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Non-Suicidal Self-Injury, Pain, and Self-Criticism: Does Changing Self-Worth Change
Pain Endurance in People who Engage in Self-Injury?

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Abstract

People who engage in non-suicidal self-injury endure physical pain for longer than non-injuring controls. Pain endurance is also predicted by the presence of highly self-critical beliefs. We tested the hypothesis that changing beliefs about the self would change pain endurance in NSSI. NSSI participants (n=50) and controls (n=84) were randomly assigned either to hear positive music, to receive a brief cognitive intervention designed to improve feelings of personal self-worth, or to a neutral condition. Pain endurance was measured before and after the experimental manipulations. As predicted there was a significant group x condition x time interaction. After the cognitive intervention NSSI participants showed a 69 second decrease in pain endurance compared to a 9 second decrease for controls. For NSSI participants, improvement in self-worth was also significantly correlated with decreased willingness to endure pain. Cognitive approaches that focus on self-worth may provide a new treatment direction for NSSI.

Non-suicidal self-injury (NSSI), involves behaviors such as cutting or burning that harm body tissue but that occur in the absence of intent to die (Hooley, 2008; Nock, 2010). NSSI is a serious and far from uncommon problem. Recently, Klonsky (2011) has reported a lifetime prevalence rate of 5.9% in a sample of 439 adults drawn from a regionally and sociodemographically diverse sample. Prevalence rates were especially high (19%) in people aged 30 and younger and were comparable to the prevalence estimates of 17% previously reported for US college students (Whitlock, Eckenrode & Silverman, 2006). Although the possibility that younger people are more able to recall having engaged in NSSI cannot be ruled out, the higher prevalence rates in younger people may indicate that NSSI is becoming increasingly common (Jacobson & Gould, 2007; Nock, 2010). This is of particular concern because individuals who engage in NSSI are at increased risk for suicide (Andover & Gibb, 2010; Guan, Fox, & Prinstein, 2012; Nock, et al., 2006; Wilkinson et al., 2011).

It is not clear why people engage in NSSI. Current theoretical models suggest that NSSI behaviors are important for regulating negative affect and reducing emotional distress (Klonsky, 2009; Nock & Prinstein, 2004). Although this is likely true, a central and as yet unanswered question is *why* some people choose NSSI as an emotion regulation strategy. A wide range of emotion regulation strategies exist (e.g., venting, exercising, seeking social support, having a glass of wine) that do not cause deliberate and direct harm to the body. Why then, in preference to these approaches to emotion regulation, do some people select NSSI?

People who engage in NSSI often report that one reason they do it is to punish themselves (Brown et al., 2002; Gunderson & Ridolfi, 2001; Nock & Prinstein, 2004).

Consistent with this, in a series of studies we have demonstrated that people who engage in NSSI are much more highly self-critical than are healthy controls (Hooley, Ho, Slater & Lockshin, 2010; Glassman, Weierich, Hooley, Deliberto, & Nock, 2007). People who engage in NSSI are also more highly self-critical than people who engage in more indirect forms of self-injury (e.g., abusing substances, depriving themselves of food, remaining in abusive relationships, etc.) but who do not engage in NSSI (St. Germain & Hooley, 2012). In a related program of research, Gilbert has also noted that self-harming behaviors are associated with self-criticism and negative feelings about the self (Gilbert et al., 2010). A form of self-criticism (evaluative concerns perfectionism) has also been linked to NSSI in a sample of inpatients with eating disorders (Claes, Soens, Vansteenkiste & Vandereycken, 2011). Moreover, using ecological momentary assessments, Nock, Prinstein and Sterba (2009) have reported that, in adolescents, the odds of engaging in NSSI were significantly increased in the presence of feelings of self-hatred and anger toward the self.

The Latin word for punishment is *poena*. Interestingly, the same word is also used to refer to pain. Laboratory research has demonstrated that people who engage in non-suicidal self-injury (e.g., cutting and burning) are more willing to endure physical pain than are healthy controls (Hooley et al., 2010; Franklin et al., 2011). In previous work, we have further demonstrated that willingness to endure pressure pain is predicted by highly self-critical beliefs (Hooley et al., 2010). We have also theorized that a cognitive style that involves highly negative feelings about the self may be a specific risk factor for the development of NSSI (Hooley et al., 2010; St. Germain & Hooley, 2012). This is because a highly negative attitude toward the self (self-criticism or, more extremely, self-

hatred) removes a potential barrier to self-injury. It does this by allowing the person to consider strategies for emotion regulation such as cutting and burning that other people (who value themselves and their bodies much more) would immediately reject. People who hold core belief about being bad, flawed or defective may therefore have less resistance to the idea of NSSI than people who have self-schemas that are more positive.

