Published in final edited form as:

Personal Ment Health. 2013 ; 7(1): 39–55. doi:10.1002/pmh.1200.

The roles of behavioural activation and inhibition among young adults engaging in self-injury

ABIGAIL L. JENKINS, ABIGAIL C. SEELBACH, BRADLEY T. CONNER, and LAUREN B. ALLOY

Department of Psychology, Temple University, 1701 N. 13th Street, Philadelphia, PA 19122, USA

Abstract

Non-suicidal self-injury (NSSI) is a prevalent behaviour, particularly among young adults. Little is known, however, about the mechanisms underlying NSSI or the personality correlates of these behaviours. The goal of this study was to examine the roles of the behavioural activation and inhibition systems (BAS and BIS) in NSSI. A total of 604 undergraduates completed two self-report measures of BAS and BIS, as well as NSSI history. Logistic and negative binomial linear regressions were used to examine the relationships between measures of BAS and BIS and the presence and course characteristics of NSSI. Approximately 30% of participants reported a history of NSSI. High scores on BAS (drive, reward and fun seeking), combined with low scores on BIS total, predicted NSSI history. However, the opposite was also true, with high levels of BIS total, combined with low levels of BAS (drive, reward and fun seeking), also predicting NSSI history. In addition, several BAS by BIS interactions predicted an NSSI course characterized by more acts and methods used. This study supports the roles of both BAS and BIS in NSSI and takes the first step in identifying how these personality correlates may help identify individuals at risk for NSSI.

Non-suicidal self-injury (NSSI), the intentional and direct destruction of one's bodily tissue without suicidal intent, is a highly prevalent phenomenon (Klonsky, Oltmanns, & Turkheimer, 2003; Nock, Joiner, Gordon, Lloyd-Richardson, & Prinstein, 2006), with approximately 4% of the general population in the United States engaging in at least one act of NSSI during their lifetime (Klonsky et al., 2003). Onset of NSSI typically occurs in early adolescence, when prevalence rates in community samples are between 7% and 21% (Mohl & Skandsen, 2011; Nock, Teper, & Hollander, 2007). These rates increase through mid-adolescence to late adolescence, peaking in young adulthood, with prevalence rates among college students ranging between 17% and 35% (Gratz, 2001; Whitlock, Eckenrode, & Silverman, 2006). These figures implicate NSSI as an important public health concern, particularly among adolescents and young adults. Despite these high rates, however, little is known about the mechanisms underlying NSSI.

Previous research has demonstrated a robust relationship between psychopathology and NSSI, which has contributed to the conceptualization of NSSI as a symptom of psychiatric

disorder, rather than a distinct clinical disorder (e.g. Andover, Pepper, Ryabchenko, Orrico, & Gibb, 2005; Gratz, Breetz, & Tull, 2010). This is represented in the current Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (American Psychiatric Association, 2000), as well as the International Classification of Diseases and Related Health Problems, 10th Edition (World Health Organization, 2010), in which NSSI appears only once as a symptom of borderline personality disorder (BPD) or emotionally unstable personality disorder—borderline type, respectively. This conceptualization fails to account for the fact that NSSI behaviours are present in many disorders, including depression, post-traumatic stress disorder, eating disorders, obsessive-compulsive disorder and substance use disorders, as well as in non-clinical samples (Jacobson, Muehlenkamp, Miller, & Turner, 2008; Muehlenkamp, 2005; Nock, 2009). The current conceptualization of NSSI as an integral feature of BPD, rather than a distinct syndrome, may be partially responsible for the dearth of research regarding the intrapersonal risk factors for NSSI. Although recent research on the functions of NSSI is providing insight into its emotional and cognitive antecedents (e.g. Klonsky & Glenn, 2009; Nock & Prinstein, 2004), little is known about the personality correlates of these functions and with NSSI, more broadly.

Of primary interest in the current study are the roles of the behavioural activation and inhibition systems (BAS and BIS), first described in Gray's (1981) reinforcement sensitivity theory. According to Gray's theory, the BAS promotes approach behaviour toward incentive or reward, whereas the BIS is responsible for the avoidance of conditioned aversive stimuli and is implicated in the expression of negative affective states such as fear or anxiety in response to cues of punishment (Gray, 1987). In sum, Gray theorized that individual differences in BIS and BAS reflect varying sensitivity toward stimuli related to negative and positive reinforcement, respectively (Franken, Muris, & Georgieva, 2006). In a recently revised version of this theory (Smillie, Pickering, & Jackson, 2006), the BIS is reconceptualized as a conflict detection system that directs attention to conflicting or novel stimuli in the environment. The BIS resolves this conflict by either inhibiting behaviour or engaging the fight-or-flight system (now considered separate from BIS), which then facilitates defensive behaviour (Gray & McNaughton, 2000). In terms of how BIS and BAS relate to personality traits, the BIS is most closely associated with trait anxiety, and activation of the BIS may be experienced as rumination or sense of possible danger. In terms of Eysenck's (1991) model of personality, BIS, or sensitivity to punishment, is related to neurotic introversion. Individual differences in BAS functioning are related to the impulsivity and Eysenck's neurotic extroversion dimension (Corr, 2004; Eysenck, 1991).

Corr's (2002) joint-subsystem hypothesis suggests that effects of BAS and BIS on behaviour are dependent upon one another and, thus, should not be examined independently. More specifically, according to the joint-subsystem hypothesis, individuals high on BAS while low on BIS will be at greatest risk for engaging in externalizing behaviours. The research examining this hypothesis, however, has revealed mixed findings (for example, see Johnson, Turner, & Iwata, 2003). Nonetheless, these systems have been implicated in many psychological constructs and forms of psychopathology, including impulsivity and anxiety (e.g. Gray, 1981), perfectionism (O'Connor & Forgan, 2007), addictive behaviours (e.g. O'Connor, Stewart, & Watt, 2009), depressive and manic episodes within bipolar disorder

(Alloy et al., 2008), externalizing disorders (e.g. Hundt, Kimbrel, Mitchell, & Nelson-Gray, 2008) and suicidality (Daniel, Goldston, Erkanli, Franklin, & Mayfield, 2009).

To date, the roles of BAS and BIS have not been examined in NSSI. However, personality constructs related to BIS and BAS, including sensitivity to conflict/anxiety and impulsivity, respectively, have been implicated in self-injurious behaviours. First, research has revealed that individuals who self-injure are extremely sensitive to cues of threat and conflict (e.g. Chapman, Gratz, & Brown, 2006) and endorse high levels of neuroticism (Hasking et al., 2010; MacLaren & Best, 2010). Previous work also suggests that individuals who self-injure tend to be impulsive (e.g. Herpertz, Sass, & Favazza, 1997). Furthermore, it is hypothesized that these traits (sensitivity to conflict and impulsivity) may interact with one another to predict self-harm behaviours. Linehan (1993) hypothesized that individuals with BPD engage in NSSI impulsively to soothe strong negative emotions. This is consistent with Whiteside and Lynam's (2001) conceptualization of one facet of impulsivity, urgency, which refers to the tendency to experience strong impulses, particularly in the presence of negative affect. Urgency has been associated with the impulsivity facet of Costa and McCrae's Big Five model (1992) as well as Eysenck's neuroticism dimension (Eysenck, 1991). A study by Lynam and colleagues revealed that urgency did, in fact, predict engagement in NSSI, even after controlling for BPD (Lynam, Miller, Miller, Bornovalova, & Lejuez, 2011). Along with personality-related risk factors, research has revealed that NSSI may be both positively and negatively reinforcing (e.g. Jenkins & Schmitz, in press; Nock & Prinstein, 2004), which also implicates roles for the BAS and BIS (Franken et al., 2006). The reinforcing properties of NSSI have been implicated in NSSI severity, such that those who experience greater increases or decreases in affect during NSSI are likely to engage in more acts of NSSI over the lifetime (Jenkins & Schmitz, in press).

