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ScienceDirect

Behavior Therapy 50 (2019) 1002–1012

Behavior Therapy

www.elsevier.com/locate/bt

A Daily Diary Investigation of the Defective Self Model Among College Students With Recent Self-Injury

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The Defective Self Model of self-injury (Hooley, Ho, Slater, & Lockshin, 2010) asserts that individuals choose to self-injure to gratify the desire for self-punishment associated with a self-critical cognitive style. Specifically, self-injury is used to regulate negative self-directed thoughts and emotions and is made accessible via the belief that the individual deserves punishment. This study sought to test primary assumptions of the Defective Self Model using a 2-week daily diary protocol. It was hypothesized that trait self-criticism would predict daily self-injury urge intensity and behaviors directly, as well as indirectly, through daily thoughts about deserving punishment. We also posited that guilt would predict self-injury urge intensity and behaviors beyond sadness, hostility, and fear. Support for primary hypotheses was mixed. Self-criticism did not directly predict self-injury outcomes, but did indirectly predict urge intensity through daily thoughts about punishment. Daily guilt predicted self-injury urge intensity beyond daily sadness, hostility and fear and was the only type of negative affect associated with self-injury behavior. Results are primarily contextualized through a social cognitive lens in which self-injury urge is precipitated by the activation of a self-critical schema in daily life. Alternatively, self-criticism may serve as a gateway to initial self-injury but lack the sensitivity to predict individual self-injury episodes. Treatments designed to reduce self-critical thoughts and bolster self-compassion may decrease self-injury urge intensity, thereby affecting the frequency of self-injury episodes.

Keywords: non-suicidal self-injury; defective self model; self-criticism; self-punishment; daily diary

NONSUICIDAL SELF-INJURY (NSSI) describes intentional and self-inflicted destruction of bodily tissue in the absence of suicidal desire or culturally sanctioned practices (Nock, 2010). Common forms of NSSI include cutting, scratching, burning, carving, and self-hitting (Klonsky, 2007). Lifetime prevalence rates of NSSI in nonclinical samples are estimated to be approximately 17.8% in adolescents, 13.4% in young adults, and 5.5% in adults (Swannell, Martin, Page, Hasking, & St John, 2014).

NSSI is a public health concern (Jacobson & Gould, 2007). Self-injury has been associated with permanent injury or tissue damage (Whitlock, Muehlenkamp, & Eckenrode, 2008), as well as more frequent visits to the emergency room compared to individuals who do not engage in NSSI (Olfson, Gameroff, Marcus, Greenberg, & Shaffer, 2005). Perhaps most importantly, repeated NSSI is a reliable predictor of subsequent suicide attempts (Horwitz, Czyz, & King, 2015), underscoring the need to understand and treat self-injury before it develops into higher risk, or even lethal, behaviors.

The Defective Self Model of NSSI (Hooley, Ho, Slater, & Lockshin, 2010) conceptualizes self-injury as a self-punitive behavior used to regulate negative thoughts and emotions through self-inflicted pain. Specifically, the model asserts that individuals who possess a highly self-critical cognitive style are more

This work was supported by a scholarship from American Psychological Foundation/Council of Graduate Departments of Psychology. Authors report no additional conflicts of interest.

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likely to self-injure due to core beliefs about being flawed and deserving punishment (Hooley et al., 2010). The belief that one deserves punishment is hypothesized to increase one's willingness to endure pain, making NSSI an accessible emotion-regulation strategy (Hooley & Franklin, 2018; Hooley & St. Germain, 2014). Consequently, emotions consistent with the experience of self-criticism, such as negative self-conscious emotions like shame or guilt, are thought to precipitate self-injury by signaling that punishment is deserved (Fox, Toole, Franklin, & Hooley, 2017; Schoenleber, Berenbaum, & Motl, 2014).

Self-punishment is a common motive cited for NSSI with approximately 10%–83% of individuals reporting the use of NSSI to self-punish depending on the sample assessed (for a review, see Klonsky, 2007). Among college students, approximately 18%–25% of students (e.g., Whitlock et al., 2011; Whitlock et al., 2014) endorse self-punishment as an important motivation for NSSI engagement. Consistent with the use of NSSI to self-punish, individuals who self-injure report increased self-criticism and desire for punishment relative to individuals who have never self-injured (e.g., Hooley et al., 2010). Further, individuals who engage in direct forms of NSSI, such as cutting, demonstrated higher self-criticism than those reporting indirect, and perhaps less deliberate, forms of self-injury (e.g., disordered eating behaviors, frequent binge-drinking, drug use; St. Germain & Hooley, 2012), suggesting self-criticism as a relevant construct in the distinction between NSSI and self-destructive behaviors more generally. Finally, self-criticism and desire for punishment are also associated with longer pain endurance and lower self-reported pain aversion in painful NSSI lab proxies among self-injuring populations (Hamza, Willoughby, & Armiento, 2014; Hooley et al., 2010). By contrast, a brief laboratory intervention designed to increase self-worth and alter self-critical thoughts has been associated with decreased willingness to endure a painful laboratory task in a sample of individuals with a history of self-injury (Hooley & St. Germain, 2014), suggesting a causal relation between negative self-beliefs and willingness to endure pain.

