

Impulsivity as a Predictor of Non-Suicidal Self-Injurious

Thoughts and Behaviors in Adolescent Inpatients

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Abstract

The high prevalence of non-suicidal self-injury (NSSI) within community and psychiatric populations is a pressing public health concern. Impulsivity is a heterogeneous construct, and although prior research has found that emotion-relevant impulsivity is associated with the occurrence of NSSI in adolescents, it remains unclear whether different components of impulsivity are differentially related to distinct NSSI outcomes. Presently, predictors of future NSSI above and beyond NSSI history remain unclear, however, emotion-relevant impulsivity may be a promising factor that confers increased vulnerability. The current study included 526 adolescent psychiatric inpatients (72.8% with lifetime NSSI). Participants completed assessments regarding mental illness, lifetime NSSI, impulsivity, and psychiatric symptoms within 48 hours of hospitalization, and a subset of the initial participants (36.3%) completed a 1-month follow-up assessment after hospital discharge. An exploratory factor analysis identified three distinct domains within the multidimensional self-report impulsivity instrument. Two emotion-relevant factors emerged: (a) Pervasive Influence of Feelings (PIF; i.e., tendency to generalize negative experiences) and (b) Feelings Trigger Action (FTA; i.e., tendency to reflexively respond to strong emotions). PIF was uniquely associated with more frequency NSSI thoughts, while FTA was uniquely related to more intense thoughts, shorter duration of thoughts before action, and younger age of onset. We found that emotion-relevant impulsivity was not significantly associated with the occurrence of lifetime NSSI, or predictive of NSSI outcomes after hospital discharge. These results point to the importance of emotion-relevant impulsivity in understanding NSSI, and indicated that specific factors of emotion-relevant of impulsivity are differentially related to NSSI thought and behavior outcomes.

Impulsivity as a Predictor of Non-Suicidal Self-Injurious Thoughts and Behaviors in Adolescent Inpatients

Non-suicidal self-injury (NSSI) is the deliberate destruction of body tissue without the intent to die (Claes & Muehlenkamp, 2013). NSSI typically emerges in adolescents between 12 and 16 years of age (Klonsky, Muchlenkamp, Lewis, & Walsh, 2011), with prevalence rates of approximately 20% in community adolescents (Muehlenkamp, Claes, Havertape, Plener, 2012) and up to 40% in clinical populations (Asarnow et al. 2011; Wilkinson, Kelvin, Roberts, Dubicka, Goodyer, 2011). Female adolescents more commonly engage in NSSI compared to male youth (Yates, Tracy, Luthar, 2008). In addition to the physical damage caused by NSSI, the behavior is of clinical significance due to its association with suicide (Asarnow et al., 2011; Stewart, Esposito, Glenn, Gilman, Pridgen, Gold, Auerbach, 2017; Wilkinson, Kelvin, Roberts, Dubicka, & Goodyer, 2011). Presently, few interventions effectively reduce NSSI behaviors, which may reflect our limited understanding of the underlying processes that contribute to NSSI (see Brausch and Girresch, 2012; Gonzales and Bergstrom, 2013; Washburn et al., 2012). Therefore, research is needed to clarify the mechanisms that contribute to NSSI, as this will inform the development of more effective treatments.

A preponderance of research has begun to investigate the relationship between impulsivity and NSSI. Moeller and colleagues (2001) defined impulsivity as “a predisposition toward rapid, unplanned reactions to internal or external stimuli without regard to the negative consequences of these reactions to the impulsive individual or to others” (p. 1784). Impulsivity is as a trait characteristic; research has found that levels of impulsivity are similar between

depressed and euthymic patients diagnosed with either bipolar or unipolar mood disorder (Peluso, Hatch, Glahn, Monkul, Sanches, Najt, Bowden, Barratt, Soares, 2007), which suggests that impulsivity is not merely a symptom of psychopathology, but rather an underlying trait present in some psychiatric patients.

