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Affect toward the self and self-injury stimuli as potential risk factors for nonsuicidal self-injury

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ABSTRACT

Few risk factors for nonsuicidal self-injury (NSSI) have been identified. This study investigated diminished aversion toward self-injury (i.e., NSSI, suicide/death stimuli) and self-criticism as unique NSSI risk factors. After terminating a treatment study, 154 adults with a recent and frequent NSSI history completed self-report and computer-based measures of psychopathology, implicit and explicit self-criticism, and implicit aversion to NSSI and suicide/death. Participants were then contacted 4 weeks later to test factors predicting NSSI frequency over this follow-up period. Diminished aversion toward NSSI stimuli and self-criticism significantly predicted NSSI 4 weeks later. These effects were unique from other theoretically important predictors, such as past week NSSI frequency and total number of NSSI methods used. Findings provide support that erosion of barriers to NSSI (e.g., aversion to self-injurious stimuli, decreased self-worth) may facilitate continued engagement in these dangerous behaviors. Results shed light on potential treatment targets for NSSI.

1. Introduction

Nonsuicidal self-injury (NSSI) is defined as direct and deliberate self-injury enacted without suicidal intent (most often self-cutting; Nock, 2010). These behaviors are surprisingly prevalent; approximately 5.5% of adults and 13.4% of young adults report engaging in these behaviors at some point in their lives (Swannell et al., 2014). Among clinical samples these rates are even higher, with around 50% reporting lifetime NSSI engagement (DiClemente et al., 1991; Penn et al., 2003). NSSI is associated with numerous health risk behaviors, most alarmingly future suicidal behaviors (Asarnow et al., 2011; Bryan et al., 2014; Cox et al., 2012; Goldstein et al., 2012; Guan et al., 2012; Whitlock et al., 2013; Wilkinson et al., 2011). Despite a few promising single-group studies, very few treatments have consistently reduced NSSI compared to active control treatments (Brausch and Girresch, 2012; Glenn et al., 2015; Gonzales and Bergstrom, 2013; Nock, 2010; Washburn et al., 2012; see Franklin et al., 2016 for an exception).

An important step toward creating effective NSSI treatments is identifying strong risk factors for these behaviors. Unlike correlates, risk factors precede NSSI and divide individuals into high- and low-risk groups (Kraemer et al., 1997). Risk factors are especially useful tools for forming and refining theory, targeting groups for prevention, and determining effective treatment targets. Few strong and consistent NSSI risk factors have been identified (Fox et al., 2016; Nock, 2010) largely due to methodological factors including few longitudinal NSSI studies; use of community samples with low rates of NSSI; long follow-up lengths (~ 12 month average); examination of highly nonspecific risk factors (e.g., depressive symptoms); inclusion of mild or common (vs. moderate) self-harming behaviors like lip biting or wound picking; and dichotomous assessment of NSSI. To identify clinically meaningful NSSI risk factors, longitudinal studies using rigorous empirical designs, narrower definitions of NSSI, continuous NSSI assessment, and shorter follow-up periods are necessary. Shorter follow-up periods are particularly useful for identifying people who are likely to engage in NSSI in the near future and for identifying treatment targets that can lead to shorter-term NSSI reductions.

An emerging model based on recent experimental and longitudinal research has proposed two novel NSSI risk factors: diminished aversion to self-injury stimuli (Franklin et al., 2014b) and self-criticism (Hooley and Germain, 2014). The Benefits and Barriers Model (Hooley & Franklin, In Press) proposes that there are benefits to engaging in NSSI, but that there are also many barriers that prevent most people from engaging in these behaviors. Benefits of NSSI, such as improved mood upon the removal of pain (i.e., pain-offset relief; Franklin et al., 2013),

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appear to be universal and are experienced by people regardless of NSSI history. The universality of these benefits indicates that they likely are not risk factors, as they cannot divide people into high- and low-risk groups. Barriers to NSSI include positive associations with the self and aversion toward NSSI stimuli. Unlike the benefits of NSSI, barrier levels tend to differ across individuals, and they can differentiate people who do and do not engage in NSSI (e.g., Franklin et al., 2014b; Hooley et al., 2010). If eroded barriers are risk factors, the degree to which these barriers are eroded should also predict future NSSI. Of note, we conceptualize eroded aversion to NSSI as a risk factor, but aversion toward NSSI could also be conceptualized as a protective factor. For more in depth discussion of these distinctions, see a recent review of this model (Hooley and Franklin, In press).

There were three primary goals in this study. First, we sought to test whether self-criticism is a risk factor for prospective NSSI frequency. Second, we sought to replicate and extend previous studies testing decreased aversion to NSSI stimuli as a risk factor for NSSI frequency. Third, we sought to examine associations among decreased aversion to NSSI stimuli, suicide/death-related stimuli, and future NSSI frequency.

1.1. Goal 1: Investigate whether self-criticism is a risk factor for NSSI

A large body of social psychology research highlights that, for a variety of reasons, people are motivated to maintain, and do maintain, relatively high levels of self-esteem (see Pyszczynski et al., 2004 for review), though this effect may be larger across North American cultures (Heine et al., 1999). It is hypothesized that these feelings of positive self-worth lead people to protect their bodies from pain and provide a barrier to intentional self-injury. When these positive feelings decrease, people likely become more willing to harm themselves (Hooley and Franklin, In press). Providing support for this theory: research suggests that negative self-beliefs directly impact one's willingness to endure pain (Bastian et al., 2011; Hooley and Germain, 2014; Hooley et al., 2010); people who engage in NSSI demonstrate lowered levels of self-worth across several domains, including body image (e.g., Muehlenkamp and Brausch, 2012), self-dissatisfaction (Victor and Klonsky, 2014), and self-criticism (e.g., Glassman et al., 2007; Hooley et al., 2010); and self-criticism mediates the relationship between childhood maltreatment and NSSI engagement (Glassman et al., 2007).

