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Emotion Regulation Strategy Choices Following Aversive Self-Awareness in People who Engage in Nonsuicidal Self-Injury and Indirect Self-Injury

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Abstract
Emotion regulation difficulties are implicated prominently in self-injury. Additionally, emotion regulation strategy selection is a core component of the emotion regulation process. Yet it is unclear how people who engage in different forms of self-injury attempt to regulate negative affect when multiple strategies are available to them. This laboratory-based study examined emotion regulation strategy choices in individuals who engage in non-suicidal self-injury (*n*=40), indirect forms of self-injury (disordered eating and problematic substance use; *n*=46), and controls (*n*=48). Following a self-relevant stressor (negative autobiographical memory recall), participants selected one of six strategies based on what they believed would most effectively alter their affect. Strategies spanned behavioral (physical pain, a snack, word activity) and non-behavioral (rumination, reappraisal, doing nothing) domains. Compared to controls, individuals who engage in NSSI and indirect self-injury were more likely to select behavioral strategies. In addition, people with NSSI and indirect self-injury were more likely than controls to choose physical pain and less likely to ruminate. Findings indicate that people with direct and indirect forms of self-injury alike are more likely to take action than engage in further thought when experiencing aversive self-awareness, even when cognitive strategies are made salient. Results illuminate intervention targets for these clinical populations.

Keywords nonsuicidal self-injury (NSSI); indirect self-injury; emotion regulation choice; pain

Emotion regulation is a key component of mental health (Aldao et al., 2015; Bonanno & Burton, 2013; Gross, 2008; Sheppes et al., 2015). However, some of the strategies people use to regulate their emotions can be maladaptive, causing short- or long-term emotional or physical harm. Self-injurious behaviors, for example, are damaging actions often used to regulate emotion (Andover & Morris, 2014; Klonsky & Glenn, 2009; Nock, 2009). These behaviors can be directly or indirectly harming. Non-suicidal self-injury (NSSI) is a direct form of self-injury because such behaviors (e.g., cutting, burning) are intentional and cause immediate physical harm to body tissue (e.g., blood from a self-inflicted wound; Nock, 2009). Indirect self-injury refers to behaviors that do not involve intentional harm to body tissue but are nevertheless damaging and dangerous to the body (St. Germain & Hooley, 2012). Example behaviors here include disordered eating and substance use.

NSSI has been consistently linked to emotion regulation difficulties (Hasking et al., 2020; Wolff et al., 2019). Indeed, emotion regulation is a commonly endorsed reason for engaging in NSSI (Andover & Morris, 2014; Nock, 2009). Additionally, people with NSSI report a heightened intensity and duration of negative emotions (Nock et al., 2008), a tendency to avoid unwanted emotions (Howe-Martin et al., 2012), and a reduced ability to recognize and describe emotions (Greene et al., 2020). They also report having limited access to emotion regulation strategies (Chapman et al., 2006; Perez et al., 2012), as well as a reduced use of generally adaptive strategies such as reappraisal (Voon et al., 2014) and a heightened use of generally maladaptive strategies such as rumination

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and avoidance (Chapman et al., 2006; Hilt et al., 2008; Selby et al., 2013).

Impaired emotion regulation is also implicated in the development and maintenance of substance use and disordered eating (Hasking et al., 2020; Prefit et al., 2019). People report engaging in substance use in part to dampen negative affect or enhance positive affect (Kober, 2014). Relatedly, heightened negative affect is associated with craving and relapse across a range of substances (Holt et al., 2012; Wilcox et al., 2016). People struggling with problematic substance use also report reduced awareness and acceptance of negative emotions, as well as difficulties controlling impulsive behaviors when experiencing negative affect (Fox et al., 2007; Garke et al., 2021). Similarly, across clinical and non-clinical samples, individuals with eating pathology report reduced awareness and acceptance of negative emotion, as well as a reduced use of reappraisal and an increased use of rumination and suppression (Prefit et al., 2019).

Although self-injury represents a relatively extreme form of emotion regulation, emotion regulation preferences more generally have seldom been studied in people who engage in self-injury. This gap in the literature is surprising given that choosing whether to regulate emotions, and selecting an appropriate strategy to do so, are key components of the emotion regulation cycle (see Gross, 2015). Related work indicates that people with NSSI or indirect forms of self-injury report heightened negative urgency (i.e., the tendency to act rashly in response to negative affect; Allen & Hooley, 2019; Wolz et al., 2017) and exhibit difficulty inhibiting behavioral responses when presented with negative stimuli (Allen & Hooley, 2019). These findings suggest that people who engage in self-injury are inclined to engage in maladaptive *behaviors* when experiencing acute negative affect. However, other research indicates that individuals with NSSI tend to ruminate on their negative affect (Selby et al., 2013). This rumination is thought to amplify the intensity of initial negative affect, leading to more extreme emotion regulation behaviors like NSSI and disordered eating (Selby & Joiner, 2013). Accordingly, individuals with self-injury might initially be inclined to engage in *cognitive* strategies when experiencing negative affect.

Much of the prior research in this area has used retrospective self-report measures to assess emotion regulation strategy use. In addition, previous studies have not assessed whether participants' emotion regulation tendencies depend in part on the *type* of emotional challenge that is being experienced, such as whether the stressor is self-relevant (e.g., an academic test) or relatively removed from self-relevance (e.g., a scary movie). This gap in the self-injury literature is noteworthy given robust evidence that the emotion regulation strategies individuals choose, and the effectiveness of these strategies, differ based on context (e.g., whether the stressor is controllable or uncontrollable; Bonanno & Burton, 2013; Troy et al., 2013). Furthermore, research examining emotion regulation in self-injury has focused almost exclusively on cognitive strategies (Voon et al., 2014; Mikhail & Kring, 2019; Weiss et al., 2018). When behavioral strategies are assessed, researchers tend to focus solely on the self-injurious behavior of relevance for the participant sample being studied. Conspicuous by its absence in the literature is a focus on emotion regulation choice across a range of behavioral and cognitive options.