If this is true, we might expect that changing beliefs about the self might change pain endurance in people who engage in NSSI. Here, in an experimental study, we test the hypothesis that changing beliefs about the self will change pain endurance in people who engage in self-injury. Specifically, we predicted that pain endurance would decrease in people who engaged in NSSI after they were exposed to a brief cognitive intervention designed to improve their sense of positive self-worth. We did not expect that the same would be true for people with no history of self injury (because they are much less self-critical than people who engage in NSSI). Accordingly, we included a comparison sample of healthy controls to test the specificity of our intervention. Use of a control sample also allowed us to see whether exposure to the cognitive intervention would normalize pain endurance in those NSSI participants who received it. We further hypothesized that NSSI participants assigned to a positive mood induction condition or to a neutral task condition would show no change in pain endurance and that healthy controls would also demonstrate no change in pain endurance across any of the three conditions. In short, we predicted a significant group x condition x time interaction.

Method

Participants

Participants were 134 individuals (101 females; 33 males; mean age 24.09 years, range 18-57, $SD = 8.07$) recruited from the local community by means of postings and email advertisements. No data on ethnicity were collected. The control group consisted of 84 participants (58 females, 26 males; average age = 24.81 years; $SD = 9.08$) who had never engaged in any form of self-injurious behavior and who had no current Axis I disorder based on a SCID assessment. The NSSI group consisted of 50 participants (43 females, 7 males), all of whom engaged in cutting without the intent to die. The mean age of onset of NSSI was at 16.34 years of age ($SD = 3.68$), and the average duration of self-injury in this group was 5.89 years ($SD = 4.97$). Participants in the NSSI group were more likely to be female (86% versus 69%) compared to participants in the control group, $X^2 = 4.85, p = .028, r = .19$. They were also slightly younger than the control participants (mean age of NSSI participants = 22.54 years, $SD = 5.55$), $t(132) = 1.80, p = .075, d = .31$. All participants provided written informed consent to a research protocol approved by the Harvard University Committee on the Use of Human Subjects and received remuneration for their participation.

Procedures

Participants who expressed interest in the study were contacted and asked to complete an initial telephone interview. This was used to confirm eligibility. During the telephone interview, participants who reported NSSI were asked about the specific type, frequency, and severity of the reported self-injurious behavior(s) using a standardized semi-structured interview (see Hooley et al., 2010). This covered content similar to that found in the Self-Injurious Thoughts and Behaviors Interview (SITB: Nock et al., 2007). Participants were also screened for the presence of DSM-IV Axis I disorders using the

SCID (First et al., 1996). To be considered for inclusion, self-injuring participants were required to have engaged in this behavior at least once (without being motivated by an intent to die) in the past month. Control participants with current Axis I disorders were excluded.

Following the phone screening, eligible participants were scheduled to participate in a single two-hour experimental session. After providing informed consent, participants completed a laboratory procedure designed to measure pain threshold and pain endurance. Following this, they were randomly assigned to one of three experimental conditions (Positive Mood, Positive Self-Worth, and Neutral), described below. Pain threshold and pain endurance were then measured again using the same procedures as before. Data were collected by research assistants who were unaware of group membership.

Pain Perception

Pain was induced using a pressure algometer. This took the form of a weighted metal lever with a blunt focal point. The pressure that is applied is standard and constant. However, when lowered onto the finger, the focal pressure creates a constantly growing “aching” pain (Forgione & Barber, 1971). Pressure pain is less influenced by physiological factors such as heart rate than other methods of pain stimulation such as thermal methods (Forgione & Barber, 1971). Previous research has demonstrated that the pressure algometer is a reliable way to induce pain (Hooley & Delgado, 2001; Hooley et al., 2010). Importantly, the use of this instrument results in no tissue damage.

During the procedure the participant was alone in a testing room, observed by the experimenter through a one-way mirror. Participants were instructed to place the

pressure point of the algometer between the knuckle and tip of the index finger of their left hand. With their right hand, participants were asked to move a switch (which turned on a light visible to the experimenter behind the mirror) when the pressure was experienced as painful. The participant was asked to again flip a switch when the pain was experienced as no longer tolerable (pain tolerance). At this point, the participant removed his/her finger from the device. Throughout the procedure the participant was in full control and could terminate the trial at any time.

Pain threshold was recorded as the time (in seconds) it took for a participant to report pain (i.e., to turn on the indicator light). Pain endurance was defined as duration of time that the participant experienced pain. It was calculated by subtracting the time taken to reach pain threshold from the time taken to terminate the trial (pain tolerance).