Prior research—primarily using self-report instruments—has found that impulsivity is associated with the occurrence of NSSI in adolescents (Gatta, Dal Santo, Rago, Spoto, Battistella, 2016; Tschan, Peter-Ruf, Schmid, In-Albon, 2017; You, Deng, Ling, Leung, 2015) and adults (Barton, Meade, Cummings, Samuels, 2014; Claes, Islam, Fagundo, Jimenes-Murcia, Granero, 2015; Glenn & Klonsky, 2010; Glenn & Klonsky, 2011; Lengel, DeShong, Mullins-Sweatt, 2015; Lynman, Miller, Miller, Bornovalova, 2011; Mullins-Sweatt, Lengel, Grant, 2013; Peters, Baetz, Marwaha, Balbeuna, Bowen, 2016; Peterson & Fischer, 2012). However, impulsivity is a heterogeneous construct, and the precise relationship between specific facets of impulsivity and NSSI remains unclear. In addition, little research has identified vulnerability factors that differentially relate to NSSI thoughts and behaviors separately, which may be important when devising effective interventions that target underlying mechanisms. To address these gaps in the literature, the present study examines whether distinct domains of impulsivity are differentially associated with NSSI thought and behavior outcomes.

Impulsivity and Non-Suicidal Self-Injury

Many individuals engage in NSSI to decrease negative affect (Glenn and Klonsky, 2010; Klonsky, 2007; Klonsky et al., 2013; Nock & Prinstein, 2004). Nock and colleagues reported that adolescents most commonly engaged in NSSI to decrease feelings of anxiety and sadness, and to distract from bad thoughts (Nock, Prinstein, Sterna, 2009). For example, in a study of

women with borderline personality disorder, 93% reported their NSSI was preceded by negative thoughts or emotions and that NSSI provided a means to mitigate these unpleasant feelings (Coid, 1993). The affect-regulation function of NSSI is empirically supported by the relationship between NSSI and emotion-relevant impulsivity, characterized by impulsive reactions to strong emotions (Glenn and Klonsky 2010; Peterson et al. 2014; Rawlings et al. 2015). This role of impulsivity in NSSI is consistent with Nock's (2009) pragmatic hypothesis of self-injury. Compared to other maladaptive methods of emotion regulation, such as drug or alcohol use, NSSI requires little planning or forethought. NSSI can be performed quickly and in virtually any context, making it an attractive choice for adolescents who are emotionally charged and prone to impulsive responses (Nock, 2009).

Recent studies have shown that negative urgency—a facet of impulsivity that is characterized by the tendency to react rapidly in response to negative affect—as being most closely associated to NSSI (Berg et al. 2015). Negative urgency has been associated with the occurrence of NSSI among drug abusers (Lynman, Miller, Miller, Bornovalova, 2011) and eating disorder patients (Peterson & Fischer, 2012), as well as the frequency of NSSI, number of NSSI methods, and number of years engaging in NSSI among young adults (Dir, Karyadi, Cyders, 2013). At the same time, non-emotion relevant impulsivity has also been associated with NSSI. Glenn and Klonsky (2010) found that low perseverance (i.e., the tendency to complete versus give up on tasks) and premeditation (i.e., to plan before acting) were associated with more frequent NSSI among self-injurers, and in a recent meta-analysis, both emotion-relevant and non-emotion relevant components of impulsivity were strongly associated with NSSI (Berg et al., 2015). Taken together, additional research is needed to clarify which domains of impulsivity

are most closely associated with NSSI outcomes.

To date, the majority of research has focused on the impulsivity-NSSI behavior relationship; however, it is important to improve our understanding of factors that confer increased risk for NSSI thoughts and behaviors as separate constructs. Very little is known about the factors contributing to NSSI thoughts, or about the transition from NSSI thoughts to behaviors. One study found that the occurrence of NSSI behaviors was predicted by shorter duration and greater intensity of NSSI thoughts (Nock, Prinstein, Sterna, 2009). To the extent that emotion-relevant impulsivity may contribute to more intense thoughts and a quicker reaction to these thoughts, understanding the role of emotion-relevant impulsivity in NSSI thoughts will provide valuable information regarding the transition from NSSI thoughts to behaviors.