In the current study, we used a novel behavioral paradigm to examine emotion regulation choices among people with NSSI and indirect forms of self-injury. A central aim of this work was to better understand how people who engage in self-injury choose to regulate their emotions when a range of emotion regulation strategies is made salient to them. To enhance ecological validity, a self-relevant stressor was used. Specifically, participants were asked to recall negative autobiographical memories, thus experiencing aversive self-awareness (i.e., negative self-relevant cognitions and emotions; Armey & Crowther, 2008). Following negative autobiographical memory recall, participants were asked to select one of six emotion regulation strategies in response to their affective state. Options included both behavioral (experiencing physical pain, eating a treat, or engaging in a word activity) and non-behavioral (reappraisal, rumination, doing nothing) choices. This allowed for the assessment of group differences in preferences for distinct types of regulation strategies. In addition, we sought to include one behavioral and one cognitive strategy that involved the active initiation of physical pain (via a pressure algometer) or the continuation of emotional pain (via rumination), respectively. This allowed us to explore whether groups differed in their likelihood of selecting maladaptive strategies following negative autobiographical memory recall.

Given evidence that people with self-injury report a limited use of adaptive cognitive emotion regulation strategies such as reappraisal (Perez et al., 2012; Voon et al., 2014), as well as theory that self-injury is used in part to provide an intense physical distraction from aversive thoughts (Selby & Joiner, 2013), we predicted that people with NSSI and indirect forms of self-injury would be more likely than controls to select behavioral strategies following negative autobiographical memory recall. Our prediction that people with self-injury would be more likely to select behavioral strategies was further derived from long-standing evidence that maladaptive behaviors (e.g., binge eating) often occur following aversive self-awareness, and thus may

represent an implicit or explicit motivation to escape from self-awareness (Heatherton & Baumeister, 1991). Accordingly, people who engage in self-injury might be more motivated to escape from aversive self-awareness via behavior, as behavioral engagement facilitates an escape from cognition via immediate physical sensation. Notably however, behaviors need not be self-injurious to enable an escape from self-awareness (e.g., exercise). We therefore believed that participants who engage in self-injury would not necessarily select behaviors that are self-injurious or maladaptive. Rather, these participants might be as likely to select alternative behavioral strategies that are not usually made salient to them (e.g., word activity) when these individuals typically experience negative thoughts and affect.

That said, given that people who engage in NSSI do so in part to regulate negative affect (Nock, 2009), an association between negative affect and physical pain is likely present among these individuals. We therefore also predicted that people with NSSI would be more likely than controls to select physical pain. Additionally, because people with NSSI report a heightened frequency of rumination (Voon et al., 2014), which can precede the self-injurious behavior (Selby et al., 2013), we predicted that people with NSSI would be more likely than controls to select rumination. More broadly, these two predictions were guided by the notion that people who engage in NSSI would be more likely to select strategies involving an active initiation of further pain. That is, people who engage in NSSI might be more likely to select strategies that "match" the negative affect they are experiencing. This conceptualization is related to self-verification theory, which broadly claims that people with generally negative self-concepts are motivated to experience emotions or engage in activities that deliberately or inadvertently verify their negative sense of self (Swann, 2012). We had no specific predictions regarding whether individuals with indirect self-injury would be more likely than controls to select physical pain. However, given the relationship between indirect self-injury and rumination (Prefit et al., 2019; Willem et al., 2011), we predicted that people with indirect self-injury would be more likely than controls to select rumination.

Method

Participants

Participants were 134 adults (*M* age = 26.60; *SD* = 8.82), including controls (*n*=48), individuals with past-year engagement in indirect self-injury (specifically, substance abuse and/or disordered eating) (*n*=46), and individuals with past-year engagement in NSSI (*n*=40). Participants were recruited from the University Psychology Study Pool, the local community (Boston, Massachusetts), and Craigslist (local community and volunteering sections) via printed or online flyers. Consistent with previous work (St. Germain & Hooley, 2012), flyers recruiting for self-injury, both direct and indirect, asked:

"Do you habitually do things or behave in ways that are not in your best interests (for example, getting into or staying in abusive relationships, drinking large quantities of alcohol, using illegal drugs, engaging in eating disordered behaviors, or deliberately causing oneself physical harm [e.g., cutting or burning])?"

The indirect self-injury group was comprised of individuals who endorsed problematic substance use, disordered eating, or both. However, the recruitment flyer for self-injury noted additional forms of indirect self-injury—specifically, getting into or staying in abusive relationships—for two reasons. First, this wording is consistent with the language used in previous studies concerning indirect self-injurious behaviors (St. Germain & Hooley, 2012). Second, we wanted participants to remain unaware of the precise forms of indirect self-injury we were interested in assessing. We believed this approach would therefore reduce the likelihood that participants would report false information simply to enter the study.

Flyers recruiting for controls asked: *"Do you generally take good care of yourself? (For example: maintaining a healthy lifestyle, generally acting in one's best interests)?"* These flyers were displayed alongside each other to reduce the possibility that ineligible individuals might be inclined to erroneously report either pathology or emotional health to participate in the study.

With respect to the NSSI group, we initially sought to recruit participants who had engaged in at least 5 episodes of NSSI in the past year (consistent with DSM-5 proposed criteria for NSSI disorder (APA, 2013)), and at least two times in the past month (to recruit individuals who had engaged in NSSI recently). However, owing to difficulties with recruitment, NSSI inclusion criteria were subsequently broadened to include people who had engaged in NSSI at least once (1+ episode) in the past year. This threshold is consistent with previous research examining people with NSSI recency (Fox et al., 2017).

Due to the high comorbidity between NSSI and indirect self-injury, and following previous research (e.g., Fox et al., 2019; St. Germain & Hooley, 2012), individuals with NSSI who endorsed indirect self-injury remained eligible for participation. In contrast, to be eligible for the indirect self-injury group participants were required to have never engaged in NSSI. Participants in the indirect self-injury group were also required to endorse indirect self-injurious behaviors (i.e., answer "yes" to the question, *"Do you*

habitually do things or behave in ways that are not in your best interests?") and to have engaged in at least one of the endorsed forms of indirect self-injury (disordered eating behaviors, substance abuse, or both) at least 5 times in the past year (i.e., 5 separate episodes of drinking, drug use, or disordered eating), with at least 2 separate episodes occurring in the past month. These frequency and recency criteria reflect those of our original criteria for the NSSI condition.

