THE JOURNAL OF CHILD PSYCHOLOGY AND PSYCHIATRY

THE ASSOCIATION FOR CHILD AND ADOLESCENT MENTAL HEALTH

Journal of Child Psychology and Psychiatry **:* (2015), pp **–** doi:10.1111/jcpp.12500

Implicit cognition about self-injury predicts actual self-injurious behavior: results from a longitudinal study of adolescents

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Background: The implicit association hypothesis of nonsuicidal self-injury (NSSI) proposes that individuals who engage in self-injury develop, over time, strong associations between themselves and NSSI, and their identification with this behavior guides their future selection of NSSI to cope. Prior research has established a relationship between implicit NSSI associations (using an Implicit Association Test for Self-Injury) and engagement in NSSI. However, previous studies have been small and cross-sectional, and thus underpowered to examine the nature of this association and the extent to which implicit associations predict the persistence of NSSI. **Methods:** This study builds on previous research in a prospective, longitudinal examination of implicit self-identification with NSSI in a large sample of middle school students. NSSI behavior and implicit NSSI associations were assessed annually in school at three time points. **Results:** Adolescents who engaged in NSSI exhibited stronger implicit self-identification with NSSI than adolescents who did not engage in NSSI. Moreover, implicit NSSI identification was stronger among adolescents who engaged in cutting, frequent NSSI, and recent NSSI. A reciprocal association was observed between NSSI frequency and implicit NSSI identification over 1 year. Notably, implicit NSSI identification uniquely and prospectively predicted engagement in NSSI over the subsequent year. **Conclusions:** Implicit self-identification with NSSI may track both trait- and state-related changes in the behavior and, importantly, may help predict continued engagement in NSSI. **Keywords:** Self-injury; self-harm; adolescence; longitudinal studies; assessment.

Introduction

Nonsuicidal self-injury (NSSI) is the direct and deliberate destruction of one's own body tissue without suicidal intent (e.g., cutting; APA, 2013). NSSI typically begins in early adolescence (ages 12–14 years; Whitlock et al., 2011; Zetterqvist, Lundh, Dahlström, & Svedin, 2013), and prevalence rates peak during this developmental period in both community (18%; Muehlenkamp, Claes, Havertape, & Plener, 2012) and clinical (53%) samples of youth (Asarnow et al., 2011; Wilkinson, Kelvin, Roberts, Dubicka, & Goodyer, 2011). These high rates are especially alarming because NSSI is related to significant functional impairment (Nock, Joiner, Gordon, Lloyd-Richardson, & Prinstein, 2006), severe psychiatric disorders (Nock et al., 2006), and increased risk for suicidal behavior (Asarnow et al., 2011; Guan, Fox, & Prinstein, 2012; Wilkinson et al., 2011).

Theoretical models of NSSI suggest that people engage in this behavior because it is reinforcing – that is, it creates desired intrapersonal (i.e., affective/cognitive) and interpersonal (i.e., social) outcomes (Nock & Prinstein, 2004). An important question, though, is why people would choose to engage in NSSI to achieve these outcomes. One possible explanation is proposed by the implicit association, or self-identification, hypothesis, which posits that, over time, self-injurers develop associations between themselves and NSSI. The identification with NSSI subsequently guides their continued selection of this particular behavior over other adaptive, or self-damaging, coping strategies (Nock & Banaji, 2007a). Although compelling, little research to date has directly tested this hypothesis and the potential to use implicit NSSI associations to inform understanding of the development and prediction of NSSI. The current study aims to significantly advance the understanding of NSSI by examining the nature of NSSI self-identification to track and predict NSSI behavior in youth.

To assess implicit associations with NSSI, Nock and Banaji (2007a) developed an Implicit Association Test for Self-Injury (SI-IAT) – a brief, computer-based task that measures the strength of association between NSSI and the self using reaction times. Measures of implicit cognition (e.g., IAT) assess processes that do not rely on conscious awareness or require introspection and, therefore, are not as susceptible to self-report biases (Nosek, Greenwald, & Banaji, 2007). Consistent with the self-identification hypothesis, prior research has found a relationship between implicit NSSI associations and engagement in NSSI. Adolescents (Dickstein et al., 2015; Nock & Banaji, 2007a) and young adults

Conflict of interest statement: No conflicts declared.

Published by John Wiley & Sons Ltd, 9600 Garsington Road, Oxford OX4 2DQ, UK and 350 Main St, Malden, MA 02148, USA

(Franklin, Lee, Puzia, & Prinstein, 2014; Glenn & Klonsky, 2011) who engage in NSSI exhibit stronger implicit self-identification with NSSI than both non-injuring adolescents and adolescents who have attempted suicide but not engaged in NSSI (Dickstein et al., 2015). Implicit NSSI associations also are uniquely related to NSSI, even when controlling for related demographic, psychiatric (Nock & Banaji, 2007a), and emotion regulation factors (Franklin, Lee et al., 2014). Moreover, there is some evidence that these implicit associations prospectively predict *suicidal* self-injury (Nock & Banaji, 2007b; Nock et al., 2010; Randall, Rowe, Dong, Nock, & Colman, 2013), but studies have not found that implicit associations with NSSI predict future engagement in NSSI specifically (Franklin, Puzia, Lee, & Prinstein, 2014; Glenn & Klonsky, 2011). Taken together, previous studies support an association between implicit cognition and NSSI, but have been limited by small samples and cross-sectional designs. Consequently, a number of important questions about the nature of implicit self-identification with NSSI remain unanswered.

