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Pain analgesia among adolescent self-injurers

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ABSTRACT

Although non-suicidal self-injury (NSSI) involves self-inflicted physical harm, many self-injurers report feeling little or no pain during the act. Here we test: (1) whether the pain analgesia effects observed among adult self-injurers are also present among adolescents, and (2) three potential explanatory models proposing that habituation, dissociation, and/or self-criticism help explain the association between NSSI and pain analgesia among adolescents. Participants were 79 adolescents (12–19 years) recruited from the community who took part in a laboratory-based pain study. Results revealed that adolescent self-injurers have a higher pain threshold and greater pain endurance than non-injurers. Statistical mediation models revealed that the habituation and dissociation models were not supported; however, a self-critical style does mediate the association between NSSI and pain analgesia. The present findings extend earlier work by highlighting that a self-critical style may help to explain why self-injurers exhibit pain analgesia. Specifically, the tendency to experience self-critical thoughts in response to stressful events may represent a third variable that increases the likelihood of both NSSI and pain analgesia. Prospective experimental studies are needed to replicate and tease apart the direction of these associations, and may provide valuable leads in the development of effective treatments for this dangerous behavior problem.

1. Introduction

Non-suicidal self-injury (NSSI) is a dangerous behavior problem that involves intentional damage to one's own body tissue in the absence of any intent to die. Engagement in NSSI is disturbingly common among adolescents with prevalence rates estimated at 13–23% in community samples (Jacobson and Gould, 2007). In addition to the inherent physical damage caused by NSSI, this behavior also has been found to be related to increased rates of suicide attempts (Nock et al., 2006), as well as depression, drug abuse, and disordered eating (Hilt et al., 2008). Despite its frequency and potential for serious harm, many fundamental aspects of NSSI are not well understood.

Although NSSI, by definition, involves hurting oneself, as many as 50% of adult self-injurers (Leibenluft et al., 1987) and 80% of adolescent self-injurers (Nock et al., 2006) report feeling little or no pain while engaging in the act. Consistent with these self-reports indicating reduced sensitivity to pain, prior laboratory studies have shown that adult self-injurers exhibit pain analgesia compared to non-injurers (Kemperman et al., 1997a; Russ et al., 1999; Bohus et al., 2000; Hooley et al., 2010; McCoy et al., 2010; Franklin et al., 2011, 2012), in that they (1) take longer to identify a sensation as painful (i.e., pain threshold), and (2) are willing to tolerate the pain for a longer period of time (i.e., pain endurance). Despite these findings, it is not yet known whether this pain analgesia is present during adolescence. Recent research has revealed that related constructs such as depression (Kaufman et al., 2001) and reward sensitivity (Steinberg, 2008) differ in adolescents relative to adults, and it is possible that pain sensitivity does as well. In addition, the experience of pain may change over time as a *result* of self-injury. One prior study suggested that the discontinuation of NSSI may be associated with normalization of pain perception and decrease in the pain analgesic effect (Ludäscher et al., 2009). Understanding the developmental course of pain analgesia among self-injurers is crucial both to our basic understanding of NSSI and to identifying potential targets for early intervention.

Another major unknown is *why* those engaging in self-injury experience this pain analgesia. Several explanations have been proposed. First, it is possible that pain analgesia results from a process of habituation through repeated exposure to painful

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stimuli. Specifically, past experiences with self-harm, including NSSI, may lead to decreased sensitivity to pain over time. In support of this theory, prior studies have found that adult self-injurers with longer histories of NSSI reported feeling less pain when engaging in the act (Claes et al., 2006) and had higher pain threshold (Hooley et al., 2010) and pain endurance (St. Germain and Hooley, 2013). However, Nock et al. (2006) found that adolescent inpatients who reported no pain during NSSI actually had fewer past NSSI episodes. As these findings underscore, evidence of a link between frequency of past NSSI and pain analgesia is mixed. As such, we tested the role of habituation by examining whether the frequency and duration of NSSI is associated with an objective measure of pain analgesia.

Second, it is possible that dissociation mediates the association between NSSI and pain analgesia. Self-injurers frequently report experiencing dissociative states (e.g., Kemperman et al., 1997b), and it is possible that the experience of dissociation alters pain perception. This relationship between NSSI and pain sensitivity may be explained in different causal directions: physical pain may serve as a means to reduce unpleasant dissociative feelings (Brown et al., 2002), or dissociative symptoms may mask the sensation of pain, rendering the physical sensation less salient (Brodsky et al., 1995). Although not examining self-injurers specifically, Ludäscher et al. (2007) found that individuals with reduced pain perception tended to have greater self-reported dissociative symptoms. However, Hooley et al. (2010) reported no association between dissociation and pain perception in a sample containing adult NSSI and control participants. Even so, both pain analgesia and dissociation are common to NSSI and it is plausible there may be an association between the two constructs.