To qualify for the control group, participants were required to have never engaged in NSSI, report no problematic indirect self-injurious behaviors (i.e., answer "no" to the question, *"Do you habitually do things or engage in ways that are not in your best interests?"*), and meet healthy cut-off scores on a brief online screener assessing elevated past-year psychopathology.

Materials

Eligibility Screener. Participant eligibility and group assignment were established via an eligibility questionnaire. This included items about past month and past year engagement in NSSI, substance use, and disordered eating behaviors. Information about current and past-year psychopathology was also collected. Additional eligibility criteria included English fluency, normal-to-corrected vision, 18+ years of age, absence of a severe learning disability, and ability to travel to the laboratory building.

Consistent with previous work (Fox et al., 2019), to screen for NSSI we asked *"How many separate times [in the past month/past year] did you engage in NSSI? Please only include those times that drew blood or left a mark lasting for at least a few days."* To screen for disordered eating behaviors, we asked about monthly and yearly engagement in restrictive eating, binge-eating, and purging behaviors. To assess restrictive eating, one item from the Dietary Restriction Screener (Haynos & Fruzzetti, 2015) was used: *"How many times [in the past month/past year] did you engage in restrictive eating because you were concerned about your body shape and/or weight?"* To assess binge-eating and purging, two items from the Eating Disorder Examination-Questionnaire (Fairburn & Beglin, 2008) were used: (1) *"How many times [in the past month/past year] have you eaten what other people would regard as an unusually large amount of food given the circumstances) AND had a sense of lost control over your eating?"* and (2) "*How many times have you done any of the following as a means of controlling your shape or weight: made yourself sick (e.g., vomited), taken laxatives, exercised in a 'driven' or 'compulsive' way?"* Similarly, the item screening for substance use asked: *"How many times [in the past month/past year/ your life] have you taken illegal drugs OR had 5+ drinks of alcohol within one sitting?"* To reduce participants' awareness of the forms of indirect self-injury that we were specifically interested in studying, the eligibility screener also included items about reckless driving and promiscuous sexual activity.

Global Appraisal of Individual Needs Short Screener 3.0 (GAIN-SS 3.0). To screen for elevated past-year psychopathology, the GAIN-SS 3.0 (Dennis et al., 2013) was used. The GAIN-SS 3.0 is a brief self-report screening instrument with demonstrated reliability and validity for the detection of diagnosable psychiatric disorders. In addition, this measure demonstrates accurate discrimination between individuals with and without a past-year or current psychiatric disorder (Dennis et al., 2013). The GAIN-SS 3.0 assesses risk for internalizing disorders (e.g., depression, anxiety, psychosis), externalizing disorders (e.g., attention-deficit hyperactivity disorder, conduct issues, gambling), substance disorders (use, abuse, and dependence), and crime/violence (e.g., interpersonal violence, drug-related violence, and property crime). Individuals assigned to the control group were required to meet healthy-cut off scores on all sections of the GAIN-SS.

Demographics Survey. Our demographics survey collected information about participants' age, sex at birth, gender, sexual orientation, race, and education level.

Eating Pathology Symptom Inventory (EPSI). The EPSI (Forbush et al., 2013) is a well-validated measure assessing eating pathology over the past four weeks. This questionnaire contains 45 items with 8 subscales assessing body dissatisfaction, binge eating, cognitive restraint, purging, restricting, excessive exercise, negative attitudes towards obesity, and muscle building. Items are on a 0-5 Likert scale where 0 = *Never* and 4 = *Very often*. Sample items include *"I felt that I needed to exercise nearly every day"* and *"I skipped two meals in a row"*. The EPSI has demonstrated strong measurement invariance, good-to-excellent internal consistency and test-retest reliability, and excellent convergent and discriminative validity (Forbush et al., 2013).

Drug Abuse Screening Test (DAST). The DAST (Skinner, 1982) is a 20-item measure of current and lifetime problems related to drug use. Items are presented in a yes and no format and summed, with higher scores indicating heightened problematic drug use. Sample items include *"have you ever neglected your family or missed work because of your use of drugs?"* and *"are you always able to stop using drugs when you want to?"* The DAST has shown good internal consistency, good discriminant validity, and successful discrimination between those with problematic alcohol use versus those with other substances (Yudko et al., 2007).

Michigan Alcohol Screening Test (MAST). The MAST (Selzer, 1971) is a 24-item measure of current and lifetime problems related to excessive alcohol use. Items are presented in a yes or no format and summed, with higher scores indicating heightened problematic alcohol engagement. Sample items include *"has your drinking ever created problems between you and your wife, husband, a parent, or other relative?"* and *"have you ever been in a hospital because of drinking?"* The MAST has demonstrated strong internal consistency, strong convergent validity, and good test-retest reliability (Minnich et al., 2018).

Beck Depression Inventory II (BDI-II). The BDI-II (Beck et al., 1996) is a widely used self-report questionnaire that assesses the severity of 21 depressive symptoms (e.g., anhedonia, difficulty concentrating, change in appetite) over the past week using a 0 = *Not at all* to 3 = *Most severe* scale. The BDI-II has demonstrated high internal consistency (Beck et al., 1996) and test-retest reliability (Beck et al., 1996).

The Self-Injurious Thoughts and Behaviors Interview (SITBI). The SITBI (Nock et al., 2007) is a comprehensive semi-structured interview used to assess the presence, severity, frequency, and characteristics of suicidal and nonsuicidal thoughts and behaviors. Items are a combination of Likert scale, open-ended, and binary (Yes/No) responses. The SITBI is a widely used measure that has demonstrated strong interrater reliability and strong convergent construct validity (Nock et al., 2007).

Need for Cognition (NFC). The NFC (Cacioppo et al., 1984) is an 18-item measure that assesses an individual's tendency to engage in and enjoy cognitive endeavors. Items are rated on a 1-5 Likert scale, where 1 = *Extremely uncharacteristic of me* and 5 = *Extremely characteristic of me.* Summed scores indicate higher engagement and enjoyment in activities requiring thinking. Sample items include: *"I find satisfaction in deliberating hard and for long hours"* and *"I like to have the responsibility of handling a situation that requires a lot of thinking"*. The NFC scale has demonstrated strong construct validity and discriminant validity (Cacioppo et al., 1984).