In sum, extant research has supported the role of personality traits related to BAS and BIS in NSSI. Additional work has elucidated the positively and negatively reinforcing properties of NSSI, which also correspond to BAS and BIS. Despite these indirect links to BAS and BIS, however, no study to date has explored the roles of these systems in NSSI directly.

Therefore, the objective of the current study was to examine the roles of the BAS and BIS in non-suicidal self-injurious behaviours. It was hypothesized that higher scores on measures of BAS and BIS, independently, as well as the interaction of high BAS and high BIS, would predict a lifetime history of NSSI. Next, it was hypothesized that BAS and BIS would not only differentiate those who self-injure from those who do not but would also predict characteristics of the course of NSSI, including how many acts of NSSI an individual had engaged in and how many different types of NSSI an individual had used. Specifically, it was predicted that higher levels of BAS and BIS alone, as well as the interaction of high BAS and high BIS, would predict more lifetime acts of NSSI and more methods of self-injury used.

Method

Participants

Participants in this study were 604 undergraduates involved in a larger study of the relationship between personality and health risk behaviours. The demographic characteristics of the sample are displayed in Table 1. A lifetime history of at least one act of NSSI was reported by 30.5% ($n = 184$) of the sample. Six individuals emerged as extreme outliers, indicating that they had engaged in over 10 000 acts of NSSI. Therefore, these individuals were removed from further analyses. The final sample consisted of 598 individuals, 178 (30%) of whom endorsed a history of NSSI.

Measures

Non-suicidal self-injury.—The Form and Function Self-Injury Scale (FAFSI; Jenkins, Conner, & Alloy, 2011) is a self-report measure that assesses the methods, course and reasons for engaging in NSSI. For the current study, only the first portion of the FAFSI, which assesses the presence and the frequency of various NSSI methods, was used. The FAFSI begins with these brief instructions: ‘This questionnaire asks about many different things that some people do. When answering these questions, please think about whether you have done any of these things at any time during your whole life. Please consider each question and respond as accurately as you can. Have you ever, intentionally or on purpose, hurt yourself in the following ways, without the intention of killing yourself?’ The FAFSI inquires about the presence, age of onset, frequency and recency of 11 distinct forms of NSSI: cutting, skin carving, burning, ingesting noxious substances, banging head, poking self with sharp or blunt object, scratching or rubbing the skin to draw blood, biting self, pulling hair out, embedding objects under nails or skin and self-hitting, as well as a fill-in ‘other’ category. For each of the NSSI methods, participants first respond to the dichotomous variable, ‘Have you ever engaged in [x behaviour]?’ Responses are coded as 0 = No and 1 = Yes. For each method endorsed, participants report how many times they engaged in that behaviour, both over the lifetime and within the past year. These variables are continuous, allowing participants to write in their responses. A continuous response format is preferable for these items, as it allows for a fuller range of responses and more precise estimates of the variables.

Among those who endorsed NSSI, the internal consistency of the dichotomous method items was high ($\alpha = 0.82$), and all methods of NSSI were endorsed by at least one participant. Corrected item total correlations ranged from 0.32 to 0.61, indicating that the items are reliably assessing the same construct and discriminating those who do not engage in NSSI from those who do.

Behavioural activation and inhibition.—As BAS and BIS are implicated in many types of psychopathology, several measures have been developed to assess these constructs (see Torrubia, Avila, Molto, & Caseras, 2001, for an overview). To date, however, the BAS and BIS constructs have yet to be conclusively defined, and the validity of their assessment has been questionable (Smillie & Jackson, 2005). As such, there is currently no widely agreed upon psychometric representation of Gray's systems, particularly for the BAS

(Smillie & Jackson, 2005). Additionally, research suggests that different measures of BAS and BIS may be differentially predictive of risky outcomes, such as drug use, risky sexual behaviours and self-harm (Jenkins, Conner, & Alloy, 2010). Therefore, the current study employed two measures of behavioural activation and inhibition. The first, the BIS/BAS Scale (Carver & White, 1994), is a widely used 24-item self-report measure assessing reactivity to negative or aversive stimuli (BIS total), approach behaviour in the context of reward (BAS drive), inclination to seek out rewarding situations (BAS fun seeking) and positive affect/excitability in response to rewards (BAS reward responsiveness). Responses are rated on a Likert-type scale from 1 to 5 (1 = not at all like me to 5 = completely like me), with higher scores on each scale indicating greater levels of BIS or BAS sensitivity. Of note, Carver and White's (1994) conceptualization of BIS encompasses both BIS and fight-or-flight system sensitivities, consistent with the original reinforcement sensitivity theory model. Previous studies have demonstrated adequate internal consistency of these four subscales, with coefficient alphas ranging from 0.69 to 0.83 (Biuckians, Miklowitz, & Kim, 2007; O'Connor & Forgan, 2007). Similarly, alphas in the current sample ranged from 0.66 to 0.78. Although some research has supported the four-factor structure of this measure (e.g. Cooper, Gomez, & Aucote, 2007), other studies have revealed that alternative solutions better fit the data (e.g. Beck, Smits, Claes, Vandereycken, & Bijttebier, 2009).

The second measure of BAS and BIS, the Sensitivity to Punishment Sensitivity to Reward Questionnaire (Torrubia et al., 2001), is a 48-item self-report measure assessing reactivity in situations that are predominantly punishing (SP) or rewarding (SR). Recent research has suggested that the SR scale actually reflects an equal combination of reward responsiveness and impulsivity (Cooper, Smillie, & Jackson, 2008). Responses are dichotomous (true/false), and subscale scores are computed by summing true responses. Higher scores on each scale indicate higher sensitivity to punishment or reward. Previous research supports a two-factor structure as well as adequate internal consistency for both scales, with alphas ranging from 0.76 to 0.84 (Torrubia, Avila, Molto, & Grande, 1995). In the current study, alphas ranged from 0.67 to 0.76.

In sum, the current study employs four measures of BAS: BAS drive, BAS fun seeking, BAS reward and SR and will hereafter be referred to collectively as BAS. Two measures of BIS are included: BIS total and SP and will hereafter be referred to collectively as BIS. In the event that specific scales or subscales are examined, they will be mentioned by name (e.g. BAS reward or SP).