Third, it may be that self-criticism serves a mediating role in the relation between NSSI and pain analgesia. That is, negative beliefs about oneself may result in greater willingness to endure pain, perhaps due to a view of the experience of pain as congruent with oneself. Recent research has shown that people who engage in NSSI are more self-critical than people who mistreat themselves in other, more indirect ways (St. Germain and Hooley, 2012), and that self-criticism (Hooley et al., 2010) and emotion dysregulation (Franklin et al., 2012) are associated with greater pain endurance. Furthermore, Bastian et al., (2011) found that participants who performed a guilt-inducing exercise (thereby increasing self-criticism) prior to engaging in a pain task tolerated pain longer and showed a greater reduction in guilt, suggesting that the pain may act as negative reinforcement for self-criticism. As has been suggested by Hooley (see Hooley et al., 2010; St. Germain and Hooley, 2012), people who are highly self-critical may regard pain as something they deserve, allowing self-injury to assume a self-punishing or guilt-reducing function. These results suggest the intuitive association between self-criticism and pain endurance in that self-injurers are experiencing pain and choosing to endure it. There is less support theoretically and empirically, however, for the association between self-criticism and pain threshold, or the idea that more self-critical individuals are not experiencing pain to the same intensity (Hooley et al., 2010).

Although self-criticism may play a crucial role in reducing some of the barriers to self-injury (e.g., pain), recent research suggests that NSSI may serve the function of reducing negative affect and increasing positive affect more generally, rather than being limited to certain kinds of emotional experiences (e.g., self-criticism, guilt). Franklin et al. (2013) have proposed *pain offset relief* (i.e., the simultaneous positive and negative reinforcement resulting from the removal of pain) as a possible mechanism by which such affective reinforcement occurs. Individuals, perhaps motivated to engage in NSSI by self-criticism and/or willingness to endure pain, incidentally derive the natural physiological benefit of pain offset relief (Franklin et al., 2013).

The purpose of the current study was to examine whether the pain analgesic effect observed among adult self-injurers also is seen among adolescent self-injurers. Our main hypothesis was that adolescent self-injurers would exhibit greater pain analgesia (i.e., decreased sensitivity to pain, and greater willingness to endure pain) relative to adolescent non-injurers. In addition, we tested these three potential explanations for the association between self-injury and pain analgesia in adolescent self-injurers.

2. Methods

2.1. Participants

Participants were 79 (63 female) adolescents and young adults ages 12–19 years ($M=17.34$, S.D.$=1.79$). Fifty-eight reported a history of NSSI and 21 were non-injurious controls. We focused on adolescence and young adulthood because of the increased risk for self-injurious thoughts and behaviors during this developmental period (Nock et al., 2008). Participants self-identified as European American (75.9%), Hispanic (7.6%), Asian American (3.8%), African American (2.5%), and other (10.1%). NSSI and control groups were matched on age, sex, and race/ethnicity to rule out the possibility that any observed effects were due to these factors. Participants were recruited from the community in a large urban northeastern U.S. city via postings in local psychiatric outpatient clinics, community bulletin boards, newspapers, and on the internet. All participants invited to the laboratory were provided with a detailed description of the study, and written informed consent (18 years or older) or verbal assent with parent consent (under 18 years). At the conclusion of the interview, each participant was administered a suicide risk assessment by trained experimenters and received a list of referrals for clinical services upon request and/or if deemed necessary. These 79 participants were drawn from a larger sample of 94 adolescents who participated in a laboratory-based study of NSSI; the pain measures were not added until participant #16 so the first 15 participants were excluded from the current analyses. Excluded participants were on average 1.36 years younger than included participants but otherwise did not differ significantly on demographics. The participants in this study have been included in several prior studies (e.g., Nock and Banaji, 2007; Nock and Mendes, 2008; Weierich and Nock, 2008); however, the current study examines unique hypotheses, measures, and analyses.