Experimental Manipulations

Positive Self-Worth Condition: The positive self-worth condition was developed specifically for this study by the first author. In other work with different samples of participants we have demonstrated that people who engage in NSSI are highly self-critical and hold beliefs about being bad or flawed as a person (Glassman et al., 2007; Hooley et al., 2010). We have also shown that this self-critical cognitive style is associated with higher durations of pain endurance. Accordingly, this experimental manipulation was specifically designed to undermine negative beliefs about the self by activating positive self-schemas.

We anticipated that thinking about themselves in a more positive way might be challenging for people who engage in NSSI. We therefore first asked all participants assigned to this condition to complete a short checklist. This contained 21 commonly

occurring positive traits or characteristics (e.g., loyal, kind, insightful, dependable). Participants were asked to check any that they thought applied to them. If participants had difficulty doing this, they were asked what someone close to them (for example a best friend) might say. Participants were also reminded that not everyone is 100 percent good all the time, and that just because they might be able to think of an occasion when they had not exhibited the positive trait in question that was not a reason not to endorse the trait if it was generally true.

After a minimum of three positive traits had been identified, a trained research assistant selected a trait from the list. The researcher then asked the participant to provide a specific example of a time when he or she had behaved in that particular way, e.g., “Tell me about a time when you were especially loyal and you felt proud of what you did.”). Participants were encouraged to tell a story about a specific event. The fact that the event cast the participant in a very positive light was also expressly acknowledged by the interviewer. After one specific example had been provided and if there was time remaining, the researcher selected another positive trait and asked the participant to talk about that. The total duration of this experimental manipulation (including completion of the checklist and discussion of specific situations) was 5 minutes.

Positive Mood Condition: Participants were asked to listen to 5 minutes of upbeat music (selections from Belize Tropical, Brazil Classics 1, compiled by David Byrne). This music has been used as a positive mood induction in previous research (Wenzlaff, Wegner & Klein, 1991). Participants were instructed to listen to the music through headphones and to use it to get themselves into a good mood.

Neutral Condition: To control for the possibility that, in a simple test-retest design, participants might respond differently at the second pain assessment, we also used a neutral distraction condition. Participants were asked to read a written passage about Ecuador. To ensure that they were paying attention to the text, participants were asked to cancel all the C and E letters that they encountered. As with the other experimental manipulations, this task lasted 5 minutes.

Measures

Visual analog scales were used to measure the effects of the experimental manipulations. Before and after each experimental condition participants were instructed to “Please make a slash mark on the line below reflecting how positive your mood is at this particular moment.” The anchor points were “not at all positive” and “extremely positive”. A second instruction asked participants to “Please make a slash mark on the line below reflecting how positively you are feeling about yourself (i.e., who you are as a person) at this moment.” The same anchor points were used. Research assistants later measured the placement of each mark on the VAS line, noting its position in millimeters. Scores from the first assessment were subtracted from scores obtained at the second assessment to provide a measure of overall change. Because these scales were added after data collection was already underway, sample sizes are reduced for these measures.

Data Analytic Strategy

Baseline pain endurance data on 63 controls and 48 NSSI participants from this sample have already been reported elsewhere (St. Germain & Hooley, 2013). As expected, the baseline data showed that NSSI participants had longer pain endurences than non-self-injuring controls. Our focus here is on the changes in pain endurance from

baseline to the post-intervention assessment that resulted from the experimental manipulations. As a manipulation check, we first examined whether participants assigned to the self-worth condition showed an increase in self-worth after this specific intervention. Given the gender and age differences between the control and NSSI groups, we also examined whether change in pain endurance was correlated with these variables. There was no significant association between age and change in pain endurance across time, $r(127) = -.11, p = .21$. There was also no relationship between gender and change in pain endurance across the two assessments, $r(127) = .03, p = .72$. Accordingly, we tested our main hypothesis using a 2 (group) x 3 (condition) x 2 (time) repeated measures ANOVA. Because we expected that only the NSSI participants who were assigned to the positive self-worth condition would show a decrease in pain endurance from the first to the second assessment, we predicted a significant 3-way interaction and followed this up with post-hoc t-tests. Finally, we examined the extent to which improvement in self-worth was correlated with change in pain endurance from the first to the second pain assessment in both controls and NSSI participants.