Visual Analog Scale (VAS). Negative and positive affect were measured using two separate VASs throughout the study. These scales were identical to those used by Fox and colleagues (2017). VASs were presented on a computer screen. Participants were asked *"how negative do you feel right now?"* and *"how positive do you feel right now?"* on scales ranging from 0 = *Not at all* to 100 = *Extremely*. As with previous research (Fox et al., 2017), we assessed the validity of VAS ratings by examining the relationship between baseline VAS ratings and past week depression scores using Pearson correlations. Higher VAS baseline ratings for negative affect were associated with heightened depressive symptoms in the past week (assessed via the BDI-II), $r(118) = .41$, $p < .0001$. Additionally, higher baseline VAS ratings for positive affect were associated with lower scores on the BDI-II over the past week, $r(120) = -.54$, $p < .0001$.

Assessment of Attention and Emotion Regulation Strategy Choices. After completing the emotion regulation choice paradigm, participants answered questions about the extent to which they were fully immersed in the activity. Consistent with previous research in this domain (Sheppes et al., 2011), participants were asked: (1) *How much were you paying attention to the task?* (2) *How distracting did you find this task?* (3) *How pleasant did you find this task?* and (4) *How unpleasant did you find this task?* All questions were answered on a 0-4 Likert scale, where 0 = *Not at all* and 4 = *Extremely*. We planned *a priori* to exclude any participants who selected 0 or 1 when asked about how much they were paying attention to the task; however, no participant selected this response. Responses on this item, as well as observations of participants during the study via a one-way mirror (described further in Procedures), suggest that participants were attentive during study procedures and followed task instructions.

To reduce other sources of potential confounds, we asked participants who chose to eat a treat to rate their hunger level on a 1-5 scale (1 = *Not at all* and 5 = *Extremely*). We intended to remove participants who reported that they were extremely hungry; no participant selected this response. Similarly, participants who selected reappraisal during the emotion regulation choice paradigm were asked to provide examples of how they implemented this strategy. Responses indicated that participants who selected reappraisal followed instructions accurately (i.e., positively reframed the situation).

Positive Affect Induction. To ensure participants left the laboratory in a positive affective state, we administered an established positive affect induction at the end of the study following the approach used by Hooley and St. Germain (2014). Participants were provided with a list of 21 positive traits (e.g., honest, courageous, kind) and asked to identify three positive traits they believe they have. Participants then talked for five minutes about specific times they behaved in a way that was consistent with each of the traits they endorsed. Following this, participants were provided with a debriefing form and compensated for their time.

Procedures

This study received ethics approval by Harvard's Institutional Review Board. Participants who expressed interest in the study by contacting the laboratory e-mail address were assigned a randomized

subject ID and sent a link to the screening questionnaire on Qualtrics (*N*= 1007). Following online screening, eligible participants were scheduled for a two-hour in-person laboratory session as part of a larger project on emotion regulation choice in self-injury. Participants received either course credit or monetary compensation ($10.00 per hour) for their participation. At the lab visit, participants were provided with a consent form outlining the broader goals and aspects of the study. Consent was indicated via a signature on the form.

Emotion Regulation Choice Instructions. After giving informed consent, participants were seated at a study computer in the laboratory testing room and provided verbal instructions for the emotion regulation choice task (full instructions in the Supplementary Materials). They were told that at some point, they would be asked to choose one of several strategies to alter their affect. Specifically, participants were asked to select a strategy *based on whatever mood they were feeling at the time they were asked to make a choice* and based on what strategy they believed would *most effectively change their current mood*. Participants were then presented with instructions regarding the six strategies. Strategies were presented to participants in randomized order. Instructions for rumination and reappraisal were adapted from previous literature involving rumination and reappraisal inductions (Grisham et al., 2011; Ray et al., 2008).

Several research design decisions were implemented to reduce the presence of confounds in the emotion regulation choice task. To avoid the possibility that terms such as "pain" or "rumination" would be interpreted negatively, we used the labels "feel pressure" and "think more", respectively, for these strategies. We also replaced the technical term "reappraisal," instead naming it "reinterpret". Another concern was that the "do nothing" strategy, which was included to allow participants to choose not to engage in any specific physical or cognitive action, might create an inadvertent opportunity for rumination. Instructions for the "do nothing" strategy therefore asked participants to stay in the present moment and focus on their breath if they found that they were thinking of the past or future. Although this might appear like asking participants to be mindful, the instructions emphasized doing nothing in response to any changes in affect. Finally, to reduce the likelihood that participants might select behavioral strategies based on visual cues (e.g., seeing the snacks or the pressure algometer), all behavioral emotion regulation strategies were hidden from participants' view prior to strategy selection.

Negative Affect Induction. Following Fox and colleagues (2017), participants were asked via instructions on a computer screen to "think about all of the times in which you failed or let yourself down in your life". Of these events, participants were asked to select the event that had the most negative impact on them and to write about the negative event for 5 minutes. The prompt further stated:
"Please include details regarding the event itself, how you felt about yourself before and after the event occurred, who was involved, and all of the different consequences of that event. Think as vividly as you can about the memory, including what you were feeling in your mind and body, etc. If you run out of things to write, read over your writing until the time is up."

Emotion Regulation Choice Task. After the negative affect induction, participants were asked via the computer screen to choose one of the six emotion regulation strategy choices based on their current affect. Participants then selected the number on the keyboard that corresponded with the strategy they wanted to implement. In line with previous work on emotion regulation choice (Sheppes et al., 2011), participants were given unlimited time to select their preferred strategy. After choosing a strategy, participants were taken to a screen that reiterated instructions for how to execute their respective strategy and received additional information as needed. If participants chose behavioral strategies, instructions were provided about where in the room to obtain the relevant materials. Additionally, participants who chose to endure physical pain were given instructions about how to place their finger in a pressure algometer (see Hooley et al., 2010 for details).

Participants then executed their chosen emotion regulation strategy for four minutes (or, if choosing physical pain or eating a snack, until they removed their finger from the pressure algometer or finished consuming the food, respectively, with a maximum of four minutes). Throughout this task, participants were alone in a testing room and observed by an experimenter through a one-way mirror.

