Negative Emotional Response Inhibition: Support for a Cognitive Mechanism Underlying
Negative Urgency in Nonsuicidal Self-Injury

Kenneth J.D. Allen^{a,b,*} and Jill M. Hooley^c

^aDepartment of Psychiatry and Human Behavior, Alpert Medical School of Brown University,
Box G-BH, Providence, RI 02912, USA

^bPsychosocial Research Program, Butler Hospital, 345 Blackstone Boulevard, Providence, RI
02906, USA.

^cDepartment of Psychology, Harvard University, 33 Kirkland Street, Cambridge 02138, MA,
USA. jmh@wjh.harvard.edu.

*Corresponding author. Email: kenneth_allen1@brown.edu.

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Abstract

Negative urgency, the self-reported tendency to act impulsively when distressed, increases risk for nonsuicidal self-injury (NSSI). Prior research also suggests that NSSI is associated with impaired negative emotional response inhibition (NERI), a cognitive process theoretically related to negative urgency. Specifically, individuals with a history of NSSI had difficulty inhibiting behavioral responses to negative affective images in an Emotional Stop-Signal Task, but not to those depicting positive or neutral content. The present study sought to replicate this finding, determine whether this deficit extends to an earlier stage of NERI, and explore whether impairment in these two stages of emotional inhibitory control helps explain the relationship between negative urgency and NSSI. To address these aims, 88 adults with NSSI histories ($n = 45$) and healthy control participants ($n = 43$) without NSSI history or psychopathology completed a clinical interview, symptom inventories, an impulsivity questionnaire, and behavioral impulsivity tasks measuring early and late emotional response inhibition. The NSSI group had worse late NERI than the control group on the Emotional Stop-Signal Task, but no group differences were observed in early NERI on an Emotional Go/no-go task. However, both early and late stages of NERI accounted for independent variance in negative urgency. We additionally found that late NERI explained variance in the association between negative urgency and NSSI. These results suggest that impulsive behavior in NSSI may involve specifically impaired inhibitory control over negative emotional impulses during late response inhibition, and that this cognitive deficit might reflect one mechanism or pathway to elevated negative urgency among people who self-injure.

Keywords: *Self-injurious behavior; Inhibition; Executive function; Impulsive behavior; Emotion regulation*

Nonsuicidal self-injury (NSSI), the direct and deliberate destruction of body tissue without suicidal intent, is a common behavior with potentially serious consequences. Lifetime prevalence rates include 17.2% of adolescents, 13.4% of young adults, and 5.5% of adults in community samples (Swannell, Martin, Page, Hasking, & St. John, 2014). Although NSSI acts are, by definition, “non-suicidal”, NSSI is strongly associated with suicidality both cross-sectionally (Joiner, Ribeiro, & Silva, 2012; Klonsky, May, & Glenn, 2013; Nock, Joiner, Gordon, Lloyd-Richardson, & Prinstein, 2006) and prospectively: NSSI is equivalent to suicide attempt history in predicting future suicidal behavior in meta-analysis (Ribeiro et al., 2016).

Trait impulsivity is one risk factor for NSSI (Fox et al., 2015). However, although people engaging in NSSI report heightened impulsivity on a variety of inventories and questionnaires, they generally do not behave impulsively in laboratory tasks (Hamza, Willoughby, & Heffer, 2015). This is likely because “impulsivity” is a multidimensional construct, encompassing several personality and behavioral subcomponents with theoretically distinct contributions to psychopathology and behavior. The model of impulsive personality developed by Whiteside and Lynam (2001) and later extended by Cyders and Smith (2008) supports the idea that certain traits are differentially involved in NSSI. Specifically, NSSI is associated with lack of perseverance, lack of premeditation, and negative urgency, which shows the largest effect size in meta-analysis ($d = 0.59$; Hamza et al., 2015). Longitudinal research indicates that negative urgency may specifically increase risk for NSSI onset, whereas lack of perseverance might promote NSSI maintenance (Riley, Combs, Jordan, & Smith, 2015). Evidence that NSSI is most strongly related to impulsivity in negative emotional contexts accords with theories conceptualizing affect dysregulation as its core feature (see Hooley & Franklin, 2018).

Despite its consistent link with self-reported impulsivity, few studies have observed impulsive behavior in NSSI. Empirical work by MacKillop and colleagues (2016) suggests that impulsivity's latent structure comprises three categories: impulsive personality, impulsive action, and impulsive choice. This study thus sought to reconcile the discrepancy between elevated negative urgency (i.e., impulsive personality) and mixed findings for impulsive action in NSSI.

Inhibitory Control in NSSI

Impulsive action results from impaired inhibitory control: a set of overlapping cognitive processes responsible for suppressing undesirable or inappropriate information and behavioral responses (Bari & Robbins, 2013). Inhibitory control includes three stages (Sebastian et al., 2013a): 1) Interference inhibition, 2) Action restraint (early response inhibition), and 3) Action cancellation (late response inhibition). Interference inhibition refers to the ability to enact target responses while suppressing distracting or competing stimulus characteristics (Nigg, 2000). Response inhibition involves withholding prepotent responses to infrequently presented stimuli (restraint) or terminating already-initiated responses (cancellation), which demands the most cognitive resources (Sebastian et al., 2013a). Impulsive behavior may arise from failure in any of these processes, and past research has examined functioning at each stage in NSSI.

Participants with and without NSSI histories demonstrated comparable interference inhibition in two studies (Allen & Hooley, 2017; Dahlgren et al., 2018). Investigations of action restraint have found no differences between NSSI and matched healthy control groups (Janis & Nock, 2009) or clinical control groups (McCloskey, Look, Chen, Pajoumand, & Berman, 2012). Past-month NSSI was also not associated with action restraint among adolescents in residential treatment (Auerbach et al., 2014). Finally, four studies report equivalent overall action

cancellation abilities in NSSI and control groups (Allen & Hooley, 2015; Fikke, Melinder, & Landrø, 2011; Glenn & Klonsky, 2010; Lengel, DeShong, & Mullins-Sweatt, 2016).

What accounts for this inconsistency between self-reported and behavioral impulsivity?

A large literature confirms that the relationship between self-report and performance-based measures of impulsivity is weak, perhaps because they tap distinct aspects of impulsivity (Aichert et al., 2012; MacKillop et al., 2016; Sharma, Markon, & Clark, 2014; Stahl et al., 2014). Indeed, Hamza et al. (2015) proposed that, since negative urgency is the impulsive trait most relevant to NSSI, negative mood might be necessary to observe impulsive behavior in lab tasks.