Results

A 2 (group) x 3 (condition) x 2 (time) repeated measures ANOVA was used to examine the effect of the different experimental conditions on participants' ratings of positive self-worth. There was a significant main effect of time, $F(1, 61) = 25.53, p < .001, n^2_p = .30$, showing that participants felt better about themselves at the time of the second assessment ($p < .05$). This was qualified by a significant condition x time interaction, $F(2, 61) = 10.37, p < .001, n^2_p = .25$, which occurred in the absence of a group by time interaction, $F(1, 61) = 1.77, p = .19, n^2_p = .03$, and a group by condition by

time interaction, $F(2,61) = 1.22$, $p = .30$, $n^2_p = .04$. Post-hoc Tukey HSD tests revealed that all participants who received the cognitive self-worth intervention reported greater increases in positive self-worth than participants assigned to either the neutral ($p = .001$) or the positive music ($p = .048$) conditions. This confirmed that our experimental manipulation was having the desired effect on all participants, regardless of whether they were in the NSSI or control groups.

There was also a significant main effect of time on change in overall positive mood from the first to the second assessment, $F(1,61) = 7.69$, $p = .007$, $n^2_p = .11$. However, contrary to expectation, there no significant condition x time interaction, $F(2,61) = 1.75$, $p = .18$, $n^2_p = .05$. All experimental conditions were associated with increases in positive mood. In other words, reading about Ecuador, listening to positive music, and recalling positive memories about the self were all associated with being in a better mood afterwards. Only the latter condition, however, also led to participants having an increased sense of positive self-worth.

Pain endurance was the amount of time participants exposed themselves to the painful stimulus after reporting the onset of pain. As noted above, change in pain endurance from the first to the second assessment was unrelated to age and gender. Analysis of the pain endurance data with 2 (group) x 3 (condition) x 2 (time) repeated measures ANOVA revealed the predicted 3-way interaction, $F(2, 121) = 3.09$, $p = .049$, $n^2_p = .049$. Follow up analyses showed that, after the cognitive intervention, the amount of time that participants with NSSI were willing to endure physical pain decreased by 69.06 seconds ($SD = 107.24$). This represents a 49.8% decrease in pain endurance for NSSI participants relative to their baseline pain endurance scores. Control participants who received this

same intervention showed a 9.13 second (SD= 61.53) or 10.4% decrease in pain endurance between the first and the second assessments. As expected, NSSI and control participants differed significantly with respect to how much their pain endurance decreased after the cognitive intervention, $t(45) = 1.96, p = .036$, one-tailed, $d = .58$. Exposure to the positive music condition was associated with non-significant increases in pain endurance in both the NSSI (mean = 14.81 seconds; SD= 83.15) and control participants (mean = 7.36 seconds, SD= 52.04) $t(40) = 0.32, p = .75, d = .10$. Finally, there was no difference in pain endurance change between control participants (mean = -40.32 seconds, SD =113.38) and NSSI participants (mean = -0.37, SD = 119.83) who were assigned to the neutral condition, $t(36) = 0.96, p = .34, d = .32$. These results are illustrated in Figure 1.

Prior to the cognitive intervention (i.e., at baseline) NSSI participants assigned to this condition showed significantly elevated pain endurances relative to controls (means = 186.45 versus 80.03 seconds, $t(45) = 2.17, p = .044, d = .65$). However, after the cognitive intervention there was no significant difference between the NSSI and control participants with respect to pain endurance (means = 117.38 versus 70.91, $t(45) = 1.53, p = .13, d = .46$). In other words, the cognitive intervention served to normalize previously elevated pain endurance in the NSSI group. Finally, we examined the extent to which change in positive self-worth was associated with change in pain endurance. For NSSI participants, improvement in self-worth led to a decrease in pain endurance, $r(28) = -.44, p = .018$. This was not the case for the healthy controls, $r(35) = .12, p = .48$. These correlations are significantly different, $z = -2.22, p = .003$.

Discussion

People who engage in NSSI are much more highly self-critical than are healthy controls (Glassman et al., 2007; Hooley et al., 2010) or people who engage in indirect methods of self-injury (St. Germain & Hooley, 2012). Negative beliefs about the self also predict how long people will endure physical pain (Hooley et al., 2010). In this study we tested the hypothesis that improving positive self-image in people who engage in NSSI would make them less willing to tolerate physical pain.

As predicted, when people who engage in NSSI receive a brief experimental manipulation designed to improve their sense of positive self-worth, they show a significant (49.8%) decline in how long they are willing to endure physical pain. The same is not true for NSSI participants who receive a positive mood induction or those who are assigned to a neutral condition. Across all NSSI participants, improvements in self-worth were correlated with decreases in pain endurance. This was not the case for healthy controls who showed little change in pain endurance after receiving positive mood or positive self-worth interventions.

A pressing question in the area of NSSI is why some people deal with emotional distress by cutting or otherwise harming the only body they have. Self-criticism may be a key factor in this regard. A cognitive style that involves high levels of self-criticism may be causal risk factor for the development of NSSI because people who believe that they are bad, flawed or defective may have less resistance to the idea of hurting themselves than people who view themselves in a more favorable light. By removing a potential barrier to self-injury, self-criticism thus allows a person to consider options such as cutting and burning that people with more healthy self-images might immediately reject.