Procedure

Undergraduate psychology students at a large, racially diverse university in the Mid-Atlantic region of the United States were informed of a research study exploring the prevalence and the personality correlates of health risk behaviours. The approximately 1.5-h assessment battery was administered via personal computer in a small-group setting (maximum of six participants per session) and was monitored by a trained research assistant. Study procedures and risks were presented via computer prior to the assessment battery, and participants were informed that the act of continuing implied their consent. Following the assessment battery, participants received a debriefing handout, which included referral information for the

national suicide hotline, local hospitals and crisis treatment centres and local agencies specializing in the treatment of specific forms of psychopathology (i.e. substance abuse). All study procedures were approved by the university's Institutional Review Board. Participants received research credits in exchange for participation.

Statistical analysis

Data were analysed in SPSS version 16.0 (SPSS Inc., 2007). First, t-tests and Pearson w^2 tests were conducted to examine potential age, sex and racial differences between those with and without a history of NSSI. Next, bivariate correlations were conducted to examine the relationships between the BAS and BIS variables of interest (data presented in Table 2). Next, a series of hierarchical logistic regressions was used to examine the ability of all BAS and BIS measures, as well as interactions between the BAS and BIS measures, to predict the probability of endorsing at least one act of NSSI.

Finally, a series of negative binomial regressions was conducted to examine whether measures of BAS and BIS, alone, as well as their interactions, predicted number of lifetime acts and methods of NSSI. In the current study, total acts of NSSI was calculated by summing the number of lifetime acts endorsed for each of the NSSI methods listed on the FAFSI. Number of NSSI methods used was calculated by summing yes responses to each of the dichotomous NSSI method variables. As these data are counts of the occurrences of these behaviours, they are not normally distributed and, therefore, violate the assumptions of normality required by ordinary least-squares regression models. Data that violate model assumptions can produce incorrect standard errors, resulting in inaccurate p-values (Atkins & Gallop, 2007). Thus, data such as these require models that account for count-distributed data. Although there are several types of regression models that can handle data distributed as count data, the negative binomial model is especially useful for addressing overdispersion (when the variance is greater than the mean), which is often present in count data (Gardner, Mulvey, & Shaw, 1995). Descriptive analysis of the two count variables described earlier revealed that the variances, indeed, were larger than the means (data presented later), indicating that the negative binomial model was the appropriate model for the proposed analyses.

In tests of the unique effects of each BAS or BIS measure, each measure was entered in step 1, individually. When examining BAS by BIS interactions, we entered the relevant BAS and BIS scales in step 1 and the interaction term, calculated using mean-centred BAS and BIS variables, in step 2. All BAS-by-BIS interactions were examined and plotted using Hayes and Matthes' (2009) MODPROBE approach. All statistics were two tailed, and α was set at 0.05 for all analyses.

Results

Demographic characteristics and prevalence of non-suicidal self-injury

Pearson w^2 and t-tests revealed no significant age or sex differences between individuals with and without a history of NSSI. However, some racial differences in NSSI history did emerge. First, the proportion of Caucasian and 'other' individuals with a history of NSSI

was significantly larger than that among individuals without a history of NSSI, $w^2 = 12.22$, $p < 0.001$ and $w^2 = 6.09$, $p = 0.014$, respectively. Conversely, the proportion of Asian and African-American individuals with a history of NSSI was significantly lower than that among individuals with no history of NSSI, $w^2 = 5.36$, $p = 0.021$ and $w^2 = 3.88$, $p = 0.049$, respectively. See Table 1 for descriptive statistics for total, NSSI history and number of NSSI history samples.

The 178 individuals with a history of NSSI reported an average of 112.53 (standard deviation (SD) = 310.24, median = 13.00, range 1–2101) lifetime acts of NSSI. These individuals indicated that they had engaged in an average of 2.55 (SD = 2.10, median = 2, range = 1–11) different methods of NSSI. The average age of onset in this sample was 12.83 years (SD = 3.54, median = 13, range = 5–23).

Behavioural activation and inhibition system measures

Preliminary analyses.—Correlations of the various BAS and BIS variables are displayed in Table 2. All correlations were in the expected direction (i.e. BAS subscales correlated with one another, BIS subscales correlated with one another and BAS negatively correlated with BIS subscales), with two exceptions. SR was significantly positively correlated with both BIS and SP. This is not unexpected, however, as Torrubia et al. (2001) also found small positive correlations between the SR and SP subscales.

In the total sample, men and women did not significantly differ on the three BAS subscale scores (BAS drive, BAS fun seeking and BAS reward responsiveness). Women, however, scored significantly higher than men on the BIS total and SP scales, $t(511) = 6.52$, $p < 0.001$ and $t(507) = 3.78$, $p < 0.001$, respectively. Men, on the other hand, scored significantly higher than women on SR, $t(507) = 2.15$, $p = 0.032$. Men and women did not differ on likelihood of engaging in NSSI, number of lifetime NSSI acts or number of NSSI methods used. Race was not associated with scores on any of the BAS and BIS variables.

Relationship to non-suicidal self-injury.—See Table 3 for descriptive statistics of the BAS and BIS variables. A series of t-tests revealed that individuals with a history of NSSI endorsed marginally higher levels of BAS reward, $t(591) = 1.82$, $p = 0.07$. Individuals with and without an NSSI history did not differ significantly on other measures of BAS or BIS.

The hierarchical logistic regressions revealed that, although no measures of BAS or BIS uniquely predicted history of NSSI (as measured dichotomously as present or not present), the interactions of several BAS and BIS variables did (see Table 4 for a summary of these analyses). Omnibus tests of model coefficients revealed that the interactions of BIS total with each of the three BAS subscales significantly negatively predicted NSSI history (BAS drive by BIS total: model $w^2 = 12.95$, degrees of freedom (df) = 3, $p = 0.005$;

BAS fun seeking by BIS total: model $w^2 = 12.29$, df = 3, $p = 0.006$; BAS reward by BIS total: model $w^2 = 15.05$, df = 3, $p = 0.002$). In other words, higher BIS total scores, in combination with higher BAS scores, were associated with a lower likelihood of engaging in at least one act of NSSI (OR = 0.97, 0.96, 0.96, respectively). This is contrary to the original

hypothesis that high BAS, in combination with high BIS, would predict NSSI history. The SR by SP interaction yielded no significant results.

As summarized in Table 5, results of the negative binomial regressions revealed that several BAS and BIS variables uniquely predicted characteristics of NSSI, including lifetime number of NSSI acts and number of NSSI methods used. First, BAS drive (model $w^2 = 24.68$, $df = 2$, $p < 0.001$), BAS fun seeking (model $w^2 = 20.34$, $df = 2$, $p < 0.001$) and SR (model $w^2 = 31.15$, $df = 2$, $p < 0.001$) each significantly predicted a greater number of lifetime acts of NSSI. Conversely, BAS reward negatively predicted a greater number of lifetime acts (model $w^2 = 20.99$, $df = 2$, $p < 0.001$).