Current study

This study addressed these gaps in knowledge and extended previous examinations of implicit associations with NSSI in five key ways. First, the SI-IAT was examined in a large ($N = 662$), normative sample of early adolescents (average age 13) – right around the average age of onset of NSSI – in a middle school setting. This is the first examination of implicit NSSI associations in early adolescents, the first administration of the SI-IAT in a school setting, and the largest study to date of the SI-IAT in youth. We tested whether implicit NSSI associations were present early in the course of NSSI and whether the SI-IAT could be used in school/community settings to assess and predict risk for NSSI. Consistent with previous research in older samples, we predicted that adolescents engaging in NSSI would exhibit stronger implicit NSSI associations than noninjuring adolescents.

Second, the large sample enabled a fine-grained analysis of fluctuations in implicit NSSI associations with trait- and state-related changes in NSSI. We examined how adolescents' implicit associations with NSSI vary by NSSI method. Since the SI-IAT includes pictures of cut skin (i.e., specific NSSI behavior), we predicted that implicit NSSI identification would be strongest among adolescents who engaged in cutting, compared to other (noncutting) forms of NSSI. We also tested whether implicit NSSI associations tracked state fluctuations in NSSI, and were stronger among those who engaged in NSSI more recently. In a small sample of young adults, Franklin, Lee et al. (2014) did not find a relationship between implicit associations and NSSI recency. We reexamined this question in a younger (right around the initial onset of NSSI) and larger sample (with more statistical power to detect smaller effects). We hypothesized that adolescents who engaged in NSSI more recently (i.e., within the past year) would exhibit stronger NSSI associations than adolescents who had engaged in NSSI historically, but not in the past year. Further, we tested how implicit associations fluctuated with NSSI severity. Franklin, Lee et al. (2014) also found a nonsignificant trend for stronger implicit NSSI associations at higher frequencies of cutting. In the current larger study, we examined how implicit identification varied at greater NSSI frequencies and whether associations were stronger among adolescents engaging in more 'clinically significant' NSSI (i.e., repeated past-year engagement in NSSI methods likely to result in tissue damage, such as cutting and burning, consistent with the DSM-5 NSSI disorder criteria). We predicted that implicit NSSI identification would be stronger with greater repetition of NSSI and among adolescents engaging in more 'clinically significant' NSSI.

Third, we tested the unique contribution of implicit cognition for predicting NSSI behavior cross-sectionally. Consistent with previous research, we predicted that implicit NSSI identification would predict engagement in NSSI, it would do so over and above related demographic and psychiatric covariates, and, moreover, that the relationship would be more robust when predicting engagement in cutting (vs. other forms of NSSI).

Fourth, we examined the predictive validity of implicit NSSI associations for predicting NSSI behavior over the subsequent year, both on its own and when controlling for previous NSSI – the most consistent and robust predictor of NSSI (Franklin, Puzia et al., 2014; Glenn & Klonsky, 2011). Although the death/suicide IAT has demonstrated predictive validity (Nock et al., 2010; Randall et al., 2013), findings with the self-injury IAT have been less promising (Franklin, Lee et al., 2014; Glenn & Klonsky, 2011). This is the first large study to examine the predictive validity of the SI-IAT in early adolescents. We hypothesized that the SI-IAT would predict NSSI over the subsequent year, even when controlling for adolescents' previous NSSI.

Finally, the repeated measures, longitudinal design enabled examination of the reciprocal association between implicit NSSI identification and engagement in NSSI over time. Previous research suggests that implicit associations with clinical symptoms may fluctuate with, and predict, changes in behavior. For instance, implicit associations with anxiety track changes in anxiety symptoms and predict symptom reduction over time (Teachman, Marker, & Smith-Janik, 2008). Given that the implicit association hypothesis suggests that identification with NSSI is strengthened with repeated engagement in NSSI behavior, greater NSSI frequency should relate to stronger implicit identification with NSSI over time. Therefore, we hypothesized a reciprocal association between implicit NSSI cognition and NSSI behavior, whereby stronger implicit NSSI identification would predict greater NSSI frequency *and* greater NSSI frequency would predict increased identification with NSSI over the subsequent year.

Methods

Participants

All seventh and eighth grade students in mainstream classrooms from three rural, low-income middle schools in the southeastern United States were eligible. Of the 891 eligible, 229 students were excluded because they did not complete the study (n = 116), had unusable SI-IAT data (n = 65), or were missing key NSSI information necessary to accurately categorize them as self-injurers or noninjurers (n = 48). Compared to adolescents included in the study, excluded adolescents were more likely to be male ($\chi^2[1, N = 868] = 11.62$, p = .001) and Hispanic ($\chi^2[1, N = 865] = 5.91$, p = .015).