Removal of this barrier to self-injury may be especially important because being willing to try NSSI allows people to discover something very fundamental: The offset of pain provides emotional benefits. A growing literature attests to the fact that the removal of pain makes people feel better (Andreatta et al., 2010; Bresin & Gordon, 2013; Bresin et al., 2010; Franklin, Lee et al., 2013; Franklin, Puzia et al., 2013). This is true regardless of whether or not they have a history of NSSI. Moreover, not only do people experience relief (negative reinforcement), but the offset of pain also serves a positive reinforcement function (Franklin, Lee et al., 2013). Pain removal is associated with self-reports of increased pleasantness (Leknes et al., 2008). It is also accompanied by an increase in activation in brain areas associated with reward (Becerra & Boorsook, 2008; Leknes et al., 2011). Research further suggests that pain offset relief is an automatic (rather than a conditioned) response that is experienced almost immediately and that lasts several seconds (Franklin, Lee et al., 2013).

Why should this be? There is a high degree of overlap between the neural circuitry that processes physical pain and emotional pain (Eisenberger, 2012). One consequence of this is that the offset of physical pain is accompanied by the offset of emotional pain. Emotional pain is often difficult to control. However, as Franklin and colleagues (2013) have noted, the pain that results from self-injurious behavior (e.g., cutting) can be initiated and terminated at will. By taking advantage of the overlap and commandeering the neural circuitry that processes pain, the offset of self-inflicted physical pain will be associated with a decrease in emotional pain through a reduction in negative affect and an increase in positive affect. This helps us understand why people who engage in NSSI commonly report that they use self-injury as a way of getting rid of

bad feelings (Nock & Prinstein, 2004; Swannell et al., 2008). Simply put, self-injury “works”.

We suggest that highly negative beliefs about the self may provide an initial pathway to NSSI by removing a potential barrier to NSSI and increasing the likelihood that people in emotional distress will learn that NSSI provides a means of affect regulation. Moreover, for people who are highly self-critical, the experience of pain may provide additional benefits. Swannell et al. (2008) reported that 84% of self-injuring adolescents on an inpatient unit reported that a motivation for their self-injury was to punish themselves for being bad. Claes and colleagues (2011) have also shown that a form of self-criticism (evaluative concerns perfectionism) is linked to patients reporting that NSSI serves self-punishing and self-torturing functions for them. Although self-punishment is rarely the primary reason people say that they engage in NSSI (affect regulation is the most often endorsed function), for people high on self-criticism, the experience of pain may be experienced as something they deserve (Hooley et al., 2010). By self-inflicting pain, people high on self-criticism may therefore be able to engage in a behavior that is both self-affirming, and that also reduces their emotional distress.

A recent study provides additional support for this idea. Bastian, Jetten and Fasoli (2011) asked a group of undergraduate participants to write about a time they had behaved unethically. Another group of participants wrote about an everyday interaction that they had recently experienced. All participants were then asked to immerse their hand in iced water and keep it there for as long as they could. As might be expected, participants who had written about an unethical experience reported that they felt more guilty than did participants who had written about a routine event. They also reported that

the experience of keeping their hands in the iced water was more painful. Despite this, and of relevance to the present discussion, participants who had been made to feel bad kept their hands in the iced water for longer than the control participants did. They also experienced a greater decline in guilt afterwards. In discussing their findings, Bastian et al. (2011) propose a judicial model of pain and suggest that, by punishing the person who is guilty, pain can provide a means of atonement. Consistent with this idea, Gordon et al. (2010) have reported that more people had engaged in self-injurious behavior in the past, the more pain they experienced during self-injury but the more soothed they reported being afterwards.

Do people higher on self-criticism get more psychological benefit from self-injury? At the present time we do not know. However, the possibility that NSSI provides a particularly appealing method of coping with emotional distress for people high on self-criticism warrants attention in future research. Going forward, it will also be important to know, through longitudinal work, the extent to which self-criticism is a risk factor for the onset of NSSI. We already know from cross sectional studies, that people who engage in NSSI are more highly self-critical than people who do not engage in NSSI (Hooley et al., 2010; St. Germain & Hooley, 2012; Claes et al., 2011; Gilbert et al., 2010). However, it is quite possible that high levels of self-criticism are a consequence of NSSI rather than an antecedent of NSSI and this warrants consideration. Arguing against this idea however, are unpublished data we obtained from a small sample ($n=7$) of people who reported serious and recurrent thoughts about NSSI but who had never actually engaged in the behavior. These NSSI ideators reported levels of self-criticism that were comparable to people who did engage in NSSI. Although preliminary, these findings thus

suggest that high levels of self-criticism may predate rather than follow acts of non-suicidal self-injury.