Self-injurious participants reported an average of 593.52 (S.D.$=268.74$) lifetime NSSI episodes, with a range of 2 to 20,000 and a median of 41. Forty one of the 58 lifetime self-injurers (70.7%) reported engaging in at least one NSSI episode during the past month ($M=31.78$, S.D.$=107.95$). The average age of onset of NSSI was 13.59 (S.D.$=2.64$) years, ranging from 5 to 18 years old. Participants utilized an average of 2.5 (S.D.$=0.80$) different methods of NSSI with only 6 (10.3%) not endorsing cutting of skin; other commonly endorsed methods included scraping (53.5%), hitting (51.7%), picking at (50.0%), and burning (36.2%) oneself.

Current psychiatric diagnoses were assessed using the Kiddie Schedule for Affective Disorders and Schizophrenia for School Age Children, Present and Lifetime Version (K-SADS-PL; Kaufman et al., 1997). Interviews were conducted by a licensed clinician and a team of trained and supervised research assistants, and showed excellent interrater reliability (average $\kappa=0.93$). According to the semi-structured diagnostic interviews, 64.6% of participants met criteria for at least one psychiatric disorder, with an average of 1.5 (S.D.$=1.9$) current disorders. The most common diagnoses were anxiety disorders (48.1%), mood disorders (35.4%), alcohol and substance use disorders (15.2%), externalizing disorders (11.4%), and eating disorders (7.6%).

2.2. Measures

2.2.1. Pain perception

We used a finger pressure algometer to measure perception of physical pain. The algometer consisted of a 35-cm-long steel arm fastened to a 1.5-in × 3.5-in wood base. A stack of washers was screwed to the end of a metal arm to increase downward pressure on the finger. The 1.5-cm × 3-mm tip of the algometer arm exerts constant pressure like that of a dull butter knife, creating an increasingly aching pain. This method of pain application was chosen for several reasons: first, although no current laboratory pain application is a perfect proxy for the type of self-inflicted pain involved in NSSI, of all available methods, we believe that pressure pain most closely approximates the pain involved in cutting, the predominant method of NSSI used by participants in this sample and arguably among self-injurers in general (Klonsky, 2011). Second, the type of focal pressure exerted by the algometer has been shown to be less susceptible to physiological changes, such as heart rate, than other methods (e.g., thermal methods) due to application to skin over bone, not muscle or fatty tissue (Forgione and Barber, 1971). Also, although prior research indicates that the premenstrual phase is associated with increased pain sensitivity in women, prior studies using pressure pain have not revealed any menstrual cycle-related differences (Fillingim and Ness,

2000). Third, previous research has supported the validity of the scores derived from this instrument to assess pain perception (Hooley and Delgado, 2001). In this task, participants are asked to pick up the algometer arm, place their left hand under the algometer arm with their palm facing downward, and lower the arm slowly onto the section of skin between the first two joints of their finger. Participants were instructed to briefly raise their free hand when they first perceived the pressure as painful, and to remove the weighted arm when the sensation of pain became intolerable.

"Pain threshold" was operationalized as the number of seconds that passed between placing the algometer weight on the finger and the first experience of pain (Feldner and Hekmat, 2001). "Pain endurance" was operationalized as the total time spent experiencing pain, calculated by subtracting the time to pain threshold from the total time that participants had their finger under the algometer arm until terminating the task (Hooley et al., 2010). Participants performed this task 3 times (once on their index, middle, and ring fingers) in order to supply a reliable index of pain threshold and tolerance. As in prior studies utilizing a finger pressure algometer (Hooley et al., 2010), trials were not allowed to exceed 8 min to prevent any potential tissue damage to the finger. Means for each pain measure were calculated by averaging times across the three fingers. If a participant reached the maximum tolerance time (i.e., 8 min) on any finger trial, subsequent trials were not conducted and mean pain scores were calculated based on the completed trials.

2.2.2. NSSI

NSSI was assessed using the Self-Injurious Thoughts and Behaviors Interview (SITBI; Nock et al., 2007), a structured clinical interview that assesses a wide range of self-injurious thoughts and behaviors. In the current study, we focused on items from the NSSI module of the SITBI in order to determine group status among participants. Participants who endorsed any prior engagement in NSSI (i.e., "Have you ever purposely hurt yourself without wanting to die?") were asked additional questions regarding specific characteristics of their behaviors, including the presence and frequency of these behaviors in the past week, past year, and over their lifetimes. The SITBI has demonstrated strong interrater reliability, test–retest reliability, and construct validity (Nock et al., 2007).