The final sample was 662 adolescents (57.7% female), who had usable SI-IAT and NSSI data. The average age at baseline was 13.14 years (SD = 0.7 years). The ethnic composition of the sample was 47.4% Caucasian, 25.1% Hispanic, 20.7% African American, 0.9% Asian, and 5.9% Mixed race/other ethnicity.

Procedure

Study procedures were approved by the relevant university's Institutional Review Board. Active parental permission and student assent were obtained prior to study initiation. Participants were assessed, using the same procedures, at three different time points: baseline (T1), 1 year after baseline (T2), and 2 years after baseline (T3). Participants completed all measures at school in groups of approximately 30; dividers were provided between students for privacy. Survey data were collected using computer-assisted self-interviewing (CASI) – a technique shown to reduce social desirability and increase validity of reporting (Turner et al., 1998). The SI-IAT was administered on the same computer as the CASI at T2 and T3. Students were compensated with a $10 gift card for each assessment.

Measures

Demographics and academic performance. At T1, basic demographic information was collected from all participants, and students' grade point average was obtained from their school records.

Nonsuicidal self-injury. At all three time points, six common NSSI behaviors were assessed (Lloyd-Richardson, Perrine, Dierker, & Kelley, 2007; Nock & Prinstein, 2004): (cutting/carving, burning, hitting, scraping/picking skin to the point of bleeding, biting, inserting objects under skin/nails). Adolescents rated how frequently they had engaged in each NSSI behavior in the past year (scale: 0–10+ times). This method has been used in previous studies to validly assess NSSI methods in adolescents (Prinstein et al., 2008).

Implicit associations with NSSI. The SI-IAT (Nock & Banaji, 2007a,b) is a computer-based, behavioral task that assesses implicit self-identification with NSSI. Concepts of 'Cutting' or 'No Cutting' appear on opposite sides of the screen and are paired with either the attribute 'Me' or 'Not Me' (e.g., 'Cutting' and 'Me' paired and 'No Cutting' and 'Not Me' paired). Participants are asked to classify words or pictures that appear in the middle of the screen as belonging to one of the four categories: Cutting versus No Cutting and Me versus Not Me. The dependent measure from the SI-IAT is a difference (or D) score (Greenwald, Nosek, & Banaji, 2003) calculated by subtracting reaction times on trials when 'Cutting' and 'Me' are paired on the same side of the screen from reaction times on trials when 'Cutting' and 'Not Me' are paired. Stronger self-identification with NSSI is demonstrated by faster reaction times when 'Cutting' and 'Me' are paired (positive D score). See Nock and Banaji (2007a) for more detailed information and scoring procedures. The SI-IAT takes approximately 5 min and was completed at T2 and T3.

Alcohol use and depression. Alcohol use frequency was assessed with the Health Risk Behavior scale, a measure developed based on the Center for Diseases Control and Prevention's Youth Risk Behavior Surveillance System (Eaton et al., 2012), previously used in studies of youth substance use (Becker et al., 2012). Problematic alcohol use was operationalized as the number of days in the past year when the adolescent drank ≥5 drinks within a few hours (scale: 0 times to 10+ times). Depression symptoms were measured using the Short Mood and Feelings Questionnaire (Angold et al., 1995) – a 13-item self-report scale that assesses mood symptoms in the past 2 weeks (scale: 0 = *not true* to 2 = *true*). Alcohol use and depression symptoms assessed at T2 were used in the current study analyses as candidate covariates.

Data analytic plan

First, we examined how implicit associations with NSSI (SI-IAT performance) related to presence (independent samples t-test), as well as method and recency of NSSI (series of one-way ANOVA). Significant omnibus tests were explored with post hoc comparisons (Tukey's HSD) when appropriate. Second, associations between SI-IAT scores and NSSI severity were examined in two ways. Spearman correlations (because NSSI frequency was a rank-order, nonnormally distributed variable) were used to assess the relationship between implicit NSSI associations and NSSI severity – indexed by NSSI frequency (across all methods), cutting frequency, and number of NSSI methods. Then, a one-way ANOVA was used to compare SI-IAT scores at high, low-medium, and no NSSI frequency levels. Third, negative binomial regression models (selected because dependent variables were NSSI frequency counts) were used to examine the (a) incremental predictive validity of the SI-IAT for predicting cross-sectional NSSI status, while controlling for related covariates, (b) predictive validity of the SI-IAT for predicting NSSI over the subsequent year, and (c) cross-lagged and reciprocal associations between SI-IAT and NSSI over 1 year (T2–T3). Finally, we conducted supplemental analyses to explore whether identified covariates moderated the relationship between SI-IAT scores and NSSI.