Questionnaires. Following the emotion regulation choice task, participants completed a battery of questionnaires via the Qualtrics website.

Data Analytic Plan

Data were cleaned and analyzed in R 3.5.0 (R Core Team, 2013). Prior to analyses, data from eight participants were removed (*N*=142 to *N*=134). Specifically, six participants changed their answers to the screening questions and no longer met eligibility criteria. Two other participants displayed erratic behavior during the study (mumbling to self, displaying evidence of hallucinations), leading to concerns about the integrity of their data.

To assess group differences in demographic variables, linear regression (for age) and chi square analyses (for all other demographic variables) were used. We also gathered descriptive data for our NSSI

Table 1. Participant Characteristics

Demographics	Control (n = 48)		Indirect Self-Injury (n = 46)		NSSI (n = 40)		p
Sex (*n, %*)							.18
Female	23 (47.92%)		31 (67.39%)		24 (60.00%)		
Male	25 (52.08%)		15 (32.61%)		15 (37.50%)		
Other	0 (0.00%)		0 (0.00%)		1 (2.50%)		
Gender (*n, %*)							.24
Female	23 (47.92%)		31 (67.39%)		24 (60.00%)		
Male	25 (52.08%)		14 (30.43%)		15 (37.50%)		
Other	0 (0.00%)		1 (2.17%)		1 (2.50%)		
Sexual Orientation (*n, %*)							.003
Heterosexual/Straight	44 (91.67%)		39 (84.78%)		22 (55.00%)		
Homosexual/Gay	2 (4.17%)		2 (4.35%)		4 (10.00%)		
Bisexual	0 (0.00%)		5 (10.87%)		12 (30.00%)		
Not Sure	1 (2.08%)		0 (0.00%)		1 (2.50%)		
Prefer Not to Say	1 (2.08%)		0 (0.00%)		1 (2.50%)		
Race (*n, %*)							.21
Black/AA	7 (14.58%)		7 (15.22%)		3 (7.50%)		
White	21 (43.75%)		26 (56.52%)		21 (52.50%)		
Asian	13 (27.08%)		11 (23.92%)		10 (25.00%)		
Hispanic/Latinx	2 (4.17%)		0 (0.00%)		2 (5.00%)		
Native American	0 (0.00%)		1 (2.17%)		0 (0.00%)		
Mixed/Other	5 (10.42%)		1 (2.17%)		4 (10.00%)		
Education Level (*n, %*)							.44
Some High School	0 (0.00%)		0 (0.00%)		0 (0.00%)		
High School Degree or Equivalent	6 (12.50%)		7 (15.22%)		5 (12.50%)		
Some college	17 (35.42%)		8 (17.39%)		14 (35.00%)		
2-year college degree	1 (2.08%)		1 (2.17%)		3 (7.50%)		
4-year college degree	13 (27.09%)		12 (26.09%)		10 (25.00%)		
Master's Degree	10 (20.83%)		15 (32.61%)		5 (12.50%)		
Professional degree (e.g., JD, MD, PhD)	1 (2.08%)		3 (6.52%)		3 (7.50%)		
	M	*SD*	*M*	*SD*	*M*	*SD*	
Age	26.10	9.03	28.00	9.36	25.60	7.90	.42

sample characteristics and assessed characteristics of our indirect self-injury sample with a one-way multivariate analysis of variance (MANOVA). The effectiveness of the negative affect induction was examined using two paired-samples t-tests (for positive and negative affect). To examine group differences in preferences for behavioral versus non-behavioral strategies, we conducted a binomial logistic regression. Strategy type (behavioral versus non-behavioral) served as the two-level outcome variable and was regressed onto group, with controls serving as the reference category for the group predictor variable. Negative affect change (pre- to post-induction) was included as a covariate. In addition, given that willingness to expend cognitive effort is associated with how much one enjoys and engages in cognitive activities (Sandra & Otto, 2018), need for cognition (i.e., summed score on the NFC scale) was included as a covariate.

We conducted two subsequent binomial logistic regressions to examine group differences in strategy choices that involved either creating or prolonging a painful experience (i.e., physical pain and rumination, respectively). Strategy type (model 1: physical pain; model 2: rumination) versus all other strategies served as the two-level outcome variable, with ontrols again serving as the reference group. For both models, negative affect change (pre- to post-induction) was included as a covariate.

Results

Descriptive Statistics

Participant characteristics are presented in Table 1. The groups did not differ on age, sex, gender, race, or education level (all *p*s>.17). Group differences were present for sexual orientation, such that there were more individuals who identified as lesbian, gay,

Table 2. Emotion Regulation Strategy Choices Across Groups

Choice	Control (n = 48)	Indirect Self-Injury (n = 46)	NSSI (n = 40)
Eat Snack ("Eat Treat") (*n, %*)	7 (14.58%)	9 (19.57%)	7 (17.50%)
Pain ("Feel Pressure") (*n, %*)	3 (6.25%)	10 (21.74%)	11 (27.50%)
Word Activity ("Write Words") (*n, %*)	8 (16.67%)	8 (17.39%)	7 (17.50%)
Reappraise ("Reinterpret") (*n, %*)	11 (22.92%)	10 (21.74%)	3 (7.50%)
Ruminate ("Think More") (*n, %*)	9 (18.75%)	3 (6.52%)	2 (5.00%)
Do Nothing ("Do Nothing") (*n, %*)	10 (20.83%)	6 (13.04%)	10 (25.00%)

Note. Phrases in quotations refer to the name of the strategies as presented to participants.

bisexual, or other (LGB+) in the NSSI group (p=.003). This is consistent with evidence that people who identify as LGB+ are at greater risk for NSSI (Taylor et al., 2018). Results described below did not differ when sexual orientation was included as a covariate (collapsed as a binary variable with LGB+ = "0" and heterosexual = "1" to preserve degrees of freedom).