2.2.3. Dissociation

Dissociation was assessed using the Adolescent Dissociative Experiences Scale-II (A-DES; Armstrong et al., 1997), a 30-item measure of the frequency of dissociative experiences such as disturbances in awareness, memory, and identity. Items (e.g., "I get confused about whether I have done something or only thought about doing it.") are rated on an 11-point scale (0="always", 10="never"), from which a mean score is calculated. The A-DES has been shown to distinguish between participants who do and do not have a dissociative disorder (Armstrong et al., 1997), and internal consistency reliability in the current sample was excellent (Cronbach's $\alpha=0.95$).

2.2.4. Self-criticism

The Self-Rating Scale (SRS; Hooley et al., 2010) is an eight-item measure assessing the extent to which one endorses self-critical statements (e.g., "Sometimes I feel completely worthless," "Others are justified in criticizing me"). Participants judge how strongly they agree with each statement according to an eight-point (0–7) scale. This measure demonstrated good internal consistency reliability in the current sample (Cronbach's $\alpha=0.88$).

2.3. Data analysis

Prior to performing analyses, all study variables were checked for missing data, outliers, and normality. Given that pain tolerance had a ceiling of 480 s, it is likely that extremely high pain threshold scores would result in artificially small pain endurance scores. Therefore, endurance scores for two participants in the NSSI group (30 s and 118 s) with outlying threshold scores (450 s and 363 s, respectively) were excluded from analyses. Notably, inclusion of these participants does not change the study results. One participant for whom total time was not recorded was included in threshold analyses only. Missing dissociation and self-criticism data for six participants were replaced with sample means. Outliers (i.e., greater than two S.D.s from the mean) for the pain and NSSI frequency variables were reassigned values one unit higher than the next most extreme non-outlier, in order to reduce their influence but also retain their relative order in the distribution (Tabachnick and Fidell, 2001). To adjust for moderate positive skewness, square root transformations of the NSSI frequency variables were used in statistical analyses (Nolan et al., 2008). The resulting transformed data more closely approximated a normal distribution.

Chi-square tests were used to evaluate whether there were any significant diagnostic differences between the NSSI and control groups. To test our main hypothesis, we examined group differences on pain threshold and pain endurance using independent samples *t* tests, and entered any significant diagnostic factors in the first step of a hierarchical linear regression to examine this relation between NSSI and pain after controlling for group differences. Enforcement of the maximum time cap may have influenced pain endurance (i.e., the higher the threshold, the smaller the time frame available for endurance). Therefore, we examined whether there were group differences in the number of participants reaching this maximum on at least one trial.

Next, we tested the three pain analgesia hypotheses by calculating zero-order correlations between relevant variables and pain measures among the total sample. Variables that were strongly associated with both pain (threshold and/or endurance) and NSSI presence were then tested as potential statistical mediators. Given our data were cross-sectional, such analyses tested whether specific third variables explain some of the variance in the association between NSSI and pain perception (i.e., statistical mediation), but were not intended to test any temporal or causal relations among variables (MacKinnon et al., 2000; Franklin et al., 2012). Regression and bootstrapping methods, as outlined by Preacher and Hayes (2008), were chosen over traditional mediation tests (e.g., Sobel and causal steps strategy) because of research indicating that traditional methods often have reduced power to detect true mediating effects in small samples and that bootstrapping is less prone to Type I error and makes fewer assumptions of normality (Preacher and Hayes, 2008). The data were resampled 5000 times in order to approximate the indirect (i.e., mediated) effects as a bias-corrected confidence interval. Hierarchical linear regression analyses were performed to test the association between the hypothesized mediators and relevant predictors and outcome variables after controlling for significant demographic or diagnostic group differences (i.e., factors entered in the first step of the regression). In short, we used regression to perform significance testing on specific paths in our mediation models and bootstrapping to produce confidence intervals for any mediation effects. Two-tailed significance tests with alpha set at 0.05 were used for all analyses.

3. Results

3.1. Preliminary analyses

The NSSI group had higher rates of mood disorders (46.6%) compared to the control group (4.8%), $\chi^2(1, N=79)=11.77$, $p=0.001$, and higher rates of anxiety disorders (58.6%) than the control group (19.0%), $\chi^2(1, N=79)=9.67$, $p=0.002$. No significant group differences were found for alcohol and substance use disorders, externalizing disorders, and eating disorders, or total number of psychiatric disorders.