Results

NSSI prevalence and methods

The prevalence of NSSI at least once in the past year was relatively high across the three assessments: 28.4%–33.9% of the sample (see Table 1). Rates were much lower (10%–11% of the sample) when using DSM-5 NSSI disorder Criterion A (i.e., NSSI methods likely to result in tissue damage ≥5 times in the past year; APA, 2013). The most common NSSI behaviors were hitting self (15.8% of total sample), scraping/

Table 1 Nonsuicidal self-injury (NSSI) prevalence and methods at three study assessments

	Time 1 (n = 657)	Time 2 (n = 650)	Time 3 (n = 610)
NSSI prevalence			
Broad criteria: n (% total sample)			
Any NSSI method ≥ 1 time past year	223 (33.9)	206 (31.7)	173 (28.4)
DSM-5 criterion A: n (% total sample)			
Cut/carved, hit, burned, inserted objects ≥ 5 times past year	70 (10.7)	76 (11.7)	71 (11.6)
Total number NSSI methods past year: M (SD)	2.01 (1.39)	2.09 (1.32)	2.05 (1.32)
NSSI method: n (% self-injurers)			
Cut/carved	80 (35.9)	91 (44.2)	87 (50.3)
Hit	123 (55.2)	99 (48.1)	82 (47.4)
Burned	26 (11.7)	33 (16.0)	23 (13.3)
Inserted objects	33 (14.8)	33 (16.0)	27 (15.6)
Scraped/picked	100 (44.8)	106 (51.5)	85 (49.1)
Bit	87 (39.0)	69 (33.5)	50 (28.9)

picking skin to the point of bleeding (15.1% of total sample), and cutting/carving skin (13.5% of total sample). Approximately half of adolescents engaging in NSSI (48.9%–51.4%) reported using more than one NSSI method in the past year.

Between-groups differences in SI-IAT

Any NSSI versus no NSSI. Adolescents reporting *any* past-year NSSI (broad criteria) at T1 or T2 (n = 302) were compared to adolescents reporting *no* past-year NSSI at T1 or T2 (n = 360). The NSSI group exhibited stronger self-identification with NSSI on the SI-IAT (standardized D score: $M = 0.09$, $SD = 0.39$) than the no NSSI group ($M = -0.01$, $SD = 0.38$; $t[660] = 3.34$, $p = .001$, Cohen's $d = 0.26$). This effect was stronger among adolescents engaging in more 'clinically significant' NSSI (≥5 severe NSSI episodes in past year). One-way ANOVA revealed significant differences between adolescents reporting: (a) 'clinically significant' NSSI at T1 or T2 (n = 118; $M = 0.15$, $SD = 0.40$), (b) NSSI that did not meet this clinical threshold at T1 or T2 (n = 185; $M = 0.06$, $SD = 0.38$), and (c) no NSSI in the past 2 years (n = 359; $M = -0.01$, $SD = 0.38$), $F(2, 661) = 7.23$, $p = .001$, $\eta^2 = .022$. Post hoc comparisons (Tukey's HSD) indicated 'clinically significant' self-injurers exhibited stronger NSSI identification than noninjurers ($p = .001$, $d = 0.41$); SI-IAT scores for the subclinical NSSI group were intermediate but not statistically different from the 'clinically significant' NSSI group ($p = .148$, $d = 0.23$) or noninjury group ($p = .137$, $d = 0.18$).

Cutting versus other NSSI methods. We examined whether implicit NSSI identification was strongest among adolescents engaging in cutting. One-way ANOVA revealed significant differences between adolescents engaged in: (a) cutting at T1 or T2 (n = 127; $M = 0.17$, $SD = 0.39$), (b) other (noncutting) NSSI methods at T1 or T2 (n = 163; $M = 0.06$, $SD = 0.37$), and (c) no NSSI at T1 and T2 (n = 360; $M = -0.01$, $SD = 0.38$), $F(2, 649) = 10.23$, $p < .001$, $\eta^2 = .031$ (see Figure 1). Post hoc comparisons (Tukey's HSD) indicated implicit NSSI associations were significantly stronger among adolescents who engaged in cutting than both noninjurers ($p < .001$, $d = 0.47$) and adolescents who engaged in other (noncutting) forms of NSSI ($p = .033$, $d = 0.29$). SI-IAT scores did not significantly differ between the other two groups ($p = .181$, $d = 0.19$).

Given that adolescents engaging in cutting are often a more severe group of self-injurers, we compared adolescents engaging in cutting to those engaging in other (noncutting) forms of NSSI in terms of NSSI methods and depression symptoms. Adolescents who engaged in cutting reported more NSSI methods in the past year ($M = 2.19$, $SD = 1.66$; $t[288] = 7.52$, $p < .001$, $d = 0.92$) and more depression symptoms ($M = 11.73$, $SD = 7.47$; $t[288] = 6.75$, $p < .001$, $d = 0.74$), than adolescents who engaged in other forms of NSSI ($M_{\text{methods}} = 0.94$, $SD = 0.99$; $M_{\text{depression}} = 6.81$, $SD = 5.68$). However, a one-way ANCOVA revealed that SI-IAT scores between these two groups remained significant even when