It remains unclear whether self-criticism precedes NSSI or NSSI precedes self-criticism. We hypothesized that self-criticism would predict NSSI frequency over a 4-week follow-up period. To test this hypothesis, we used multiple measures of self-criticism. First, we utilized a previously used self-report measure of self-criticism (i.e., the Self-Rating Scale; Hooley et al., 2010). Second, given limitations of self-report (e.g., limited capacity for introspection; Nisbett and Wilson, 1977) and the unique importance automatic, unconscious processes (Greenwald and Banaji, 1995), we created an implicit test of self-criticism to provide unique insights into the construct. This implicit measure of self-criticism (implicit affect toward the self) examines automatic, emotional responses to self-related words (described in more detail below).

1.2. Goal 2: Replicate and extend previous research testing decreased aversion to NSSI stimuli as a risk factor for NSSI

Serving as a barrier to engaging in NSSI, people typically find NSSI stimuli (e.g., knives, blood, razors, cuts) highly unpleasant and rate them as even more negative than other unpleasant images (Franklin et al., 2014a). Several factors (e.g., pain offset relief conditioning, peer, familial, or media exposure to NSSI, media exposure to blood, wounds, and gore) may reduce this aversion and thereby increase the likelihood that someone will choose to engage in NSSI (Hooley and Franklin, In press). Providing support for this hypothesis, people who engage in NSSI report self-injury-related stimuli to be less aversive or even positive on explicit (Glenn and Klonsky, 2010), implicit (Franklin et al., 2014a; Nock and Banaji, 2007), behavioral (Allen and Hooley, 2015), and psychophysiological measures (Brain et al., 1998). Moreover, diminished implicit and explicit aversion to NSSI stimuli significantly predicts future NSSI frequency (Franklin et al., 2014b).

Together, this literature suggests that decreased aversion toward NSSI might be a risk factor for NSSI. However, only one study to date has examined the longitudinal association between diminished aversion to NSSI and future NSSI frequency. Franklin et al. (2014b) found that diminished aversion to NSSI (but not unpleasant stimuli more generally) predicted NSSI frequency across implicit and explicit measurement. However, the study suffered from a number of limitations including infrequent NSSI engagement among a small number of participants (i.e., 24/49 participants engaged in NSSI over the follow-up period) and use of a relatively long follow-up period (i.e., 6 months). Participants also varied in terms of how recently and frequently they had engaged in NSSI at baseline. It is thus unclear whether aversion to NSSI would remain a significant NSSI risk factor among participants with a more frequent and recent history of these behaviors. This distinction will be critical in determining whether different levels of aversion to NSSI mirror variations in NSSI frequency. We hypothesized that aversion toward NSSI would predict NSSI frequency over a 4-week follow-up period within a sample with a recent and frequent NSSI history. To test this hypothesis, we used implicit affective ratings toward NSSI (i.e., self-cutting) related stimuli.

1.3. Goal 3: Examine whether decreased aversion to suicide/death stimuli is a risk factor for NSSI

Engagement in NSSI, especially moderate and repetitive NSSI, is associated with suicidal thoughts and behaviors concurrently (Brunner et al., 2007; Lloyd-Richardson et al., 2007; MacLaren and Best, 2010; Tang et al., 2011) and prospectively (Ribeiro et al., 2016). One possibility for this overlap is that people who engage in NSSI develop a diminished aversion toward self-injury more generally (i.e., not just NSSI, but suicidal self-injury as well). If this is the case, people who engage in NSSI will demonstrate a similar decreased aversion to both NSSI and suicide/death. Consequently, this decreased aversion to suicide/death will predict prospective NSSI frequency. Another possibility is that people who engage in NSSI will demonstrate a diminished aversion specific to NSSI stimuli. In this case, diminished aversion to suicide/death will not be a NSSI risk factor. Notably, research using the implicit association test (IAT) examining automatic associations between oneself and death supports this second hypothesis, as implicit associations with suicide/death were associated with a history of suicide attempts, not NSSI (Nock et al., 2010). However, it remains unclear whether implicit affect scores, which measure automatic, emotional responses to suicide/death stimuli, will show the same pattern. This is particularly important in light of evidence that measures of implicit identification are uncorrelated with implicit affect, likely because they represent unique constructs (Franklin et al., 2014b; Payne et al., 2008). Thus, it remains unclear whether diminished aversion to self-cutting images generalizes to death and suicide relevant stimuli. This could have important implications for our understanding of comorbidity between NSSI and suicidal thoughts and behaviors.

Addressing many limitations of previous NSSI risk factor studies, we tested whether self-criticism and decreased aversion to self-injury stimuli (i.e., NSSI specific and suicide/death-relevant) acted as risk factors for NSSI frequency. Specifically, we examined whether implicit affect toward the self, self-cutting stimuli (e.g., knives, blood, cuts on skin, blades), and suicide/death stimuli (e.g., skulls, nooses) acted as unique predictors of NSSI frequency over a short-term (i.e., 4-week) follow-up period among people with a recent and frequent history of NSSI. We used an online format for this study. Recent research suggests that online and in-person recruitment procedures produce highly similar results across a wide range of tasks and populations (Bauermeister et al., 2012; Crump et al., 2013; Hauser and Schwartz, 2016; Weinberg

et al., 2014). In addition, online studies facilitate participant anonymity and privacy. This may increase participant comfort in disclosing stigmatized thoughts, behaviors, and symptoms, including self-injury (Swannell et al., 2014).

