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Recent and Frequent Nonsuicidal Self-Injury Is Associated With Diminished Implicit and Explicit Aversion Toward Self-Cutting Stimuli

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Abstract
In the present study, we tested the hypothesis that an instinctive barrier to nonsuicidal self-injury (NSSI)—the aversion to self-cutting stimuli—is diminished in people who engage in NSSI. In a sample of 86 noninjurers and 58 people with a history of self-cutting, we found that NSSI was associated with substantially reduced aversion to self-cutting stimuli across measures of both implicit (d = 0.61) and explicit (d = 0.93) affect even after controlling for emotion reactivity and dysregulation. This diminished aversion primarily applied to individuals who had engaged in NSSI within the past year or who had 10 or more lifetime episodes of self-cutting (ds = 0.87–1.23). Implicit identification with NSSI also significantly distinguished between groups (d = 0.67) but was not correlated with affective measures or NSSI recency/frequency. Although previous work has shown that the affective benefits of NSSI are natural and universal, these findings suggest that diminished instinctive barriers to NSSI may be specific NSSI risk factors that can be targeted in novel interventions.

Keywords
nonsuicidal self-injury, affect, implicit associations

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Millions of people engage in nonsuicidal self-injury (NSSI) each year (Klonsky, 2011; Nock & Prinstein, 2004). NSSI behaviors involve the intentional destruction of one's own body tissue in the absence of suicidal intent (e.g., cutting or burning; Nock, 2010). Although NSSI itself is harmful, it is perhaps most dangerous because it increases the risk of future suicidal behaviors. In fact, recent studies have indicated that NSSI is a stronger prospective predictor of suicidal behaviors than are prior suicidal behaviors (e.g., Guan, Fox, & Prinstein, 2012). Despite attempts with a wide range of interventions, currently there are no empirically supported treatments for NSSI (Nock, 2010). This distinction highlights the need for a greater understanding of the processes that drive NSSI and how to counteract them.

Over the course of the past decade, studies have consistently shown that the most common self-reported reason for engaging in NSSI is affect regulation (e.g., Klonsky, 2007; Nock & Prinstein, 2004). Results from our laboratory NSSI studies have supported this finding and have clarified that mechanisms such as pain-offset relief may contribute to affect regulation during NSSI (e.g., Franklin et al., 2013). It should be noted, however, that such mechanisms are not specific to NSSI; rather, they appear to be natural affect regulation mechanisms that are available to nearly all people and species (see Franklin et al., 2013; Tanimoto, Heisenberg, & Gerber, 2004). Indeed, NSSI laboratory studies that have included a painful stimulus have shown that NSSI and control

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groups display similar affect regulation after pain (e.g., Bresin & Gordon, 2013; Franklin et al., 2010, 2013). These findings evoke a perplexing question that is central to understanding the processes that drive NSSI: If the affective benefits of NSSI are natural and normal, what prevents the majority of the population from accessing these benefits?

One potential answer is that there are instinctive barriers that deter most people from accessing these benefits of NSSI. Unlike the affective benefits of NSSI, these barriers may powerfully distinguish between individuals who do and do not engage in NSSI. Accordingly, these barriers may represent important potential risk factors and treatment targets for NSSI. A key cognitive barrier is the implicit identification with NSSI, which is the spatiotemporal distance in the mind between the self and NSSI. A stronger implicit identification with NSSI may facilitate the selection of NSSI as a viable behavior. Results obtained by Nock and Banaji (2007) supported this possibility and showed that adolescents with a history of NSSI displayed a substantially stronger implicit identification with NSSI (d = 1.20), as measured with the Implicit Association Test (IAT). An important sensory barrier to NSSI is pain perception. Recent laboratory studies have shown that this barrier is diminished in many people who engage in NSSI (Franklin, Aaron, Arthur, Shorkey, & Prinstein, 2012; Franklin, Hessel, & Prinstein, 2011; Hooley, Ho, Slater, & Lockshin, 2010). Moreover, the degree of diminished pain perception in these studies has ranged from moderate to large (average d for pain threshold = 0.55, average d for pain tolerance = 0.70).

We propose that the instinctive aversion to self-mutilation stimuli is a major affective barrier to NSSI (Franklin et al., 2013; cf. Joiner, Ribeiro, & Silva, 2012). In normative samples, stimuli depicting wounds, attack, blood, and injury tend to evoke the most negative responses across a wide range of measures (e.g., Bradley, Codispoti, Cuthbert, & Lang, 2001). This aversion may motivate most people to avoid NSSI; conversely, a reduced aversion to these stimuli may facilitate NSSI. We are not aware of any published studies that have directly tested this hypothesis, but Glenn and Klonsky (2010) provided preliminary support for this possibility. They found that 51.6% of an NSSI sample retrospectively reported that seeing blood during self-injury was important and tended to be associated with relief. In the present study, we directly tested this hypothesis by examining implicit and explicit affective reactions to self-cutting stimuli in participants with and without a history of NSSI. We aimed to advance knowledge about aversion to NSSI stimuli in four major ways.

First, we investigated the degree to which NSSI participants display a diminished aversion to self-cutting stimuli. To accomplish this, we compared affective reactions to self-cutting stimuli with affective reactions to standardized pleasant, neutral, and unpleasant stimuli. On the basis of prior studies (e.g., Bradley et al., 2001), we hypothesized that a control group of noninjuring participants would display their most negative reactions to the self-cutting category. Consistent with the hypothesis that the aversion to NSSI stimuli is reduced in people who engage in NSSI, our hypothesis predicted that the NSSI group would display reactions to the self-cutting category that approached their reactions to the neutral category.

Second, we examined whether the potential diminished aversive reactions in the NSSI group were present on a deeper, implicit level. According to dual-process models (e.g., Gawronski & Bodenhausen, 2006), there are two types of affective attitudes: implicit and explicit. Implicit attitudes are governed by associative processes, which are automatically evoked in reaction to a stimulus. Implicit attitudes typically are indexed by performance-based measures such as the IAT. In contrast, explicit attitudes are based on propositional reasoning processes, which are concerned with assessing the truth-value of beliefs. Explicit attitudes are most often indexed with self-report measures. Both types of attitudes arise from the same reaction; however, implicit measures provide a relatively direct assessment of this reaction, whereas explicit measures screen it through a filter that is vulnerable to self-report biases, such as lack of insight and social desirability (Gawronski & Bodenhausen, 2006; Nisbett & Wilson, 1977). Although implicit and explicit attitudes are often consistent with one another, they diverge in many situations. For example, individuals with a low motivation to conceal racial bias display both implicit and explicit biases, but individuals with a high motivation to conceal racial bias display only an implicit bias (Payne, Cheng, Govorun, & Stewart, 2005).