The idea that self-criticism is a risk factor for NSSI has the potential to provide us with much needed leverage in understanding self-injury. NSSI has been linked to childhood maltreatment or abuse (Glassman et al., 2007; Whitlock et al., 2006) as well as to perfectionism (Claes et al., 2011; Hoff & Muehlenkamp, 2009) high levels of perceived parental criticism (Yates, Tracy & Luthar, 2008) and high levels of parental expressed emotion in the form of criticism (Wedig & Nock, 2007). All of these might be expected to increase the likelihood of developing pathologically high levels of self-criticism. If this is true, self-criticism (as a mediator) has the potential to help us understand why NSSI should be correlated with such a broad range of bad experiences.

A focus on self-criticism is important for other reasons as well. Decades of research on expressed emotion have taught us that criticism from others is a reliable predictor of negative clinical outcomes across a range of different disorders (see Hooley, 2007). This may be because criticism challenges brain areas involved in emotion regulation (Hooley et al., 2005, 2009; Servaas et al., 2013). Moreover, people who perceive higher levels of criticism in their closest relationships show increased limbic reactivity and decreased activity in prefrontal (regulatory) areas when exposed to criticism (Hooley, Siegle & Gruber, 2012). Relative to people who score low on perceived criticism, they also demonstrate impaired executive control of negative emotional information on an attentional task (Masland, Hooley, Tully, Dearing & Gotlib, 2013). Going forward, we need to know more about how actual criticism, perceived criticism, and self-criticism might be related. We also need to explore whether, as is the

case for actual and perceived criticism, high levels of self-criticism make people especially vulnerable to aberrant neural functioning in the context of emotional challenges. The neural correlates of self-criticism have been investigated in one preliminary study involving healthy controls (Longe et al., 2010). Similar research with participants who engage in NSSI is an obvious next step. Also needed are studies showing how NSSI participants respond to being criticized. More specifically the questions of whether self-criticism increases the extent to which neural processing (in fMRI studies) or cognitive control (in studies of executive function) becomes dysregulated under conditions of social challenge should be addressed.

Limitations of the current study include the small number of participants in some of the experimental groups and the fact that measures of change in self-worth were not collected for all participants. Nonetheless, despite being preliminary, our findings suggest that people who engage in NSSI may be motivated to do bad things to themselves because they feel bad about who they are. The finding that pain endurance can be reduced in these people after a cognitive intervention lasting only 5 minutes is very provocative. The nature of our experimental design also rules out the possibility that a simple improvement in mood is the reason pain endurance decreases. This highlights the role of cognitive factors. Specific treatments for NSSI are greatly needed. Although much remains to be learned, our findings suggest that cognitively-based approaches may hold considerable potential. Clinical interventions designed to increase feelings of positive self-worth based on already available self-knowledge may reduce the extent to which people are inclined to select physically damaging and painful methods to cope with emotional distress.

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References

- Andover, M. S., & Gibb, B. E. (2010). Non-suicidal self-injury, attempted suicide, and suicidal intent among psychiatric inpatients. *Psychiatry Research, 178*, 101-105.
- Andreatta, M., Muhlberger, A., Yarali, A., Gerber, B., & Pauli, P. (2010). A rift between implicit and explicit conditioned valence in human pain relief learning. *Proceedings of the Royal Society of Biology, 277*, 2411-2416.
- Bastian, B., Jetten, J., & Fasoli, F. (2011). Cleansing the soul by hurting the flesh: The guilt-reducing effect of pain. *Psychological Science, 22*, 334-335.
- Becarra, L., & Borsook, D. (2008). Signal valence in the nucleus accumbens to pain onset and offset. *European Journal of Pain, 12*, 866-869.
- Bresin K., & Gordon, K. H. (2013). Changes in negative affect following pain (vs nonpainful) stimulation in individuals with and without a history of nonsuicidal self-injury. *Personality Disorders: Theory, Research, and Treatment, 4*, 62-66.
- Brown, M. Z., Comtois, K. A., & Linehan, M. M. (2002). Reasons for suicide attempts and nonsuicidal self injury in women with borderline personality disorder. *Journal of Abnormal Psychology, 111*, 198-202.
- Claes, L., Soens, B., Vansteenkiste, M., & Vandereycken, W. (2011). The scars of the inner critic: Perfectionism and nonsuicidal self-injury in eating disorders. *European Eating Disorders Review, 20*, 196-202.
- Eisenberger, N. I. (2012). The neural bases of social pain: Evidence for shared representations with physical pain. *Psychosomatic Medicine, 74*, 126-135.