With respect to negative self-focused emotion, experience-sampling research has shown that individuals who self-injure report increased daily experiences of self-dissatisfaction and shame relative to those with no self-injury history (Victor & Klonsky, 2014). Further, research suggests that guilt increases in the hours preceding NSSI (Armey, Crowther, & Miller, 2011) and that feeling anger or hatred toward the self predicts NSSI in real-time (Nock, Prinstein, & Sterba, 2009). Similarly, recalling a guilty memory in a laboratory manipulation with healthy control college students predicted more intense self-inflicted pain relative to recalling a neutral memory (Inbar et al., 2013), suggesting that negative emotion experienced *toward* the self plays a pivotal role in self-punitive behaviors more broadly. However, as few studies to date have examined the unique relations of specific types of negative affect to NSSI behavior when controlling for alternative negative emotions (e.g., Nock et al., 2009), it is unclear if guilt predicts NSSI beyond other types of negatively valenced emotions associated with self-injury, including sadness (e.g., Bresin, Carter, & Gordon, 2013), hostility (e.g., Armey et al., 2011), and anxiety/fear (Klonsky, 2007).

To date, no research has examined primary assumptions posed by the Defective Self Model using an ecologically valid approach. The present study addressed this gap in the literature by employing a 2-week daily diary design in a sample of college students who self-injure. Participants responded to a baseline measure of trait self-criticism, as well as daily assessments of cognitions about deserving punishment, affective experiences, and self-injury urge intensity and behaviors. We hypothesized that trait self-criticism would predict NSSI urge intensity and behavior directly, as well as indirectly through daily cognitions about deserving punishment. Second, we hypothesized that daily guilt would predict NSSI urge intensity and behavior when controlling for other negative emotions commonly associated with NSSI: daily sadness, hostility and fear. Please note that the measure of guilt we employed (Watson & Clark, 1994; PANAS-X) includes a variety of negative self-conscious emotions (e.g., shame). This is theoretically useful in the current context, given the Defective Self Model's broad emphasis on negative self-relevant thoughts and emotions.

Method

PARTICIPANTS AND PROCEDURE

Participants were 48 undergraduate students, age 18 and older, who reported at least one self-injurious episode within the past year. Given that only approximately 6.8% of college students report NSSI within the past year (Whitlock et al., 2011), a threshold of one NSSI episode over the past year was chosen to ensure individuals reported some level of recent self-injury urges and behaviors rather than only a distal history of NSSI. Participants were recruited from the larger campus community (n = 31) or the psychology research pool (n = 17). To be included in the study, participants must have had daily access to a smartphone with cellular data or the ability to connect to the internet to complete surveys over the 2-week period.

Participants who met inclusion criteria for the study were invited into the lab to complete informed consent and baseline measures and receive instructions for the 2-week daily diary protocol. Participants began the 2-week daily diary protocol on the same day they completed the baseline session. Participants were sent a link to the survey via text message each evening at 7 p.m. from a lab email account using Microsoft SendLater software. They were instructed to complete the survey via smartphone by 4 a.m. the following morning. To receive full compensation for participation, $25 or research credit toward a psychology class, participants must have completed a valid diary entry on at least 12 of the 14 possible evenings of the study. Those who completed less than 12 surveys on twelve different days were granted partial credit ($10 or reduced psychology credit). Following the 2-week diary protocol, participants returned to the lab for debriefing and to receive compensation. All procedures were approved by the relevant Institutional Review Board.

MEASURES

Baseline Measures

Nonsuicidal self-injury history. The Inventory of Statements about Self-injury (ISAS; Klonsky & Glenn, 2009; Klonsky & Olino, 2008) was used to screen for individuals who reported self-injury within the last 12 months. The ISAS assesses lifetime frequency of 12 intentional self-injurious behaviors (e.g., cutting, biting, burning) as well as endorsement of a variety of intrapersonal (e.g., affect regulation, self-punishment) and interpersonal (e.g., autonomy, interpersonal boundaries) functions served by NSSI. For screening purposes, two additional items were added: "Have you self-injured within the last 3, 6, or 12 months?" and "How long ago was the last time you self-injured?" The ISAS was chosen for this study over a formal self-injury interview, such as the self-injurious thoughts and behaviors interview (SITBI; Nock, Holmberg, Photos, & Michel, 2007) due to its brief nature and strong psychometrics. Although self-report measures can have reduced accuracy relative interviewer-coded measures, the ISAS has demonstrated construct validity, strong test-retest reliability (Glenn & Klonsky, 2011), and low participant burden, suggesting its appropriateness for a screen-in measure of self-injury for the larger study.

Self-critical cognitive style. Presence of a self-critical cognitive style was assessed using the Self-Rating Scale (SRS; Hooley et al., 2010). The SRS is an 8-item measure designed to assess the presence of a "defective self" cognitive schema (see Hooley et al., 2010). Items on the scale describe feelings or thoughts that "directly relate to masochistic ideation, self-directed anger, and feelings of worthlessness" (p. 80; St. Germain & Hooley, 2012). Internal consistency for the SRS ranges from 0.73 to 0.88 (Glassman, Weierich, Hooley, Deliberto, & Nock, 2007; Hooley et al., 2010) and was excellent in this sample ($\alpha = .94$).