2. Methods

2.1. Procedures

Participants were recruited from online forums related to self-injury and severe psychopathology to participate in one of three larger, online treatment studies in which they were randomized to a treatment or a control group for the first four weeks of the study (detailed description of recruitment and treatment study are described elsewhere; Franklin et al., 2016). Briefly, based on research described above, the treatment sought to increase self-harm aversion and decrease self-criticism using an application-like game. The present study combined participants recruited for both Study 1 and Study 2, but not Study 3, as both Studies 1 and 2 included participants recruited based on their recent NSSI histories and included the same set of measures.

We sought to predict NSSI frequency over the final month of the study (i.e., 4 weeks after treatment termination). Specifically, on the final day of the online treatment, participants completed a battery of questionnaires, including past week and month NSSI frequency, self-criticism, and emotion reactivity. After completing these questionnaires, participants completed a computerized assessment of implicit affect toward the self, NSSI, and suicide/death using the affect misattribution procedure (AMP) described in more detail below. They were then contacted for a follow-up assessment four weeks later. We decided to use the final two assessments for the present analyses because treatment effects did not persist over this final follow-up period (Franklin et al., 2016). Therefore, we anticipated that there would be little to no effect of treatment group on NSSI frequency on results. Indeed, results are nearly identical when controlling for treatment group and these results are available upon request.

2.2. Subjects

Participants were adults ages 18 and older who were fluent in English, who had a recent history of NSSI (i.e., 2+ episodes of self-cutting in the past month), and who completed the final assessment in the treatment study described above. Of the 243 participants in the larger study, 154 (63.37%) completed both the end of treatment assessment and the final follow-up assessment four weeks later. We conducted Little's (Little, 1988) Missing Completely at Random (MCAR) test to determine the representativeness of non-missing data. Results were non-significant, suggesting that data were missing at random.

Participants were primarily young adults (M = 22.68 years old, SD = 5.52) reporting female sex at birth (79.87%) and female gender (76.62%). The majority of participants identified as European American (78.6%), with remaining participants identifying as Asian (7.8%), Black/African American (1.3%), Hispanic/Latino (3.2%), and Other (9.0%; e.g., Native American, mixed race).

2.3. Measures

2.3.1. Demographics

We assessed basic demographic information (i.e., sex, gender, age, race).

2.3.2. Self-Injurious Thoughts and Behaviors Interview (SITBI; Nock et al., 2007)

The SITBI assesses the presence, frequency, and characteristics of suicidal and non-suicidal self-injurious thoughts and behaviors. This measure has demonstrated strong test-retest reliability (average kappa = 0.70) and interrater reliability (average kappa = 0.99). We used an online version of the SITBI in the present study; the online and in-person versions of the SITBI produce very similar estimates of NSSI status and frequency (Franklin et al., 2014a).

At baseline, the SITBI was used to assess self-injurious thoughts and behaviors over participants' lifetime, past year, past month, and past week. At the final assessment, past week and past month self-injurious thoughts and behaviors, including NSSI, were assessed. Of note, NSSI frequency variables were calculated as a composite of the reported number of episodes of self-cutting, burning, hitting, scraping skin to the point of drawing blood, and inserting objects under the skin during a given period. This ensured that mild behaviors (e.g., picking at wounds) were not included.

2.3.3. The Self-Rating Scale (SRS; Hooley et al., 2010)

The SRS is an eight-item measure assessing self-critical thoughts. Sample items include: "Sometimes I feel completely worthless" and "Others are justified in criticizing me." Responses are provided on a 1 (strongly disagree) to 7 (strongly agree) scale. The reliability of the SRS ranges from 0.73 to 0.88 (Glassman et al., 2007; Hooley et al., 2010). At baseline, Cronbach's alpha was 0.95.

2.3.4. Emotion Reactivity Scale (ERS; Nock et al., 2008)

The ERS is a 21-item self-report questionnaire of emotion reactivity, a component of emotion regulation involving emotional sensitivity, intensity, and persistence. Responses are provided on a 0 (not at all like me) to 4 (completely like me) scale. The ERS demonstrates strong internal consistency, convergent and divergent construct validity, and criterion-related validity (Nock et al., 2008). At baseline, Cronbach's alpha was 0.87.

2.3.5. The self-injury and self-criticism Affect Misattribution Procedure (AMP, Payne et al., 2005)

The AMP is a brief computerized task that measures implicit affect. On each trial of the AMP, participants see an emotionally evocative stimulus (i.e., images, words) for 75 ms, a blank screen for 125 ms, an ambiguous Chinese symbol for 100 ms, and, last, a gray screen. On each trial, participants were instructed to ignore the picture or word that they saw prior to the Chinese symbol, and to judge whether the Chinese symbol was more or less pleasant than average. Despite instruction to ignore the emotional stimuli, several studies have demonstrated that Chinese symbol ratings are influenced by the emotional stimulus preceding this symbol; more pleasant stimuli generate more pleasant ratings of subsequent symbols (Payne et al., 2005). This likely occurs because individuals misattribute the emotional response evoked by the earlier stimulus as being evoked by the later ambiguous Chinese symbol. Through this misattribution, the AMP indexes implicit affective reactions to the emotional stimuli that are flashed at the beginning of each trial.

The current AMP contained neutral (e.g., towel, plates; n = 6), suicide/death (e.g., skulls, gun pointed at head, skeletons, graveyard; n = 6; termed implicit affect toward suicide/death), and self-cutting images (n = 12; termed implicit affect toward NSSI) that have been validated in prior studies (Franklin et al., 2014a, 2014b). In addition, the present AMP included images of 5 self-related words (i.e., I, mine, my, me, myself; termed implicit affect toward the self) and 5 images of other-related words (i.e., other, them, their, theirs, they). AMP scores are calculated as the number of trials on which participants select a positive association compared to the total number of trials within a given category. Higher scores on the AMP indicate a more positive association toward the category.