- First, M. B., Spitzer, R. L., Gibbon, M., & Williams, J. B. W. (1996). *Structured Clinical Interview for DSM-IV Axis I Disorders, Clinician Version (SCID-CV)*. Washington, D.C.: American Psychiatric Press, Inc.
- Forgione, A. G., & Barber, T. X. (1971). A strain gauge pain stimulator. *Psychophysiology*, 8(1), 102-106.
- Franklin, J.C., Hessel, E. T., & Prinstein, M. J. (2011). Clarifying the role of pain tolerance in suicidal capability. *Psychiatry Research*, 189, 362-367.
- Franklin, J. C., Lee, K. M., Hanna, E. K., & Prinstein, M. J. (2013). Feeling worse to feel better: Pain offset relief simultaneously stimulates positive affect and reduces negative affect. *Psychological Science*, 24, 521-529.
- Franklin, J. C., Puiza, M. E., Lee, K. M., Chung, G., Hanna, E. K., Spring, V. L., & Prinstein, M. J. (2013). The nature of pain offset relief in nonsuicidal self-injury: A laboratory study. *Clinical Psychological Science*, 2, 110-119.
- Gilbert, P., McEwan, K., Irons, C., Bhundia, R., Christie, R., Broomhead, C., & Rockliff, H. (2010). Self-harm in a mixed clinical population: The roles of self-criticism, shame, and social rank. *British Journal of Clinical Psychology*, 49, 563-576.
- Gordon, K. H., Selby, E. A., Anestis, M. D., Bender, T. W., Witte, T. K., Braithwaite, S., Van Orden, K. A., Bresin, K., & Joiner, T. E. (2010). The reinforcing properties of repeated deliberate self-harm. *Archives of Suicide Research*, 14, 329-341.
- Guan, K., Fox, K. R., & Prinstein, M. J. (2012). Nonsuicidal self-injury longitudinally predicts adolescent suicide ideation and attempts in a diverse community sample. *Journal of Consulting and Clinical Psychology*, 80, 842-849.

- Glassman L. H., Weierich, M. R. Hooley, J. M., Deliberto, T. L., & Nock, M. K. (2007). Child maltreatment, non-suicidal self-injury, and the mediating role of self-criticism. *Behavior Research and Therapy*, *45*, 2483-2490.
- Gunderson, J. G. & Ridolfi, M. E. (2001). Borderline personality disorder: Suicidality and self-mutilation. *Annals of the New York Academy of Sciences*, *932*, 61-73.
- Hoff, E. R., & Muehlenkamp, J. J. (2009). Nonsuicidal self-injury in college students: The role of perfectionism and rumination. *Suicide and Life Threatening Behavior*, *39*, 576-587.
- Hooley, J.M. (2007). Expressed emotion and relapse of psychopathology. *Annual Review of Clinical Psychology*, *3*, 329-352.
- Hooley, J. M. (2008). Self-harming behavior: Introduction to the special series on non-suicidal self-injury and suicide. *Journal of Applied and Preventative Psychology*, *12*, 155-158.
- Hooley, J. M., & Delgado, M. L. (2001). Pain insensitivity in the relatives of schizophrenia patients. *Schizophrenia Research*, *47*, 265-273.
- Hooley, J. M, Gruber, S. A, Parker, H., Guillaumot, J., Rogowska, J., & Yurgelun-Todd, D. A. (2009). Cortico-limbic response to personally-challenging emotional stimuli after complete recovery from major depression. *Psychiatry Research Neuroimaging* *171*, 106-119
- Hooley, J. M., Gruber, S.A., Scott, L.A., Hiller, J. B., & Yurgelun-Todd, D. A. (2005). Activation in dorsolateral prefrontal cortex in response to maternal criticism and praise in recovered depressed and healthy control participants. *Biological Psychiatry*, *57*, 809-812.