Preliminary evidence has suggested that people who engage in NSSI may display diminished explicit aversion to self-cutting stimuli (Glenn & Klonsky, 2010), but it remains unclear whether this finding would extend to implicit aversion. Various self-report biases and cognitive heuristics could explain diminished explicit aversion to self-cutting (cf. Nisbett & Wilson, 1977), but a fundamentally aberrant affective association may be necessary to explain diminished implicit aversion. Given that such reactions are evolutionarily conserved and vital to survival, fundamentally diminished aversion to self-cutting stimuli may be rare. To test the hypothesis that NSSI is associated with fundamentally diminished aversion to these stimuli, we measured both implicit and explicit affect. Specifically, we employed the affect misattribution procedure (AMP; Payne et al., 2005) to measure implicit affect and a computerized survey rating scale to measure explicit affect.

Third, we investigated the degree to which affective reactions to self-cutting stimuli overlap with implicit identification with self-cutting. As noted earlier, NSSI has been associated with substantially stronger implicit identification with self-cutting (Nock & Banaji, 2007). It is possible that implicit identification with NSSI and diminished aversion toward NSSI are highly redundant. Specifically, individuals may identify more strongly with NSSI if they have a more positive affective attitude toward NSSI (or vice versa). However, we hypothesized that implicit identification with NSSI (i.e., the self-cutting IAT) and affect toward NSSI would display little overlap; this hypothesis is consistent with findings from a similar study on affect toward and implicit associations with alcohol (Payne, Govorun, & Arbuckle, 2008).

Fourth, we examined the associations between NSSI frequency/recency and affect toward/implicit identification with NSSI. Contrary to our hypotheses, the results of our recent study showed that NSSI frequency was not associated with heightened relief after pain (Franklin et al., 2013). This finding suggests that self-injury experience does not heighten the affective benefits of NSSI; nonetheless, it remains possible that self-injury experience erodes the barriers to NSSI. Specifically, given that implicit associations may be based in part on temporal contiguity and pairing frequency (see Gawronski & Bodenahusen, 2006), we hypothesized that more frequent and more recent NSSI would generate a stronger implicit identification with NSSI. Similarly, taking into account potential mechanisms, such as habituation and pain-offset relief conditioning (cf. Andreatta, Muhlberger, Yarali, Gerber, & Pauli, 2010), we hypothesized that more frequent and more recent NSSI would be associated with more positive affective reactions toward self-cutting stimuli. If these frequency and recency hypotheses are supported, it may suggest that these factors have the potential to be powerful predictors of future self-injury. Correspondingly, such a finding would indicate that these factors may be important potential treatment targets.

Method

Participants

Control group. The control group consisted of 86 (46 females and 40 males) college undergraduates who participated to partially fulfill an introductory psychology research option. Participants voluntarily signed up for the present study, which was described as a study about self-injurious behaviors in the absence of any desire to die. Participants were included in this group only if they reported no history of any form of NSSI, as assessed by the Self-Injurious Thoughts and Behaviors Interview (SITBI; Nock, Holmberg, Photos, & Michel, 2007; see the SITBI section for more detail). This group had an average age of 19.24 (*Mdn* = 19.00, *SD* = 1.31) and an ethnic composition of 67.4% Caucasian, 11.6% African American, 11.6% Asian American, and 9.3% mixed/other. No demographic variable was significantly associated with any of the implicit affect, explicit affect, or implicit identification variables (ps > .05).

NSSI group. The NSSI group consisted of 58 (43 females and 15 males) participants recruited from campus, community, and psychiatric hospital advertisements that offered $75 for participation in a study on self-cutting behaviors. This group had an average age of 23.24 (*Mdn* = 21.00, *SD* = 6.90) and an ethnic composition of 63.8% Caucasian, 6.9% African American, 13.8% Asian American, 3.4% Hispanic, and 12.1% mixed/other. No demographic variable was significantly associated with any of the implicit affect, explicit affect, or implicit identification variables (ps > .05).

Participants were included in this group only if they reported a history of self-cutting as assessed by the SITBI. Self-cutting was selected as a necessary behavior because (a) our experimental tests were specific to cutting; (b) in contrast to behaviors such as hitting or biting, cutting is an unambiguously severe NSSI behavior; and (c) several studies have reported that cutting is the most common NSSI behavior (e.g., Nock & Prinstein, 2004). The mean number of lifetime self-cutting episodes for this group was 146.02 (*Mdn* = 25, *SD* = 469.25, range = 1–3,000). The mean number of months since the last self-cutting episode was 12.12 (*Mdn* = 1.00, *SD* = 27.06, range = 0–62).

Measures

SITBI. The SITBI (Nock et al., 2007) is a structured interview that measures the presence, frequency, and characteristics of various types of self-injurious thoughts and behaviors. It has modules for suicidal ideation, suicide plans, suicide gestures, suicide attempts, and NSSI. The SITBI has strong interrater reliability (average κ = .99, r = 1.0) and test-retest reliability (average κ = .70, intraclass correlation coefficient = .44) over a 6-month interval (Nock et al., 2007). The SITBI shows strong construct validity, which converges with other measures of suicidal ideation (average κ = .54), suicide attempts (average κ = .65), and NSSI (average κ = .87). In the present study, we used the NSSI module of the SITBI to assess the presence, frequency, and recency of NSSI behaviors.

Difficulties in Emotion Regulation Scale. The Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004) is a self-report questionnaire that assesses emotion regulation and dysregulation. All items are scored on a scale from 1 (*almost never*) to 5 (*almost always*). Higher overall DERS scores indicate poorer emotion regulation. The DERS shows high internal consistency, good test-retest reliability, and adequate construct and predictive validity and is positively correlated with NSSI in both men and women (see Gratz & Roemer, 2004). Consistent with DERS results reported in prior studies (e.g., Franklin et al., 2013; Gratz & Roemer, 2004), DERS scores were significantly higher in the present NSSI group (M = 99.47, SD = 19.35) compared with the control group (M = 81.07, SD = 13.01), $F(1, 141) = 49.79$, $p < .001$, $d = 1.16$. To ensure that this group difference in emotion dysregulation did not confound group differences in affect toward and implicit identification with NSSI stimuli, we employed DERS scores as a covariate in these analyses.