Diary Measures

Daily affect. Daily affect was assessed using 4-item versions of the Guilt, Hostility, Sadness, and Fear subscales from the Positive and Negative Affect Schedule – Extended (PANAS X; Watson & Clark, 1994). Subscales were shortened to the four items on each scale with the highest internal consistencies in the literature (Bolger & Laurenceau, 2013). Items included from the guilt subscale were "guilty," "ashamed," "dissatisfied with self," and "angry at self." Items from the Positive Affect subscale of the PANAS-X were included to balance negatively valenced emotion items but were not used in analyses. For each item, the participant was asked to indicate "to what extent [you] have felt this way today" on a scale from 1 (*very slightly or not at all*) to 5 (*extremely*). The abbreviated PANAS-X scales used in this study demonstrated good to excellent internal consistencies (guilt: $\alpha = .90$; sadness: $\alpha = .88$; hostility: $\alpha = .82$; fear: $\alpha = .81$).

Daily cognitions about punishment. Daily cognitions about punishment were assessed via 3 items from the original 10-item Punishment Deservingness Scale (PDS-3) developed by Schoenleber and colleagues (2014). Items were chosen to assess the extent to which participants believed they deserved punishment over the course of the day, and included "I deserved to be treated badly," "Bad things should be done to me," and "I deserved to be punished." Participants are asked to rate "the extent to which you believed or thought this way *today*" on a Likert scale ranging from 1 (*very slightly or not at all*) to 5 (*extremely*). Items were embedded within seven other personality-based distractor items to reduce demand characteristics. The PDS-3 demonstrated strong internal consistency in this study ($\alpha = .92$).

Daily NSSI urge and behavior. The presence of self-injurious urge over the past 24 hours was assessed via a yes/no question ("Since the last diary entry, did you feel an urge to self-injure?"). Individuals who reported a self-injury urge were asked to rate NSSI urge intensity on a Likert scale (0 = *none at all* to 6 = *strong urge, self-injured or would have if able*) adapted from the Alexian Brothers Urge to Self-Injure Scale (Washburn, Juzwin, Styer, & Aldridge, 2010). To detect the presence of NSSI behavior in the past 24 hours, participants were asked whether or

not they self-injured since their previous diary entry (yes/no).

ANALYTIC PLAN

Multilevel modeling (MLM) was used to test all predictions using NSSI urge intensity as the outcome (Raudenbush & Bryk, 2002). Predictions using NSSI behavior as the outcome of interest utilized generalized linear mixed modeling (GLMM). Like MLM, GLMM accounts for the inherent nonindependence of observations in nested data structures, but uses maximum likelihood estimation to infer the probability of a binary dependent variable (Raudenbush & Bryk, 2002). All hypotheses were tested using MPlus version 8 software (Muthén & Muthén, 2017.

Model Structure

A two-level nesting structure was used to test all hypotheses. Observations were modeled at Level 1 (within subjects) and participants were modeled at Level 2 (between subjects). Unconditional models including no predictor variables were tested for both NSSI urge intensity and NSSI behavior to ensure a two-level structure was needed. The unconditional model for NSSI urge intensity demonstrated significant within- (b = 1.696; SE = 0.108; $p < .001$) and between-subjects variances (b = 1.330; SE = 0.307; $p < .001$; Intraclass correlation = .44), thus indicating the need for a two-level model (Bolger & Laurenceau, 2013). Results for the unconditional model testing the binary outcome of NSSI demonstrated significant between-subjects variability (b = 2.321, SE = .0151, Wald χ^2_1 = 15.346, $p < .001$). Intraclass correlation (ICC) for this model was calculated using with guidelines provided by Muthén and Muthén (2017) using the logit link function. The associated ICC was .40, meriting a two-level model structure.

Tests of Direct and Indirect Effects

Tests of direct effects were conducted by simultaneously entering independent variables predicting NSSI urge intensity and GLMMs predicting NSSI behavior. Survey order (i.e., whether it was a participant's 1st, 2nd, 3rd, etc. daily survey) was included as a covariate. Given the largely exploratory nature of these analyses, no other covariates were included.

For MLMs and GLMMs containing observation-level predictors (e.g., daily emotions, daily punishment deservingness), models were specified to allow for fixed and random effects. Fixed effects are defined as the average effect of the independent variable on the dependent variable across individuals (Raudenbush & Bryk, 2002) and are of primary theoretical interest in this study. While fixed effects are necessarily included in multilevel models, Bolger and Laurenceau (2013) recommend the inclusion of random effects in intensive longitudinal data analysis. Random effects indicate whether there is evidence that a fixed effect varied randomly across different participants within the sample (Raudenbush & Bryk, 2002). Thus, inclusion of random slopes in MLMs and GLMMs allow for detection of random variability without requiring knowledge of the causal processes behind it (Bolger & Laurenceau, 2013). If random effects did not reach marginal statistical significance ($p < .10$) in the initial test of each model, they were excluded and a random-intercept only model containing just fixed effects was conducted (Nezlak, 2008).