3.2. Main analyses

Analyses revealed that adolescent self-injurers ($n=58$) had higher pain thresholds ($M=59.6$ s, S.D.=39.5) than non-injurers ($n=21$; $M=30.8$, S.D.=22.7), $t(61.7)=4.02$, $p<0.001$, $d=0.89$ (Fig. 1). Self-injurers also had greater pain endurance ($M=104.1$, S.D.=118.6) than non-injurers ($M=36.9$, S.D.=33.1), $t(70.4)=3.83$, $p<0.001$, $d=0.77$. This effect remained even after controlling for diagnostic differences, for both threshold ($\beta=0.33$, $t[75]=2.75$, $p=0.007$) and endurance ($\beta=0.26$, $t[72]=2.05$, $p=0.04$). In addition, a greater number of participants from the NSSI group ($n=13$) than from the control group ($n=0$) reached the maximum time on a finger trial, $\chi^2(1, N=76)=5.99$, $p=0.01$.

3.3. Habituation, dissociation, and self-criticism as potential statistical mediators

Analyses revealed that neither lifetime, past year, and past month NSSI frequencies nor duration of self-injury (i.e., the number of years since age of NSSI onset) were significantly correlated with threshold or endurance (Table 1). Dissociative symptoms were also not correlated with either pain threshold or endurance. These results thus excluded habituation and dissociation as potential statistical mediators of the association between NSSI and threshold/endurance. Self-criticism had a small but non-significant positive association with pain threshold ($r=0.16$, $p=0.167$), and a medium positive association with pain endurance ($r=0.37$, $p=0.001$). In a mediation model statistically controlling for observed diagnostic differences in the first step, the significant initial relationship between NSSI and pain endurance ($\beta=0.26$, $t[72]=2.05$, $p=0.04$) decreased and became non-significant after

entering self-criticism in the model (β=0.17, t[71]=1.38, p=0.17), whereas the initial association between self-criticism and endurance (β=0.38, t[72]=2.94, p=0.004) remained significantly predictive of endurance after controlling for NSSI (β=0.33, t[71]=2.48, p=0.02). Bootstrapping analyses confirmed the significant mediating effect of self-criticism (95% CI: 1.13–53.17; bias-corrected indirect effect CI does not include zero).

4. Discussion

The primary aim of the current study was to test whether adolescent self-injurers exhibit pain analgesic effects similar to those observed previously among adult self-injurers in order to better understand the developmental trajectory of NSSI. As hypothesized, results revealed that community adolescent self-injurers have a higher pain threshold and pain endurance than do non-injurers. Post-hoc analyses suggest that higher rates of mood and anxiety disorders among the NSSI group did not account for the observed pain analgesia. Moreover, all of the participants who achieved the maximum trial time limit came from the NSSI group. Had this limit not been externally imposed, we expect that these self-injurers may have even higher total time scores, further increasing the difference in pain endurance between NSSI and control participants. These results suggest that pain analgesia may be a general feature of NSSI that is present not just in adulthood but in adolescence as well.

Our secondary aim was to test several potential explanations regarding why self-injurers have higher pain thresholds and endurance. Joiner's (2005) interpersonal-psychological theory of suicide posits that painful and provocative events (PPEs) increase pain tolerance, which thereby increases acquired capability for suicide. Our results did not support the hypothesis that prior experience with self-injury leads to habituation to pain: although those with a history of NSSI had elevated pain tolerance, the *number* or *frequency* of past NSSI episodes did not explain this association. The current results are in line with those from other studies failing to find an association between frequency of NSSI and increased pain tolerance. Nock et al. (2006) found that adolescents reporting more pain during NSSI did not have a greater number of past NSSI episodes. Additionally, Franklin et al. (2013) found that NSSI frequency was not associated with greater pain offset relief, which does not support the interpersonal-psychological theory's prediction that more PPEs should lead to greater relief after injury/pain. It is important to note, however, that NSSI is only one form of PPEs, and it is possible that the self-injurers with fewer NSSI episodes experienced PPEs in other ways, either indirect forms of self-injury (e.g., eating disorder) or abuse. Taken together, these findings indicate that pain perception may be a stable feature among self-injurers and that having a reduced sensitivity to pain may serve as a risk factor for, rather than a result of, engagement in NSSI.

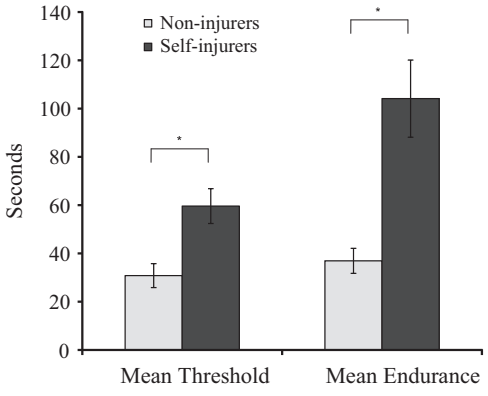

Fig. 1. Pain threshold and endurance for non-injurers and self-injurers. *$p < 0.05$.