Emotion Reactivity Scale. The Emotion Reactivity Scale (ERS; Nock, Wedig, Holmberg, & Hooley, 2008) is a self-report questionnaire that measures emotion reactivity, which is composed of emotional sensitivity, intensity, and persistence. The ERS has shown strong internal consistency, convergent and divergent construct validity, and criterion-related validity (Nock et al., 2008). The ERS is positively correlated with self-injury and has been shown to mediate the association between psychopathology and self-injury (Nock et al., 2008). Similar to ERS results obtained in previous studies (e.g., Franklin et al., 2013; Nock et al., 2008), ERS scores were significantly higher in the present NSSI group (M = 56.40, SD = 17.61) compared with the control group (M = 38.29, SD = 13.49), $F(1, 141) = 48.65$, $p < .001$, $d = 1.15$. Following a procedure similar to that used with the DERS scores, we employed ERS scores as a covariate in analyses that examined group differences in affect toward and implicit identification with NSSI.

Explicit picture ratings survey. Explicit affect was assessed with a computerized self-report survey. On each trial, a picture was presented and participants were asked to rate the picture on a scale from −4 (*extremely unpleasant*) to 0 (*neutral*) to 4 (*extremely pleasant*). After participants made their ratings, they clicked on a button to move on to the next trial. Pictures were divided into four categories: pleasant (e.g., kittens), neutral (e.g., a chair), unpleasant (e.g., a spider), and NSSI. There were 12 pictures per category, which resulted in 48 total trials. All pleasant, neutral, and unpleasant pictures were chosen from the International Affective Pictures System (Lang, Bradley, & Cuthbert, 2008). All NSSI pictures were created specifically for this project with digital art and theatrical makeup techniques. We created these stimuli ourselves because we wanted high-definition pictures that covered several aspects of self-cutting. These images depicted aspects including (a) a knife or razor blade approaching unharmed skin, (b) a knife or razor blade touching skin, (c) a knife or razor blade appearing to cut skin and draw blood, or (d) bloody wounds apparently made by either a knife or a razor blade. Post hoc analyses revealed that all NSSI picture subtypes (e.g., blood vs. no blood) were similarly related to our major variables of interest.

The AMP. The AMP (Payne et al., 2005) is a brief computer-based task that measures implicit affect. On each trial of the AMP, the computer flashed an emotionally evocative picture for 75 ms, a blank screen for 125 ms, a Chinese symbol for 100 ms, and finally a gray screen that remained until the participant pressed a key. Participants were instructed to press one key (e.g., "p") if they judged the Chinese symbol to be more pleasant than an average symbol (that they could imagine on the basis of their prior experience with Chinese symbols) and another key (e.g., "q") if they judged the Chinese symbol to be less pleasant than an average symbol. Participants were instructed to ignore the emotionally evocative pictures during their judgments of the Chinese symbols. Previous studies have shown, however, that despite such an instruction, evaluations are influenced by the nature of the picture, with more pleasant pictures generating more pleasant evaluations of subsequent Chinese symbols (e.g., Payne et al., 2005). This result occurs because individuals misattribute the affect evoked by the earlier emotional picture as being evoked by the later ambiguous Chinese symbol (Loersch & Payne, 2011; Payne et al., 2005). Through this misattribution, the AMP is able to index implicit affective reactions to the emotional pictures that are flashed at the beginning of each trial. The dependent variable for the AMP was the proportion of trials on which a positive evaluation occurs to the total number of trials within a given picture category.

In the present study, we created a modified version of the AMP that included the same 48 pleasant, neutral, unpleasant, and NSSI pictures that were included in the explicit affect ratings survey, which resulted in 48 unique AMP trials. Following a procedure similar to that used in other AMP studies (e.g., Payne et al., 2005, 2008), we presented each unique trial twice to increase reliability.

The NSSI IAT. The NSSI IAT (Nock & Banaji, 2007) is a brief computer-based task that measures implicit identification with NSSI. Specifically, it assesses the strength of the association that participants hold between themselves and NSSI. On each trial, participants were presented with either two or four words or phrases at the top of the computer screen. Two of these words were opposing concepts (e.g., "cutting," "no cutting") and two of these words were opposing attributes (e.g., "me," "not me").

Each screen contained a picture that was either NSSI related (e.g., pictures of skin that had been cut) or neutral (e.g., noninjured skin). Participants were asked to press one key (e.g., "e") if the concept on the left correctly classified the picture and another key (e.g., "i") if the concept on the right correctly classified the picture. Reaction time was recorded for each trial on which a correct classification was made. If an incorrect classification was made, the trial was repeated.

The NSSI IAT comprised two main blocks. In one block, NSSI concepts (e.g., "cutting") were on the same side as self-related attributes (e.g., "me"). A previous study has shown that compared with non-NSSI participants, adolescents with a history of NSSI classify NSSI pictures more quickly in this kind of block (Nock & Banaji, 2007). In the other block, NSSI concepts were not on the same side as self-related concepts. Non-NSSI participants have been shown to be faster at correctly classifying NSSI-related pictures in this kind of block (Nock & Banaji, 2007). The strength of association between NSSI and oneself is quantified by taking a standardized difference score for each participant. Positive difference scores reflect stronger associations.

Procedure

Participants arrived in the lab, signed an informed consent form, and were administered the SITBI. Participants then completed the three laboratory tasks: the AMP, IAT, and explicit ratings survey.

Data analytic plan

Group differences. We tested the hypothesis that the NSSI group would display abnormal implicit and explicit affective reactions to self-cutting stimuli. For the AMP and the explicit ratings survey, we conducted 2 × 4 (Group × Valence Category) mixed analyses of variance (ANOVAs). Pending significant interaction effects, we conducted follow-up analyses of covariance (ANCOVAs) to test for potential group differences within each valence category, with a particular interest in the NSSI category. To control for the potential confounds of response bias, emotion reactivity, and emotion dysregulation, we included the following covariates in these ANCOVAs: scores for the neutral category of either the AMP or the explicit ratings survey (cf. Payne et al., 2005; note that analyses for the neutral category did not include this covariate), ERS scores, and DERS scores. To test the hypothesis that the NSSI group would display significantly stronger implicit identification with NSSI, we conducted an ANCOVA with ERS and DERS scores as covariates to examine group differences on NSSI IAT scores.