Emotional Inhibitory Control in NSSI

Three recent studies have attempted to address this possibility. Allen and Hooley (2017) observed no difference between participants with and without NSSI histories on the Multi-Source Interference Task (Bush, Shin, Holmes, Rosen, & Vogt, 2003) at baseline mood. Following a negative mood induction designed to activate self-critical schemas (participants wrote about a time they felt worthless, shameful, or failed to meet the expectations of someone important), the NSSI group reported increased negative mood but did not show worse interference inhibition than the control group. There was no relationship between changes in negative mood and interference inhibition, indicating that NSSI may not involve impairment in the first stage of inhibitory control, even with combined interference from cognitive and emotional sources.

Lengel et al. (2016) similarly assessed impulsive action in NSSI before and after a negative mood induction, using the Stop-Signal Task (Logan, 1994). The authors asked participants to write a detailed account of their most stressful experience within the past year, which they listened to as an auditory recording in a subsequent session to induce negative mood.

In line with other work, this study found no baseline differences between NSSI and control groups, and consistent with Allen and Hooley (2017), increasing negative mood did not impair response inhibition in the NSSI group. These findings suggest that negative mood does not promote impulsive action in NSSI. In sum, NSSI is not apparently associated with inhibitory deficits at baseline, or with difficulty inhibiting emotional interference during negative mood.

If negative mood does not impair inhibitory control in NSSI, elevated negative urgency may instead reflect failure to inhibit impulses directly motivated by negative emotion, or negative emotional response inhibition (NERI). The above studies indicate that people engaging in NSSI possess normative abilities to redirect attention from distracting negative emotional interference, e.g., suppressing negative affect to focus on a task. NSSI could rather involve problems suppressing *urges* that naturally ensue from negative emotions, e.g., yelling when angry or crying when sad. Allen and Hooley (2015) assessed this possibility using a novel task requiring participants to quickly discriminate the valence (positive or negative) of affective images by keypress, while occasionally inhibiting initiated motor responses (and associated emotional reactions). Adults reporting NSSI demonstrated worse response inhibition *specifically* to negative affective stimuli, i.e., when attempting to “cancel” negative emotional reactions. To our knowledge, NERI dysfunction observed in that study remains the only evidence of behavioral impulsivity in this population. This process fits theoretically with negative urgency in NSSI, which may reflect specifically impaired inhibitory control over negative emotional impulses, rather than generally impaired inhibitory control during negative emotional states.

The Present Study

This study’s primary aim was to evaluate NERI as a potential cognitive mechanism supporting negative urgency in NSSI. To achieve this, we sought to: a) replicate the finding that

NSSI involves impaired late response inhibition to negative emotional stimuli; b) explore whether this deficit is also present in early response inhibition; and c) examine relationships between early and late NERI, negative urgency, and NSSI history. Deficits in one or both of these processes may contribute to increased trait negative urgency and help explain its relationship to NSSI.

Late emotional response inhibition was measured using the Emotional Stop-Signal Task (Allen & Hooley, 2015). Based on that study, we hypothesized that participants with a history of NSSI would commit more errors during stop trials with negative affective images, but not those with positive or neutral images. We also predicted that the NSSI group would fail to inhibit a greater proportion of responses reflecting negative emotional impulses, regardless of image valence (i.e., commission errors during stop trials in which participants classify stimuli as “negative”), compared to the control group. That is, accounting for the tendency to categorize images as “negative” in the absence of stop-signals, we expected NSSI to be associated with impaired late NERI: difficulty interrupting negative emotional reactions after their initiation.

We used the Emotional Go/no-go task to assess early emotional response inhibition (Hare et al., 2008; Tottenham, Hare, & Casey, 2011). We defined early NERI as commission errors to negative emotional no-go stimuli in this task, which the task developers interpret as inhibitory deficits in negative emotional contexts (c.f., negative urgency; Tottenham et al., 2011). We predicted that the NSSI group would demonstrate worse early NERI relative to the control group.

Finally, we hypothesized associations between negative urgency and NSSI, as well as between negative urgency and impaired NERI on both tasks. We predicted that early and late NERI would each explain unique variance in negative urgency itself, as well as in its relationship with NSSI. In other words, we expected to observe indirect effects of negative urgency on the

presence of NSSI history through NERI deficits. Although the cross-sectional design of this study precludes tests of true mediation, observing indirect effects (indicating that NERI accounts for shared variance between negative urgency and the presence of NSSI history) would provide preliminary evidence that these deficits might represent mechanisms underlying this trait in NSSI. Given this conceptualization of NERI as a set of cognitive processes contributing to negative urgency, we also expected associations between poor NERI and symptoms of psychopathology that involve heightened negative urgency (e.g., alcohol misuse, borderline personality traits, cyclothymia, and disordered eating; see Berg, Latzman, Bliwise, & Lilienfield, 2015 for a meta-analytic review).

Method

Participants

Participants aged 18+ were recruited primarily via the online university study pool, which comprises a mix of local students and non-student adults seeking paid research opportunities, and through advertisements posted in the community. Interested individuals completed an online screening that collected demographic and psychiatric information. Eligibility criteria included English proficiency, no concussion history, and no impairments in motor ability, hearing, or vision. Participants provided informed consent before completing a 90-minute IRB-approved protocol that included counterbalanced self-report measures, a clinical interview, and cognitive tasks. Two groups of participants completed this session: those reporting a history of at least one NSSI episode using any method (confirmed via clinical interview; $n = 45$; 35 female) and control adults ($n = 43$; 34 female) reporting no history of NSSI, suicidality, psychiatric treatment, or psychological problems (including scores beneath thresholds on the symptom measures below).

Most participants in the NSSI group endorsed a history of at least one psychiatric diagnosis ($n = 31$, 69%), and many had multiple comorbidities ($n = 21$, 47% of the NSSI group). The most common reported diagnosis was depression ($n = 25$, 56%), followed by anxiety disorders ($n = 19$, 42%: generalized anxiety disorder $n = 8$; social phobia $n = 6$; post-traumatic stress disorder $n = 4$; panic disorder $n = 1$). Six participants reported eating disorders (13%), five reported developmental disorders/learning disabilities (11%), three reported bipolar disorder (7%), and two each (4%) reported alcohol or other substance use disorders, obsessive-compulsive disorder, and personality disorders. One participant (2%) reported a psychotic disorder. 18 NSSI participants (40%) had received psychological or psychiatric treatment in the past month; 13 (29%) reported current psychiatric medication use.

Measures

Clinical measures. We used the Self-Injurious Thoughts and Behaviors Interview (Nock, Holmberg, Photos, & Michel, 2007) to evaluate NSSI history. This measure has strong inter-rater reliability (mean $\kappa = 0.99$, $r = 1.0$), 6-month test-retest reliability (mean $\kappa = 0.70$, ICC = 0.44), and construct validity via correspondence with other measures of NSSI (Nock et al., 2007).