NSSI Sample Characteristics. All participants in the NSSI group reported at least one past year NSSI episode that resulted in skin damage. Given that participants reported a wide range of NSSI episodes, both the mean and median of NSSI episodes are reported here. The mean number of past-year NSSI episodes was 7.32 episodes (SD = 17.44, Mdn = 3), and the mean number of lifetime NSSI episodes was 76.76 (SD = 259.70, Mdn = 12). Most participants reported no NSSI episodes in the past month (M = 1.94, SD = 4.62, Mdn = 0). Participants reported several methods for NSSI, with 50.00% endorsing self-cutting and 50.00% endorsing self-hitting. Additional methods included scraping skin and drawing blood (45.00%), biting (22.50%), burning (20.00%), inserting a sharp object into skin and drawing blood (10.00 %), and "other" (e.g., self-inflicted pain using ropes, choking self; 7.50%). On average, participants began engaging in NSSI at 14.35 years old (SD = 4.20). One participant reported receiving medical treatment for NSSI-related wounds. Most participants reported a moderate to strong desire to stop engaging in NSSI; on a scale of 0 = *Not at all* to 4 = *Extremely*, the mean score was 3.19 (SD = 1.01).

Indirect Self-Injury Sample Characteristics. Among eligible participants who endorsed indirect self-injury, 33 (71.74%) reported disordered eating (restrictive eating, bingeing and/or bingeing/purging) and 18 (39.13%) endorsed problematic substance use (alcohol and/or drug use). Five participants (10.87%) endorsed both disordered eating and problematic substance use.

To further assess sample characteristics, we conducted a MANOVA examining between-group differences (across NSSI, indirect self-injury, and control groups) in problematic alcohol use (measured with the MAST), problematic drug use (measured with the DAST), and disordered eating (using the summed score across EPSI subscales). Because the assumption of normality was violated (verified via Shapiro-Wilk tests and qqplots), we ran a non-parametric MANOVA using Wilks' lambda with 1,000 permutations via the *npmv* package in R (Burchett et al., 2017). A main effect for the MANOVA was present (F(6,248) = 10.68, p<0.0001), as well as significant group differences for each outcome variable. Tukey's post-hoc analyses on subsequent univariate ANOVAs for drug use and alcohol use showed that people with NSSI reported significantly heightened drug use compared with controls (NSSI M = 3.16, SD = 4.48; Control M = 0.787, SD = 0.93; *95% CI* = 0.77 – 2.37; p = 0.002). In addition, people with NSSI reported significantly heightened alcohol use compared with controls (NSSI M = 7.82, SD = 8.77; Control M = 3.62, SD = 3.55; *95% CI* = 0.87 – 7.52; p = 0.02). Given that the homogeneity of variance assumption was violated for the disordered eating ANOVA, the Games-Howell post-hoc test was

used. Both participants with NSSI and those with indirect self-injury endorsed significantly heightened disordered eating relative to controls (NSSI $M = 67.60$, $SD = 25.20$; Control $M = 35.50$, $SD = 17.60$; *95% CI* = 21.00 – 43.70; $p < .0001$;

Indirect $M = 56.00$, $SD = 21.90$; *95% CI* = 9.95 – 29.90; $p < .0001$). A between-group difference for disordered eating also emerged for the NSSI and indirect groups, such that participants with NSSI reported heightened disordered eating (*95% CI* = -0.0003 – 12.40; $p = .05$).

Negative Affect Induction

Negative affect increased following the negative affect induction (pre-induction: $M = 30.11$, $SD = 22.65$; post-induction: $M = 46.95$, $SD = 27.81$; $t(121) = 8.02$, $p < .0001$; *95% CI:* 12.28 – 20.33; Cohen's $d = 0.66$). Additionally, positive affect decreased (pre-induction: $M=65.90$, $SD=21.60$; post-induction: $M = 50.93$, $SD = 25.08$), $t(123)= -8.09$, $p < .0001$; *95% CI:* -18.23 –-11.06; Cohen's $d = 0.64$).

Emotion Regulation Strategy Selection

Strategy selection choices across groups are provided in Table 2. Among people with NSSI and indirect self-injury, 25 (62.50%) and 27 (58.70%) selected behavioral strategies, respectively, compared with 18 (37.50%) controls. In addition, 11 (27.50%) participants with NSSI and 10 (21.74%) participants with indirect self-injury chose to experience physical pain, whereas only 3 (6.25%) controls selected this strategy. Contrary to expectation, 9 (18.75%) controls chose to ruminate, compared with two (5.00%) participants with NSSI and three (6.52%) participants with indirect self-injury.

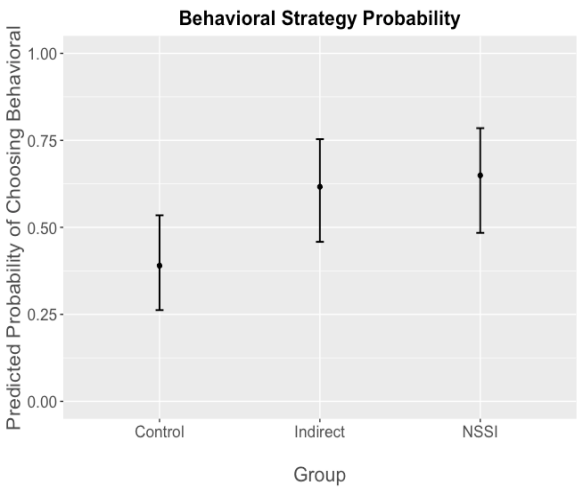
Behavioral versus Non-Behavioral Strategies

Results indicated a significant effect of group on emotion regulation choice, such that participants who engaged in NSSI were more likely than controls to select behavioral strategies to regulate their negative affect (*OR* = 2.90; *95% CI:* 1.20 – 7.29; *p = 0.02*). This was also the case for those who engaged in indirect self-injury (*OR* = 2.52; *95% CI:* 1.05 – 6.19; *p = 0.04*). Neither heightened acute negative affect nor need for cognition was associated with strategy choice (*OR* = 1.00). Predicted probabilities across groups are presented in Figure 1.