Associations among variables in the NSSI group. We examined Pearson product-moment correlations among implicit affect, explicit affect, implicit associations, NSSI frequency, and NSSI recency. Because there are no universally accepted procedures for calculating NSSI frequency/recency, we calculated these variables in three ways. First, we examined recency in both months and years and frequency as the raw numbers reported by participants. Second, we transformed raw frequency values into class intervals in which (a) values between 1 and 10 were assigned a value of 1, (b) values between 11 and 50 were assigned a value of 2, (c) values between 51 and 100 were assigned a value of 3, (d) values between 101 and 500 were assigned a value of 4, and (e) values 501 and beyond were assigned a value of 5. Third, we examined rank-ordered Spearman's rho correlations between recency/frequency and the other major variables.

Patterns across NSSI frequency and recency intervals. We sought to further delineate the association between NSSI recency/frequency and the other major variables. One possible explanation for these associations is that any experience with NSSI—even a single instance of self-cutting many years ago—is associated with abnormal implicit identification with and affect toward NSSI. Another possible explanation is that abnormal attitudes toward NSSI are present only in individuals with highly frequent and very recent NSSI. To provide a more detailed examination of these associations, we divided participants into groups on the basis of their NSSI frequency and recency. Participants were sorted into the following frequency groups: no history of NSSI (n = 86), 1 to 9 lifetime episodes of self-cutting (n = 19), 10 to 99 lifetime episodes of self-cutting (n = 26), and greater than 100 episodes of self-cutting (n = 13). These intervals were chosen in part to allow for adequate group sizes for statistical comparisons and in part to approximate relatively infrequent, moderately frequent, and highly frequent self-cutting subgroups. For recency analyses, participants were sorted into the following groups: no history of NSSI (n = 86); a history of self-cutting, but not within the past year (n = 14); self-cutting between 1 and 12 months ago, but not within the past month (n = 19); and self-cutting within the past month (n = 25). These intervals were chosen in part to allow for adequate group sizes for statistical comparisons and in part to approximate nonrecent, moderately recent, and very recent self-cutting subgroups.

To investigate the effect of these frequency and recency groups on implicit and explicit affect toward NSSI, we conducted ANCOVAs with scores on neutral trials, ERS scores, and DERS scores as covariates. Similarly, to examine the effect of these groups on implicit identification with NSSI, we conducted an ANCOVA with ERS and DERS scores as covariates. Pending significant effects, we employed post hoc tests to investigate differences among frequency and recency subgroups.

Results

Explicit affect

The mixed ANOVA showed that there was a significant interaction effect of group and picture category on explicit affect, $F(3, 423) = 18.21$, $p < .001$, $\eta^2 = .12$. There was a main effect of category on explicit affective ratings, $F(3, 423) = 611.55$, $p < .001$, $\eta^2 = .81$, with both groups showing the expected pattern of more negative ratings from pleasant to neutral to unpleasant categories (see Fig. 1 for affect by picture category). Follow-up ANCOVAs revealed no main effect of group on explicit affect in the neutral ($p = .12$, $d = 0.17$) or unpleasant ($p = .80$, $d = 0.05$) categories, but there was a significant main effect of group in the pleasant category, $F(1, 138) = 7.19$, $p = .01$, $d = 0.47$ (see Fig. 1). There was a comparatively larger effect of group on explicit affect toward NSSI stimuli ($d = 0.93$), with an ANCOVA revealing that this was a significant main effect, $F(1, 138) = 15.88$, $p < .001$. Results showed that the NSSI group displayed greater positive affect toward NSSI (see Fig. 1) even after we controlled for response bias, emotion reactivity, and emotion dysregulation, which was consistent with our predictions. These findings indicated that abnormal explicit affective responses in the NSSI group were largely specific to the NSSI category.

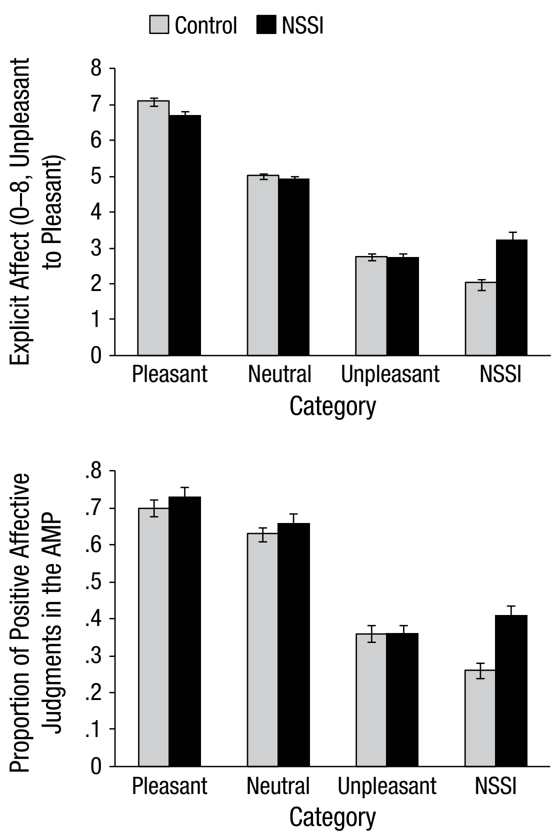

Fig. 1 Explicit and implicit affect by picture category. NSSI = nonsuicidal self-injury; AMP = affect misattribution procedure. Error bars represent ±1 standard error of the mean.

Implicit affect

The mixed ANOVA revealed that there was a significant interaction effect of group and category on AMP scores, $F(3, 423) = 2.70$, $p = .05$, $\eta^2 = .02$. As with explicit affect, there was a main effect of category on AMP scores, $F(3, 423) = 107.72$, $p < .001$, $\eta^2 = .44$, with both groups displaying diminishing positive affect across pleasant, neutral, and unpleasant categories (see Fig. 1). Follow-up ANCOVAs, in which we controlled for response bias, emotion reactivity, and emotion dysregulation indicated that there were no significant main effects of group on AMP scores within the pleasant ($p = .94$, $d = 0.15$), neutral ($p = .12$, $d = 0.16$), or unpleasant ($p = .99$, $d = 0.04$) categories. However, there was a significant main effect of group on AMP scores within the NSSI category, $F(1, 138) = 6.02$, $p < .01$, $d = 0.61$, with the NSSI group displaying significantly higher positive implicit affect. Similar to the explicit affect findings, these results indicate that abnormal implicit affect responses in the NSSI group were specific to the NSSI category.