We assessed recent symptoms of anxiety and depression using the Beck Anxiety Inventory (BAI; Beck & Steer, 1993) and the Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996). Each contains 21 Likert-type items rated on a severity scale of 0-3. Both have established psychometric properties, including one-week test-retest reliability (BAI: $r = 0.75$, Beck, Epstein, Brown, & Steer, 1988; BDI-II: $r = 0.93$, Beck et al., 1996), internal consistency (BAI: $\alpha = 0.92$ and BDI-II: $\alpha = 0.94$ in this study), as well as concurrent, discriminant, and criterion validity (BAI: Beck & Steer, 1993; BDI-II: Arnau, Meagher, Norris, & Bramson, 2001;

Beck et al., 1996). For control group inclusion, we used cutoff scores of 26 for the BAI and 29 for the BDI-II, corresponding to “severe” levels (Beck & Steer, 1993; Beck et al. 1996).

The Eating Disorder Examination-Questionnaire (EDE-Q; Fairburn & Beglin, 1994) is a 22-item measure rated on 7-point symptom frequency and severity scales. It has high internal consistency ($\alpha = 0.96$ in this sample), as well as concurrent and criterion validity in community samples of adults (Mond, Hay, Rodgers, Owen, & Beumont, 2004). We used a cutoff score of 2.3 on the global EDE-Q scale for the control group, which yields the best compromise between sensitivity and specificity in identifying individuals meeting DSM-IV (American Psychiatric Association, 1994) eating disorder criteria (Mond et al., 2004).

We used the Michigan Alcoholism Screening Test (MAST; Selzer, 1971), a 24-item yes/no self-report checklist, to assess current and past problems with alcohol use. A score of 5 or above on the MAST corresponds to “alcoholism”, which we used as the clinical cutoff. The MAST has established test-retest reliability (4.8-month interval $r = 0.84$) and validity (Storgaard, Nielsen, & Gluud, 1994). Internal consistency was $\alpha = 0.80$ in this sample.

The McLean Screening Instrument for borderline personality disorder (MSI-BPD; Zanarini et al., 2003), a 10-item yes/no self-report checklist, assessed BPD traits. We used the recommended cutoff score (7 affirmative items), which is both highly sensitive and specific (both above 0.90 in young adults). This measure’s criterion validity is established in community samples (Patel, Sharpy, & Fonagy, 2011). Zanarini et al. (2003) also report adequate one-week test-retest reliability ($r = 0.72$) and internal consistency ($\alpha = 0.82$ in this sample).

The 17-item cyclothymic scale of the TEMPS-A (Akiskal, Akiskal, Haykal, Manning, & Connor, 2005a) is a yes/no self-report measure of temperamental mood lability. It has been validated in healthy and clinical samples (Akiskal et al., 2005b), has adequate test-retest

reliability (6-12 month interval: $r = 0.68$; Akiskal et al., 2005a), and good internal consistency in the current sample ($\alpha = 0.87$). We used Akiskal and Akiskal's (2005) suggested cutoff of 11.

UPPS-P Impulsivity Scale. The UPPS-P (Lynam et al., 2006) is a 59-item self-report inventory with items rated on a 4-point Likert scale. It measures five impulsive personality traits: 1) negative and 2) positive urgency, rash action in response to negative or positive emotion, respectively; 3) lack of premeditation, action without forethought; 4) lack of perseverance, low tolerance for difficult or boring tasks; and 5) sensation seeking, pursuing exciting or novel experiences. These subscales demonstrate convergent and discriminant validity (Cyders et al., 2007; Cyders & Smith, 2008; Smith et al., 2007), as well as internal consistency in this sample (negative urgency $\alpha = 0.92$; positive urgency $\alpha = 0.95$; lack of premeditation $\alpha = 0.81$; lack of perseverance $\alpha = 0.87$; sensation seeking $\alpha = 0.88$).

Emotional Response Inhibition Tasks

The Emotional Go/no-go task (Hare et al., 2008; Tottenham et al., 2011) measures early emotional response inhibition, using images of 10 adult faces (five males and five females) in five different expressions (neutral, happy, fearful, angry, and sad). Research shows convergent (Schulz et al., 2007) divergent validity (Casey et al., 2011) between non-emotional and emotional versions of the Go/no-go task. The Emotional Go/no-go requires participants to rapidly respond *only* to a given facial target that varies by task block. These “go” trials occur frequently in order to generate a prepotent response tendency. Participants must withhold responses to non-target facial stimuli that appear in 33% of trials. Each block includes an emotional expression paired with a neutral expression, and depending on the block, either the emotional face serves as the go stimulus (with neutral as no-go) or the no-go stimulus (with neutral as go). Participants completed eight randomized blocks of 30 trials in each condition.

Early NERI was defined as the commission error rate to negative emotional non-target faces. Prior studies have found associations between worse early NERI and childhood adversity (Johnson & Tottenham, 2015; Tottenham et al., 2010), depression-related constructs (Hjorft et al., 2017; Vanderhasselt, Kühn, & De Raedt, 2011), as well as violence among psychiatric inpatients (Brugman et al., 2016), aggression (Denny & Siemer, 2012), and criminality/psychopathy (Iria, Barbosa, & Paixão, 2011). Neuroimaging indicates that negative urgency is related to recruitment of inhibitory regions during early NERI (Chester et al., 2016).

We used E-Prime software to present task stimuli and collect data, which were included in analyses only if correct hit rate exceeded 75% (see Johnson & Tottenham, 2015). Two NSSI participants had missing data, resulting in a sample of $n = 83$ (NSSI: $n = 41$; control: $n = 42$).

The Emotional Stop-Signal Task (Allen & Hooley, 2015) is a modification of the original Stop Signal Task (SST), which measures late response inhibition (Verbruggen & Logan, 2008). In the SST, participants discriminate between serially displayed left and right arrows by pressing the key corresponding to the direction of the arrow (“go” trials). However, unpredictable auditory stop-signals appear almost immediately after some arrows on a 25% of trials, indicating that participants should cancel their prepotent response (“stop” trials). These stop-signals occur with a variable delay that is adjusted to ensure that roughly half of stop trials result in errors, to calculate the time necessary for successful inhibition, known as stop-signal reaction time.