The hypothesized indirect effect was tested using a multilevel mediation procedure outlined by Preacher and Hayes (2008). The model specified self-criticism (assessed during the baseline session) as a level-two predictor variable (X), punishment deservingness as a level-one intervening variable (M; assessed on day d of the daily protocol), and NSSI urge intensity as a level-one outcome variable (also assessed on day d; i.e., a 2 - 1 - 1 indirect effects model; Preacher & Hayes, 2008). As in traditional OLS regression, the indirect effect is calculated by multiplying the "a" path (self-criticism predicting daily punishment deservingness) by the "b" path (daily punishment deservingness predicting NSSI) (Hayes, 2009; see Figure 1).

Variable Centering

Level 2 predictors were grand-mean centered (Enders & Tofighi, 2007). Level 1 predictors, with the exception of survey order, were centered on each participant's mean (group-mean centered; Bolger & Laurenceau, 2013) to appropriately separate variance across levels of analysis (Allison, 2009). Survey order was grand-mean centered to allow an interpretable zero point across individuals.

Results

DATA SCREENING

A total of 604 diary surveys were recorded across 48 participants. Surveys were then screened for missing data and repetitive and random response patterns using a series of validity checks (Ferguson, unpublished dissertation; McCabe, Mack, & Fleeson, 2014). First, surveys completed outside the allotted window of time (7:00 p.m. – 4:00 a.m.) were discarded. Next, based on procedures outlined by McCabe et al. (2014), entries missing greater than 20% of responses were flagged as invalid observations. To assess for repetitive and random responses, the number of sequential response repetitions for each survey was calculated and assigned a z-score based on the sample-wide mean number of sequential response repetitions. Surveys with z-scores greater than 1.65

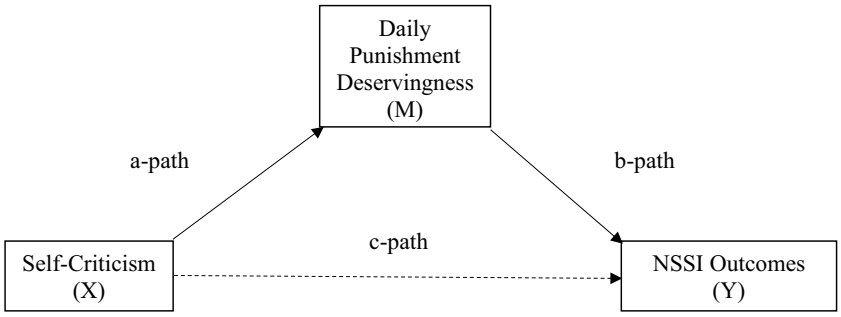

FIGURE 1 Visual Representation of Indirect Effects Models.

(e.g., exhibiting repetitive responding) and less than -1.65 (i.e., exhibiting random responding) were flagged for from the data set. The more liberal z-value of 1.65 was chosen due to the restricted range of the possible repetitive values in the survey and corresponds to roughly 10% of the z-distribution (approximately 5% for each tail).

Surveys were then assessed for valid response duration. The duration of each daily diary survey was calculated by subtracting the start time for each observation from the end time of each observation (e.g. 7:56:00 p.m. [end time] – 7:45:00 p.m. [start time]). Next, each survey was assigned a z-score based on the sample-wide mean response duration (M = 08:13). Surveys with response durations greater than three standard deviations from the mean were excluded from analysis. Due to floor effects associated with the brief nature of this survey, the use of a statistical approach to identify unrealistically short response times was unreasonable. Instead, a cut point was established based on feasibility. The experimenter repeatedly took the survey as quickly as possible to account for speed and practice effects likely exhibited by participants near the end of the two-week period. Based on these repeated trials, a response duration of less two minutes was identified as a cut point for an unreasonably short duration. Surveys with a response duration less than or equal to one minute and fifty-nine seconds (N = 24) were flagged for exclusion from analyses.

Finally, using the above validity indices, a dichotomous composite variable was created to indicate the validity of each observation (valid = 0; invalid = 1). The percentage of valid surveys for each participant was calculated by cross-tabulating the validity variable with participant ID number. Next, each survey was assigned a z-score based on the sample-wide mean of the percentage of valid completed surveys. All responses from participants with a total percentage of valid responses more than three standard deviations from the mean (n = 1; z = -3.739) were marked as invalid and excluded from analyses. These screening procedures resulted in the deletion of 66 surveys, including the complete set of responses from one participant. This left a total of 538 observations across 47 participants for analyses. The number of valid responses across participants ranged from 6 – 15 with a mean of 11.45 (SD = 2.03).

DESCRIPTIVE STATISTICS

Participants (n = 47) reported a mean age of 19.87 (SD = 1.91) and the majority identified as female (n = 43; 91.5%), White (n = 38; 80.9%) and of Non-Hispanic ethnicity (n = 41; 87.2%). Twenty-five participants (53.2%) identified as heterosexual. A series of t-tests were conducted to ensure individuals recruited by alternate means did not differ systematically. No reliable differences across individuals recruited via the campus community (n = 31) and the psychology research pool (n = 17) were detected in age, biological, gender identity, sexual orientation, race, ethnicity, trait self-criticism (t_{44} = 0.102; p =.102) or lifetime NSSI frequency (t_{43} = 0.124; p =.304). Individuals from the campus community reported higher Lifetime NSSI versatility (total number of NSSI methods endorsed; M = 6.613; SD = 1.995) than participants from the psychology research pool (M = 4.500; SD = 2.191; t_{45} = 3.329; p =.002). Given that participants were comparable on most demographic and clinical indices, the groups were determined to be similar enough to combine. Means, standard deviations, and correlations of study variables are found in Table 1. All study variables met assumptions of multivariate normality within normal limits for a sample of the given size (Skew ≤ 1.752; Kurtosis ≤ 3.060; Tabachnick & Fidell, 2013).