Pain-Oriented Strategies: Physical Pain and Rumination

Results from the binomial logistic regression assessing preferences for physical pain (feel pressure = "1" vs. all other strategies = "0") indicated that individuals with NSSI showed a heightened selection of physical pain compared with controls (*OR* = 4.98; *95% CI:* 1.37 – 23.85; p=0.02. An effect in the same direction emerged for those with indirect self-injury compared with controls, though this effect did not meet conventional significance (*OR* = 3.66; *95% CI:* 0.99 – 17.61; p=0.06). For predicted probabilities across groups, see Figure 2a. Results from the rumination model (rumination = "1" vs. other strategies = "0") indicated that people with indirect self-injury were significantly *less* likely than controls to select rumination (*OR* = 0.18; *95% CI:* 0.02 – 0.76; $p = 0.04$). A similar effect emerged for individuals with NSSI, though this effect did not meet conventional significance (*OR* = 0.20; *95% CI:* 0.03 – 0.88; p = 0.055). For predicted probabilities across groups, see Figure 2b.

Figure 1. Predicted Probability of Selecting Behavioral Strategies by Group

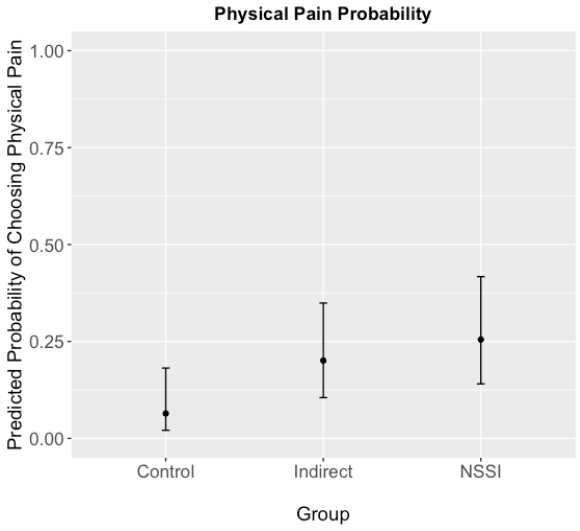


Note. Predicted probabilities of choosing behavioral strategies (relative to cognitive strategies) across controls, people with indirect self-injury, and people with NSSI, holding negative change and need for cognition constant at their means. Bars reflect 95% confidence intervals.

Discussion

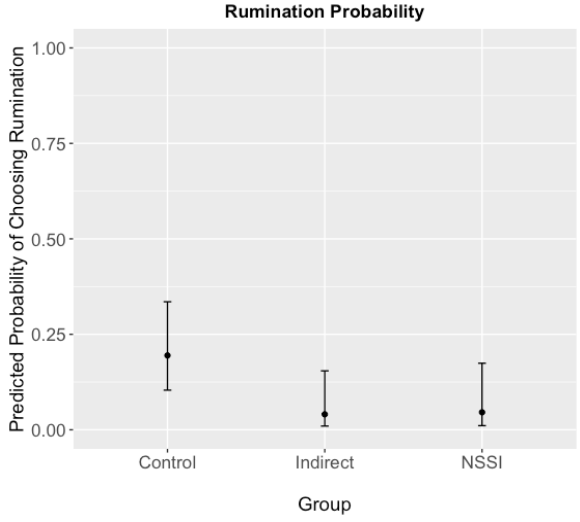
This study is the first to date examining emotion regulation choices in people with NSSI and indirect self-injury following a self-relevant stressor (here, negative autobiographical memory recall). By examining regulation strategies that differ in form (behavioral versus non-behavioral), and in the extent to which these strategies involve an active initiation of physical pain or a continued focus on emotional pain, this research provides a nuanced glimpse into how people who engage in self-injury might respond to self-relevant negative affect.

Figure 2a. Predicted Probability of Selecting Physical Pain by Group



Note. Predicted probabilities of preferences for physical pain (relative to all other strategies), with negative affect change held constant at its mean. Bars reflect 95% confidence intervals.

Figure 2b. Predicted Probability of Selecting Rumination by Group



Note. Predicted probabilities of preferences for rumination (relative to all other strategies), with negative affect change held constant at its mean. Bars reflect 95% confidence intervals.

Findings provide support for the notion that people with NSSI prefer behavioral strategies when experiencing aversive self-awareness. This effect was also present for people with indirect forms of self-injury. In addition, the current research provides preliminary evidence regarding preferences for strategies that are generally viewed as more maladaptive (i.e., causing physical pain to the body or engaging in rumination). As expected, people with NSSI showed a heightened preference for physical pain compared with controls. People with indirect self-injury also showed this preference, though this effect did not meet significance. Nonetheless, given that nearly 22.00% of those with indirect self-injury chose to experience physical pain, these results give some cause for concern. Indeed, this group reported no past experience with NSSI, so having a history of pain offset relief learning (such as that associated with NSSI; Hooley & Franklin, 2018) cannot explain their emotion regulation choice. However, this finding does align with recent evidence indicating that people with disordered eating sometimes engage in disordered eating behaviors with the intention of hurting themselves physically (Fox et al., 2019). Future work should continue to examine the association between indirect self-injury and use of physically painful emotion regulation strategies in response to self-relevant negative affect. Additionally, future research could assess whether seeking physical pain in response to negative affect is a predictor of future NSSI engagement in those with indirect self-injury.

Contrary to expectation, healthy controls showed a *heightened* likelihood of regulating their negative affect by engaging in rumination relative to those with indirect self-injury. This was also the case for controls when compared with individuals with NSSI, though this effect did not meet significance. These findings are surprising given robust evidence for an association between rumination and self-injury (NSSI and indirect; Voon et al., 2014; Prefit et al., 2019). Though the instructions for rumination were adopted from that of previously validated rumination inductions (Grisham et al., 2011; Ray et al., 2008), control participants might have interpreted the instructions of this strategy, or the name used ("think more"), to mean that the strategy involved adaptive self-reflection. Future research could examine whether distinct names and descriptions for strategies modify the likelihood that participants, healthy and unhealthy alike, will select those strategies. As an alternative interpretation of the present findings, participants with self-injury might have been implicitly or explicitly dissuaded from selecting rumination because the strategy asked them to engage in further thought. This latter interpretation is in line with this paper's main finding indicating that people with NSSI or indirect self-injury prefer to act than to engage in thought following aversive self-awareness.