In lieu of arrow stimuli, the emotional version uses 36 images from the International Affective Picture System (Lang et al., 2008) comprised of neutral, positive, and negative categories (12 of each type).¹ Images were selected based on equivalent standardized ratings of

¹ Neutral images: 2102, 2215, 2280, 2305, 2385, 2396, 2411, 2440, 2480, 2516, 2840, 8312; positive images: 1340, 2045, 2075, 2091, 2209, 2550, 4614, 5470, 5831, 8190, 8200, 8470; negative images: 2053, 2205, 2456, 2800, 2900, 3350, 6370, 6821, 9040, 9417, 9800, 9810.

valence intensity in the positive and negative categories, with neutral images being rated as neither positive nor negative. All three categories were matched in terms of arousal, with normative ratings within the “not arousing and not unarousing” range. Participants quickly and accurately distinguish the valence of each image (positive or “pleasant” vs. negative or “unpleasant”) by keypress. As in the SST, 25% of trials include a stop-signal indicating that participants should inhibit emotional classification responses. Participants completed four blocks of randomized images from all three categories, for 192 total trials. Given this task’s overall commission error rate approximates 50% by design, deviation from this rate indicates the relative difficulty of inhibiting reactions to different stimuli. We thus examined commission error rate separately in each image category to replicate the previous association between NSSI and worse late response inhibition to negative stimuli. The primary outcome was late NERI: failure to cancel motor responses reflecting negative emotional impulses across all stimulus categories.

We used Inquisit software to present stimuli and collect data. As with the Emotional Go/no-go, analyses were restricted to participants with hit rate above 75% and omission error rate under 25%; omission errors occur when participants wait for stop signals, rather than quickly responding as instructed. This yielded a sample of $n = 79$ (NSSI: $n = 41$; control: $n = 38$).

Statistical Procedures

We first derived descriptive statistics from interview responses in the NSSI group and then conducted χ^2 and t -tests comparing groups on demographic, clinical, and self-reported impulsivity variables (after examining normality and applying transformations where

appropriate²). We also adjusted outliers in past-year and lifetime NSSI frequency³ to account for potential recall biases and improve correlation estimates, consistent with our previous studies (e.g., Allen, Fox, Schatten, & Hooley, 2019). We used *t*-tests to examine group differences in overall task performance; repeated-measures ANOVAs to examine the effects of group membership, stimulus valence, and trial type (to assess our central hypotheses regarding NSSI history and NERI⁴) and follow-up *t*-tests to probe significant main effects and interactions. To reduce the likelihood of error, we used bootstrapped bias-corrected and accelerated (BCa) 95% confidence intervals (CIs) to evaluate linear associations among task performance and self-report measures, given that most variables violated normality assumptions even after applying transformations and the number of tests performed. To determine the specificity of associations between NSSI history and NERI, we performed linear regression analysis with group membership and symptom measures as independent variables predicting task performance, and also conducted linear regression to evaluate our hypothesis that early and late NERI account for variance in negative urgency. We used the PROCESS macro (Hayes, 2012) to test our hypothesis that NERI explains significant variance in the association between negative urgency and NSSI history (i.e., negative urgency exerts an indirect effect on NSSI through NERI), and to examine

² We applied logarithmic and square root transformations to improve normality of variables with substantial skew or kurtosis (absolute values above 1), using whichever most closely approximated the normal distribution in inferential analyses; all descriptive statistics reflect original values (with adjusted outliers; see below) to aid interpretation. We report skewness and kurtosis for transformed variables with values remaining above 1. Additional information regarding normality and transformations applied to specific variables is available upon request.

³ We replaced values above three standard deviations from the mean with the next value higher than the largest number of NSSI episodes reported beneath this threshold. This resulted in resulting in two adjustments in past-year and one in lifetime frequency.

⁴ As positive values reflect more errors and worse response inhibition, these variables are “reverse coded” akin to (lack of) premeditation on the UPPS-P. For simplicity, we use NERI rather than worse NERI throughout the Results section.

alternative models. We also performed a series of exploratory, post-hoc zero-inflated negative binomial (ZINB) regression analyses to determine the presence of an indirect effect of negative urgency on past-year and lifetime NSSI frequency through NERI. Participants with missing data were excluded from the appropriate analyses. We conducted analyses in SPSS 25.0 using two-tailed tests with $p < .05$ as the significance threshold and bootstrapping with 5000 samples to estimate 95% CIs for correlation and regression coefficients.

Results

Self-report Measures

The average age of NSSI onset was 14.45 years ($SD = 3.00$). The most commonly endorsed method of NSSI was cutting/carving skin (57.78%), followed by scraping skin (35.56%), self-battery (26.67%), burning (24.44%), and picking skin (22.22%). 40% endorsed some other method (e.g., self-flagellation). 25 participants (55.56%) endorsed multiple methods (two: $n = 8$, 17.78%; three: $n = 9$; 20%; four to six: $n = 8$; 17.78%). Four participants (8.89%) reported past-week NSSI ($M = 0.62$ episodes, $SD = 3.06$, $Mdn = 0$; skewness = 4.30, kurtosis = 19.60; within-group: $M = 7.00$, $SD = 8.83$, $Mdn = 4.0$), 12 (26.67%) reported past-month NSSI ($M = 2.79$ episodes, $SD = 12.26$, $Mdn = 0$; skewness = 3.03, kurtosis = 9.73; within-group: $M = 10.46$, $SD = 22.66$, $Mdn = 1$), and 27 (60%) reported past-year NSSI ($M = 22.24$ episodes, $SD = 61.31$, $Mdn = 2$; within-group: $M = 37.07$, $SD = 76.09$, $Mdn = 5$). Mean lifetime frequency was 187.40 episodes ($SD = 519.08$, $Mdn = 20$; skewness = 1.34; kurtosis = 1.11).

There were no group differences in gender, ethnicity, age (kurtosis = 2.87), or education; the NSSI group had more participants who identified as non-heterosexual, and reported more symptoms on each of the clinical measures (Table 1). Five NSSI participants (11.11%) each endorsed severe symptoms of anxiety and depression on the BAI and BDI-II, respectively; 18

surpassed the EDE-Q threshold for eating disorders (40%); seven met MAST criteria for “alcoholism” (15.56%); nine met MSI-BPD criteria (20%), and 11 exceeded the TEMPS-A cyclothymic cutoff (24.44%). The NSSI group also reported higher levels of negative urgency [$M = 29.20$, $SD = 8.64$; $t(75.39) = 5.57$, $p < .001$, Cohen’s $d = 1.18$], lack of perseverance [$M = 22.07$, $SD = 6.37$; $t(86) = 3.77$, $p < .001$, Cohen’s $d = 0.81$], and positive urgency [$M = 23.80$, $SD = 9.28$; $t(75.93) = 3.17$, $p = .002$, Cohen’s $d = 0.71$], compared to the control group (negative urgency: $M = 20.63$, $SD = 5.54$; lack of perseverance: $M = 17.63$, $SD = 3.88$; positive urgency: $M = 18.67$, $SD = 5.00$). There were no differences in lack of premeditation or sensation seeking.