Implicit identification with NSSI

The ANCOVA revealed that there was a significant main effect of group on NSSI IAT scores, $F(1, 139) = 13.30$, $p < .001$, $d = 0.67$, even after we controlled for emotion reactivity and emotion dysregulation. Specifically, the NSSI group displayed more positive IAT scores ($M = .04$, $SD = .48$) compared with the control group ($M = -.29$, $SD = .48$). Consistent with findings from prior studies in adolescents (Nock & Banaji, 2007), these results indicate that a history of self-cutting is associated with a stronger implicit identification with cutting.

Correlations among variables within the NSSI group

As shown in Table 1, measures of implicit and explicit affect toward NSSI were moderately correlated, but neither affective measure was significantly correlated with implicit identification with NSSI. This result suggests that affective associations and implicit identification with NSSI display little overlap. Both implicit and explicit affect

Table 1. Correlations Among Nonsuicidal Self-Injury (NSSI), Affective, and Implicit Identification Variables Within the NSSI Group.

	Affect		
Variable	Implicit	Explicit	Implicit identification
Implicit affect	—	—	—
Explicit affect	.54***	—	—
Implicit identification	−.14	.12	—
Frequency – Raw	.34**	.41***	.04
Frequency – Class	.38**	.43***	.05
Frequency – Rank	.42***	.46***	.08
Recency – Months	−.28*	−.33**	−.15
Recency – Years	−.29*	−.34**	−.14
Recency – Rank	−.24*	−.37**	−.13

Note: Implicit affect = scores in the NSSI category of the affect misattribution procedure; Explicit affect = scores in the NSSI category of the explicit ratings survey; Implicit identification = scores on the NSSI Implicit Association Test; Frequency – Raw = exact self-reported NSSI frequency; Frequency – Class = NSSI frequency grouped into class categories; Frequency/Recency – Rank = Spearman rank order correlations. $N = 58$.
*$p < .05$. **$p < .01$. ***$p < .001$.

toward NSSI were moderately correlated with NSSI frequency and recency, regardless of how NSSI recency and frequency were calculated. In contrast, implicit identification with NSSI was not significantly correlated with NSSI frequency or recency, with many of these correlations being near 0. These results indicate that NSSI recency and frequency may substantially alter affect toward NSSI (or vice versa) but that implicit identification with NSSI may be largely independent of these factors.

Patterns across NSSI frequency intervals

An ANCOVA revealed that there was a significant effect of frequency interval on explicit affect toward NSSI, $F(1, 138) = 12.85$, $p < .001$, $d = 0.61$, after we controlled for response bias, emotion reactivity, and emotion dysregulation (see Fig. 2 for self-cutting frequency effects). Post hoc tests revealed that the group that had never engaged in NSSI displayed similar responses to the subgroup that had engaged in NSSI fewer than 10 times ($p = .48$, $d = 0.25$) but displayed significantly more negative responses compared with the subgroups of individuals who had engaged in 10 to 99 episodes ($p < .001$, $d = 1.12$) and 100 or more episodes ($p < .001$, $d = 1.23$). Similarly, the subgroup that had engaged in NSSI fewer than 10 times displayed significantly more negative responses than did the subgroups of individuals who had engaged in 10 to 99 episodes ($p < .001$, $d = 0.96$) and 100 or more episodes ($p < .001$, $d = 1.04$). These latter two subgroups did not significantly differ from one another ($p = .90$, $d = 0.03$). This pattern is reflected in Figure 2, which shows that there is a large contrast in explicit affect ratings of NSSI stimuli between individuals with a history of fewer than 10 self-cutting episodes and individuals with a history of 10 or more episodes. It is interesting that on average, these latter individuals explicitly rated NSSI stimuli similarly to how they rated neutral stimuli (cf. Figs. 1 and 2).

A separate ANCOVA indicated a significant effect of frequency interval on implicit affect toward NSSI, $F(1, 138) = 5.94$, $p < .001$, $d = 0.41$, after we controlled for response bias, emotion reactivity, and emotion dysregulation. Echoing the subgroup pattern for explicit affective ratings, post hoc test results showed that there were no significant differences between individuals who had never engaged in NSSI and individuals who had engaged in NSSI fewer than 10 times ($p = .87$, $d = 0.04$), but individuals who had never engaged in NSSI again displayed significantly more negative responses compared with the subgroups of individuals who had engaged in 10 to 99 episodes ($p < .001$, $d = 0.93$) and 100 or more episodes ($p = .001$, $d = 0.87$). Likewise, the subgroup who had engaged in NSSI fewer than 10 times displayed significantly more negative responses than did the subgroups of individuals who had engaged in 10 to 99 episodes ($p = .003$, $d = 0.90$) and 100 or more episodes ($p = .005$, $d = 0.85$). Once again, these latter two subgroups did not significantly differ from one another ($p = .68$, $d = 0.10$). Similar to explicit affective ratings results, this finding resulted in a pattern whereby there was a clear demarcation between individuals who had engaged in self-cutting fewer versus greater than 10 times (see Fig. 2).