Two BAS by BIS interactions also significantly predicted number of NSSI acts, such that BIS moderated the effects of BAS. Specifically, the interaction of BAS reward with BIS total significantly negatively predicted a greater number of NSSI acts (model $w^2 = 26.95$, $df = 4$, $p < 0.001$). Specifically, among individuals who scored low on BIS total, higher BAS reward scores did not significantly predict engagement in more acts of NSSI across the lifespan. However, for individuals who scored high on BIS total, BAS reward scores significantly negatively predicted number of NSSI acts (Figure 1). The SR by SP interaction was also significant (model $w^2 = 102.89$, $df = 4$, $p < 0.001$).

Among those who scored both low and high on SP, higher scores on SR significantly predicted a greater number of lifetime NSSI acts. However, the effect of SR on number of acts was stronger among those who scored low on SP, such that the magnitude of change in NSSI acts was significantly greater among those who scored low on SP than those who scored high on SP (Figure 2).

Next, several BAS and BIS variables also uniquely predicted the use of more methods of NSSI. BAS fun seeking (model $w^2 = 8.40$, $df = 2$, $p = 0.015$), SR (model $w^2 = 10.61$, $df = 2$, $p = 0.005$) and SP (model $w^2 = 10.17$, $df = 2$, $p = 0.006$) each significantly predicted a greater number of NSSI methods used. In addition, several BAS by BIS interactions significantly predicted the number of methods used. Specifically, the interactions of each of the three BAS subscales with BIS total significantly negatively predicted the number of methods used (BAS drive by BIS total: model $w^2 = 12.89$, $df = 4$, $p = 0.012$;

BAS fun seeking by BIS total: model $w^2 = 19.78$, $df = 4$, $p = 0.001$; BAS reward by BIS total: model $w^2 = 24.59$, $df = 4$, $p < 0.001$). For the BAS drive by BIS total and BAS reward by BIS total interactions, among those with lower scores on BIS total, higher BAS subscale scores significantly predicted the use of more NSSI methods. Among those with high BIS total scores, however, higher BAS subscale scores significantly negatively predicted number of NSSI methods (Figures 3 and 4). For the BAS fun seeking by BIS total interaction, among those with low BIS total scores, higher BAS fun seeking scores significantly predicted use of more NSSI methods. Among those with high BIS total scores, however, BAS fun seeking score was not significantly associated with number of methods (Figure 5).

Discussion

Among a large, racially diverse sample of college students, approximately 30% of participants reported a lifetime history of at least one act of NSSI. This rate is consistent with that found in other college samples (e.g. Whitlock et al., 2006). Participants with a history of NSSI reported, on average, 113 lifetime incidents of NSSI, the use of more than two different methods of NSSI and an age of onset of approximately 13 years. These figures not only replicate previous research with college samples but also emphasize the importance of examining NSSI among non-clinical samples.

Research on NSSI, to date, has primarily focused on the clinical and environmental correlates of these behaviours, largely to the exclusion of broader personality correlates that have been implicated in many other forms of psychopathology, but whose role in NSSI is yet to be determined. The current study attempted to address this gap by examining the roles of the BAS and the BIS, as assessed by multiple measures, in NSSI.

It was hypothesized that high levels of BAS and BIS, both alone and in combination, would predict a history of at least one act of NSSI, as self-injuring individuals tend to be both impulsive, implicating high BAS, and extremely sensitive to cues of threat or conflict, implicating high BIS (e.g. Chapman et al., 2006). Results showed, however, that no measure of BAS or BIS was uniquely associated with NSSI. As previous research has supported links between BIS/BAS and impulsive behaviours, including suicide (e.g. Daniel et al., 2009; O'Connor & Forgan, 2007), these results are somewhat surprising. However, NSSI is a quite heterogeneous behaviour that may take many courses (e.g. experimenting with NSSI vs. chronic lifetime course) and occur for many reasons (e.g. emotion regulation vs. interpersonal influence). Thus, BIS and BAS may not uniquely predict the presence of NSSI across the wide variety of individuals who engage in this behaviour, as these individuals may not be universally impulsive or sensitive to conflict.

Although BAS and BIS did not uniquely predict a history of NSSI, the interactions of BAS and BIS were associated with the presence of NSSI, consistent with Corr's (2002) joint-subsystem hypothesis. Results revealed that high BAS (drive, reward and fun seeking), combined with low BIS total, was most predictive of a history of NSSI. Although this was also contrary to hypotheses, it is consistent with the pattern seen in other forms of psychopathology (e.g. Alloy et al., 2008; Hundt et al., 2008; Daniel et al., 2009). Surprisingly, the combination of high BIS total and low BAS (drive, reward and fun seeking) also predicted a history of NSSI. This finding, however, is consistent with results of a recent study, which found that high levels of BIS total, combined with low levels of BAS drive, were associated with increases in suicidal thinking (Rasmussen, Elliot, & O'Connor, 2012).

Similarly, it was hypothesized that high levels of BAS and BIS, both alone and in combination, would predict not only whether or not an individual had ever self-injured, but how many times he or she had self-injured and how many different NSSI methods that individual had used. Specifically, it was hypothesized that both high BAS and high BIS, as well as a combination of high BAS and high BIS, would predict a greater number of lifetime

acts and methods. The results from these analyses were mixed. Consistent with hypotheses, several measures of BAS and BIS significantly predicted a greater number of lifetime acts of NSSI. Specifically, BAS drive, BAS fun seeking, SR and SP each uniquely predicted a greater number of NSSI acts. In addition, BAS fun seeking, SR and SP each uniquely predicted a greater number of NSSI methods used. Contrary to hypotheses, however, BAS reward predicted fewer lifetime acts of NSSI. This may have occurred because this subscale assesses positive feelings upon attaining reward, and as NSSI may be better characterized as avoiding punishment than attaining reward, this subscale may be less relevant to those engaging in NSSI.

Also contrary to hypotheses, but consistent with other results obtained in this study, the BAS reward by BIS total and SR by SP interactions predicted fewer lifetime acts of NSSI. Similarly, the interactions of the three BAS subscales (drive, reward and fun seeking) with BIS total each predicted fewer NSSI methods tried. Taken together, these results indicate that although BAS and BIS may independently predict more NSSI acts and methods used, a more active BIS may serve as a protective factor against NSSI when BAS levels are high. Results of the BAS by BIS interactions revealed that high levels of BIS also significantly predicted more lifetime NSSI acts and methods, but only among those with low BAS, suggesting that among these individuals, higher levels of BAS may serve as a protective factor against NSSI. Across most analyses, the combination of low BAS and low BIS was associated with the lowest likelihood of engaging in NSSI, as well as engaging in the fewest number of NSSI acts and methods. Similarly, the combination of high BAS and high BIS was also associated with a lower likelihood of engaging in NSSI, in most cases (Figures 1–5).