Recency of self-injury at recruitment was in the past 1 month, 3 months, 6 months, and past year

Table 1
Bivariate Correlations, Means, and Standard Deviations of Study Variables

Variables	1.	2.	3.	4.	5.	6.	7.	8.
1. SRS (trait)	1							
2. PDS-3 (diary)	**.423**	1						
3. PANAS-sad (diary)	**.329**	**.427**	1					
4. PANAS-hos (diary)	**.455**	**.412**	**.457**	1				
5. PANAS-guilt (diary)	**.371**	**.532**	**.516**	**.651**	1			
6. PANAS-fear (diary)	**.418**	**.270**	**.393**	**.511**	**.439**	1		
7. NSSI urge intensity	.237	**.456**	**.397**	**.359**	**.429**	**.245**	1	
8. NSSI behavior (Y/N)	.059	**.341**	**.334**	**.225**	**.347**	**.201**	**.709**	1
M	35.40	4.61	8.97	6.17	8.54	7.44	1.08	N/A
SD	10.67	2.43	3.93	2.82	4.20	3.21	1.75	N/A

Note: Bolded values indicate statistical significance at $p < .05$; NSSI = non-suicidal self-injury; PDS-3 = Punishment Deservingness Scale; PANAS-sad = Adapted PANAS sadness subscale; PANAS-hos = Adapted PANAS hostility subscale; PANAS-guilt = Adapted PANAS guilt subscale; PANAS-fear = Adapted PANAS fear subscale; Standardized correlation coefficients obtained by regressing y variable onto associated x variable in each unique bivariate multilevel model to account for non-independence of nested data structure and calculated using following equation: $b = b_{StdYX}$ = B*SD(x)/SD(y).

for 19 participants (40.4%), 4 participants (8.5%), 9 participants (19.1%), and 15 participants (32.0%), respectively. Participants reported a mean of 273.24 (*SD* = 324.36; *Mdn* = 100.00; *IQR* = 421.00; *range* = 6.00 – 915.00) lifetime self-injury episodes. Lifetime NSSI versatility ranged from 2–9 methods, with a mean of 5.89 methods (*SD* = 2.28; *Mdn* = 6.0; *IQR* = 4.0).

A total of 210 self-injury urges across 45 participants were reported over the 2-week period (39.03% of total surveys entered in the NSSI group). Participants reported a mean of 0.907 (*SD* = 1.277) urges per day, with total number of daily urges ranging from 0 to 7. On average, participants' strongest self-injury urge occurred mid-afternoon (*m* = 3:34 p.m.). Self-reported NSSI urge intensity ranged from 0–6, with a mean of 1.08 (*SD* = 1.75). Consistent with prior research (Nock et al., 2009), NSSI urge intensity reliably predicted the presence of NSSI behavior at the daily level ($b = 1.605$; $SE = 0.243$; $p < .001$; OR = 4.979; 95% CI for OR: [3.091, 8.022]).

Forty-eight unique self-injury episodes occurred across 20 participants over the 2-week duration of the study (8.9% of total surveys). NSSI method frequency over the 2-week period is outlined in Table 2. Of those who self-injured during the study, the number of NSSI episodes ranged from 1–10 over the 2-week period. The mean level of pain intensity for NSSI episodes reported was 2.96 (*SD* = 2.07) on a 0–10 scale. Finally, the mean time of NSSI occurrence was 3:37 p.m.

PRIMARY HYPOTHESES

Direct Effects of Self-Criticism on NSSI Outcomes
The direct relation of trait self-criticism to NSSI urge intensity was tested by regressing NSSI urge intensity onto SRS scores. Results indicated that trait self-criticism did not reliably predict NSSI urge intensity ($b = 0.027$; $SE = 0.017$; $p = .109$) over the 2-week period when controlling for survey order ($b = -0.023$; $SE = 0.016$; $p = .144$). The direct association of trait self-criticism and NSSI behavior was tested via a GLMM using NSSI behavior as the outcome and identical predictor variables. Results indicated that trait self-criticism did not reliably predict the occurrence of NSSI behavior ($b = 0.012$; $SE = 0.034$; $p = .711$) over the 2-week period when controlling for survey order ($b = -0.041$; $SE = 0.050$; $p = .408$).

Indirect Effects of Self-Criticism on NSSI Outcomes
It has been traditionally thought that in the absence of a significant *direct* effect (i.e., of *x* on *y*), there is little point in probing for evidence of an *indirect* effect (i.e., of *x* on *y* through *m*; e.g., Baron & Kenny, 1986). More recently, however, multiple

Table 2
Self-Injury Methods Reported in Diary Entries

Method	Frequency
Cutting	20
Biting	2
Burning	1
Carving	1
Pinching	9
Pulling Hair	6
Severe Scratching	13
Banging/Hitting Self	5
Interfering with Wound Healing	24
Swallowing Dangerous Substances	1
Other	4

Note: Frequency does not sum to N = 48 as self-injury episodes may have included multiple methods.