While prior research has shown that past NSSI behaviors are a strong predictor of subsequent NSSI behaviors, further research is needed to identify trait-based factors that prospectively predict NSSI behaviors (see Guerry and Prinstein, 2010; Chapman, Derbidge, Cooney, Hong, Linehan, 2009; Janis & Nock, 2008; Yates et al. 2008). Glenn and Klonsky (2011) found that significant factors in cross-sectional models, including impulsivity, depression, and anxiety symptoms, were not predictive of NSSI behaviors over time. Less research, however, has been conducted in youth samples, and the present study sought to address this important gap by testing the cross-sectional and prospective impact of impulsivity in adolescent inpatients, a group that is at high risk for more persistent NSSI thoughts and behaviors (Stewart et al., 2017).

Goals of the Current Study

In the current study, we tested whether different domains of impulsivity are

cross-sectionally and prospectively related to NSSI thoughts (i.e., frequency, intensity, duration of thoughts before actions) and behaviors (i.e., occurrence, age of onset, frequency, number of NSSI methods). The sample included 526 adolescent psychiatric inpatients. Participants completed an assessment within 48 hours of hospitalization, and a subset of the initial participants completed a 1-month follow-up assessment after hospital discharge. To assess impulsivity, we utilized a self-report instrument, which included ten subscales designed to capture the multidimensional nature of impulsivity (Carver, Johnson, Joormann, Kim, Nam, 2011). Consistent with past research, an exploratory factor analysis identified a three-factor solution (Auerbach et al., 2017; Carver et al., 2011; Johnson et al., 2013). The first two factors, Pervasive Influence of Feelings (i.e., the tendency for negative emotions to affect an individual's thinking) and Feelings Trigger Action (i.e., the tendency to reflexively respond to strong emotions), capture emotion-relevant components of impulsivity. The third, Lack of Follow-Through (i.e. the tendency to complete versus give up on tasks), is not non-emotion relevant.

To address gaps in our understanding of impulsivity and NSSI, we tested the following hypotheses. First, in both our cross-sectional and prospective models, we hypothesized that Pervasive Influence of Feelings (PIF), which captures aspects of impulsive thoughts, would be uniquely associated with more frequent and intense NSSI thoughts. Second, past studies have found that negative urgency, included in the Feelings Trigger Action (FTA) factor, is associated with the occurrence, frequency, and number of NSSI methods (i.e. cutting, burning, hitting, etc.) (Berg et al. 2015; Dir, Karyadi, Cyders, 2013; Lynman, Miller, Miller, Bornovalova, 2011; Peterson & Fischer, 2012). Thus, when testing our cross-sectional models, we hypothesized that

Feelings Trigger Action (FTA) would be uniquely associated with shorter duration of NSSI thoughts before behaviors, the occurrence of lifetime NSSI, younger age of onset of NSSI, more frequent NSSI behaviors, and a greater variety of NSSI methods. Last, we also assessed adolescent inpatients 1-month post-discharge, and we hypothesized that PIF would be uniquely related to frequency of NSSI thoughts, while FTA would be uniquely associated with occurrence and frequency of NSSI behaviors.

Methods

Participants

Participants included 526 psychiatric adolescent inpatients (151 male, 352 female) aged 13 to 19 years ($M = 15.61$, $SD = 1.43$). Their racial distribution was 83.5% White, 9.7% multiracial (i.e. more than one race endorsed), 3.8% Asian, 1.5% Black or African American, and 0.8% American Indian/Alaskan Native. Most participants came from well-educated families; 66.4% of female guardians and 61.6% of male guardians completed a 4-year degree or higher. Current and lifetime psychopathology were assessed using the Mini International Neuropsychiatric Interview for children and adolescents (MINI-KID; Sheehan et al. 2010). The most common diagnoses included unipolar mood disorders (i.e., major depression or dysthymia; $n = 432$, 82.1%) and anxiety disorders (i.e., panic disorder, generalized anxiety disorder, social anxiety disorder, post-traumatic stress disorder, specific phobia, and separation anxiety disorder; $n = 250$, 47.5%) (see Table 1). Thirty-seven adolescents (7.0%) did not receive a diagnosis, 134 (25.5%) had one diagnosis, 143 (27.2%) had two diagnoses, and 212 (40.3%) met criteria for at least three diagnoses. A subset of participants ($n = 191$, 36.3%) also completed a 1-month post-discharge assessment after being released from inpatient care where the average length of

stay is approximately 13 days (see van Alphen, Stewart, Esposito, Pridgen, Gold, Auerbach, 2016).