Task Performance

Emotional Go/no-go Task. There were no group differences in reaction time, omission errors, or commission errors. We conducted a 2 (valence: positive vs. negative) X 2 (trial: go vs. no-go) X 2 (group: control vs. NSSI) repeated-measures ANOVA for commission errors, observing main effects of valence [$F(1, 81) = 18.76$, $p < .001$, partial $\eta^2 = .19$] and trial [$F(1, 81) = 157.85$, $p < .001$, partial $\eta^2 = .66$], as well as a significant interaction between the two [$F(1, 81) = 43.26$, $p < .001$, partial $\eta^2 = .38$]. Follow-up tests revealed that participants had a higher commission error rate during blocks containing negative emotional stimuli ($M = 11.14\%$, $SD = 7.30\%$) compared to positive stimuli ($M = 9.16\%$, $SD = 8.62\%$), $t(82) = 2.17$, $p = .03$, Cohen’s $d = 0.24$. Participants also made more errors when trying to inhibit emotional responses, i.e., during emotional no-go/neutral go blocks ($M = 15.74\%$, $SD = 10.50\%$) than during neutral no-go/emotional go blocks ($M = 4.56\%$, $SD = 6.08\%$, kurtosis = 2.16), $t(82) = 10.33$, $p < .001$, Cohen’s $d = 1.36$. These main effects were qualified by a valence X trial interaction: participants made more errors to neutral no-go faces when go faces were positive ($M = 6.60\%$, $SD = 10.39\%$, kurtosis = 2.36) rather than negative ($M = 2.49\%$, $SD = 3.64\%$, kurtosis = 3.00), $t(82) = 3.87$, $p <$

.001, Cohen's $d = 0.53$. Commission error rate was highest during NERI blocks (negative no-go/neutral go faces; $M = 19.80\%$, $SD = 12.89\%$), which involved more errors than positive no-go/neutral go blocks [$M = 11.70\%$, $SD = 11.88\%$; $t(82) = 5.62$, $p < .001$, Cohen's $d = 0.62$] and negative go/neutral no-go blocks [$t(82) = 13.74$, $p < .001$, Cohen's $d = 2.05$]. We did not observe any effects of group membership on early emotional response inhibition in this task. Given these null findings, we ran exploratory ANOVAs restricting the NSSI group to participants who surpassed clinical thresholds on symptom measures, and also using three comparison groups (control vs. past-year NSSI vs. prior NSSI), which both yielded comparable results.

Emotional Stop-Signal Task. We did not observe group effects in overall reaction time, stop-signal reaction time (kurtosis = 5.38), omission errors, or commission errors (skewness = 2.59, kurtosis = 11.00). A 3 (valence: neutral vs. positive vs. negative) X 2 (group: control vs. NSSI) repeated-measures ANOVA revealed a main effect of valence [$F(2, 154) = 217.80$, $p < .001$, partial $\eta^2 = .74$] as well as an interaction between valence and group [$F(2, 154) = 4.24$, $p = .02$, partial $\eta^2 = .05$] on commission errors. Post-hoc t -tests indicated worse inhibition to emotional stimuli (positive: $M = 51.97\%$, $SD = 14.89\%$; negative: $M = 49.63\%$, $SD = 17.04\%$) than to neutral stimuli [$M = 37.80\%$, $SD = 14.15\%$, kurtosis = 2.55; $t(78) = 22.25$, $p < .001$, Cohen's $d = 3.46$ and $t(78) = 18.08$, $p < .001$, Cohen's $d = 2.92$ for positive and negative images, respectively]. There was no difference in commission errors to positive and negative stimuli in both groups combined; however, follow-up t -tests confirmed that the NSSI group made more commission errors to negative stimuli [Table 2; $t(77) = 2.05$, $p = .04$, Cohen's $d = 0.46$], in the absence of group differences to positive or neutral stimuli.

To assess the association between NSSI history and late NERI, we ran a 2 (trial: go vs. stop) X 2 (group: control vs. NSSI) repeated measures ANOVA on negative emotional

classification responses (Fig. 1). This analysis evaluated the tendency to judge images as negative in the absence of inhibitory demands (i.e., the percentage of go trials in which participants made negative emotional responses, regardless of image valence) relative to the percentage of stop trials in which participants failed to inhibit negative emotional judgments across all image types (i.e., late NERI). There was a main effect of group, indicating that NSSI participants made more negative judgments overall [$F(1, 77) = 11.78, p = .001$, partial $\eta^2 = .13$], and a group X trial interaction [$F(1, 77) = 10.84, p = .002$, partial $\eta^2 = .12$]. As predicted, t -tests confirmed that the NSSI group had worse late NERI than the control group [$t(77) = 3.73, p < .001$, Cohen's $d = 0.84$; Table 2 and Fig. 1], with no group differences in negative emotional judgments during go trials. The NSSI group also made more negative emotional classification responses during stop trials relative to go trials, $t(40) = 3.15, p = .003$, Cohen's $d = 0.49$. The control group, in contrast, had equivalent rates of negative emotional judgments across trial type.

Associations between Task Performance and Self-report

Reaction time and omission errors on the tasks were correlated, $r(74) = .31$, BCa 95% CI: .10 – .48 and $r(74) = .29$, CI: .01 – .53, respectively. There were no associations between total commission errors, or between commission errors to specific types of emotional stimuli. As Table 3 shows, there was an association between early and late NERI (CI: .003 – .39), and both correlated with negative urgency (early CI: .05 – .45; late CI: .11 – .46). Early NERI was further associated with cyclothymic temperament scores on the TEMPS-A (CI: .06 – .36) and positive urgency (CI: .05 – .42). Partial correlations suggested that negative and positive urgency accounted for overlapping variance in early NERI, i.e., neither correlation was significant when controlling for the other variable. Late NERI was correlated with scores on all clinical measures except the MAST. To confirm that the association between NSSI history and late NERI was not

accounted for by psychopathology symptoms, we conducted a linear regression predicting late NERI from group membership and scores on significantly associated clinical measures, which determined that NSSI history was the only variable to explain significant variance in late NERI (Table 4). Our hypothesis that early and late NERI accounted for separate variance in negative urgency was supported by another linear regression in Table 4. NSSI frequency was not associated with NERI on either task. We also conducted *t*-tests comparing individuals who engaged in past-year NSSI vs. those who did not and observed no group differences in NERI. We observed no other correlations with NSSI frequency aside from BDI-II scores [past-month $r(45) = .24$, CI: .03 – .50; past-year $r(45) = .26$, CI: .02 – .48; lifetime $r(45) = .31$, CI: .05 – .52].