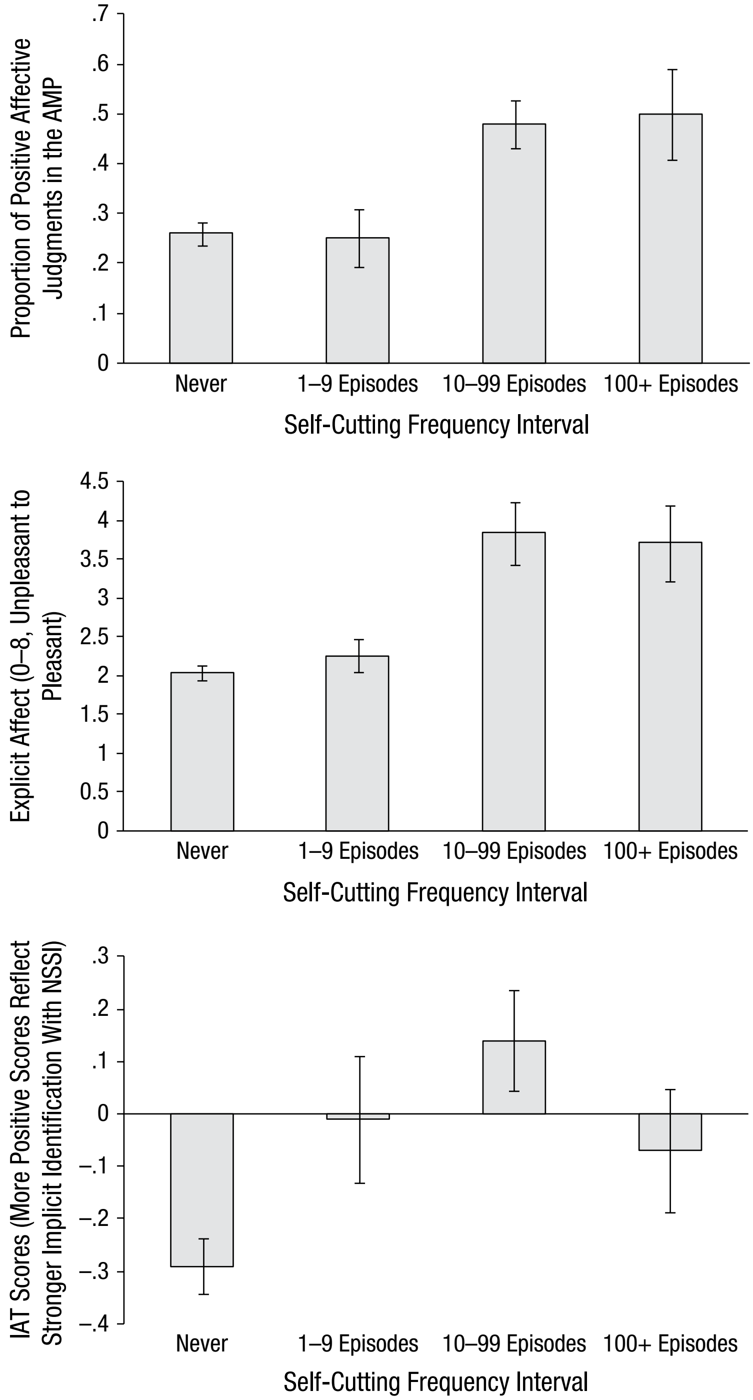

Fig. 2. Self-cutting frequency effects on explicit affect, implicit affect, and implicit identification. AMP = affect misattribution procedure; IAT = Implicit Association Test; NSSI = nonsuicidal self-injury. Error bars represent ±1 standard error of the mean.

Another ANCOVA showed that there was a significant effect of frequency interval on implicit identification with NSSI, $F(1, 139) = 5.11$, $p < .01$, $d = .38$, after we controlled for emotion reactivity and emotion dysregulation. However, post hoc tests revealed a subgroup pattern that differed from that observed for implicit and explicit affect. Individuals who had never engaged in NSSI displayed substantially more negative scores than did subgroups who had engaged in NSSI fewer than 10 times (p = .02, d = 0.56), between 10 and 99 times (p < .001, d = 0.88), and greater than 100 times (p = .15, d = 0.49). But the subgroup of individuals who had engaged in fewer than 10 episodes did not significantly differ from subgroups of individuals who had engaged in between 10 and 99 episodes (p = .34, d = 0.28) or greater than 100 episodes (p = .74, d = 0.13), and these latter two groups did not significantly differ from one another (p = .24, d = 0.44). As illustrated in Figure 2, this resulted in a pattern in which any history of self-cutting was associated with an abnormally positive implicit identification with NSSI, regardless of frequency.

Patterns across NSSI recency intervals

An ANCOVA indicated that there was a significant effect of recency interval on explicit affective ratings of NSSI stimuli, $F(1, 138) = 9.45$, $p < .001$, $d = 0.52$, after we controlled for response bias, emotion reactivity, and emotion dysregulation. Post hoc tests showed that there were no significant differences between subgroups with no lifetime history of self-cutting and no self-cutting episodes within the past year (p = .45, d = 0.28), but there were significant differences between the group with no lifetime history of self-cutting and the subgroups who had engaged in NSSI between 1 and 12 months prior (p < .001, d = 0.99) and within the past month (p < .001, d = 1.11). Also echoing frequency results, individuals who had not engaged in NSSI within the past year displayed significantly more negative responses than did individuals who had engaged in NSSI within 1 and 12 months prior (p = .01, d = 0.77) and within the past month (p < .001, d = 0.92). These latter two groups were not significantly different from one another (p = .34, d = 0.20). Although this statistical pattern was similar to the pattern shown in frequency interval results, the pattern of means across recency intervals increased in a more consistent manner from least recent to most recent NSSI (see Fig. 3 for self-cutting recency effects).

An additional ANCOVA revealed that there was a significant effect of recency interval on implicit affect toward NSSI stimuli, $F(1, 138) = 4.03$, $p < .01$, $d = 0.34$, after we controlled for response bias, emotion reactivity, and emotion dysregulation. Post hoc tests showed that individuals who had never engaged in NSSI displayed significantly more negative responses compared with individuals who had engaged in NSSI in the past month (p < .001, d = 0.95), but these same individuals did not significantly differ from individuals who had last engaged in NSSI between 1 and 12 months prior (p = .37, d = 0.24) or greater than 1 year prior (p = .12, d = 0.41). The subgroup of individuals who had engaged in NSSI greater than 1 year prior significantly differed from individuals who had engaged within the past month (p = .04, d = 0.61) but did not significantly differ from individuals who had last engaged in NSSI between 1 and 12 months prior (p = .67, d = 0.14). These latter two groups did not significantly differ from one another (p = .08, d = 0.48). As with explicit affective ratings, there was a linear pattern of means across recency intervals (see Fig. 3).

Another ANCOVA showed that there was a significant main effect of recency interval on implicit identification with NSSI, $F(1, 139) = 4.49$, $p < .01$, $d = 0.36$, after we controlled for emotion reactivity and emotion dysregulation. Post hoc tests indicated that the subgroup of individuals who had never engaged in NSSI displayed significantly more negative implicit identification with NSSI compared with individuals who had last engaged in NSSI greater than 1 year prior (p = .05, d = 0.48), within 1 to 12 months prior (p = .006, d = 0.72), and within the past month (p = .003, d = 0.75). However, individuals who had last engaged in NSSI greater than 1 year prior did not differ significantly from those individuals who had last engaged in NSSI 1 to 12 months prior (p = .60, d = 0.17) or within the past month (p = .64, d = 0.16), and these latter two groups did not significantly differ from one another (p = .93, d = 0.02). This result is reflected in Figure 3, which shows that any engagement in self-cutting, regardless of recency, was indicative of a more positive implicit identification with NSSI.