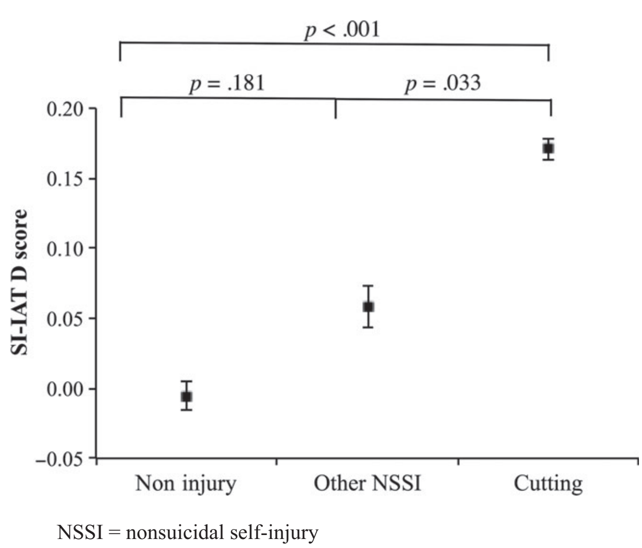

Figure 1 Implicit self-identification with NSSI (SI-IAT) among adolescents who engaged in nonsuicidal cutting, other (noncutting) forms of NSSI, and no NSSI in past 2 years (noninjury group). NSSI = nonsuicidal self-injury. Error bars represent standard errors

controlling for these differences, $F(3, 286) = 3.31$, $p = .021$, $\eta^2 = .034$.

Past-year versus history of NSSI. To examine whether implicit NSSI associations track recent engagement in NSSI, we compared adolescents who engaged in: (a) any NSSI in the past year (prior to T2: $n = 206$) – 'past-year' self-injurers, (b) NSSI within the past 2 years but not in the past year (prior to T1 but not year prior to T2: $n = 84$) – 'historical' self-injurers, and (c) no NSSI prior to T1 or T2 ($n = 360$) – 'noninjurers.' One-way ANOVA indicated significant differences in SI-IAT scores across the three groups, $F(2, 649) = 8.86$, $p < .001$, $\eta^2 = .027$. Post hoc comparisons (Tukey's HSD) revealed past-year self-injurers ($M = 0.13$, $SD = 0.38$) had significantly stronger associations with NSSI than noninjurers ($M = -0.01$, $SD = 0.38$; $p < .001$, $d = 0.37$). Historical self-injurers' SI-IAT scores were intermediate ($M = 0.04$, $SD = 0.37$), but were not significantly different from the past-year NSSI ($p = .140$, $d = 0.24$) or noninjury groups ($p = .574$, $d = 0.13$).

Effects were stronger among adolescents engaging in cutting. One-way ANOVA revealed significant differences between adolescents engaged in: (a) past-year cutting at T2 ($n = 91$; $M = 0.21$, $SD = 0.38$), (b) cutting 1–2 years ago ($n = 36$; $M = 0.07$, $SD = 0.39$), and (c) no NSSI prior to T1 or T2 ($n = 360$; $M = -0.01$, $SD = 0.38$), $F(2, 486) = 11.83$, $p < .001$, $\eta^2 = .047$. Post hoc comparisons (Tukey's HSD) indicated stronger implicit NSSI associations among adolescents engaged in past-year cutting than noninjurers ($p < .001$, $d = 0.58$). SI-IAT scores of adolescents reporting historical cutting were intermediate, but not significantly different than those reporting past-year cutting ($p = .135$, $d = 0.36$), or no NSSI in past 2 years ($p = .520$, $d = 0.21$).[1]

SI-IAT and NSSI severity

Implicit NSSI self-identification was positively, but weakly, correlated with past-year NSSI frequency ($r_s[650] = .17$, $p < .001$), past-year cutting frequency ($r_s[650] = .19$, $p < .001$), and past-year number of NSSI methods ($r_s[650] = .18$, $p < .001$).

We also tested whether implicit NSSI associations were strongest at the highest cutting frequencies. One-way ANOVA revealed significant differences between adolescents who engaged in: (a) 10+ instances of cutting in the past year ($n = 17$; $M = 0.35$, $SD = 0.24$), (b) 1–9 instances of cutting in the past year ($n = 74$; $M = 0.18$, $SD = 0.40$), and (c) no NSSI in the past 2 years ($n = 360$; $M = -0.01$, $SD = 0.38$), $F(2, 451) = 13.21$, $p < .001$, $\eta^2 = .056$. Post hoc comparisons (Tukey's HSD) indicated both cutting groups (1–9 and 10+ times) had stronger NSSI identification than those who did not engage in NSSI ($p = .001$, $d = 1.13$ and $p < .001$, $d = 0.49$, respectively). Differences between the two cutting groups were not statistically significant ($p = .219$, $d = 0.52$).