An additional interesting finding was that the two measures of BAS and BIS used in this study did not equally predict NSSI or its characteristics. First, Carver and White's (1994) BAS subscales and BIS total scale did not uniquely predict NSSI history, but all combinations of BAS subscales with BIS total did, again supporting Corr's (2002) hypothesis that BAS and BIS should be jointly examined. In addition, the ability of the BAS subscales to predict number of NSSI acts and methods used was mixed. Some subscales predicted a greater number of acts and another predicted fewer; one predicted more NSSI methods, whereas the others did not. Furthermore, BIS total failed to uniquely predict any NSSI characteristics. Finally, although all BAS by BIS interactions did significantly predict fewer methods used, not all combinations predicted fewer lifetime acts (Tables 4 and 5). These results emphasize the importance of examining Carver and White's three BAS subscales separately and perhaps even examining their psychometric properties within the particular dataset being used, as the multiple conceptualizations of BAS captured in this measure appear to be differentially related to course characteristics of NSSI.

The SP and SR of Torrubia et al. (2001), both alone and in combination, failed to predict history of self-injury. On the other hand, SP and SR each uniquely predicted a greater number of lifetime acts and a greater number of methods used. Furthermore, the SP by SR interaction predicted fewer lifetime acts of NSSI. This finding suggests that the conceptualizations of BAS that predict the presence of NSSI may differ from those that predict the course of NSSI. Thus, future research should use multiple measures of these

constructs to tap the BIS/BAS conceptualization most relevant to the particular outcome of interest.

Taken together, these results indicate that BAS and BIS do, indeed, interact and that in most cases high levels of one, in the presence of low levels of the other, predict the presence and severity of NSSI. More specifically, individuals who have stronger approach tendencies (high in BAS) and who are less inhibited (low in BIS) are more likely to engage in NSSI. Conversely, individuals who are highly inhibited (high in BIS) and unlikely to approach (low in BAS) are also more likely to engage in NSSI. Thus, being high on either (but not both) is associated with similarly poor outcomes. Interestingly, individuals who are high on both BAS and BIS are not the most likely to engage in NSSI, contrary to hypotheses. This implies that higher levels of dysregulation do not drive these behaviours, in general. Instead, high levels of one drive may buffer against high levels of the other. This is consistent with previous work, suggesting that those high in BIS may be less impulsive in relation to rewards as opposed to threats, which automatically triggers impulsive behaviour (DeYoung, 2011). In other words, the tendency to perceive situations as rewarding (implicating higher levels of BAS) may reduce the potentially negative impacts of BIS.

Several limitations of this study should be noted and addressed by future research. First, the use of a college sample, although useful in terms of acquiring the large sample size required for examining behaviours with low base rates (i.e. specific methods of NSSI) and important because of the high prevalence of NSSI among college students, limits the generalizability to broader community and clinical samples. In addition, some selection bias may have occurred because the study was advertised as a study of personality and health risk behaviours. As the rates of NSSI observed in this sample are consistent with rates found in other college samples, however, this limitation may not greatly limit the generalizability of these results to other college samples.

Next, the measures employed in this study, like any self-report measures, are prone to participant methodological variance, dishonesty or lack of insight. Of all assessment modalities, however, participants may be most likely to endorse NSSI on a self-report measure, perhaps because they perceive this modality as being the most confidential (Prinstein, Nock, Spirito, & Grapentine, 2001).

Another limitation of this study and of NSSI research, in general, is the ability to obtain accurate reports of course characteristics of NSSI. Individuals may have difficulty recalling precisely how many times they have engaged in NSSI, particularly if they have done it frequently over many years. In addition, as the number of acts variable used in this study was calculated by summing the lifetime number of acts of each of the specific types of NSSI, overestimation of total number of acts may have occurred, particularly if individuals frequently engaged in multiple methods of NSSI during any given act or episode.

Finally, as the current study was cross-sectional, it is not possible to draw causal conclusions regarding the relationships between BAS and BIS and NSSI. Although BAS and BIS are presumed to be temporally stable, participants' BAS and BIS levels may be influenced by

their engagement in NSSI. As these are common limitations of any cross-sectional study, longitudinal studies are needed to more accurately assess predictors of NSSI and its course.

It is also necessary to address the effect sizes and clinical significance of the findings of this study. The effect sizes for many of the significant findings were in the small to medium range. Although this may appear to limit the meaningfulness of the findings, it is important to note that the goal of the study was to identify variables that will allow for early detection of those at highest risk for engaging in NSSI. Clinicians and researchers may find it useful to assess BAS and BIS along with other well-known risk factors to best determine risk. Although BAS and BIS alone may not provide the optimal estimate of risk, a personality profile characterized by high BAS combined with low BIS (or high BIS combined with low BAS), along with a history of childhood maltreatment or negative life events, for example, may improve the ability to identify those at highest risk for engaging in NSSI, prior to the onset of the behaviour. Such research has led to great advances in identifying prospectively individuals at risk for other forms of psychopathology. For example, research on bipolar disorder has revealed that individuals with high BAS sensitivity (as calculated by a combination of high scores on the BAS subscale and on the SR subscale) are more likely to develop a first onset of bipolar spectrum disorder (Alloy et al., 2011), progress to more severe bipolar disorders along the bipolar spectrum (Alloy et al., 2012) and experience relapses/recurrences of bipolar mood episodes (Alloy et al., 2008; Salavert et al., 2007).

This study theoretically supports Gray's (1993) conceptualization of personality, which predicts a positive association between high BAS and externalizing behaviour. In addition, this study is consistent with Corr's (2002) joint-subsystem hypothesis, which emphasizes the concurrent examination of BAS and BIS. As both BAS and BIS appear to play important roles in NSSI, future research should examine how NSSI's potentially positively or negatively reinforcing properties may map onto these dimensions more directly by assessing affective states surrounding NSSI.

Additionally, little research has closely examined the role of personality in NSSI specifically. Examining different models of personality (i.e. Costa and McCrae, 1992; Tellegen, 1985; DeYoung's, 2011, metatrait model) may provide insight into which personality traits or dimensions may be most relevant to those engaging in NSSI.

Identifying and understanding the factors that predict engagement in NSSI will allow for more targeted intervention strategies and may help clinicians to select and tailor appropriate interventions, prior to the onset of negative health behaviours such as NSSI. In terms of prevention, previous research on drug use prevention has suggested that interventions targeted towards highly impulsive individuals may be more effective if they emphasize the excitement of activities other than substance use, such as extreme sports (D'Silva, Harrington, Palmgreen, Donohew, & Lorch, 2001). To the extent that BAS is associated with impulsivity, this prevention strategy may also be viable for individuals who engage in NSSI. Furthermore, an individual's level of BAS and BIS sensitivity may have implications for treatment. Given the difficulty of changing relatively stable personality correlates such as BAS and BIS, traditional cognitive behavioural approaches may be enhanced by incorporating goal adjustment and problem-solving strategies (O'Connor & Forgan, 2007).

In conclusion, behavioural inhibition and behavioural activation sensitivities both appear to play a role in the presence and severity of NSSI. Furthermore, the poorest outcomes (more NSSI acts and methods) are associated with high sensitivity in one domain combined with low sensitivity in the other. Additional research is needed to more closely examine this interaction and the potential roles of positive and negative reinforcement, as well as how these interactions might map onto broader conceptualizations of personality.