Seventeen participants from the initial sample of 543 were excluded: (a) did not complete the impulsivity instrument ($n = 4$), (b) failed 3 or more catch items (e.g. “leave this item blank”) on the impulsivity instrument ($n = 4$), (c) provided poor data quality ($n = 3$), or (d) were diagnosed with pervasive developmental or psychotic disorder ($n = 6$). Thus, the final sample included 526 adolescents.

Procedure

The study was approved by the Partners Institutional Review Board. Legal guardians and adolescents over 18 years of age provided written consent and adolescents under 18 provided assent. Adolescents completed assessments within 48 hours of admission to an acute psychiatric facility. During their initial assessment, participants were administered clinical interviews assessing psychopathology and self-injurious thoughts and behaviors, and then completed self-report measures of impulsivity and psychiatric symptoms. One month following hospital discharge, participants were asked to complete a 20-minute follow-up assessment by phone to assess self-injurious thoughts and behaviors and current symptom severity.

Instruments

Psychopathology and Non-Suicidal Self-Injury. The Mini International Neuropsychiatric Interview for Children and Adolescents (MINI-KID, Sheehan et al., 2010) is a structured diagnostic interview that assesses current and lifetime psychopathology in children and adolescents using DSM-IV criteria (American Psychiatric Association, 2000). Before administering the interview, graduate students and research assistants received 25 hours of

training including observations and practice interviews. The MINI-KID possesses strong psychometric properties and has been validated for use with adolescent psychiatric inpatients (Auerbach et al., 2015).

The Self-Injurious Thoughts and Behaviors Interview (SITBI, Nock et al., 2007) is a structured clinical interview assessing current and lifetime suicidal and non-suicidal self-injurious (NSSI) thoughts and behaviors. The SITBI has demonstrated strong psychometric properties, including high inter-rater reliability (average $\kappa = .99$) and high construct validity with previous measures of NSSI ($\kappa = .87$; Nock et al., 2007). The SITBI has been previously validated for use with adolescent inpatients (Auerbach et al., 2015; Venta & Sharp, 2014). NSSI thoughts are operationalized as thoughts about hurting oneself without wanting to die, and NSSI behaviors are defined as acts to hurt oneself without the intent to die. For the present study, NSSI thoughts focused on frequency, intensity, and duration. The frequency of thoughts was operationalized as the number of days in the past month that the participant had thoughts of NSSI, and participants rated their average intensity of thoughts on a scale of 0 (*not at all*) to 4 (*extremely*). Duration of thoughts was assessed using the question, “On average, how long have you thought of purposely hurting yourself without wanting to die before actually doing it?” using a scale ranging from 1 (*0 seconds*) to 6 (*more than two days*). With regards to NSSI behaviors, hypotheses tested lifetime history (i.e., yes/no), age of onset, frequency of NSSI, and number of NSSI methods. Frequency of behaviors was operationalized as the number of times participants had hurt themselves without wanting to die in the past month.

Depression Symptoms. The Center for Epidemiologic Studies Depression Scale (CES-D, Radloff, 1977) is a 20-item self-report instrument that assesses depressive symptom

severity in the past week. Example items include, “I was bothered by things that don’t usually bother me” and “I felt that everything I did was an effort.” Respondents rate each item on a scale from 0 (*rarely or none of the time*) to 3 (*most or all of the time*). Total scores range from 0 to 60, with higher scores indicating more severe depressive symptoms. Internal consistency was excellent (Cronbach’s $\alpha = 0.96$).