Of note, at the start of the treatment study, implicit affect toward the self, but not other related words (e.g., "they," "them"), was significantly associated in the expected directions with SRS scores (Spearman rho = − 0.20, $p < 0.05$), suggesting that these measures are likely assessing aspects of the same construct, or a related construct.

2.4. Data analytic plan

First, we examined characteristics, including means, standard deviations, and spearman correlations, among variables of interest at baseline (i.e., at the end of the treatment study). Second, we examined which independent variables (i.e., self-criticism, implicit affect toward the self, implicit affect toward NSSI and suicide/death stimuli, past week and month NSSI frequency, baseline psychopathology, emotion reactivity, total number of methods used for NSSI engagement) significantly predicted NSSI frequency over the follow-up period. Third, after examining each of these variables' unadjusted, univariate association with NSSI frequency over the 4-week follow-up period, we examined which variables uniquely contributed to prospective NSSI frequency when controlling for variance due to relevant covariates (i.e., prior NSSI, number of NSSI methods employed). Due to high levels of multicollinearity and to increase the power of our final model, we only included measures with significant univariate associations with follow-up NSSI frequency. In cases where multiple measures of the same construct (i.e., past week and past month NSSI) showed significant univariate associations with NSSI frequency at follow-up, we only included the measure with the stronger univariate association.

NSSI frequency outcome variables typically violate the assumptions of statistical tests based on normal distributions as they represent count data including a large number of small values and a small number of very large values. Moreover, NSSI frequency outcomes are often zero-inflated, positively skewed count variables. These violations were also true in the present study. To model these types of data, zero-inflated Poisson (ZIP) and zero-inflated negative binomial (ZINB) regression are appropriate. ZINB is utilized when data are overdispersed, above and beyond of the context of the excess zeros inherent in these data. Given that the overdispersion parameter calculated by ZINB was not significant across the majority of analyses, we utilized ZIP to model these data. We used listwise deletion to handle missing data.

3. Results

Means, standard deviations, and Spearman correlations among variables of interest are listed in Table 1. Past week and past month NSSI frequency at baseline were correlated with the self-rating scale (i.e., explicit self-criticism), but not implicit affect toward the self or implicit affect toward NSSI stimuli, at this time point. Interestingly, although implicit affect toward the self and self-rating scale scores were correlated at baseline of the treatment study, they were no longer correlated by the end of treatment and the start of this assessment. Implicit affect toward NSSI and implicit affect toward suicide/death were moderately correlated.

In addition to reporting two or more episodes of self-cutting in the past month at the start of the treatment study (as required by inclusion criteria), participants continued to self-reported extensive NSSI histories at the end of the treatment, which served as the baseline for these analyses. At time one, participants reported that their NSSI episodes included self-cutting (42.21%), self-hitting (23.38%), scraping to the point of drawing blood (20.78%), burning (12.99%), and inserting objects under the skin (12.99%). "Other" methods were not included in analyses to decrease the likelihood that minor, more normative self-harming behaviors (e.g., picking at wounds) would be included in analyses. Additionally, at time one, most participants reported suicide ideation (76.62%) in the past month, and almost half reported suicide plans (42.86%) in the past month. Over the 4-week follow-up period, 66.89% of participants reported continued NSSI engagement. The majority of participants reported that these episodes involved self-cutting (56.49%), though participants also reported self-hitting (29.22%), scraping to the point of drawing blood (22.73%), burning (14.29%), and inserting objects under the skin (9.09%).

Univariate ZIP models assessing each covariate revealed that each of the following significantly predicted NSSI frequency over the 4-week follow-up period: past week NSSI episodes, past month NSSI episodes, total number of NSSI methods used, implicit affect toward the self (negatively), implicit affect toward NSSI images, and self-criticism scores (i.e., SRS). Implicit affect toward suicide/death stimuli and emotion reactivity (i.e., ERS) were not significant predictors (see Table 2).

Given stronger associations with the outcomes of interest, we included past week instead of past month NSSI frequency in the final model. Together, the multiple ZIP model included past week NSSI episodes, total number of NSSI methods ever used, SRS, implicit affect toward NSSI-stimuli, and implicit affect toward the self. Results demonstrated that each of these variables significantly and uniquely predicted NSSI frequency over the 4-week follow-up period (See Table 3).

Table 2
Univariate predictors of NSSI episodes.

	Zero-inflated poisson regression		
Predictors	**B (SE)**	**IRR**	**95% CI**
Past Week NSSI Episodes	0.09 (0.05)	1.07***	(1.06, 1.08)
Past Month NSSI Episodes	0.02 (0.001)	1.02***	(1.02, 1.02)
Number of NSSI methods	0.23 (0.03)	1.26***	(1.20, 1.32)
Implicit Affect: Self	− 0.53 (0.10)	0.59***	(0.48, 0.71)
Implicit Affect: NSSI	0.45 (0.10)	1.56***	(1.29, 1.90)
Implicit Affect: Death	− 0.14 (0.64)	0.83	(0.68, 1.01)
Self-Rating Scale	0.03 (0.003)	1.03***	(1.02, 1.04)
Emotion Reactivity Scale	0.01 (0.01)	1.01	(0.99, 1.02)

B = Beta; SE = Standard error; IRR = Incident Rate Ratio; * < 0.05; ** < 0.01; *** < 0.001.