Discussion

Much research of the past decade has focused on the affective benefits that reinforce NSSI, but converging evidence has suggested that these are natural benefits that apply to the majority of people, not just to people who engage in NSSI (e.g., Bresin & Gordon, 2013; Franklin et al., 2013; Tanimoto et al., 2004). This evidence raises a crucial question regarding which factors distinguish between people who do and do not engage in NSSI. Previous studies have established relatively nonspecific factors that distinguish between individuals who do and do not engage in NSSI (e.g., emotion dysregulation; Gratz & Roemer, 2004), but in the present study, we attempted to establish factors that are highly specific to NSSI. In a previous study, we proposed that these specific distinguishing factors include instinctive barriers to NSSI, such as aversion to mutilation stimuli (Franklin et al., 2013; cf. Joiner et al., 2012). Supporting this hypothesis, the present results demonstrated that NSSI is associated with diminished aversion to self-cutting stimuli even after controlling for more general factors. This diminished aversion may represent an important NSSI marker and may accordingly aid in the assessment, prediction, and treatment of NSSI.

Results indicated that implicit and explicit aversive reactions to self-cutting stimuli were diminished in

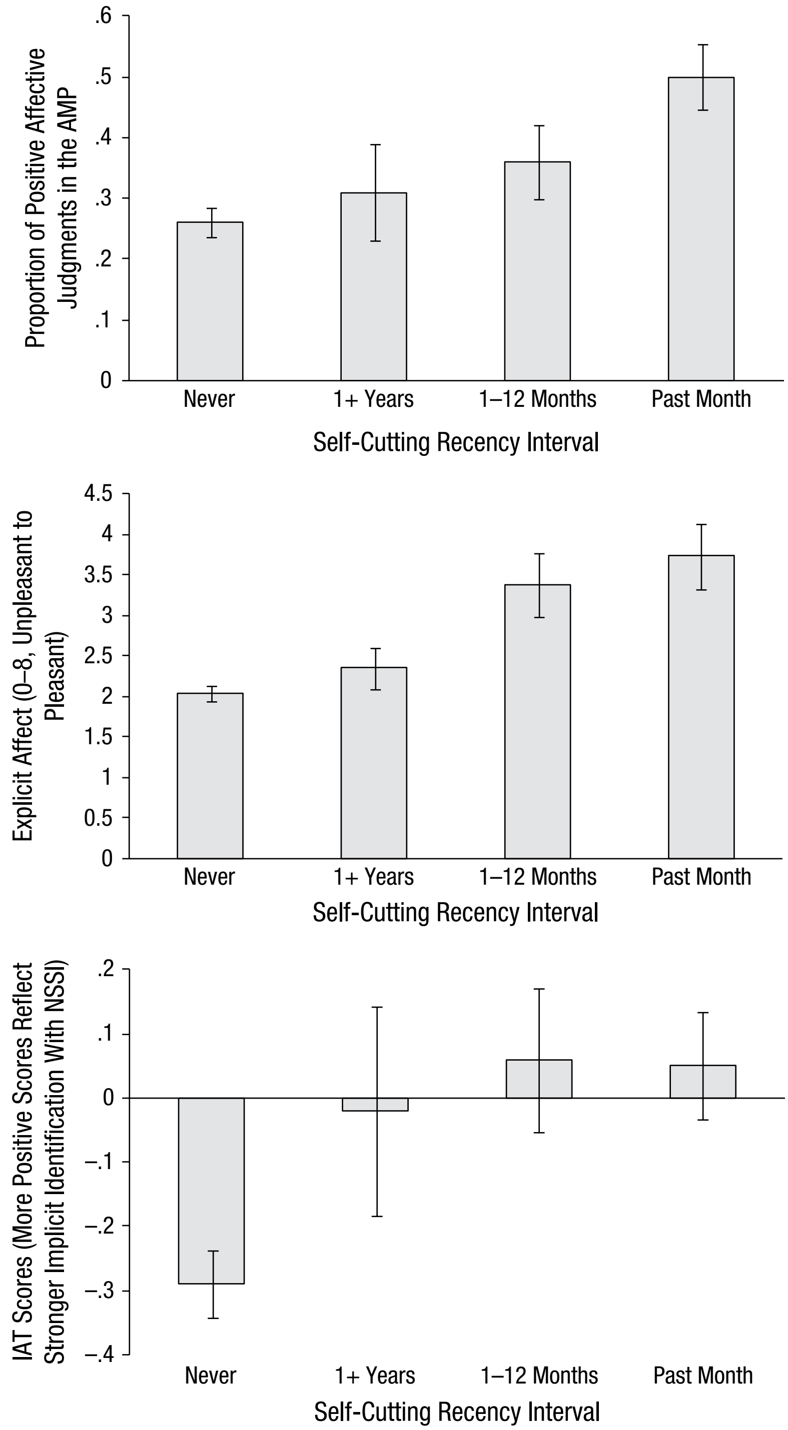

Fig. 3. Self-cutting recency effects on explicit affect, implicit affect, and implicit identification. AMP = affect misattribution procedure; IAT = Implicit Association Test; NSSI = nonsuicidal self-injury. Error bars represent ±1 standard error of the mean.

people with a history of NSSI (see Fig. 1). These effects remained after we controlled for large group differences in emotion reactivity and emotion dysregulation. The implicit affect findings suggest that people with a history of NSSI have abnormal affective associations with these stimuli that cannot be explained by self-report biases (cf. Nisbett & Wilson, 1977). The theoretical framework of Gawronski and Bodenhausen (2006) may help to explain the relative strength of explicit affect group differences for this category (d = 0.93) compared with the implicit affect group differences (d = 0.61). According to this framework, implicit and explicit processes often interact such that explicit attitudes can represent a combination of automatic affective associations and propositional reasoning based in part on these associations. In other words, the present explicit affect effects may be stronger because they reflect a combination of both abnormal automatic affective associations (i.e., implicit affect) and propositional reasoning processes (e.g., "I often cut myself, so I must like blood and wounds"). Future studies are needed to more effectively disentangle these processes.