- Hooley, J. M., Ho, D. T., Slater, J., & Lockshin, A. (2010). Pain perception and non-suicidal self-injury: A laboratory investigation. *Personality Disorders: Theory, Research, and Treatment, 1*, 170-179.
- Hooley, J.M., Siegle, G., & Gruber, S.A. (2012). Affective and neural reactivity to criticism in individuals high and low on perceived criticism. *PLoS ONE, 7*(9) e44412.
- Jacobson, C.M., & Gould, M. (2007). The epidemiology and phenomenology of non-suicidal self-injurious behavior among adolescents: A critical review of the literature. *Archives of Suicide Research, 11*, 129-147.
- Klonsky, E. D. (2009). The functions of self-injury in young adults who cut themselves: Clarifying the evidence for affect regulation. *Psychiatry Research, 166*, 260-268.
- Klonsky, E. D. (2011). Non-suicidal self-injury in United States adults: prevalence, sociodemographics, topography and functions. *Psychological Medicine, 41*, 1981-1986.
- Leknes, S., Brooks, J. C. W., Weich, K., & Tracey, I. (2008). Pain relief as an opponent process: a psychophysical investigation. *European Journal of Neuroscience, 28*, 794-801.
- Leknes, S., Lee, M., Berna, C., Andersson, J., & Tracey, I. (2011). Relief as a reward: Hedonic and neural responses to safety from pain. *PLoS ONE 6*(4): e17870
- Leknes, S., & Tracey, I. (2008). A common neurobiology for pain and pleasure. *Nature Reviews Neuroscience, 9*, 314-320.

- Longe, O., Maratos, F. A., Gilbert, P., Evans, G., & Volker, F. (2010). Having a word with yourself: Neural correlates of self-criticism and self-reassurance. *Neuroimage*, *49*, 1849-1856.
- Masland, S. R., Hooley, J. M., Tully, L. M., Dearing, K., & Gotlib, I. H. (2013). *Perceived Criticism is Associated with Transdiagnostically Relevant Cognitive Processing Biases*. Submitted manuscript.
- Nock, M.K. (2010). Self-injury. *Annual Review of Clinical Psychology*, *6*, 339-363.
- Nock, M. K., Holmberg, E., Photos, V. I., & Michel, B. D. (2007). Self-Injurious Thoughts and Behaviors Interview: Development, reliability, and validity in an adolescent sample. *Psychological Assessment*, *19*, 309-317.
- Nock, M.K., Joiner, T., Gordon, K., Lloyd-Richardson, E., & Prinstein, M. (2006). Non-suicidal self-injury among adolescents: Diagnostic correlates and relation to suicide attempts. *Psychiatry Research*, *144*(1), 65-72.
- Nock, M.K., & Prinstein, M. (2004). A functional approach to the assessment of self-mutilative behavior. *Journal of Consulting & Clinical Psychology*, *72*, 885-890.
- Nock, M. K., Prinstein, M. J., & Sterba, S. K. (2009). Revealing the form and function of self-injurious thoughts and behaviors: A real-time ecological assessment study among adolescents and young adults. *Journal of Abnormal Psychology*, *118*, 816-827.
- Servaas, M. N., Riese, H., Renken, R. J., Marsman, J-B C., Lambregs, J., Ormel, J., & Aleman, A. (2013). The effect of criticism on functional brain connectivity and associations with neuroticism. *PLoS ONE*, *8*(7): e69606.
- St. Germain, S. A. & Hooley, J. M. (2012). Direct and indirect forms of non-suicidal

- self-injury: Evidence for a distinction. *Psychiatry Research*, 197, 78-84.
- St. Germain, S. A. & Hooley, J. M. (2013). Aberrant pain perception in direct and indirect non-suicidal self-injury: An empirical test of Joiner's interpersonal theory. *Comprehensive Psychiatry*, 54, 694-701.
- Swannell, S., Martin, G., Scott, J., Gibbons, M., & Gifford, S. (2008). Motivations for self-injury in an adolescent inpatient sample: development of a self-report measure. *Australian Psychiatry*, 16, 98-103.
- Wedig, M. M. & Nock, M. K. (2007). Parental expressed emotion and adolescent self-injury. *Journal of the American Academy of Child and Adolescent Psychiatry*, 46, 1171-1178.
- Wenzlaff, R. M., Wegner, D. M., & Klein, S. B. (1991). The role of thought suppression in the bonding of thought and mood. *Journal of Personality and Social Psychology*, 60, 500-508.
- Whitlock, J., Eckenrode, J., & Silverman, D. (2006). Self-injurious behaviors in a college population. *Pediatrics*, 117, 1939-1948.
- Wilkinson, P., Kelvin, R., Roberts, C., Dubicka, B., & Goodyear, I. (2011). Clinical and psychosocial predictors of suicide attempts and nonsuicidal self-injury in the adolescent depression antidepressants and psychotherapy trial (ADAPT). *American Journal of Psychiatry*, 168, 495-501.
- Yates, T. M., Tracy, A. J., & Luthar, S. S. (2008). Nonsuicidal self-injury among "privileged" youths: Longitudinal and cross-sectional approaches to developmental processes. *Journal of Consulting and Clinical Psychology*, 76, 52-62.

Figure Caption

Error bars represent 95% confidence intervals.

Figure 1: Change in Pain Endurance Following Experimental Manipulations