4. Discussion

This study examined self-criticism and diminished aversion to NSSI and suicide/death as risk factors for prospective NSSI frequency. These associations were examined within a large, Internet-based sample with

Table 1
Spearman correlation among variables of interest at baseline.

	1	2	3	4	5	6	7	8
1. Past month NSSI	1.00	0.81**	0.25**	0.05	0.00	− 0.02	0.27**	0.25**
2. Past week NSSI		1.00	0.26**	0.10	0.02	− 0.04	0.17*	0.24**
3. Number of NSSI methods used			1.00	0.11	− 0.12	0.18*	0.11	0.08
4. Implicit affect: NSSI				1.00	− 0.02	0.37**	− 0.11	− 0.02
5. Implicit affect: Self					1.00	− 0.09	0.05	− 0.07
6. Implicit affect: Suicide/Death						1.00	− 0.05	− 0.09
7. Emotion Reactivity Scale							1.00	0.54**
8. Self-Rating Scale								1.00
Mean	11.76	3.03	3.19	0.51	0.46	0.39	57.70	44.60
SD	19.27	5.49	1.18	0.31	0.31	0.30	19.05	9.59

Table 3
Multivariate model of NSSI prediction.

	Zero-inflated poisson regression		
Predictors	**B (SE)**	**IRR**	**95% CI**
Intercept	1.12 (0.21)	3.06***	(2.04, 4.58)
Past Week NSSI Episodes	0.07 (0.004)	1.07***	(1.06, 1.08)
Number of NSSI methods	0.12 (0.03)	1.13***	(1.07, 1.19)
Self-Rating Scale	0.02 (0.003)	1.02***	(1.01, 1.02)
Implicit Affect: Self	− 0.65 (0.10)	0.52***	(0.30, 0.63)
Implicit Affect: NSSI	0.51 (0.09)	1.66***	(1.37, 2.02)

B = Beta; SE = Standard error; IRR = Incident Rate Ratio; * < 0.05; ** < 0.01; *** < 0.001.

a recent and frequent history of NSSI across a 4-week follow-up period. Results demonstrated that self-criticism, measured implicitly and explicitly, and an implicit measure of diminished aversion to NSSI, were each associated with NSSI frequency over the follow-up period.

4.1. Goal 1: Investigate whether self-criticism is a risk factor for NSSI

Across implicit and explicit measurement, results demonstrated that both measures of self-criticism significantly predicted NSSI frequency. Both self-criticism, as measured by the self-rating scale and as measured by implicit affect toward the self, remained significant even when controlling for numerous theoretically important factors, including frequency of past week NSSI, total number of NSSI methods ever used, and implicit aversion to NSSI stimuli. Results suggest that self-criticism is an independent predictor of future NSSI.

4.2. Goal 2: Replicate and extend previous research testing decreased aversion to NSSI stimuli as a risk factor for NSSI

Findings replicated and extended previous research suggesting that diminished aversion to NSSI is an important NSSI risk factor. Specifically, results showed that even within a sample engaging in recent and frequent NSSI, diminished aversion to NSSI predicted prospective NSSI frequency. Findings suggest that different levels of NSSI aversion predict variations in NSSI frequency. Even when controlling for other theoretically important factors, decreased aversion toward NSSI predicted follow-up NSSI frequency.

4.3. Goal 3: Examine whether decreased aversion to suicide/death stimuli is a risk factor for NSSI

Previous research demonstrated that diminished aversion toward NSSI, but not negative stimuli more generally, is associated with prospective NSSI frequency (Franklin et al., 2014a). However, prior to the present study, it remained unclear whether this effect was specific to NSSI stimuli or whether it generalized to suicide/death stimuli. Results showed that aversion toward NSSI and aversion toward suicide/death were moderately correlated, but that aversion toward NSSI and not death related stimuli predicted follow-up NSSI frequency. Accordingly, results suggest that decreased aversion toward NSSI-relevant stimuli, but not suicide/death more generally, increase risk for NSSI frequency. However, additional studies replicating this effect in larger samples, using both implicit and explicit measures of this aversion, are needed.

4.4. Limitations

These findings should be interpreted in light of several limitations. First, aversion to NSSI was assessed using pictures relevant to self-cutting (e.g., knives, blood, cuts). Self-cutting is not specific to NSSI and is also involved in some suicide attempts. Although our images depict moderately self-harming behavior (e.g., surface level cuts, blood, scars not requiring medical care) that likely appear less severe than would wounds arising from a self-cutting suicide attempt, it is possible that these stimuli are not unique to NSSI and instead also prime affective responses to suicide as well. Moreover, self-cutting is only one form of NSSI. Future studies should consider including images related to other forms of NSSI (e.g., bruises, burns, fists) to test whether these findings generalize to other types of NSSI. Second, measures were administered in the same order across participants, with AMP measures occurring last. Although this is consistent with prior work utilizing similar measures (e.g., Franklin et al., 2014a, 2014b), ordering effects may have biased responses on implicit (i.e., AMP) ratings. For example, participants who reported more extensive SITB histories during the survey may have been primed to rate these stimuli more positively than those with less extensive histories, thus biasing results. Future research should consider investigating whether the order in which these measures are administered influences results.

Third, participants were recruited from online forums related to self-injury and all participants reported recent (i.e., past month) histories of NSSI. Consequently, the present study examined risk factors only for continued NSSI frequency. It remains unclear whether these factors are risk factors for the onset of NSSI. Future research should consider using longitudinal designs among younger samples with no prior history of NSSI to test this possibility. Such studies could clarify whether self-criticism and diminished aversion to NSSI are risk factors for the initiation of NSSI, and whether these factors could be targets for prevention.