Anxiety Symptoms. The Multidimensional Anxiety Scale for Children (MASC, March et al., 1997) is a 39-items self-report measure that assesses different anxiety domains, including physical symptoms, harm avoidance, social anxiety, and separation/panic. Sample items include, “I worry about getting called on in class” and “I stay away from things that upset me.” Items are rated on a scale from 0 (*never true about me*) to 3 (*often true about me*), with a total score ranging from 0 to 117. Higher scores indicate more severe anxiety symptoms. Internal consistency was excellent (Cronbach’s $\alpha = 0.92$).

Impulsivity. Impulsivity was measured using a 90-item self-report questionnaire (Carver et al., 2011). These items reflect 10 domains of impulsivity: negative generalization (4 items, $\alpha = 0.85$), urgency (11 items, $\alpha = 0.90$), lack of perseverance (9 items, $\alpha = 0.85$), lack of self-control (14 items, $\alpha = 0.84$), laziness (19 items, $\alpha = 0.90$), sadness paralysis (2 items, $\alpha = 0.84$), inability to overcome lethargy (7 items, $\alpha = 0.91$), emotions color worldview (3 items, $\alpha = 0.72$), distractibility (9 items, $\alpha = 0.92$), and reflexive reactions to feelings (7 items, $\alpha = 0.86$). Items ranged from 1 (*I agree a lot/never*) to 5 (*I disagree a lot/very often*), and higher scores indicate greater impulsivity. The instrument also included 4 “catch items” (i.e., leave this item blank) to identify random responding patterns. Participants who answered three or more of these items incorrectly were excluded from analyses. Previous studies utilizing this instrument have used

factor analysis for data reduction and identified a three-factor model in adolescents (Auerbach et al., 2017) and adults (Carver et al., 2011; Johnson et al., 2013). These factors include: (a) Feelings Trigger Actions (FTA), the tendency to immediately react to strong emotions, (b) Pervasive Influence of Feelings (PIF), the extent to which feelings impact one's worldview, and (c) Lack of Follow Through (LFT), the propensity to see things through to the end versus let them go.

Data Analytic Overview

IBM SPSS Statistics version 20.0 (Armonk, NY) was used for all analyses. Consistent with prior research (Auerbach, Stewart, Johnson, 2017), we conducted an Exploratory Factor Analysis (EFA). In line with Fabrigar et al. (1999), we first ran a Maximum Likelihood Estimation (MLE) with a Direct Oblimin rotation ($\delta = 0$) and eigenvalues greater than 1. This generated a 3-factor solution that accounted for 75.6% of the variance. Based on the scree plot, a 3-factor solution seemed to be the best fit but 2 or 4 factors may also have been appropriate. We then specified 1-, 2-, 3-, and 4- factor solutions and, based on the scree plot and pattern matrixes, determined that a 3-factor solution was indeed the best fit. The factor loadings of this solution are provided in Table 2 and are consistent with previous studies (Auerbach et al., 2017; Carver et al., 2011; Johnson et al., 2013). As expected, the three factors were significantly associated ($r_s=0.27-0.46$, $p_s<0.001$).

Once the 3-factor model was established, we conducted a series of univariate regression analyses to identify potential covariates (e.g., age, sex, symptom severity) for each NSSI outcome. Only significant univariate predictors were included in final models. To test our primary hypotheses, we conducted a series of multivariate regression models. For NSSI

thoughts, we used a linear regression model to test predictors of past month NSSI thought frequency, and ordinal logistic regressions examined intensity of NSSI thoughts and duration of NSSI thoughts before actions. For NSSI behaviors, a binary logistic regression was used to assess the presence of lifetime NSSI, and a linear regression was used to examine age of onset of NSSI behaviors. We ran a Poisson regression to assess past month NSSI behaviors after data were winsorized to account for high positive skew and kurtosis. For our prospective prediction models, a linear regression was used to test the frequency of NSSI thoughts in the month following hospital discharge. With respect to NSSI behaviors, we ran a binary logistic regression to predict the presence or absence of NSSI behaviors, as well as a Poisson regression to examine NSSI behavior frequency at the 1-month follow-up assessment after data were winsorized to account for high positive skew and kurtosis. All multivariate analyses included the previously identified significant univariate predictors (i.e. demographic and clinical variables) as well as the three impulsivity factors.