To assess our hypothesis that NERI contributes to the relationship between negative urgency and NSSI, we examined a model employing logistic regression to predict the presence or absence of NSSI history (i.e., group membership) from negative urgency, with late NERI entered as a “mediator” to estimate an indirect effect. This model significantly predicted NSSI history overall, $\chi^2(2, N = 79) = 30.99, p < .001$, Nagelkerke's $R^2 = .43$, with significant direct effects of negative urgency on late NERI, late NERI on NSSI, and negative urgency on NSSI (see Fig. 2). As hypothesized, negative urgency had a significant indirect effect on NSSI history through late NERI ($b = 0.02, SE = 0.02, CI: 0.004 – 0.06$). The results of this analysis were supported by comparing correlations between group membership and negative urgency before [$r(79) = .51, CI: .34 – .67$] and after controlling for late NERI [$r(76) = .46, CI: .28 – .61$], which suggested that this cognitive process accounted for approximately 5-8% of the variance in the association between negative urgency and NSSI history. We evaluated two alternative models to elucidate the specificity of these relationships. First, we evaluated whether lack of perseverance also exerted an indirect effect on NSSI group membership through late NERI, which produced a

significant overall model [$\chi^2(2, N = 79) = 23.81, p < .001$, Nagelkerke's $R^2 = .35$], with direct effects observed for lack of perseverance ($b = 0.16, SE = 0.06, CI: 0.06 - 0.31$) and late NERI ($b = 6.13, SE = 2.09, CI: 2.76 - 11.08$) on NSSI group, but no effect of perseverance on late NERI (and no indirect effect on NSSI). We constructed a final model using BDI-II scores to predict NSSI group, again including late NERI as a “mediator” to determine the presence of an indirect effect. This model was also significant [$\chi^2(2, N = 79) = 47.47, p < .001$, Nagelkerke's $R^2 = .60$], including direct effects of BDI-II on late NERI ($b = 0.03, SE = 0.009, CI: 0.01 - 0.05$) and on NSSI ($b = 1.22, SE = 0.29, CI: 0.66 - 1.77$). However, late NERI did not have a direct effect on NSSI in this model, nor was there evidence for an indirect effect. Post-hoc ZINB regression models indicated no effects of negative urgency or late NERI on past-year or lifetime NSSI frequency, consistent with correlation estimates but in contrast to logistic regression analyses using the binary outcome of NSSI history (i.e., group membership).

Discussion

This study sought to extend previous work by clarifying the nature of emotional response inhibition in NSSI and how it relates to self-reported negative urgency. We replicated the previous association between NSSI and poor late response inhibition to negative affective images in the Emotional Stop-Signal Task, without group differences to neutral or positive images (Allen & Hooley, 2015). On each trial in this task, participants rapidly judge the valence of the presented image as positive or negative. Although the NSSI and control groups were equally likely to categorize images as negative in the absence of a stop signal, the NSSI group had more difficulty inhibiting negative categorization responses (theoretically reflecting negative emotional reactions) when a stop signal occurred – a process we define as *late NERI* (Fig. 1). In other words, participants from the NSSI and control groups demonstrated a similar amount of

negative behavioral/emotional responses in contexts without inhibitory demand, but those with NSSI history were less able to terminate those responses after they were initiated.

Our primary aim was to evaluate whether impaired NERI represents a cognitive process underlying the association between self-reported negative urgency and NSSI. Our hypotheses were partially supported: early and late NERI explained independent variance in negative urgency, but only late NERI accounted for a small but significant portion of the variance in the relationship between negative urgency and NSSI history. Alternative models evaluating lack of perseverance and depressive symptoms did not produce indirect effects through late NERI, providing preliminary evidence for the specificity of this proposed mechanism. Although worse late NERI was correlated with various symptoms of psychopathology, NSSI history accounted for these associations in regression. These findings suggest that late NERI impairment may reflect one cognitive pathway to heightened negative urgency in NSSI.

People who engage in NSSI might report that they behave impulsively when distressed due to difficulty controlling urges accompanying their negative affect – only *after* those urges surpass a certain temporal or intensity threshold. This implies that a causal event could actually precede NSSI by hours, through a slow increase in negative affect that goes unnoticed until it reaches sufficient intensity to generate a behavioral impulse that cannot be suppressed. This creates the impression of acting “impulsively” under distress, because the emotional state and urge were not attended to until after the behavior occurred. From a clinical perspective, promoting self-awareness (of urges/emotional states) and implementing alternative behavioral routines *preventatively* could thus be a helpful strategy; for example, learning to respond quickly and habitually to mild frustration or a fleeting desire to self-injure with a distracting activity.

Another goal of the study was to assess emotional action restraint in NSSI using the Emotional Go/no-go task. As in prior research, participants made more commission errors to emotional faces than to neutral faces and during blocks including negative faces (Johnson & Tottenham, 2015; Tottenham et al., 2011). We found an exception for more commission errors during neutral no-go blocks with positive faces compared to negative faces, possibly reflecting a positive interpretive bias. This could also explain the relatively low percentage (below 50%) of negative classification responses on the Emotional Stop-Signal Task (Fig. 1).

Although results supported the hypothesized association between early NERI and negative urgency, we found no evidence of impaired early NERI in the NSSI group. This follows work suggesting that NSSI does not involve deficient negative emotional interference inhibition (Allen & Hooley, 2017; Lengel et al., 2016), the earliest stage of inhibitory processing (Sebastian et al., 2013a). As predicted, early and late NERI were correlated, but accounted for separate variance in negative urgency and showed distinct (if overlapping) patterns of association with clinical measures. These results are consistent with the notion that action restraint and action cancellation represent neurocognitively dissociable processes (Sebastian et al., 2013b), and support the validity of these tasks to probe different stages of emotional response inhibition. Results also accord with meta-analysis indicating that response inhibition is the facet of impulsivity most related to negative urgency (Cyders & Coskupinar, 2011). However, the magnitude of negative urgency's association with NERI is larger than with traditional measures of (non-emotional) response inhibition, and conceptually, NERI fits closely within urgency theory articulated by Cyders and Smith (2008).