Table 3
Indirect Effects of Self-Criticism on NSSI Outcomes Through Daily Punishment Deservingness

Model	a-path (se), *p*	b-path (se), *p*	ab [95% CI], *p*	c' (se), *p*
NSSI urge intensity	0.055 (0.019), .004*	0.391 (0.052), < .001*	0.023 [0.005, 0.041], .012*	-0.003 (0.012), .798
NSSI behavior	0.055 (0.026), .030*	0.417 (0.101), < .001*	0.023 [-.005, 0.051], .111	-.0.020 (0.035), .557

Note: * indicates $p < .05$; Both models controlled for survey order (NSSI urge intensity: $b = -0.026$; $SE = 0.016$; $p = .117$; NSSI behavior: $b = -0.057$; $SE = 0.054$; $p = .296$); ab = indirect effect; c' = remaining effect controlling for indirect effect; parameter estimates refer to unstandardized coefficients; *se* = standard error; CI = confidence interval; Visual representation of models in Figure 1; NSSI = non-suicidal self-injury.

scholars have noted that the indirect effect can often be more robust than the direct effect (e.g., Hayes, 2009; Preacher & Hayes, 2004; Shrout & Bolger, 2002). For example, the direct relationships between *x* and *y* may be masked by a suppressor or be too distal to detect with available sample sizes. In such cases, there may be more power to detect a correctly specified indirect effect.

As such, we next conducted an MLM testing the indirect relation of self-criticism (assessed at baseline) on NSSI urge intensity (assessed at day *d* of the daily protocol) through daily cognitions about punishment (also assessed at day *d*). The direct effects of self-criticism on daily cognitions about punishment (path a) was significant, as was the direct effect of daily cognitions about punishment on NSSI urge intensity (path b). Of primary importance, a significant indirect effect of self-criticism through daily cognitions about punishment on NSSI (path ab) was also detected. For full model details, see Table 3.

We next conducted GLMM to assess the indirect influence of self-criticism (assessed at baseline) on NSSI behavior (assessed on day *d*) through daily cognitions about punishment (also assessed at day *d*). A significant direct effect of self-criticism on daily cognitions about punishment (path a) was once again observed. Daily cognitions about punishment were also reliably associated with probability of NSSI behavior (path b). However, the aggregate influence of self-criticism through daily cognitions about punishment on NSSI behavior (path ab) did not reach statistical significance. Complete model results are listed in Table 3.

Daily Guilt on NSSI Outcomes

An MLM was next conducted regressing NSSI urge intensity onto PANAS-guilt, sadness, hostility, and fear scores. Each individual MLM included both fixed and random effects associated with each daily-level emotion. Results indicated significant fixed effects for daily guilt, sadness, and hostility on NSSI urge intensity ($p \leq .031$).

The random slope for the relation of sadness and NSSI urge intensity was also statistically significant ($b = 0.012$, $p = 0.034$), indicating reliable between-subjects variability in the relation between daily sadness and NSSI urge intensity across individuals. Random slopes for daily guilt, hostility, and fear did not reach statistical significance ($p \geq .112$). Model parameters associated with fixed effects for this analysis presented in Table 4.

The analogue GLMM conducted using NSSI behavior as the dependent variable indicated a significant fixed effect of daily guilt ($b = 0.188$, $p = 0.024$) on the probability of NSSI behavior. No other significant fixed effects associated with daily affect reliably predicted NSSI behavior ($p \geq .081$). All four daily emotions tested demonstrated non-significant random slopes ($p \geq .294$) suggesting little between-subjects variability in the relations between each daily emotion and NSSI behavior. Model details are listed in Table 4.

Discussion

This study is the first known attempt to test the Defective Self Model of NSSI using an ecologically valid approach. Although evidence regarding

Table 4
Daily Emotion Predicting NSSI Urge Intensity and Behavior

Variable	NSSI Urge *b*	*SE*	95% OR (*b*)	*p*	NSSI Behavior *b*	*SE*	OR	95% CI (OR)	*p*
Guilt	0.119	0.029	[0.063, 0.175]	<.001*	0.188	0.084	1.207	[1.025, 1.422]	.024*
Sadness	0.090	0.028	[0.034, 0.145]	.001*	0.149	0.086	1.161	[0.982, 1.373]	.081
Hostility	0.083	0.038	[0.008, 0.158]	.031*	0.020	0.095	1.020	[0.847, 1.228]	.836
Fear	-0.017	0.029	[-0.074, 0.040]	.563	-0.003	0.018	0.997	[0.963, 1.033]	.882
Survey Order	-0.008	0.013	[-.034, 0.018]	.543	-0.027	0.054	0.973	[0.875, 1.083]	.616

Note: Parameter estimates listed refer to model fixed effects; * indicates $p < .05$; NSSI = non-suicidal self-injury

specific hypotheses was mixed, the broad pattern of results is congruent with the Defective Self Model. Specifically, we found that self-criticism was indirectly related to NSSI urge intensity through daily cognitions about punishment. Daily guilt was also related to NSSI behavior beyond other types negative affect. This suggests that the experience of negative thoughts and emotions *toward* oneself was associated with self-injury urges and behaviors at the daily level.