Fourth, the present sample may demonstrate even greater decreased aversion toward self-injury (i.e., NSSI and suicide/death) stimuli both because they choose to converse about this topic online and because most participants also reported histories of suicidal thoughts and behaviors. It is possible that these risk factors may operate differently in samples that do not use these online forums and in samples that have a less extensive history of suicidal thoughts and behaviors. Future research should consider a more fine-grained examination of how risk factors act among those with a history of NSSI alone and among those with a history of both NSSI and suicidal thoughts and behaviors, using diverse samples recruited online and in person. Such research could be especially helpful in understanding the role of diminished aversion toward NSSI and suicide/death-related stimuli.

Finally, the sample was limited in several ways. First, the sample was primarily female and European American. Large prevalence studies (Klonsky, 2011) and meta-analyses of prevalence studies (Swannell et al., 2014) have found equal rates of NSSI among males and females, suggesting that our sample may be biased. Notably, research suggests that females engage in more self-cutting whereas males engage in more self-hitting (Barrocas et al., 2012; Sornberger et al., 2012). Accordingly, our inclusion criteria may have played a role in the greater number of females in the study, and results may not generalize to samples including more males or greater racial diversity. Second, our sample had just undergone treatment for NSSI. Although the NSSI treatment effects did not persist over the follow-up period examined, participants and our variables of interest may have been impacted by the treatment in relevant ways. Future studies replicating this effect in novel samples are needed.

In summary, the present study suggests that diminished aversion to NSSI and self-criticism are significant predictors of NSSI frequency over a 4-week follow-up period, above and beyond other theoretically important factors. Future research should further investigate whether more diverse samples with different forms and trajectories of NSSI demonstrate similar associations. This could have important implications for the treatment and prevention of NSSI.

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References

Allen, K.J.D., Hooley, J.M., 2015. Inhibitory control in people who self-injure: evidence for impairment and enhancement. Psychiatry Res. 225, 631–637. http://dx.doi.org/10.1016/j.psychres.2014.11.033.

Asarnow, J.R., Porta, G., Spirito, A., Emslie, G., Clarke, G., Wagner, K.D., et al., 2011. Suicide attempts and nonsuicidal self-injury in the treatment of resistant depression in adolescents: findings from the TORDIA study. J. Am. Acad. Child Adolesc. Psychiatry 50, 772–781. http://dx.doi.org/10.1016/j.jaac.2011.04.003.

Barrocas, A.L., Hankin, B.L., Young, J.F., Abela, J.R.Z., 2012. Rates of nonsuicidal self-injury in youth: age, sex, and behavioral methods in a community sample. Pediatrics 130, 39–45.

Bastian, B., Jetten, J., Fasoli, F., 2011. Cleansing the soul by hurting the flesh: the guilt-reducing effect of pain. Psychol. Sci. 22, 334–335. http://dx.doi.org/10.1177/0956797610397058.

Bauermeister, J.A., Zimmerman, M.A., Johns, M.M., Glowacki, P., Stoddard, S., Volz, E., 2012. Innovative recruitment using online networks: lessons learned from an online study of alcohol and other drug use utilizing a web-based, respondent-driven sampling (webRDS) strategy. J. Stud. Alcohol Drugs 73, 834–838. http://dx.doi.org/10.15288/jsad.2012.73.834.

Brain, K.L., Haines, J., Williams, C.L., 1998. The psychophysiology of self-mutilation: evidence of tension reduction. Arch. Suicide Res. 4, 227–242. http://dx.doi.org/10.1023/A:1009692507987.

Brausch, A.M., Girresch, S.K., 2012. A review of empirical treatment studies for adolescent nonsuicidal self-injury. J. Cogn. Psychother. 26, 3–18. http://dx.doi.org/10.1891/0889-8391.26.1.3.

Brunner, R., Parzer, P., Haffner, J., Steen, R., Roos, J., Klett, M., Resch, F., 2007. Prevalence and psychological correlates of occasional and repetitive deliberate self-harm in adolescents. Arch. Pediatr. Adolesc. Med. 161, 641–649. http://dx.doi.org/10.1001/archpedi.161.7.641.

Bryan, C.J., Bryan, A.O., Ray-Sannerud, B.N., Etienne, N., Morrow, C.E., 2014. Suicide attempts before joining the military increase risk for suicide attempts and severity of suicidal ideation among military personnel and veterans. Compr. Psychiatry 55, 534–541. http://dx.doi.org/10.1016/j.comppsych.2013.10.006.

Cox, L.J., Stanley, B.H., Melhem, N.M., Maria, A., Birmaher, B., Burke, A., Kolko, D.J., Jamie, M., Mann, J.J., Porta, G., Brent, D.A., 2012. A longitudinal study of non-suicidal self-injury in offspring at high risk for mood disorder. J. Clin. Psychiatry 73, 821–828. http://dx.doi.org/10.4088/JCP.11m07250.A.

Crump, M.J.C., McDonnell, J.V., Gureckis, T.M., 2013. Evaluating amazon's mechanical turk as a tool for experimental behavioral research. PLoS One 8. http://dx.doi.org/10.1371/journal.pone.0057410.

DiClemente, R.J., Ponton, L.E., Hartley, D., 1991. Prevalence and correlates of cutting behavior: risk for HIV transmission. J. Am. Acad. Adolesc. Psychiatry 30, 735–739.

Fox, K.R., Franklin, J.C., Ribeiro, J.D., Kleiman, E.M., Bentley, K.H., Nock, M.K., 2016. Meta-analysis of risk factors for nonsuicidal self-injury. Clin. Psychol. Rev. 42, 156–167. http://dx.doi.org/10.1016/j.cpr.2015.09.002.Meta-analysis.