SI-IAT predicting NSSI: cross-sectional and longitudinal

Incremental utility of the SI-IAT at T2 for predicting NSSI status at T2 was examined, controlling for the following relevant demographic and psychiatric covariates: gender (females had significantly stronger implicit NSSI associations than males: $t[653] = 2.75$, $p = .006$, $d = 0.21$),[2] depression symptoms ($r[654] = .11$, $p = .005$), and problematic alcohol use ($r[658] = .13$, $p = .001$). Negative binomial regression models indicated that SI-IAT scores significantly predicted NSSI status (both any NSSI and cutting only) over and above these covariates (see Table 2). When analyses were restricted to cutting, only depression symptoms and SI-IAT scores significantly predicted cutting frequency.

Negative binomial regression models also were used to examine the utility of the SI-IAT for prospectively predicting NSSI at T3. Stronger implicit NSSI associations predicted greater likelihood of engagement in any NSSI (OR = 3.18), and cutting specifically (OR = 4.23), over the subsequent year (see

Table 2 Negative binomial regression models for cross-sectional prediction of nonsuicidal self-injury (NSSI), controlling for related demographic and psychiatric covariates

Predictor	B (SE)	Wald χ^2	p	Odds Ratio [95% CI]
Predicting total NSSI frequency				
Gender (reference = male)	−0.25 (.14)	3.39	.065	0.78 [.59, 1.02]
Depressive symptoms	0.11 (.01)	131.20	<.001	1.10 [1.09, 1.13]
Problematic drinking	0.21 (.09)	4.79	.029	1.24 [1.02, 1.50]
SI-IAT	0.71 (.17)	18.55	<.001	2.04 [1.47, 2.82]
Omnibus $\chi^2(4) = 292.30$, $p < .001$				
Predicting cutting frequency				
Gender (reference = male)	−0.14 (.03)	19.84	<.001	0.87 [.82, 0.92]
Depressive symptoms	0.03 (.01)	79.10	<.001	1.03 [1.03, 1.04]
Problematic drinking	0.05 (.04)	1.61	.205	1.05 [.97, 1.25]
SI-IAT	0.17 (.05)	11.45	.001	1.18 [1.07, 1.31]
Omnibus $\chi^2(4) = 235.68$, $p < .001$				

SI-IAT = Self-Injury Implicit Association Test.

Table 3). Effects remained when controlling for past NSSI.

Cross-lagged and reciprocal associations between SI-IAT and NSSI

We examined cross-lagged and reciprocal associations between SI-IAT and NSSI over 1 year (T2–T3). NSSI was relatively stable from T2 to T3 (r[674] = .56, $p < .001$), while SI-IAT scores were less stable (r[656] = .20, $p < .001$). In Mplus version 7.0 (Muthén & Muthén, 2013), we tested a cross-lagged panel design in which NSSI frequency and SI-IAT at T3 were regressed onto NSSI frequency and SI-IAT at T2. Due to significant overdispersion from NSSI at T2 ($b = 5.30$, $p < .001$) and T3 ($b = 3.90$, $p < .001$) a negative binomial model was used.[3] There were significant direct paths from NSSI frequency at T2 to NSSI frequency at T3 ($b = 0.29$, $p < .001$) and from SI-IAT at T2 to SI-IAT at T3 ($b = 0.19$, $p < .001$), indicating test–retest reliability for both constructs (Figure 2). There were also significant cross-lagged effects that existed above and beyond the relationships between constructs over time. SI-IAT at T2 predicted NSSI frequency at T3 ($b = 0.55$, $p = .029$) and NSSI frequency at T2 predicted SI-IAT at T3 ($b = 0.02$, $p = .002$). That is, implicit NSSI associations at T2 predicted changes in NSSI behaviors at T3 and NSSI behaviors at T2 predicted changes in implicit NSSI associations at T3.

Finally, we conducted supplemental exploratory analyses to examine whether the previously identified covariates (i.e., gender and depression symptoms) moderated the relationship between SI-IAT scores and NSSI (any NSSI and cutting only). Gender moderated the relationship between SI-IAT scores and NSSI ($b = -0.76$, $SE = .23$, $p < .01$), such that there was a significant effect for girls ($b = 0.90$, $SE = .12$, $p < .001$), but not boys ($b = 0.71$, $SE = .21$, $p = .738$). Depression symptoms did not moderate the relationship between SI-IAT and NSSI ($b = -0.14$, $SE = .08$, $p = .073$). Finally, neither gender ($b = -1.12$, $SE = .98$, $p = .255$) nor depression symptoms moderated the relationship between SI-IAT scores and cutting only ($b = -0.13$, $SE = .37$, $p = .733$).