The statistically reliable indirect path of self-criticism through daily punishment deservingness on NSSI urge intensity suggests that trait self-criticism predicts the degree to which one believes they deserve punishment throughout the day, which in turn predicts intensity of self-injury urges. This finding was not replicated for NSSI behavior. One possibility for this discrepancy may be reduced power associated with the limited number of NSSI episodes observed in this sample. An adequate number of NSSI episodes was obtained to detect direct effects of within-subject predictors (e.g., guilt) on NSSI behavior, due to the 538 daily surveys obtained. However, more power may be necessary to reliably test effects involving between-subject variables (e.g., self-criticism), given the same sample at this level of 47 participants. Future research may benefit from implementing a longer study duration (e.g., 3 weeks) or an increased threshold for NSSI recency (e.g., > 5 past year episodes as consistent with DSM-5 criteria) to obtain an increased number of self-injury observations.

Consistently, statistical experts (e.g., Hayes, 2009; Shrout & Bolger, 2002) have provided at least two explanations for a pattern of results containing such a discrepancy. First, Hayes (2009) noted that the direct effect may be masked by a second indirect effect operating in the *opposite* direction. Applied to the current study, this account raises the possibility that self-criticism is somehow *decreasing* NSSI urge intensity through some fourth, unmeasured variable. Although this is a logical possibility that we cannot conclusively rule out, given the extensively documented positive relation between trait self-criticism (e.g., Gilbert et al., 2010; Hooley, Fox, Wang, Kwashie, 2018; Hooley et al., 2010; Hooley & St. Germain, 2014), we can also think of no theoretically plausible variable that could serve this role. Thus, another explanation offered by Shrout and Bolger (2002) appears more likely. These authors suggested that the direct relationship between x and y will sometimes be nonsignificant if these two variables are only distally related to one another (e.g., linked via modest associations with an intervening variable). In such cases, the power to detect a correctly specified indirect effect is often much higher than the power to detect the direct effect. Given the strong basis of this hypothesis in prior theory (Hooley et al., 2010) and the temporal separation between the predictor and outcome variable, this seems the most plausible explanation.

Beyond statistical considerations, Social Cognitive Theory (Mischel, 1973) may inform another plausible explanation. Specifically, that being high in trait self-criticism is not sufficient to produce NSSI urge. Rather, it is the activation of a self-critical schema by one's environment that produces thoughts about deserving punishment and subsequent NSSI urge. Within this framework, even highly self-critical individuals will not experience strong self-injury urges if state-level self-critical thoughts are not activated.

Alternatively, it could also be that self-criticism predicts who uses NSSI, but not individual occurrences of self-injury. That is, a critical view of the self may be a necessary gateway for an individual to choose NSSI over another behavior for emotion regulation (Hooley & Franklin, 2018), but after that threshold is met, greater levels of self-criticism do not confer more frequent NSSI or the occurrence of self-injury at the daily level. In support of this assertion, several studies have shown that higher self-criticism differentiates individuals with NSSI history from those without (Fox et al., 2017; Hooley et al., 2010; Hooley & St. Germain, 2014), suggesting a certain level of self-criticism may be necessary to choose NSSI for emotion regulation. Similarly, trait self-criticism was also shown to moderate affect regulation in a painful lab task, such that that only those who reported high levels of self-criticism showed reductions in negative affect after experiencing pain (Fox et al., 2017), suggesting an effect of trait self-criticism at the between-subjects level. Conversely, a single, brief intervention designed to bolster self-worth was associated with reduced willingness to tolerate a painful lab task among individuals with a history of NSSI (Hooley & St. Germain, 2014). These results may point to a state-level association between self-critical cognitions and the desire for pain, as altering individual personality traits would likely require an intervention of longer duration and intensity. In our data, daily guilt was associated with NSSI behavior whereas sadness, hostility, and fear were not, suggesting self-conscious affect, a correlate of self-critical thoughts (Gilbert et al., 2010), acts as a predictor of individual self-injury occurrences. Future ecological momentary assessment studies should explore whether (a) the activation of self-critical cognitions temporally precedes NSSI urges and behaviors, (b) trait self-criticism primarily serves as an initial gateway to make NSSI accessible for

emotion regulation more broadly, or (c) whether self-criticism plays a dual role in initial NSSI engagement and maintenance over time.

Another important question is whether the current study supports the hypothesized causal order implied by this mediation model. Because the current study lacked experimental manipulations, definitive conclusions regarding causality can certainly not be made. However, such experimental manipulations can often only be done in much more artificial, laboratory settings. Thus, we would argue that there is value in the current ecologically valid design, even if definitive causal conclusions cannot be made. Moreover, the study design and pattern of results suggest that the hypothesized causal order (i.e., self-criticism > punishment-deservingness > NSSI urge intensity) is at least the most plausible explanation. Self-criticism was assessed prior to all other variables, and there is reason to suspect that it may be more temporally stable than other variables (e.g., it asks about a person's general tendencies). Thus, self-criticism is likely causally antecedent to punishment-deservingness and NSSI urge intensity. Beyond this, self-criticism exhibited a significant, direct relationship with punishment-deservingness, but not with NSSI urge intensity. This is more consistent with the hypothesized causal order (i.e., self-criticism > punishment-deservingness > NSSI urge intensity) than with an alternative model (i.e., which suggests that self-criticism > NSSI urge intensity > punishment-deservingness).