Franklin, J., Puzia, M., Lee, K., 2014a. Low implicit and explicit aversion toward self-cutting stimuli longitudinally predict nonsuicidal self-injury. J. Abnorm. Psychol. 123 (2), 463–469.

Franklin, J.C., Lee, K.M., Puzia, M.E., Prinstein, M.J., 2014b. Recent and frequent non-suicidal self-injury is associated with diminished implicit and explicit aversion toward self-cutting stimuli. Clin. Psychol. Sci. 2, 306–318. http://dx.doi.org/10.1177/2167702613503140.

Franklin, J.C., Fox, K.R., Franklin, C.R., Kleiman, E.M., Ribeiro, J.D., Jaroszewski, A.C., Hooley, J.M., Nock, M.K., 2016. A brief mobile app reduces nonsuicidal and suicidal self-injury: evidence from three randomized controlled trials. J. Consult. Clin. Psychol. http://dx.doi.org/10.1037/ccp0000093. ePub.

Franklin, J.C., Puzia, M.E., Lee, K.M., Lee, G.E., Hanna, E.K., Spring, V.L., Prinstein, M.J., 2013. The nature of pain offset relief in nonsuicidal self-injury: a laboratory study. Clin. Psychol. Sci. 1, 110–119. http://dx.doi.org/10.1177/2167702612474440.

Glassman, L., Weierich, M., Hooley, J.M., Deliberto, T.L., Nock, M.K., 2007. Child maltreatment, non-suicidal self-injury, and the mediating role of self-criticism. Behav. Res. Ther. 45, 2483–2490.

Glenn, C.R., Franklin, J.C., Nock, M.K., 2015. Evidence-based psychosocial treatments for self-injurious thoughts and behaviors in youth. J. Clin. Child Adolesc. Psychol. 44, 1–29. http://dx.doi.org/10.14440/jbm.2015.54.A.

Glenn, C.R., Klonsky, E.D., 2010. A multimethod analysis of impulsivity in nonsuicidal self-injury. Personal. Disord. Theory Res. Treat. 1, 67–75. http://dx.doi.org/10.1037/a0017427.

Goldstein, T.R., Ha, W., Axelson, D.A., Goldstein, B.I., Liao, F., Gill, M.K., et al., 2012. Predictors of prospectively examined suicide attempts among youth with bipolar disorder. Arch. Gen. Psychiatry 69, 1113–1122. http://dx.doi.org/10.1001/archgenpsychiatry.2012.650.

Gonzales, A.H., Bergstrom, L., 2013. Adolescent non-suicidal self-injury (NSSI) interventions. J. Child Adolesc. Psychiatr. Nurs. 26, 124–130. http://dx.doi.org/10.1111/jcap.12035.

Greenwald, A.G., Banaji, M.R., 1995. Implicit social cognition attitudes, self-esteem, and stereotypes. Psychol. Rev. 102, 4–27. http://dx.doi.org/10.1037/0033-295X.102.1.4.

Guan, K., Fox, K.R., Prinstein, M.J., 2012. Nonsuicidal self-injury as a time-invariant predictor of adolescent suicide ideation and attempts in a diverse community sample. J. Consult. Clin. Psychol. 80, 842–849. http://dx.doi.org/10.1037/a0029429.

Hauser, D.J., Schwartz, N., 2016. Attentive turkers: mturk participants perform better on online attention checks than subject pool participants. Behav. Res. Methods 48, 400–407. http://dx.doi.org/10.1017/CBO9781107415324.004.

Heine, S.J., Lehman, D.R., Markus, H.R., Kitayama, S., 1999. Is there a universal need for positive self-regard? Psychological Rev. 106 (4), 766.

Hooley, J.M., Ho, D.T., Slater, J., Lockshin, A., 2010. Pain perception and nonsuicidal self-injury: a laboratory investigation. Personal. Disord. 1, 170–179. http://dx.doi.org/10.1037/a0020106.

J.M. Hooley J.C. Franklin Do People Hurt Themselves?. A New Conceptual Model of Nonsuicidal Self-Injury C lin. Psychol. Sci.(In Press).

Hooley, J.M., St Germain, S.A., 2014. Nonsuicidal self-injury, pain, and self-criticism: does changing self-worth change pain endurance in people who engage in self-injury? Clin. Psychol. Sci. 2, 297–305. http://dx.doi.org/10.1177/2167702613509372.

Klonsky, E.D., 2011. Non-suicidal self-injury in United States adults: prevalence, sociodemographics, topography and functions. Psychol. Med. 41, 1981–1986. http://dx.doi.org/10.1017/S0033291710002497.

Kraemer, H.C., Kazdin, A.E., Offord, D.R., Jensen, R.C., Kupfer, D.J., 1997. Coming to terms with the terms of risk. Archives Gen. Psychiatry 54 (4), 337–343.

Little, R.J.A., 1988. A test of missing completely at random for multivariate data with missing values. J. Am. Stat. Assoc. 83, 1198–1202.

Lloyd-Richardson, E.E., Perrine, N., Dierker, L., Kelley, M.L., 2007. Characteristics and functions of non-suicidal self-injury in a community sample of adolescents. Psychol. Med. 37, 1183–1192. http://dx.doi.org/10.1017/S003329170700027X.

MacLaren, V.V., Best, L.A., 2010. Nonsuicidal self-injury, potentially addictive behaviors, and the five factor model in undergraduates. Personal. Individ. Differ. 49, 521–525. http://dx.doi.org/10.1016/j.paid.2010.05.019.