Results

Descriptive Statistics

A majority of participants endorsed lifetime NSSI thoughts ($n = 411$; 78.1%) and behaviors ($n = 383$; 72.8%), and in the past month participant reported the occurrence of NSSI thoughts on 11.1 days ($SD = 11.4$) and engaged in NSSI behaviors 4.6 times ($SD = 11.3$). The average age of onset for NSSI thoughts ($M = 12.64$, $SD = 2.34$) and behaviors ($M = 13.10$, $SD = 2.12$) occurred during early adolescence. The most common durations of NSSI thoughts before action were 2-15 minutes ($n = 117$, 22.2%) and 16-60 minutes ($n = 71$, 13.5%), and participants primarily used the following methods to self-injure: cutting ($n = 348$, 66.2%), hitting oneself ($n =$

168, 31.9%), scraping skin to draw blood ($n = 163$, 31.0%), picking skin to draw blood ($n = 152$, 28.9%), and burning ($n = 108$, 20.5%).

A total of 191 adolescents, 36.3% of the initial sample, completed the one-month follow-up assessment post-discharge. Compared to those who completed the follow-up, those who did not had significantly higher baseline depression scores, $t(516) = -2.38$, $p = 0.02$, $d = 0.22$, and higher PIF scores, $t(516) = -2.443$, $p = 0.015$. No other between-group differences emerged: (a) age, $t(524) = -1.16$, $p = 0.25$, $d = 0.10$, (b) sex, $\chi^2(1, n = 191) = 0.23$, $p = 0.63$, (c) race, $\chi^2(1, n = 191) = 0.11$, $p = 0.74$, (d) anxiety symptoms, $t(524) = -1.91$, $p = 0.06$, $d = 0.17$, and (e) LFT, $t(516) = 0.18$, $p = 0.86$. In the month after hospital discharge, 118 (61.46%) participants reported NSSI thoughts and 74 (22.4%) youth engaged in NSSI behaviors. On average, participants reported experiencing NSSI thoughts 6.30 days ($SD 8.34$) days and engaging in NSSI behaviors 2.19 times ($SD 6.35$) in the month post-discharge.

Cross-Sectional Models of NSSI Thoughts and Behaviors

We first examined univariate predictors (i.e., age, sex, race, depression severity, anxiety severity) related to the NSSI outcomes of interest. Only significant predictors were included in the final multivariate analyses (see Tables 3 and 4). Cross-sectional associations with NSSI thoughts are summarized in Table 5. First, when testing the relationship between impulsivity and frequency of past month NSSI thoughts, we included age, sex, depression severity, and anxiety severity as covariates. In line with our hypothesis, there was a significant relationship between PIF and the frequency of NSSI thoughts. Second, when examining the relationship between impulsivity and NSSI intensity, sex, depression severity, and anxiety severity were included as covariates. Contrary to our hypothesis, higher FTA scores were significantly related to greater

average intensity of NSSI thoughts. Last, when testing the relationship between impulsivity and the duration of NSSI thoughts prior to action, sex, depression severity, and anxiety severity were included as covariates. Consistent with our hypothesis, greater FTA scores were related to shorter duration of NSSI thoughts prior to engaging in NSSI behaviors.

Models testing the cross-sectional relationship between impulsivity and NSSI behaviors are presented in Table 6. First, when examining whether impulsivity was related to NSSI behaviors age of onset, age and sex were included as covariates. Higher FTA scores were associated with a younger age of onset for NSSI behaviors. Second, age, sex, depression severity, and anxiety severity were included as covariates in the model testing the impulsivity-lifetime NSSI behaviors relationship. FTA was associated with the lifetime NSSI at a statistical trend. Third, we tested the relationship between impulsivity and the frequency of NSSI behaviors in the past month. Age, sex, depression severity, and anxiety severity were included as covariates, and both FTA and LFT were associated with NSSI frequency at a trend level. Last, we tested the whether impulsivity was related to the number of NSSI methods. Age, sex, depression severity, and anxiety severity were entered as covariates, and greater PIF and FTA scores were associated with the number of methods at a trend level.