Suggesting that these abnormal reactions were specific to self-cutting stimuli, results from the two groups showed nearly identical reactions across pleasant, neutral, and unpleasant categories. The two groups did display significantly different explicit ratings in the pleasant category, but this effect was small (see Fig. 1) and was not replicated for implicit affect. On average, the NSSI group displayed implicit and explicit affect toward self-cutting stimuli that were between their reactions to unpleasant and neutral stimuli (see Fig. 1). We also noted that some of these individuals displayed highly positive affect toward NSSI stimuli. This suggests that for some individuals, the aversion to mutilation stimuli is not only reduced but also transformed into motivational approach. Such individuals may be especially likely to engage in NSSI; longitudinal studies are needed test this possibility.

As indicated by the correlation results shown in Table 1, group differences in aversion toward NSSI stimuli were primarily driven by individuals who had engaged in NSSI especially frequently and recently. Results shown in Figures 2 and 3 clarify that diminished aversion toward NSSI stimuli was primarily confined to individuals who had engaged in NSSI 10 or more times or within the past year (especially within the past month); individuals who had engaged in NSSI fewer than 10 times or more than 1 year ago were largely indistinguishable from individuals who had never engaged in NSSI. This suggests that aversion toward NSSI stimuli may represent a valuable predictor of future NSSI and a potential marker of NSSI recovery. These possibilities remain highly speculative, but the present study provides a foundation for future investigations that directly examine these hypotheses.

Given the cross-sectional nature of the present study, the directionality of the correlations between affect and NSSI frequency/recency remains unclear. One possible explanation is that through potential mechanisms, such as habituation and pain-offset relief conditioning (see Andreatta et al., 2010), NSSI experience gradually leads to diminished aversion toward NSSI stimuli. This explanation also implies that abstaining from NSSI may extinguish positive or neutral associations with NSSI stimuli (cf. Fig. 3). Another possibility is that some individuals naturally possess less aversion toward these stimuli, and this facilitates NSSI. We hypothesize that there may be a transaction between these two possibilities, whereby NSSI experience gradually diminishes aversion toward NSSI, which facilitates more NSSI episodes, which in turn further diminishes aversion toward NSSI.

Consistent with findings in adolescents (Nock & Banaji, 2007), results revealed that young adults with a history of NSSI displayed a significantly stronger implicit identification with cutting (d = 0.67). However, implicit identification was not significantly correlated with either affective measure and, moreover, was not significantly correlated with any index of NSSI recency/frequency (see Table 1 and Figs. 2 and 3). These findings indicate that implicit identification with NSSI may occur after just a single episode, whereas several episodes may be required to alter affective responses to NSSI stimuli. Although frequency/recency results suggest that conditioning mechanisms appear to be viable candidates for the development of diminished aversion toward NSSI stimuli, these results provide little insight into the development of implicit identification with NSSI. We speculate that processes such as categorizing oneself as a self-cutter or being repeatedly exposed to NSSI stimuli via friends, the Internet, or media may increase implicit identification with NSSI. Future studies may benefit from investigating these and other possibilities. In addition, in line with prior research on alcohol (Payne et al., 2008), the dissociation between affect toward and implicit associations with NSSI suggests that these factors may be largely independent predictors of future NSSI. Longitudinal studies are needed to test this possibility.

The present findings should be interpreted in light of the limitations of our study. First, NSSI stimuli in the present study were specific to self-cutting. Although some of the stimuli involved relatively general depictions of self-injury (e.g., bloody wounds), future studies are needed to ensure that the present findings extend to behaviors such as burning. Second, the present study was cross-sectional, preventing interpretations of directionality within the correlations between affect and NSSI recency/frequency. However, the present findings lay a foundation for longitudinal studies that employ these affect measures as predictors of NSSI.

Conclusions and Future Directions

Along with several other recent NSSI studies, the present findings contribute to an emerging framework that may help to address the most important, urgent, and difficult issue facing NSSI research: an effective treatment. Every popular form of treatment—including techniques that are effective for reducing suicidal behaviors—has been applied to NSSI, but none has produced a reduction in NSSI that significantly exceeds that of a control group (see Nock, 2010). It is clear that a new treatment approach is needed, but the exponential increase in NSSI research over the course of the past decade has so far been unable to produce an effective approach. A large literature has shown that emotion dysregulation is strongly associated with NSSI, but this factor is nonspecific, and treatments targeting this factor have been unsuccessful. A similarly large literature has reported on the affective functions of NSSI; however, recent evidence indicates that the affective benefits of NSSI are natural and not specific to individuals who engage in NSSI (e.g., Bresin & Gordon, 2013; Franklin et al., 2010, 2013) or even to nonhuman mammals (e.g., Tanimoto et al., 2004). Accordingly, the affective benefits of NSSI may be difficult (if not impossible) to counteract and do not appear to be promising treatment targets.

Future research would greatly benefit from taking a new treatment approach that involves identifying and targeting highly specific factors that motivate and facilitate NSSI. At present, there appear to be two promising targets. First, recent work has indicated that self-criticism mediates the association between childhood maltreatment and NSSI (Glassman, Weierich, Hooley, Deliberto, & Nock, 2007), differentiates between direct and indirect self-injury (St. Germain & Hooley, 2012), and increases pain endurance in individuals who engage in NSSI (Hooley et al., 2010). These results suggest that self-criticism plays an important role in the selection of NSSI as a behavior and increases the ability to withstand the pain involved in NSSI. Second, the present results suggest that diminished aversion to self-cutting stimuli plays a crucial role in facilitating NSSI. Future research should focus on designing interventions that target these and similar factors. For example, cognitive interventions could focus on altering self-critical thoughts rather than more general dysregulated thoughts. Similarly, behavioral interventions could focus on establishing aversive contingencies with self-injury stimuli rather than altering contingencies related to NSSI reinforcement. In short, it is crucial that future research identify more of these factors, experimentally examine how these factors work, and use this knowledge to design novel interventions that interrupt these processes and ultimately lead to effective treatments for NSSI.

Author Contributions

J. C. Franklin developed and designed the study. J. C. Franklin, K. M. Lee, and M. E. Puzia conducted the study and analyzed the results. J. C. Franklin drafted the manuscript. K. M. Lee, M. E. Puzia, and M. J. Prinstein critically revised the manuscript. M. J. Prinstein provided guidance on all aspects of the project. All authors approved the final version of the manuscript for submission.

Declaration of Conflicting Interests

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

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