References

- Alloy LB, Abramson LY, Walshaw PD, Cogswell A, Grandin LD, Hughes ME, Iacoviello BM, Whitehouse WG, Urosevic S, Nusslock R, Hogan ME. Behavioral approach system and behavioral inhibition system sensitivities and bipolar spectrum disorders: Prospective prediction of bipolar mood episodes. *Bipolar Disorders*. 2008; 10(2):310–322. [PubMed: 18271911]
- Alloy LB, Bender RE, Whitehouse WG, Wagner CA, Liu RT, Grant DA, Jager-Hyman S, Molz A, Choi JY, Harmon-Jones E, Abramson LY. High Behavioral Approach System (BAS) sensitivity and reward responsiveness predict first onset of bipolar spectrum disorders: A prospective behavioral high-risk design. 2011 Manuscript under editorial review.
- Alloy LB, Urosevic S, Abramson LY, Jager-Hyman S, Nusslock R, Whitehouse WG, Hogan ME. Progression along the bipolar spectrum: A longitudinal study of predictors of conversion from bipolar spectrum conditions to bipolar I and II disorders. *Journal of Abnormal Psychology*. 2012; 121:16–27. [PubMed: 21668080]
- American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 4th ed., text revision. Author; Washington, DC: 2000.
- Andover MS, Pepper CM, Ryabchenko KA, Orrico EG, Gibb BE. Self-mutilation and symptoms of depression, anxiety, and borderline personality disorder. *Suicide and Life-Threatening Behavior*. 2005; 35(5):581–591. [PubMed: 16268774]
- Atkins DC, Gallop RJ. Re-thinking how family researchers model infrequent outcomes: A tutorial on count regression and zero-inflated models. *Journal of Family Psychology*. 2007; 21(4):726–735. [PubMed: 18179344]
- Beck I, Smits DJM, Claes L, Vandereycken W, Bijttebier P. Psychometric evaluation of the behavioral inhibition/behavioral activation system scales and the sensitivity to punishment and sensitivity to reward questionnaire in a sample of eating disordered patients. *Personality and Individual Differences*. 2009; 47(5):407–412.
- Biuckians A, Miklowitz DJ, Kim EY. Behavioral activation, inhibition and mood symptoms in early-onset bipolar disorder. *Journal of Affective Disorders*. 2007; 97:71–76. [PubMed: 16890995]
- Carver CS, White TL. Behavioral inhibition, behavioral activation, and affective responses to impending reward and punishment: The BIS/BAS scales. *Journal of Personality and Social Psychology*. 1994; 67(2):319–333.
- Chapman AL, Gratz KL, Brown MZ. Solving the puzzle of deliberate self-harm: The experiential avoidance model. *Behaviour Research and Therapy*. 2006; 44(3):371–394. [PubMed: 16446150]
- Cooper A, Gomez R, Aucote H. The behavioural inhibition system and behavioural approach system (BIS/BAS) scales: Measurement and structural invariance across adults and adolescents. *Personality and Individual Differences*. 2007; 43(2):295–305.
- Cooper AJ, Smillie LD, Jackson CJ. A trait conceptualization of reward-reactivity. *Journal of Individual Differences*. 2008; 29(3):168–180.
- Corr PJ. J. A. Gray's reinforcement sensitivity theory: Tests of the joint subsystems hypothesis of anxiety and impulsivity. *Personality and Individual Differences*. 2002; 33:511–532.
- Corr PJ. Reinforcement sensitivity theory and personality. *Neuroscience and Biobehavioral Reviews*. 2004; 28(3):317–332. [PubMed: 15225974]
- Costa, P.; McCrae, RR. Revised NEO personality inventory (NEO-PI-R) and the five factor inventory (NEOFFI): Professional manual. Psychological Assessment Resources Inc.; Odessa, Florida: 1992.

- Daniel SS, Goldston DB, Erkanli A, Franklin JC, Mayfield AM. Trait anger, anger expression, and suicide attempts among adolescents and young adults: A prospective study. *Journal of Clinical Child and Adolescent Psychology*. 2009; 38(5):661–671. [PubMed: 20183651]
- DeYoung, CG. Impulsivity as a personality trait.. In: Vohs, KD.; Baumeister, RF., editors. *Handbook of self-regulation: Research, theory, and applications*. 2nd ed.. Guilford; NY: 2011. p. 485-502.
- D'silva MU, Harrington NG, Palmgreen P, Donohew L, Lorch EP. Drug use prevention for the high sensation seeker: The role of alternative activities. *Substance Use & Misuse*. 2001; 36:373–385. [PubMed: 11325172]
- Eysenck HJ. Dimensions of personality: 16, 5, or 3? Criteria for a taxonomic paradigm. *Personality and Individual Differences*. 1991; 12:773–790.
- Franken IH, Muris P, Georgieva I. Gray's model of personality and addiction. *Addictive Behaviors*. 2006; 31(3):399–403. [PubMed: 15964149]
- Gardner W, Mulvey EP, Shaw EC. Regression analyses of counts and rates, Poisson, overdispersed Poisson, and negative binomial models. *Psychological Bulletin*. 1995; 118(3):392–404. [PubMed: 7501743]
- Gratz KL. Measurement of deliberate self-harm: Preliminary data on the deliberate self-harm inventory. *Journal of Psychopathology and Behavioral Assessment*. 2001; 23(4):253–263.
- Gratz KL, Breetz A, Tull MT. The moderating role of borderline personality in the relationships between deliberate self-harm and emotion-related factors. *Personality and Mental Health*. 2010; 4(2):96–107.
- Gray, JA., editor. *A critique of Eysenck's theory of personality*. Springer; New York: 1981.
- Gray JA. Perspectives on anxiety and impulsivity: A commentary. *Journal of Research in Personality*. 1987; 21:493–509.
- Gray, JA. Framework for a taxonomy of psychiatric disorder.. In: van Gozen, S.; van de Poll, N.; Sergeant, JA., editors. *Emotions: Essays on emotion theory*. Lawrence Erlbaum Associates, Inc.; New Jersey: 1993.
- Gray, JA.; McNaughton, N. *The neuropsychology of anxiety*. Oxford University Press; Oxford: 2000.
- Hasking PA, Coric SJ, Swannell S, Martin G, Thompson HK, Frost ADJ. Brief report: Emotion regulation and coping as moderators in the relationship between personality and self-injury. *Journal of Adolescence*. 2010; 33(5):767–773. [PubMed: 20056516]
- Hayes AF, Matthes J. Computational procedures for probing interactions in OLS and logistic regression: SPSS and SAS implementations. *Cognitive Therapy and Research*. 2009; 26:924–936.
- Herpertz S, Sass H, Favazza A. Impulsivity in self-mutilative behavior: Psychometric and biological findings. *Journal of Psychiatric Research*. 1997; 31(4):451–465. [PubMed: 9352472]
- Hundt NE, Kimbrel NA, Mitchell JT, Nelson-Gray RO. High BAS, but not low BIS, predicts externalizing symptoms in adults. *Personality and Individual Differences*. 2008; 44(3):565–575.
- Jacobson CM, Muehlenkamp JJ, Miller AL, Turner JB. Psychiatric impairment among adolescents engaging in different types of deliberate self-harm. *Journal of Clinical Child and Adolescent Psychology*. 2008; 37(2):363–375. [PubMed: 18470773]
- Jenkins, AL.; Conner, BT.; Alloy, LB. The role of personality among self-injuring adolescents.. In: Conner, BT., editor. *Adolescents at risk: Examining variables that predict sex, drug use, and self-injury*. Symposium conducted at the Meeting of the Association for Psychological Science. Boston, MA: May. 2010
- Jenkins, AL.; Conner, BT.; Alloy, LB. Poster presented at the Meeting of the American Psychological Association. Toronto, Canada: Aug. 2011 *The Form and Function of Self-Injury Scale: Development and psychometric evaluation..*
- Jenkins AL, Schmitz M. The roles of affect dysregulation and positive affect in non-suicidal self-injury. *Archives of Suicide Research*. in press.
- Johnson SL, Turner RJ, Iwata N. BIS/BAS levels and psychiatric disorder: An epidemiological study. *Journal of Psychopathology and Behavioral Assessment*. 2003; 25(1):25–36.
- Klonsky ED, Glenn CR. Assessing the functions of non-suicidal self-injury: Psychometric properties of the Inventory of Statements about Self-Injury (ISAS). *Journal of Psychopathology and Behavioral Assessment*. 2009; 31(3):215–219.