Prospective Models of NSSI Thoughts and Behaviors

Before completing multivariate models of prospective prediction, significant univariate predictors were identified. In addition to the clinical and demographic variables included in the cross-sectional analyses, cross-sectional NSSI outcomes were included as potential prospective predictors (i.e. frequency of thoughts, frequency of behaviors). The results of these univariate analyses are summarized in Table 7. Only significant univariate predictors were included in the

final multivariate models, which are presented in Table 8.

We included age, sex, race, depression severity, anxiety severity, and cross-sectional frequency of NSSI thoughts in our multivariate regression model examining frequency of NSSI thoughts post-discharge, and none of the impulsivity factors were significantly related to frequency of NSSI thoughts post-discharge. For the occurrence of NSSI behaviors during the 1-month follow-up assessment, age, sex, depression severity, and anxiety severity were included as covariates. Contrary to our hypothesis, we found that none of the three factors significantly differentiated those who did or did not engage in NSSI. Finally, we included age, sex, depression severity, anxiety severity as covariates in our model predicting the NSSI behavior frequency during the 1-month follow-up assessment, and impulsivity was did not emerge as a significant predictor.

Discussion

The high prevalence of NSSI within community and psychiatric populations is a pressing public health concern (Asarnow et al., 2011; Muehlenkamp et al., 2012; Wilkinson et al., 2011). In the current study, we found that PIF was uniquely associated with more frequent NSSI thoughts, while FTA was associated with more intense NSSI thoughts, shorter duration of NSSI thoughts before actions, and earlier age of onset. However, we did not find that domains of impulsivity were related to the occurrence of lifetime NSSI, or that the factors predicted NSSI outcomes one month post-discharge. These findings support the role of emotion-relevant impulsivity in the study of NSSI, and highlight the need to investigate specific NSSI outcomes, as they are related to impulsivity in different ways.

Emotion-relevant Impulsivity and NSSI

The primary goal of this study was to examine whether distinct domains of emotion-relevant impulsivity are differentially related to NSSI thought and behavior outcomes. Our conservative, multivariate analyses included demographic and clinical covariates as well as all three impulsivity factors. In contrast, past studies have analyzed each component of impulsivity separately, without controlling for the other highly correlated domains (see Glenn and Klonsky, 2010). In order to accurately determine which facets of impulsivity are the most relevant to individual aspects of NSSI, all domains must be included in analyses. Our results showed that PIF and FTA are each uniquely associated with NSSI outcomes while controlling for covariates and other impulsivity factors, which makes our results especially striking.

These findings have implications for the clinical treatment of NSSI. We found that PIF is uniquely associated with the frequency of NSSI thoughts, while FTA is associated with the intensity of thoughts and duration of thoughts before action. Higher FTA scores were also related to earlier age of onset of NSSI behaviors, suggesting that this facet of impulsivity may serve as an early risk factor for the development of NSSI. Interventions that target these aspects of impulsive thoughts and reactions may succeed in slowing or halting the progression from thoughts to behaviors. The PIF factor includes two realms of impulsive thoughts: the tendency for negative affect to color worldview, and the tendency to experience thoughts or emotions as overwhelming. The subscales include statements such as “when even one thing goes wrong, I begin to wonder whether I can do anything right at all” and “when I feel sad, it paralyzes me.” FTA includes statements such as “it’s hard for me to resist acting on my feelings” and “when I have an emotional reaction to something, I often act without thinking.” By directly addressing these experiences in treatment, clinicians may succeed in decreasing these impulsive tendencies,

and lessen the impact of distressing NSSI thoughts.