Table 1
Correlations between pain and variables related to pain analgesia hypotheses.

Measure	Pain threshold	Pain endurance
Habituation (NSSI) †		
Lifetime frequency	−0.05	0.10
Past year frequency	−0.02	0.15
Past month frequency	0.15	0.06
Duration (years since onset)	0.08	−0.01
Dissociation		
A-DES	0.13	0.20
Self-criticism		
SRS	0.16	0.37**

Note. NSSI=non-suicidal self-injury; A-DES=Adolescent Dissociation Experiences Scale; SRS=Self-Rating Scale.

** $p < 0.01$.

† Correlations performed among self-injurers only.

These findings also did not support the hypothesis that dissociative symptoms mask or alter pain perception among self-injurers. These null results are consistent with the empirical findings of Hooley et al. (2010) and a review by Giesbrecht et al., (2008) that challenge the commonly held assumption that dissociative states involved inhibited sensory processing. In fact, there is some evidence to suggest that high dissociating individuals may exhibit a desire for, and increased sensitivity to, sensory stimulation, for which NSSI serves as a potential solution. In other words, it may be that self-injurers, even if indeed experiencing elevated dissociation, would be no more likely to experience pain analgesia compared to non-injurers.

We found preliminary support for the hypothesis that self-criticism, or negative beliefs about the self, helps explain the association between NSSI and pain perception (see Hooley et al., 2010). Self-criticism was significantly correlated with pain endurance and remained a strong predictor even after controlling for NSSI and diagnostic factors, suggesting that self-criticism may play an important role in the relationship between NSSI and pain endurance. These findings support the notion that the tendency to experience self-critical thoughts may represent a third variable that increases the likelihood of both NSSI and pain analgesia among adolescents. While our study could not establish causal direction, Hooley and St. Germain (2014) recently showed experimental evidence for self-criticism as a causal mechanism for increased pain endurance among adult self-injurers.

It remains unclear, however, why higher pain *threshold* is associated with NSSI. Similar to recent findings by Franklin et al. (2012) in an adult sample, none of the three potential explanatory models helped to explain the association between NSSI and pain threshold among adolescents. A number of alternative explanations warrant further experimental testing. One possibility is that the link between NSSI and pain sensitivity has a genetic basis. Prior studies have shown that polymorphisms in the SCN9A gene are associated with individual differences in pain perception (Reimann et al., 2010), and perhaps adolescent self-injurers and non-injurers exhibit genetic differences. Additionally, it still is possible that NSSI reduces pain sensitivity through some process of habituation. Contrary to our findings, a cross-sectional study showed that the termination of NSSI is associated with a normalization of, and increase in, pain sensitivity (Ludäscher et al., 2007). Both study designs, however, make it impossible to tease out the

causal directions of the association of NSSI and pain threshold. As such, future longitudinal studies would help clarify these questions about causality.

It is important to note several methodological limitations of this study. First, although the use of self-report allowed us to gather extensive data on history of self-injurious behaviors and psychological factors (e.g., dissociation proneness), this methodology may be prone to inaccuracies (e.g., problems with retrospective recall) and potential biases (e.g., social desirability). Second, given that our sample consisted of adolescent self-injurers, the associations found in this study between NSSI and pain (as well as those between NSSI and habituation, dissociation, and self-criticism) may not generalize to other age groups. Third, participants' responses to pain as measured with an algometer arm may not be consistent with other experimental methods (e.g., cold pressor, tourniquet, and electric stimulation). Fourth, the cross-sectional design of the study limited our ability to test the temporal directions of the observed relations among constructs. Our analyses utilized mediation analyses, but not with traditional assumptions of causality; other mediation methods appropriate for cross-sectional data analysis, such as autoregressive models, could help further support our conclusions (Maxwell et al., 2011). Fifth, given that the laboratory conditions likely did not produce emotional pain as intense as self-injurers may typically experience prior to engagement in NSSI, the current results may reflect trait, rather than state, differences in pain analgesia. Future prospective studies are needed to overcome these limitations and to tease apart the direction of these observed associations. Despite its limitations, the present study enhances our understanding of the association between pain analgesia and NSSI.

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