Muehlenkamp, J.J., Brausch, A.M., 2012. Body image as a mediator of non-suicidal self-injury in adolescents. J. Adolesc. 35, 1–9. http://dx.doi.org/10.1016/j.adolescence.2011.06.010.

Nisbett, R.E., Wilson, T.D., 1977. Telling more than we can know: verbal reports on mental processes. Psychol. Rev. 84, 231–259. http://dx.doi.org/10.1037/0033-295X.84.3.231.

Nock, M.K., 2010. Self-injury. Annu. Rev. Clin. Psychol. 6, 339–363. http://dx.doi.org/10.1146/annurev.clinpsy.121208.131258.

Nock, M.K., Banaji, M.R., 2007. Assessment of self-injurious thoughts using a behavioral test. Am. J. Psychiatry 164, 820–823. http://dx.doi.org/10.1176/appi.ajp.164.5.820.

Nock, M.K., Holmberg, E.B., Photos, V.I., Michel, B.D., 2007. Self-injurious thoughts and behaviors interview: development, reliability, and validity in an adolescent sample. Psychol. Assess. 19, 309–317. http://dx.doi.org/10.1037/1040-3590.19.3.309.

Nock, M.K., Park, J.M., Finn, C.T., Deliberto, T.L., Dour, H.J., Banaji, M.R., 2010. Measuring the suicidal mind: implicit cognition predicts suicidal behavior. Psychol. Sci. 21, 511–517. http://dx.doi.org/10.1177/0956797610364762.

Nock, M.K., Wedig, M.M., Holmberg, E.B., Hooley, J.M., 2008. The emotion reactivity scale: development, evaluation, and relation to self-injurious thoughts and behaviors. Behav. Ther. 39, 107–116. http://dx.doi.org/10.1016/j.beth.2007.05.005.

Payne, B.K., Cheng, C.M., Govorun, O., Stewart, B.D., 2005. An inkblot for attitudes: affect misattribution as implicit measurement. J. Personal. Soc. Psychol. 89, 277–293. http://dx.doi.org/10.1037/0022-3514.89.3.277.

Payne, B.K., Govorun, O., Nathan, L., 2008. Automatic attitudes and alcohol: does implicit liking predict drinking? Cogn. Emot. http://dx.doi.org/10.1080/02699930701357394.

Penn, J.V., Esposito, C.L., Schaeffer, L.E., Fritz, G.K., Spirito, A., 2003. Suicide attempts and self-mutilative behavior in a juvenile correctional facility. J. Am. Acad. Child Adolesc. Psychiatry 42, 762–769. http://dx.doi.org/10.1097/01.CHI.0000046869.56865.46.

Pyszczynski, T., Greenberg, J., Solomon, S., Arndt, J., Schimel, J., 2004. Why do people need self-esteem? A theoretical and empirical review. Psychol. Bull. 130, 435–468. http://dx.doi.org/10.1037/0033-2909.130.3.435.

Ribeiro, J.D., Franklin, J.C., Fox, K.R., Bentley, K.H., Kleiman, E.M., Chang, B.P., Nock, M.K., 2016. Self-injurious thoughts and behaviors as risk factors for future suicide ideation, attempts, and death: a meta-analysis of longitudinal studies. Psychological Med. 46 (2), 225–236.

Sornberger, M.J., Heath, N.L., Toste, J.R., McLouth, R., 2012. Nonsuicidal self-injury and gender: patterns of prevalence, methods, and locations among adolescents. Suicide Life Threat Behav. 42, 266–278. http://dx.doi.org/10.1111/j.1943-278X.2012.0088.x.

Swannell, S.V., Martin, G.E., Page, A., Hasking, P., St John, N.J., 2014. Prevalence of nonsuicidal self-injury in nonclinical samples: systematic review, meta-analysis and meta-regression. Suicide Life Threat Behav. 44, 273–303. http://dx.doi.org/10.1111/sltb.12070.

Tang, J., Yu, Y., Wu, Y., Du, Y., Ma, Y., Zhu, H., et al., 2011. Association between non-suicidal self-injuries and suicide attempts in Chinese adolescents and college

students: a cross-section study. PLoS One 6. http://dx.doi.org/10.1371/journal.pone.0017977.
Victor, S.E., Klonsky, E.D., 2014. Correlates of suicide attempts among self-injurers: A meta-analysis. Clin. Psychology Rev. 34 (4), 282–297.
Washburn, J.J., Richardt, S.L., Styer, D.M., Gebhardt, M., Juzwin, K.R., Yourek, A., Aldridge, D., 2012. Psychotherapeutic approaches to non-suicidal self-injury in adolescents. Child Adolesc. Psychiatry Ment. Health 6, 1–8. http://dx.doi.org/10.1186/1753-2000-6-14.
Weinberg, J., Freese, J., McElhattan, D., 2014. Comparing data characteristics and results of an online factorial survey between a population-based and a crowdsource-recruited sample. Sociol. Sci. 1, 292–310. http://dx.doi.org/10.15195/v1.a19.
Whitlock, J., Muehlenkamp, J., Eckenrode, J., Purington, A., Baral Abrams, G., Barreira, P., Kress, V., 2013. Nonsuicidal self-injury as a gateway to suicide in young adults. J. Adolesc. Heal. 52, 486–492. http://dx.doi.org/10.1016/j.jadohealth.2012.09.010.
Wilkinson, P., Kelvin, R., Roberts, C., Dubicka, B., Goodyer, I., 2011. Clinical and psychosocial predictors of suicide attempts and nonsuicidal self-injury in the adolescent depression antidepressants and psychotherapy trial (ADAPT). Am. J. Psychiatry 168, 495–501. http://dx.doi.org/10.1176/appi.ajp.2010.10050718.