In contrast to previous studies (Barton et al., 2014; Claes et al., 2015; Evans et al., 1996; Gatta et al., 2016; Glenn & Klonsky, 2010; Glenn & Klonsky, 2011; Lengel et al., 2015; Lynman et al., 2011; McCloskey et al., 2012; Mullins-Sweatt et al., 2013; Peters et al., 2016; Peterson & Fischer, 2012; Tschan et al., 2017; You et al., 2016), we did not find that emotion-relevant impulsivity predicted the occurrence of lifetime NSSI. This finding is likely a reflection of our population. Rather than differentiating individuals with and without lifetime NSSI, past studies utilizing community samples may instead have found that impulsivity differentiated individuals with high versus low levels of psychopathology. Our sample consisted of inpatient adolescents hospitalized primarily for suicide and self-harm, and nearly three-quarters of participants endorsed lifetime NSSI. Emotion-relevant impulsivity may therefore be an excellent indicator of psychopathology and NSSI risk in community and outpatient populations but not in our severe clinical sample, particularly as there may be insufficient variability in the present sample.

Our prospective analyses found that none of the impulsivity factors were related to the frequency of NSSI thoughts, or the occurrence or frequency of NSSI behaviors in the month after hospital discharge. Consistent with past research, NSSI history was the only significantly predictive variable in our multivariate prospective prediction models. This is surprising, considering the strong cross-sectional relationships between emotion-relevant impulsivity and NSSI outcomes. Our null findings may be due to our high attrition rates (63.7%). However, we may be unable to determine longitudinal patterns of impulsivity and NSSI in the short period after hospital discharge. Adherence to psychiatric treatment decrease over time. In a recent study examining a sample of psychiatric adolescent inpatients, researchers found that engaging in

NSSI was related to especially low treatment adherence (Timlim et al., 2015). Another study found low rates of medication adherence among depressed adolescents after 6 weeks of treatment (Woldu et al., 2011). It is likely that participants in the present study would follow a similar trajectory of treatment compliance, which may in turn affect their engagement in NSSI. Prospective prediction of NSSI in such a short window of time may not be representative of NSSI further in the future. Evaluating NSSI at later timepoints post-discharge may therefore reveal different patterns in the relationship between impulsivity and NSSI. The identification of strong predictors of future NSSI remains a pressing concern for research, especially among high-risk adolescent inpatients, as it will inform clinical treatment.

Limitations

There are several limitations to this study, which should be addressed in future research. First, this study utilized a sample of inpatient adolescents with severe psychopathology. While our results provide valuable information regarding the role of impulsivity in this high-risk sample, future studies are needed to evaluate the generalizability of our findings to community populations. Second, this sample was made up predominantly of white adolescents living in Western Massachusetts with well-educated parents. This sample therefore presents a limited view of self-injury that cannot be generalized to adolescents of different racial, ethnic, or socioeconomic statuses. Third, only 36.3% of participants completed their follow-up assessment one month after hospital discharge, and those who completed their follow-up were significantly less depressed and reported significantly lower levels of PIF. Given these differences, our high rates of attrition may have impacted our prospective findings. Fourth, this study utilized a self-report impulsivity instrument. Self-report measures have the benefit of providing a wide

range of information about a variety of feelings and actions, and allow researchers to establish patterns of behaviors. However, self-report questionnaires are vulnerable to response biases. Last, the present study tested the impulsivity-NSSI relationship 1-month post-discharge. Future research should test these effects over longer periods of time.

Conclusion

As a whole, these results highlight the need for precise operational definitions of impulsivity domains, as different aspects of impulsivity are related to psychiatric outcomes in unique ways. LFT, the single non-emotion relevant impulsivity factor, was not significantly related to any of the NSSI outcomes. Our results support the importance of focusing on emotion-relevant impulsivity in the study of NSSI. In addition, the identification of risk factors for NSSI is needed to develop targeted interventions for this distressing and damaging behavior. Our cross-sectional results suggest that FTA is related to more intense thoughts of NSSI, earlier age of onset of NSSI, and more rapid, frequent, and diverse NSSI behaviors, while PIF is related to more frequent thoughts. Targeted treatments that address these aspects of impulsivity may therefore be effective means of decreasing NSSI in this high-risk population.

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