- Klonsky ED, Oltmanns TF, Turkheimer E. Deliberate self-harm in a nonclinical population: Prevalence and psychological correlates. *The American Journal of Psychiatry*. 2003; 160(8):1501–1508. [PubMed: 12900314]
- Linehan, MM. Skills training manual for treating borderline personality disorder. Guilford Press; New York, NY US: 1993. Skills training manual for treating borderline personality disorder..
- Lynam DR, Miller JD, Miller DJ, Bornovalova MA, Lejuez CW. Testing the relations between impulsivity-related traits, suicidality, and nonsuicidal self-injury: A test of the incremental validity of the UPPS model. *Personality Disorders: Theory, Research, and Treatment*. 2011; 2(2):151–160.
- MacLaren VV, Best LA. Nonsuicidal self-injury, potentially addictive behaviors, and the Five Factor Model in undergraduates. *Personality and Individual Differences*. 2010; 49(5):521–525.
- Mohl B, Skandsen A. The prevalence and distribution of self-harm among Danish high school students. *Personality and Mental Health*. Advance online publication. 2011 doi: 10.1002/pmh.191.
- Muehlenkamp JJ. Self-injurious behavior as a separate clinical syndrome. *The American Journal of Ortho-psychiatry*. 2005; 75(2):324–333.
- Nock MK. Suicidal behavior among adolescents: Correlates, confounds, and (the search for) causal mechanisms. *Journal of the American Academy of Child and Adolescent Psychiatry*. 2009; 48(3): 237–239. [PubMed: 19242288]
- Nock MK, Joiner TE Jr. Gordon KH, Lloyd-Richardson E, Prinstein MJ. Non-suicidal self-injury among adolescents: Diagnostic correlates and relation to suicide attempts. *Psychiatry Research*. 2006; 144(1):65–72. [PubMed: 16887199]
- Nock MK, Prinstein MJ. A functional approach to the assessment of self-mutilative behavior. *Journal of Consulting and Clinical Psychology*. 2004; 72(5):885–890. [PubMed: 15482046]
- Nock MK, Teper R, Hollander M. Psychological treatment of self-injury among adolescents. *Journal of Clinical Psychology*. 2007; 63:1081–1089. [PubMed: 17932981]
- O'Connor RC, Forgan G. Suicidal thinking and perfectionism: The role of goal adjustment and behavioral inhibition/activation systems (BIS/BAS). *Journal of Rational-Emotive & Cognitive Behavior Therapy*. 2007; 25(4):321–341.
- O'Connor RM, Stewart SH, Watt MC. Distinguishing BAS risk for university students' drinking, smoking, and gambling behaviors. *Personality and Individual Differences*. 2009; 46:514–519.
- Prinstein MJ, Nock MK, Spirito A, Grapentine WL. Multimethod assessment of suicidality in adolescent psychiatric inpatients: Preliminary results. *Journal of the American Academy of Child and Adolescent Psychiatry*. 2001; 40(9):1053–1061. [PubMed: 11556629]
- Rasmussen SA, Elliott MA, O'Connor RC. Psychological distress and perfectionism in recent suicide attempters: The role of behavioural inhibition and activation. *Personality and Individual Differences*. 2012; 52(6):680–685.
- Salavert J, Caseras X, Torrubia R, Furest S, Arranz B, Duenas R, San L. The functioning of the Behavioral Activation and Inhibition Systems in bipolar I euthymic patients and its influence in subsequent episodes over an 18-month period. *Personality and Individual Differences*. 2007; 42:1323–1331.
- Smillie LD, Jackson CJ. The appetitive motivation scale and other BAS measures in the prediction of approach and active avoidance. *Personality and Individual Differences*. 2005; 38(4):981–994.
- Smillie LD, Pickering AD, Jackson CJ. The new reinforcement sensitivity theory: Implications for personality measurement. *Personality and Social Psychology Review*. 2006; 10(4):320–335. [PubMed: 17201591]
- SPSS Inc.. SPSS base 16.0 for Windows user's guide. SPSS Inc.; Chicago, IL: 2007.
- Tellegen, A. Structure of mood and personality and their relevance to assessing anxiety, with an emphasis on self-report.. In: Tuma, AH.; Maser, JD., editors. *Anxiety and the anxiety disorders*. University of Minnesota Press; Minneapolis, MN: 1985. p. 681-706.
- Torrubia R, Avila C, Molto J, Caseras X. The Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ) as a measure of Gray's anxiety and impulsivity dimensions. *Personality and Individual Differences*. 2001; 31:837–862.
- Torrubia, R.; Avila, C.; Molto, J.; Grande, I. Testing for stress and happiness: The role of the behavioral inhibition system.. In: Spielberger, CD.; Saranson, IG.; Brebner, J.; Greenglass, E.;

Laungani, P.; O'Roark, AM., editors. Stress and emotion: Anxiety, anger, and curiosity. Vol. 15. Taylor and Francis; Washington DC: 1995. p. 189-211.

Whiteside SP, Lynam DR. The Five Factor Model and impulsivity: Using a structural model of personality to understand impulsivity. *Personality and Individual Differences*. 2001; 30:669–689.

Whitlock J, Eckenrode J, Silverman D. Self-injurious behavior in a college population. *Pediatrics*. 2006; 117(6):1939–1948.