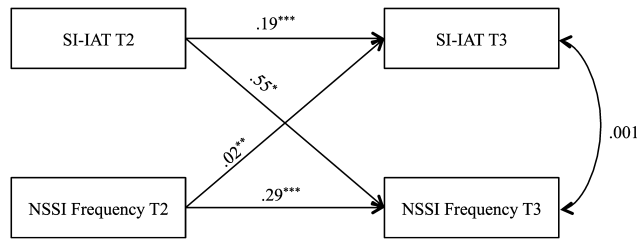

Figure 2 Cross-lagged associations between nonsuicidal self-injury (NSSI) frequency and implicit associations with NSSI (SI-IAT) over 1 year (T2–T3). Unstandardized coefficients displayed. For clarity, disturbances are not displayed. Covariances involving exogenous variables are not estimated in count models. ***$p < .001$; **$p < .01$; *$p < .05$

Discussion

This study is the largest and most fine-grained analysis of implicit self-identification with NSSI, and the first repeated measures, prospective examination of these implicit associations in a community sample. Moreover, this is the first examination of implicit NSSI identification in early adolescents – right around the typical onset of NSSI – in a school setting. Replicating previous research with older adolescents and adults (Dickstein et al., 2015; Franklin, Lee et al., 2014; Glenn & Klonsky, 2011; Nock & Banaji, 2007a), we found that adolescents who engaged in NSSI exhibited stronger self-identification with NSSI than their noninjuring peers, over and above related demographic and psychiatric correlates. This suggests that identification with

Table 3 Negative binomial regression models for prospective prediction of nonsuicidal self-injury (NSSI), controlling for past-year NSSI

Predictor	*B* (*SE*)	Wald χ^2	*p*	Odds ratio [95% CI]
Predicting total NSSI frequency				
Step 1:				
SI-IAT	1.16 (.27)	18.01	<.001	3.18 [1.87, 5.43]
Step 2:				
Past-year NSSI frequency	0.27 (.03)	74.63	<.001	1.31 [1.23, 1.39]
SI-IAT	0.49 (.29)	2.92	.088	1.63 [.93, 2.86]
Omnibus $\chi^2(2) = 270.38$, $p < .001$				
Predicting cutting frequency				
Step 1:				
SI-IAT	1.44 (.32)	20.22	<.001	4.23 [2.26, 7.94]
Step 2:				
Past-year cutting frequency	0.99 (.08)	134.12	<.001	2.69 [2.28, 3.18]
SI-IAT	0.62 (.37)	2.74	.098	1.85 [.89, 3.85]
Omnibus $\chi^2(2) = 232.18$, $p < .001$				

SI-IAT = Self-Injury Implicit Association Test.

NSSI may be present from early in the course of the behavior, rather than acquired over years of engagement, and was not solely attributable to demographic variation or general clinical severity.

These findings enhance our understanding of how implicit NSSI identification tracks trait- and state-related changes in NSSI. Implicit NSSI associations were stronger among adolescents who engaged in cutting, which is not surprising given that the SI-IAT includes pictures of cut skin as target NSSI stimuli (however, this had never been directly tested). Results could indicate the specificity of the SI-IAT for measuring implicit associations with *cutting*. Alternative interpretations are that individuals who engage in cutting are a more severe group of self-injurers and identify more with NSSI than individuals who engage in other NSSI behaviors. Previous studies have found that, compared to other forms of NSSI, cutting is related to more severe outcomes (Asarnow et al., 2011; Wilkinson et al., 2011). In the current study, we found that adolescents who engaged in cutting reported more NSSI methods and depression symptoms than adolescents engaged in other forms of NSSI. However, greater self-identification with NSSI was not completely accounted for by greater clinical severity, suggesting that self-identification with NSSI may be another indication of this group's severity.

Implicit self-identification with NSSI was related to more frequent and severe NSSI. Consistent with previous research (Franklin, Lee et al., 2014), we found that implicit associations were stronger among adolescents who engaged in more frequent NSSI in the past year. Because of the nonclinical sample, the size of the high frequency NSSI group was small, potentially limiting our power to detect effects between the moderate and high frequency NSSI subgroups. We also found that adolescents engaged in clinically significant NSSI exhibited stronger identification with NSSI than adolescents engaged in less severe, or less frequent, NSSI.

In addition to tracking trait differences in NSSI, this is the first study to find that implicit NSSI identification fluctuates with recency of NSSI. Implicit NSSI associations were stronger among adolescents who had engaged in past-year NSSI compared to both adolescents who had engaged 1–2 years ago (but not in the past year) and those who had not engaged in NSSI in the past 2 years. Further indicating the state-like nature of these implicit associations, SI-IAT predicted continued engagement in NSSI over the next year, even when controlling for previous history of NSSI. This suggests that identification with NSSI is stronger when NSSI behavior is more recent and is particularly strong if an individual is at risk for continued engagement in NSSI.

Not only do implicit NSSI associations prospectively predict NSSI frequency, but results also indicate that NSSI frequency reciprocally predicts changes in implicit NSSI associations. As individuals increase their engagement in NSSI, their implicit NSSI identification increases, which may subsequently increase the likelihood of their engagement in NSSI during future periods of distress. Overall, these findings demonstrate the temporal sensitivity of individuals' implicit associations, and suggest that they may be useful for both tracking and predicting risk for actual NSSI behavior. Of note, reciprocal associations were stronger among girls, which could suggest a gender-specific mechanism or may be due to the disproportionate number of girls engaged in NSSI overall and cutting specifically. Future research would benefit from directly addressing this question and expanding current models of NSSI by examining gender-specific mechanisms of risk for NSSI.