Prior studies have established that NSSI is not associated with impulsive action in non-emotional contexts. This study adds to the line of research examining inhibitory control over

negative emotion at each stage of inhibition in NSSI, as negative urgency might reflect deficits in any of these processes. The present study extends prior research demonstrating normative interference inhibition in the context of negative mood (stage 1), by also finding no evidence for negative emotional action restraint (stage 2). This stage involves withholding an impulse before it is initiated, as opposed to action cancellation (stage 3), which involves terminating an ongoing response after initiation. The present findings, in combination with Allen and Hooley (2015), provide evidence that impulsive action in NSSI might be restricted to cancelling ongoing negative emotional impulses. Although late NERI accounted for relatively small statistical variance, the observed indirect effect of negative urgency on NSSI history through this cognitive deficit provides initial support for the idea that it might comprise one mechanism underlying impulsive personality associated with NSSI. These results suggest that the tendency to behave impulsively during negative mood associated with NSSI might be specifically related to difficulty suppressing already-initiated impulses motivated by negative emotion. Lack of impairment in the first two stages of emotional inhibitory control could be interpreted as people who engage in NSSI possessing normative abilities disengaging from negative mood (interference inhibition) and suppressing negative emotional impulses (e.g., to harm oneself or others) before taking action (early NERI). However, once these impulses surpass a certain threshold (late NERI), individuals with NSSI histories may find them more difficult to control.

Study groups were demographically similar, except that more participants reporting NSSI identified as LGBT/Q, consistent with evidence for higher NSSI rates among non-heterosexuals (Fox et al., 2017). By design, control participants also reported fewer psychopathology symptoms. Late NERI was correlated with most clinical measures; although NSSI history explained the most variance in regression (indicating that symptoms alone did not account for

group differences in late NERI), more research is needed to draw firm conclusions regarding NERI deficits in other forms of psychopathology. Negative urgency is transdiagnostic, and as a proposed mechanism for this trait, we expect that NERI might operate similarly. However, this study adds to evidence that behavioral impulsivity in NSSI may be distinct from other disorders in that late NERI is thus far the *only* inhibitory process implicated in these behaviors.

The specificity of this deficit also has therapeutic implications. As mentioned above, difficulty suppressing negative emotional impulses only *after* they have been initiated indicates that NSSI is most likely to occur once urges have reached a certain threshold. Treatments promoting awareness of one's internal experiences (e.g., mindfulness-based interventions, see Heath, Carsley, De Riggi, Mills, & Mettler, 2016) may therefore prove clinically useful, by empowering clients to address mild distress and/or self-harm urges before they reach a "tipping point". Concrete strategies to delay or interrupt this process may also be important. For example, treatment could focus on increasing the latency between urges and action by limiting access to preferred self-injury tools and/or environments, in line with lethal means restriction, an empirically-supported intervention for suicide (Yip et al., 2012). Consistent with Dialectical Behavior Therapy skills training, which reduces NSSI in patients with BPD (Linehan et al., 2015), clients might attach written reminders of goals or self-encouraging statements to NSSI tools or place pleasant visual cues in the environments in which they typically self-injure.

There were several limitations to this study. We did not directly assess valence intensity or arousal associated with the images in these tasks; thus, we cannot determine whether images were similarly perceived across study groups. For example, the negative affective images may have elicited stronger aversive reactions in the NSSI group, possibly contributing to their relative difficulty inhibiting responses to those images. However, NSSI and control participants were

equally likely to categorize images as positive or negative in the Emotional Stop-Signal task, suggesting that negativity bias does not fully explain the observed deficit in late NERI among participants reporting NSSI.

The present findings may not be generalizable to severe clinical populations, given the relatively low NSSI frequency observed in this sample. Likely due to this limited variance and relatedly, insufficient statistical power,⁵ we did not detect an association between NSSI frequency and NERI. In fact, BDI-II scores were the only correlate of NSSI frequency, which might also reflect low levels of overall psychopathology in this sample compared to other studies. Future work investigating whether these neurocognitive deficits are associated with NSSI in psychiatric patients is thus needed. Results from ZINB regression analyses likewise contrasted with models treating NSSI history as a binary outcome. In light of substantial literature indicating associations between NSSI frequency and many of the variables we tested in the current study (e.g., negative urgency, BPD symptoms), we believe that limited sample size was the primary reason for failing to reject the null hypothesis in generalized linear models (vs. logistic regression). However, individuals with a lifetime NSSI history comprise a heterogeneous population, warranting examination of these constructs and their underlying mechanisms in larger, more diverse samples.

We similarly found no late NERI differences among participants in the NSSI group with and without past-year episodes. That is, poor late NERI alone is not sufficient to maintain NSSI, as individuals seem to “recover” from these behaviors while this underlying deficit remains. It is therefore possible that impairment in this process might be a risk factor for NSSI or a “scar” (i.e.,

⁵ Post-hoc power analysis indicated that we achieved a power level of 0.55 for these correlations, given the NSSI group sample size ($n = 45$), to detect a modest effect of $r = 0.30$. We were only adequately powered (at ~ 0.80) to detect a relatively large minimum effect size of $r = 0.40$.

a consequence that persists after NSSI cessation). As negative urgency precedes NSSI onset (Fox et al., 2015; Riley et al., 2015), we expect that late NERI deficits may correspondingly increase NSSI risk. These data are cross-sectional, however, and cannot disambiguate temporal relationships between NSSI, late NERI, and negative urgency. More, the indirect effect indicating overlapping variance in these constructs was small, suggesting that negative urgency in NSSI is likely supported by multiple mechanisms that have yet to be determined. The present results suggest that late NERI may be less sensitive to changes in frequency of NSSI engagement than other constructs involving impulsive behavioral reactivity to negative affective states (e.g., risky decision-making; see Allen et al., 2019).

In sum, these results provide further evidence that behavioral impulsivity in NSSI is limited to poor control over negative emotional impulses in the final stage of inhibitory control. We found preliminary support for the proposal that impaired late NERI is a cognitive mechanism underlying the tendency to act impulsively in the context of negative emotions. These data help reconcile discrepant findings between heightened negative urgency in NSSI and normal performance on non-emotional impulsivity tasks. In line with affect regulation models, the present study indicates that NSSI history may involve difficulty inhibiting initiated impulses motivated by negative emotion. NSSI may be the manifestation of such impulses, providing quick relief from unpleasant affective states, before or despite the consideration of potentially enduring negative consequences. These results also encourage future research elucidating the cognitive and neural underpinnings of negative urgency in NSSI (including late NERI). Such work might reveal specific, objective markers that could provide novel intervention targets. Prospective studies are also needed to evaluate whether late NERI longitudinally predicts NSSI.

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Figure 1. Percentage of negative responses by trial type on the Emotional Stop-Signal Task.
Note. $**p \leq .01$; $***p \leq .001$. *Note.* HC = healthy control; NSSI = nonsuicidal self-injury.