World Health Organization. International classification of diseases and related health problems (10th ed., revised). World Health Organization; Geneva: 2010. Retrieved from: <http://apps.who.int/classifications/icd10/browse/2010/en>

Figure 1. Interaction of behavioural activation system (BAS) reward by behavioural inhibition system (BIS) predicting number of lifetime acts of non-suicidal self-injury (NSSI). Low and high values represent -1 and $+1$ standard deviation, respectively. See Table 5 for interaction statistics

Figure 2.

Interaction of sensitivity to reward (SR) by sensitivity to punishment (SP) predicting number of lifetime acts of non-suicidal self-injury (NSSI). Low and high values represent -1 and $+1$ standard deviation, respectively. See Table 5 for interaction statistics

Figure 3. Interaction of behavioural activation system (BAS) drive by behavioural inhibition system (BIS) predicting number of methods of non-suicidal self-injury (NSSI). Low and high values represent -1 and +1 standard deviation, respectively. See Table 5 for interaction statistics

Figure 4. Interaction of behavioural activation system (BAS) reward by behavioural inhibition system (BIS) predicting number of methods of non-suicidal self-injury (NSSI). Low and high values represent -1 and $+1$ standard deviation, respectively. See Table 5 for interaction statistics

Figure 5.

Interaction of behavioural activation system (BAS) fun seeking by behavioural inhibition system (BIS) predicting number of methods of non-suicidal self-injury (NSSI). Low and high values represent -1 and $+1$ standard deviation, respectively.

See Table 5 for interaction statistics

Table 1

Sample demographics

	Total sample (<i>n</i> = 598)	NSSI history (<i>n</i> = 178)	No NSSI history (<i>n</i> = 420)
Sex (% female)	71.4%	72.5%	71.0%
Age	20.79	21.04	20.68
Race			
White	57.7%	68.5%	53.1%
Black	24.4%	19.1%	26.7%
Asian	13.4%	8.4%	15.5%
Other	1.1%	2.8%	.4%
No response	3.4%	1.2%	4.3%

Note. NSSI = non-suicidal self-injury.

Table 2Correlations among BAS and BIS variables ($n = 598$)

	1	2	3	4	5	6
1. BAS drive	—					
2. BAS fun seeking	0.42**	—				
3. BAS reward	0.51**	0.43**	—			
4. SR	0.35**	0.30**	0.22**	—		
5. BIS	-0.04	-0.11**	-0.05	0.10*	—	
6. SP	-0.16**	-0.22**	-0.16**	0.16**	0.54**	—

Note. BAS = behavioural activation system; BIS = behavioural inhibition system; SP = sensitivity to punishment; SR = sensitivity to reward.

*
 $p < 0.05$

**
 $p < 0.01$.

Table 3

Descriptive statistics of BAS and BIS scores across groups

	<u>Total sample (<i>n</i> = 598)</u>		<u>NSSI history (<i>n</i> = 178)</u>		<u>No NSSI History (<i>n</i> = 420)</u>	
	Mean (SD)	Median	Mean (SD)	Median	Mean (SD)	Median
BAS drive	10.98 (2.36)	11.00	11.26 (2.30)	11.00	10.88 (2.34)	11.00
BAS fun seeking	12.21 (2.03)	12.00	12.29 (1.94)	12.00	12.18 (2.07)	12.00
BAS reward	16.15 (1.87)	16.00	16.30 (1.84)	16.00	16.09 (1.87)	16.00
SR	10.23 (3.70)	10.00	10.56 (3.50)	11.00	10.10 (3.77)	10.00
BIS	20.96 (3.73)	21.00	21.12 (4.25)	21.00	20.90 (3.48)	21.00
SP	9.92 (4.57)	10.00	10.36 (4.42)	10.00	9.73 (4.58)	10.00

Note. BAS = behavioural activation system; BIS = behavioural inhibition system; NSSI = non-suicidal self-injury; SD = standard deviation; SP = sensitivity to punishment; SR = sensitivity to reward.

Table 4Summary of logistic regressions of BAS and BIS variables predicting at least one act of NSSI ($n = 598$)

					95% confidence interval	
Predictor	<i>B</i> (<i>SE</i>)	Wald χ^2	<i>p</i>	<i>AOR</i>	Lower	Upper
BAS variables						
BAS drive	0.069 (0.038)	3.281	0.070	1.07	0.994	1.157
BAS fun seeking	0.028 (0.044)	0.402	0.526	1.028	0.943	1.122
BAS reward	0.060 (0.049)	1.537	0.215	1.062	0.966	1.168
SR	0.034 (0.024)	1.945	0.163	1.035	0.986	1.085
BIS variables						
BIS	0.016 (0.024)	0.412	0.521	1.016	0.969	1.065
SP	0.031 (0.020)	2.374	0.123	1.031	0.992	1.072
BAS * BIS interactions						
BAS drive * BIS	−0.031 (0.010)	8.751	0.003	0.970	0.950	0.990
BAS fun seeking * BIS	−0.041 (0.012)	10.902	0.001	0.960	0.937	0.984
BAS reward * BIS	−0.046 (0.013)	12.307	<0.001	0.955	0.931	0.980
SR * SP	−0.001 (0.005)	0.010	0.919	1.000	0.990	1.009

Note. AOR = adjusted odds ratio; BAS = behavioural activation system; BIS = behavioural inhibition system; NSSI = non-suicidal self-injury; SE = standard error; SP = sensitivity to punishment; SR = sensitivity to reward.

df for all Wald χ^2 tests = 1.

Table 5

Summary of negative binomial regressions of BAS and BIS variables predicting NSSI characteristics ($n = 598$)

Predictor	Lifetime # NSSI acts			Lifetime # NSSI methods used		
	<i>B</i> (<i>SE</i>)	Wald χ^2	<i>p</i>	<i>B</i> (<i>SE</i>)	Wald χ^2	<i>p</i>
BAS variables						
BAS drive	0.039 (0.015)	6.701	0.010	0.033 (0.026)	1.540	0.215
BAS fun seeking	0.073 (0.025)	12.856	<0.001	0.077 (0.031)	6.156	0.013
BAS reward	-0.063 (0.021)	8.904	0.003	0.034 (0.033)	1.116	0.291
SR	0.036 (0.010)	13.831	<0.001	0.046 (0.017)	7.283	0.007
BIS variables						
BIS	0.007 (0.010)	0.589	0.443	0.026 (0.016)	2.973	0.085
SP	0.084 (0.013)	44.803	<0.001	0.042 (0.014)	8.684	0.003
BAS * BIS interactions						
BAS drive * BIS	-0.003 (0.004)	0.428	0.513	-0.016 (0.007)	5.792	0.016
BAS fun seeking * BIS	0.006 (0.005)	1.859	0.173	-0.022 (0.008)	7.644	0.006
BAS reward * BIS	-0.027 (0.005)	29.004	<0.001	-0.035 (0.008)	17.970	<0.001
SR * SP	-0.022 (0.004)	37.898	<0.001	-0.002 (0.004)	0.188	0.664

Note. BAS = behavioural activation system; BIS = behavioural inhibition system; SP = sensitivity to punishment; SR = sensitivity to reward.

df for all Wald χ^2 tests = 1.