Implications

These findings could inform comprehensive models of NSSI and suggest potential treatments targets. First, this research provides support for the implicit association, or self-identification, hypothesis, which suggests one way that NSSI may be maintained over time (Nock & Banaji, 2007a). Overall, findings indicated that adolescents' implicit self-identification with NSSI was associated with more recent and, to some degree, more frequent NSSI. This self-identification increased over time with further engagement in the behavior and significantly, but modestly, predicted continued engagement in NSSI. We were not able to make conclusions about how self-identification with NSSI related to the initial onset of NSSI because age of NSSI onset was not specifically assessed. Results did suggest, however, that identification with NSSI is present early on in the course of the behavior. An important focus of future research will be to examine whether self-identification with NSSI develops before individuals start engaging in NSSI. Also in an effort to refine current comprehensive models of NSSI, it will be important for future studies to examine how the reinforcement of NSSI, which also maintains the behavior over time (Nock & Prinstein, 2004), may be related to NSSI self-identification. Existing research suggests that reinforcement, by either intrapersonal or interpersonal processes, increases the frequency of NSSI and the subsequent increase in frequency may then lead to increased self-identification with the behavior. However, we are unaware of any studies with the temporal resolution necessary to examine the nuances of this association and clarify how these two processes might influence each other over time.

Notably, we found that self-identification with NSSI weakened as NSSI frequency decreased. Given the reciprocal association between implicit associations and NSSI, it may be useful for interventions to directly target individuals' self-identification with NSSI (e.g., evaluative conditioning) in order to reduce their behavior. Few interventions have been developed to reduce NSSI specifically, but those that have demonstrated potential efficacy (e.g., cognitive behavioral therapy, dialectical behavior therapy; Brent et al., 2013; Ougrin, Tranah, Stahl, Moran, & Asarnow, 2015) may indirectly target these implicit associations by helping individuals increase their engagement in, and ultimate identification with, more adaptive coping strategies.

Limitations and future directions

Some study limitations warrant discussion. First, the assessment of NSSI was brief (ideal for measurement of large samples) and therefore limited in scope. Past-year NSSI was measured at multiple time points, but the study did not include a lifetime measure of NSSI. Therefore, the non-injuring comparison groups were comprised of adolescents who did not report NSSI within the past 2 years, as opposed to lifetime noninjurers. In addition, NSSI was assessed using a self-report questionnaire, rather than a clinical interview, and it is possible that the definition of NSSI, or specific NSSI behaviors, were misinterpreted. Further, we did not measure functions of NSSI and therefore were unable to examine how NSSI motivations may influence an individual's self-identification with NSSI.

Second, our conclusions are limited to community samples of adolescents. Replications in clinical samples of youth are necessary before findings can be generalized to more severe adolescent populations. Of note, at least one study found greater prospective utility of implicit associations with suicide among a clinical sample of adults (Nock et al., 2010), suggesting that these tools may be even more useful among severe populations.

Third, although study findings enhance understanding of state-related fluctuations in implicit self-identification with NSSI, additional research is needed before the SI-IAT can be used for assessing and predicting risk at the individual level. For instance, it is currently unclear how much to weight SI-IAT scores in prediction models, especially when an individual denies engagement in NSSI.

Finally, this study included only one measure of implicit cognition. Although the SI-IAT appears to add incrementally to the prediction of NSSI, there remains a significant amount of variance unaccounted for in these models. Research should continue to test novel, theory-driven, and objective predictors that may further enhance our understanding of the development and maintenance of NSSI over time.

Acknowledgements

The research was supported by grants (R01 MH085505 [MJP and MKN] and (F32 MH097354 [CRG]) from the National Institute of Mental Health and with support from the John D. and Catherine T. MacArthur Foundation (MKN).

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Key points

- Nonsuicidal self-injury (NSSI) typically develops in early adolescence and rates of NSSI peak during this developmental period.
- The implicit association hypothesis suggests that individuals' self-identification with NSSI may guide their selection of that specific behavior to cope.
- The nature of implicit self-identification with NSSI was examined in a large sample of middle school students using a prospective, longitudinal design.
- Implicit self-identification with NSSI was stronger among adolescents who engaged in more frequent and more recent NSSI, and predicted NSSI behaviors over the next year.
- Implicit identification with NSSI may track both trait- and state-related changes in the behavior and, importantly, may help predict continued engagement in NSSI over time.

Notes

1. SI-IAT patterns were similar among adolescents engaging in more recent and clinical significant NSSI (any NSSI and cutting only).
2. Gender differences in SI-IAT scores may be somewhat accounted for by gender differences in NSSI. More females than males reported engaging in cutting, and SI-IAT scores were higher among adolescents engaging in cutting.
3. Models specifying NSSI frequency as continuous and using cutting (vs. any method of NSSI) resulted in the same overall pattern and interpretation of findings.

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Accepted for publication: 2 November 2015