Figure 2. Proposed conceptual model and statistical results. *Note.* Direct and indirect effects are expressed on a log-odds metric. Unstandardized coefficients and 95% confidence intervals (CI) derived from bootstrapping with 5000 samples.

Table 1
Sample Characteristics

	NSSI group (<i>n</i> = 45)	HC group (<i>n</i> = 43)
Sex: $\chi^2(1, 88) = 0.02, p = .88, \phi = .02$	<i>n</i> (%)	
Female	35 (77.78)	34 (79.07)
Male	10 (28.57)	9 (20.93)
Orientation: $\chi^2(1, 88) = 10.61, p = .001, \phi = .02$	<i>n</i> (%)	
Heterosexual	29 (64.44)	40 (93.02)
LGBT/Q	16 (35.56)	3 (6.98)
Ethnicity: $\chi^2(4, 88) = 6.01, p = .20, \phi = .26$	<i>n</i> (%)	
White/Caucasian	28 (62.22)	18 (41.86)
Black/African-American	6 (13.33)	4 (9.30)
Asian	8 (17.78)	13 (30.23)
Hispanic/Latinx	1 (2.22)	3 (6.98)
Mixed/Other	2 (4.44)	5 (11.63)
Age: $t(86) = 0.63, p = .53$, Cohen's $d = 0.10$	24.22 (6.53)	23.58 (7.18)
Years education: $t(86) = 0.98, p = .33$, Cohen's $d = 0.21$	14.58 (1.84)	14.18 (1.92)
BAI: $t(86) = 5.50, p < .001$, Cohen's $d = 1.16$	12.91 (9.03)	4.09 (4.36)
BDI-II: $t(79.59) = 7.69, p < .001$, Cohen's $d = 1.63$	15.91 (10.78)	3.67 (4.28)
EDE-Q Global: $t(74.12) = 3.85, p < .001$, Cohen's $d = 0.82$	1.96 (1.59)	0.82 (0.70)
MAST: $t(86) = 4.10, p < .001$, Cohen's $d = 0.86$	3.89 (6.76)	1.05 (1.19)
MSI-BPD ¹ : $t(75.44) = 3.96, p < .001$, Cohen's $d = 2.18$	4.84 (2.13)	0.71 (1.13)
TEMPS-A Cyclothymic scale: $t(86) = 7.42, p < .001$, Cohen's $d = 1.58$	7.93 (3.99)	2.74 (2.67)

Note. BAI = Beck Anxiety Inventory; BDI-II = Beck Depression Inventory-II; EDE-Q = Eating Disorder Examination-Questionnaire; MAST = Michigan Alcoholism Screening Test; MSI-BPD = McLean Screening Instrument for Borderline Personality Disorder. Values are *M* (*SD*) unless otherwise indicated. ¹One NSSI participant had incomplete MSI-BPD data.

Table 2
Emotional Response Inhibition

Commission Error %	NSSI group ¹	HC group ²
Emotional Go/no-go task		
Neutral stimuli no-go	4.76 (6.50)	4.37 (5.71)
Positive stimuli no-go	11.20 (11.44)	12.10 (12.40)
Negative stimuli no-go (early NERI)	21.14 (9.96)	18.49 (15.23)
Emotional Stop-Signal Task		
Neutral stimuli stop	37.24 (13.19)	38.41 (15.27)
Positive stimuli stop	50.06 (15.13)	54.03 (14.55)
Negative stimuli stop	53.34 (16.78)*	45.62 (16.62)
Negative stop responses across stimuli (late NERI)	46.22 (14.05)***	35.28 (11.85)

Note. NERI = negative emotional response inhibition. Values are given as *M* (*SD*) in percent. * $p < .05$; *** $p \leq .001$. ¹NSSI group $n = 41$ for both tasks; ²Control group $n = 42$ for Emotional Go/no-go and $n = 38$ for Emotional Stop-Signal Task analyses.

Table 3Pearson Correlations ($N = 88$)

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. Early NERI ¹												
2. Late NERI ²	.21*											
3. BAI	.17	.25*										
4. BDI-II	.17	.34*	.66*									
5. EDE-Q Global score	.08	.31*	.31*	.46*								
6. MAST	.10	.10	.17	.24*	-.01							
7. MSI-BPD ³	.14	.25*	.53*	.69*	.44*	.20						
8. TEMPS-A Cyclothymic scale	.22*	.34*	.53*	.71*	.39*	.22*	.72*					
9. Negative urgency	.26*	.27*	.44*	.62*	.40*	.18	.64*	.63*				
10. Lack of premeditation	.05	-.07	.09	.13	-.01	-.11	.22*	.14	.41*			
11. Lack of perseverance	-.01	.22	.23*	.42*	.08	.01	.37*	.37*	.47*	.40*		
12. Sensation seeking	.09	.11	-.13	-.10	-.15	.12	-.03	.11	.05	.14	.04	
13. Positive Urgency	.24*	.26*	.29*	.38*	.27*	.15	.47*	.50*	.73*	.34*	.35*	.34*

Note. *Indicates significant linear correlation coefficients, based on bootstrapped bias corrected and accelerated confidence intervals (CIs) with 5000 samples, i.e., 95% CIs that do not include zero. ¹ $n = 83$; ² $n = 79$; ³ $n = 87$.

Table 4
Multiple Linear Regression Analyses

DV: Late NERI	B (SE)	Bootstrapped <i>p</i>	BCa 95% CI	β
Constant	0.30 (0.04)	$p < .001$	0.21 – 0.37	
Group (HC = 0, NSSI = 1)	0.10 (0.05)	$p = .04$	0.01 – 0.19	.34
BAI	-0.01 (0.05)	$p = .90$	-0.11 – 0.12	-.02
BDI-II	0.01 (0.02)	$p = .71$	-0.03 – 0.03	.07
EDE-Q Global score	0.04 (0.04)	$p = .20$	-0.02 – 0.12	.18
MSI-BPD	-0.01 (0.01)	$p = .21$	-0.03 – 0.01	-.24
TEMPS-A Cyclothymic scale	0.02 (0.02)	$p = .36$	-0.02 – 0.06	.17
Model summary: $F(6, 71) = 3.09, p = .01, R^2 = .21$				
DV: Negative Urgency	B (SE)	Bootstrapped <i>p</i>	BCa 95% CI	β
Constant	16.21 (2.38)	$p < .001$	11.33 – 21.01	
Early NERI	39.28 (18.40)	$p = .03$	3.10 – 76.01	.22
Late NERI	14.25 (5.60)	$p = .01$	3.70 – 24.55	.24
Model summary: $F(2, 71) = 5.26, p = .007, R^2 = .13$				

Note. Estimates derived from bootstrapping with 5000 samples.