Notably, 25% of people who engage in NSSI opted to do nothing to regulate their negative affect. Given that we emphasized to participants that the "do nothing" strategy entailed not doing anything in response to their negative affect, this strategy can be

considered a marker of inaction in response to distress. Accordingly, when considered alongside the finding that people with NSSI tend to prefer behavioral strategies, this descriptive finding provides preliminary support for the notion that some people with NSSI are neither inclined to act nor to engage in effortful thought when confronted with self-relevant negative affect. Doing nothing in response to negative affect can also be viewed as a willingness to endure the negative affect. Under this conceptualization, doing nothing is similar to pain-oriented strategies (here, physical pain and rumination). However, one important distinction between these strategies is that doing nothing involves a *passive* response to negative affect, whereas physical pain and rumination involve an *active* initiation of pain via physical means or via perseverating on the negative stimulus that first elicited the emotional pain (e.g., a negative autobiographical memory).

Although we conceptualized the "do nothing" strategy as a passive response, in some cases this strategy might reflect an *active* effort to accept and persevere despite the presence of negative affect. Accordingly, doing nothing could be a helpful regulation strategy if used in a resilient manner. Though we do not know whether this is indeed the case, it is worth noting that a considerable portion of controls did opt to do nothing (20.83%). Whether this finding has any prognostic significance with respect to the likelihood of the onset of future emotional difficulties remains an open question.

A deeper understanding of emotion regulation strategy preferences and strategy tendencies among people with self-injury has important implications for clinical intervention approaches. For example, the current results show that reappraisal, though a generally effective strategy for reducing negative affect, does not appear to be a *preferred* strategy for people with NSSI, with only 7.50% of the NSSI sample choosing this strategy. Asking patients who engage in NSSI to use reappraisal in such circumstances may not be the most effective general approach. Relatedly, research suggests that people who engage in NSSI tend to find writing about their positive characteristics less enjoyable and more annoying than writing about negative or upsetting topics (Hooley et al., 2018). Rather than trying to encourage reappraisal or activate positive self-schemas, clinicians might first suggest behavioral strategies that patients with NSSI could use when confronted with acute self-relevant negative affect. Still, reappraisal is a powerful emotion regulation strategy that can alleviate negative affect and enhance positive affect. Reappraisal is therefore likely a good technique to use in therapy with this population. Indeed, having patients execute reappraisal (inside and outside of sessions) may help patients become more adept at using this strategy in their daily lives (Denny & Ochsner, 2014). It may also behoove clinicians to explicitly assess whether patients with self-injury prefer behavioral or cognitive strategies, and to learn what types of behavioral strategies patients believe might be effective when experiencing negative affect regarding the self. Patients might also benefit from tracking behavioral and cognitive strategy use in daily life to better understand *when* they tend to prefer behavioral versus cognitive strategies.

One limitation of this study is that a relatively large number of emotion regulation strategies were presented to participants. This may have influenced participants' expectations about the efficacy of the strategies (Bigman et al., 2017). However, a benefit of offering more strategies to participants is that the resulting selection process may be more naturalistic and reflective of daily life. Though people have greater difficulty maintaining awareness of emotion regulation options when experiencing heightened negative affect (Linehan et al., 2007), a cornerstone of cognitive behavioral therapy entails providing individuals with a repertoire of cognitive and behavioral strategies to use when they are in distress. The present work illuminates what emotion regulation strategies people might use when several strategies are salient.

Relatedly, the emotion regulation strategies used in this work varied across several dimensions. We assessed two dimensions: form of strategy (behavioral and non-behavioral) and whether the strategy involved pain (physical or emotional). However, these strategies could be conceptualized in alternative ways. For example, the behavioral strategies used in this work could be viewed as distractions from negative affect, whereas the non-behavioral strategies could be conceptualized as confronting negative affect—specifically, perseverating on, sitting with, or reframing the negative affect (rumination, do nothing, and reappraisal, respectively). Strategies also varied in how much effort they required of participants, with strategies such as doing nothing or eating a treat involving relatively low effort and reappraisal requiring a greater effort from participants. In light of recent work indicating that perceived effort plays a role in emotion regulation choice (Scheffel et al., 2021), future research could take perceived effort into account when examining relationships between self-injury and emotion regulation.

The current research focused on negative affect stemming from negative autobiographical memories. Future studies on emotion regulation choice in self-injury could examine whether choices differ based on the type of stimuli eliciting negative affect (e.g., a self-relevant versus non-self-relevant stimulus), or across distinct type of negative emotions (e.g., shame, anger). Future research could also focus on positive emotions, assessing how people with self-injury choose to

regulate when experiencing positive affect more broadly, or distinct positive emotions (e.g., pride, joy) in particular. Indeed, positive affect has been generally neglected in self-injury research, especially with respect to NSSI (Perini et al., 2021).

Finally, because the indirect self-injury group included individuals with problematic substance use or disordered eating (or their co-occurrence), it is unclear whether these sub-groups would show similar emotion regulation choices when considered separately. Future research could compare individuals with problematic substance use (and no disordered eating) to those with disordered eating (and no problematic substance use) to examine the extent to which emotion regulation choices differ for people with distinct forms of indirect self-injury. Additionally, given preliminary evidence that people with different eating disorder subtypes have distinct types of emotion regulation difficulties (Danner et al., 2014), future research could examine whether individuals with distinct forms of disordered eating show different emotion regulation choices when experiencing negative affect. The same approach could be taken for subtypes of problematic substance use. Future work might use such statistical techniques as latent class analysis to examine whether there are subgroups of individuals, within and across self-injurious behaviors, who tend to choose specific emotion regulation strategies consistently. Such analyses could illuminate individual differences that underlie these tendencies.

Additional Information

Supplementary Materials

Supplementary materials for this article can be viewed here: https://osf.io/xuzdb.

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Conflict of Interest

The authors report no conflict of interest.

Ethical Approval

This study received ethics approval by Harvard's Institutional Review Board.

Data Availability

Data and corresponding code script available on request.

Author CRediT Statement

C.B. and J.M.H. conceptualized the study and designed this research; C.B. conducted the study and analyzed data; C.B. wrote first draft of the manuscript and J.M.H. added additional content and provided critical revisions. Both authors have approved the final manuscript.

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