsive and self-injuring in specific (similar) contexts, the logical next question is: What context would lead to these behaviors? One possibility is that negative affect provides such a context. As stated, individuals who engage in NSSI have poor affect regulation (Claes, Klonsky, Muehlenkamp, Kuppens, & Vandereycken, 2010; Franklin et al., 2010; Herpertz, 1995), negative emotion, and emotional distress that are associated with increased NSSI (Brown, Comtois, & Linehan, 2002; Klonsky, 2007; Najmi, Wegner, & Nock, 2007; Ruuska, Kaltiala-Heino, Rantanen, & Koivisto, 2005). Among at-risk groups, acute negative affect is associated with increased urges to engage in other impulsive behaviors such as alcohol and drug use (Sinha, Fuse, Aubin, & O’Malley, 2000; Sinha et al., 2008), binge eating and purging (Smyth et al., 2007), and risky sexual behavior (Brown, Yung, Cosgrave, Killackey, Buckby, & Standford, 2006). Furthermore, research has identified urgency (making impulsive decisions in response to negative emotions) as one of the four facets of impulsivity (Whiteside & Lynam, 2001). Not surprisingly, urgency discriminates NSSI+ and NSSI− groups (Glenn & Klonsky, 2010). Unfortunately, we were not able to directly measure negative affect at baseline and postadministration of the behavioral tasks. Thus, future research will need to directly test this relationship to see whether (1) the NSSI group reports higher negative affect during the SAP, (2) negative affect is associated with shock intensity on the SAP among NSSI subjects, and (3) negative affect is mediated by the relationship between self-shock and motor impulsivity.

Self-injurious individuals also exhibited more self-aggression on this behavioral task than comparison groups. Specifically, they set higher mean self-shocks on the SAP than the HV group. Furthermore, SAP responses were positively correlated with the frequency of NSSI. These results provide further support for the utility of the SAP as a measure of self-injurious behavior. Interestingly, self-shock intensity on the SAP was not associated with risky decision making (i.e., bad deck selections) as assessed by the BGT. This may, in part, be a function of decreased power to detect group differences. Correlations between the SAP and risky decision making at quartiles 2 and 3, where group differences would be expected to be strongest, were all positive and ranged from \( r = .17 \) to .41, suggesting medium effects (Cohen, 1988). Additionally, the choice of task may have also played a role. The BGT not only is a behavioral measure of impulsive decision making, but is also associated with learning. Specifically, the BGT is associated with learning the relationship between wins and losses linked with each deck (Bechara et al., 1997). A more prototypical, or “purer,” behavioral measure of impulsive decision making, such as delay discounting, might have shown a stronger relationship with SAP self-aggression among self-injurers. Finally, NSSI urges and behaviors may be more strongly associated with acute changes in motor impulsivity than with other forms of impulsive decision making, although it is unclear why this would be so. More research is needed to assess the relationship between acute self-aggression and cognitive impulsivity.

The results of the current study provide further evidence for a relationship between a history of NSSI and self-ratings of impulsivity as well as extend previous findings by demonstrating a relationship between temporally contiguous self-injurious behavior and behavioral impulsivity. Strengths of this study include the use of a medication-free clinical population, a non-NSSI psychiatric control group, and a validated laboratory measure of self-aggressive behavior. However, inclusion of a more prototypical behavioral measure of impulsive decision making may have helped to elucidate the relationship between impulsive decision
making and NSSI. Also, future research would benefit by experimentally manipulating the context in which the behavioral tasks were completed, and assessing negative affect at baseline and postbehavioral tasks, neither of which were carried out in the current study. Future studies might also benefit from the use of more multidimensional self-report measures of impulsivity such as the UPPS (Whiteside & Lynam, 2001).

Despite these limitations, the current findings provide support for the notion that impulsive tendencies are related to self-injurious behaviors and that the type of measure used to assess both impulsivity and self-injury is an important consideration for researchers in the field. Future studies will be needed to confirm our findings and ascertain the mechanisms through which impulsive and self-injurious behavior are linked.

REFERENCES


Dougherty, D. M., & Marsh, D. M. (2003). Immediate and delayed memory tasks (IMT/ DMT 2.0): A research tool for studying attention, memory, and impulsive behavior [manual]. Houston, TX: Neurobehavioral Research Laboratory and Clinic, University of Texas Health Science Center at Houston.


Manuscript Received: April 15, 2011
Revision Accepted: December 9, 2011