The hypothesized association between guilt and NSSI urge intensity was supported. Results indicated that daily sadness, daily guilt, and daily hostility all uniquely predicted NSSI urge intensity, suggesting that several types of negative affect are associated with the strength of NSSI urges. This pattern of findings is somewhat consistent with findings indicating that daily sadness reliably predicts the presence NSSI urge (Bresin et al., 2013; Nock et al., 2009), and that daily hostility increases prior to NSSI engagement (Armey et al., 2011). Notably, daily fear did not significantly predict NSSI urge or behavior when controlling for other types of negative affect. Consistent with this finding, Klonsky (2009) found that although individuals often reported anxiety preceding NSSI and decreasing following self-injury, feeling afraid was not endorsed prior to NSSI and did not decrease following injury. Taken together, these findings likely indicate that feelings of "anxiety" or "tension" often reported retrospectively as reasons for self-injuring (e.g., Klonsky, 2007) are not best operationalized as feelings of fear, but rather other types of negative affect.

Despite the association of multiple negative emotions and NSSI *urge intensity*, only daily guilt predicted NSSI *behavior* when controlling for alternate negative emotions. This finding is congruent with prior experience sampling findings that self-directed anger and guilt (measured by the PANAS) predict NSSI episodes (Armey et al., 2011), while other negative emotions, such as sadness, predict NSSI urges, but not behaviors (Nock et al., 2009). Moreover, this pattern of findings is consistent with the Defective Self Model as only negative feelings experienced *toward* the self reliably predicted self-injurious behavior.

Although preliminary, these results have implications for the clinical treatment of self-injury. Consistent with the scant literature examining brief interventions for NSSI (Hooley & St. Germain, 2014), treatments that foster self-worth and compassion may decrease the intensity of NSSI urges and reduce capacity for self-injurious behavior to regulate emotion. Hooley and Franklin (2018) argue that increasing barriers to NSSI, such building positive self-associations, are particularly fruitful treatment avenues rather than solely focusing on reducing risk factors for self-injury (e.g., affect dysregulation, self-critical thoughts).

Recent research suggests brief digital interventions designed to bolster self-worth both explicitly and implicitly are associated with reduced NSSI over time. For example, individuals randomly assigned to complete daily Autobiographical Self-Enhancement Training (ASET), a writing exercise designed to focus on positive participant characteristics, reported decreased self-criticism, depression, and NSSI episodes at the end of 28 days (Hooley et al., 2018). Although these decreases were not maintained at 1- and 3-month follow-ups, results suggest that when individuals are actively engaged in identifying positive self-talk, risk for NSSI is reduced. Further, Franklin and colleagues (2016) demonstrated that by reducing implicit self-critical biases through pairing words like "nice" and "mine" while also working to increase aversion to self-injury stimuli through Therapeutic Evaluative Conditioning (TEC), NSSI episodes were reduced across a 4-week period across two studies. Consistent with findings for ASET, reductions in NSSI associated with TEC were not maintained at 1-month follow-up, suggesting that active participation in TEC was necessary to observe treatment effects.

This study boasts several strengths, including the recruitment of a substantial number of individuals with a self-injury history to examine NSSI urges and behaviors in real-time using an ecologically valid design. However, this study should be interpreted in the context of its limitations. Although diary studies offer increased ecological validity relative to cross-sectional designs, experience-sampling studies that

assess individuals at multiple time points throughout the day provide more nuanced data and allow for the temporal association between daily mood states and NSSI outcomes, such as how mood states change following injury (e.g., Armey et al., 2011). As such, due to the use of one-assessment point per day, we lack clear temporal information regarding the order of daily emotional states, punishment thoughts, and NSSI urges and behaviors. Thus, it remains possible that cognitive and affective predictors measured in this study occurred simultaneously or following NSSI outcomes. For example, although one plausible explanation is that guilt preceded self-injury urges and behaviors, it remains possible that guilt co-occurred or was produced as a consequence of having engaged in self-injury. Consistent with the former, Armey et al. (2011) found that guilt increased in hours preceding NSSI episodes and slowly tapered following NSSI engagement. Yet, cross-sectional data also suggest that individuals reported sometimes feeling "guilty" and "ashamed" after engaging in self-injury (Klonsky, 2009). Thus, the temporal hypothesis regarding the relation of guilt and NSSI presented in this study remains speculative. Future research should include multiple assessment points per day to establish a clear temporal trajectory for negative affective states, particularly guilt, daily punishment deservingness, and self-injury urges and behaviors.

Analyses using NSSI behavior as the dependent variable should also be replicated, as they may have been underpowered due to the low base rate of NSSI episodes in this study. Finally, due to the fairly homogeneous sample, generalizations to non-White individuals or biological males may be limited. Future research should prioritize replicating these effects in a sample with an increased number of male participants and broader racial diversity.

Taken together, results obtained from this study broadly support the Defective Self Model of NSSI. Although trait level self-criticism did not directly predict NSSI urge intensity or behavior, self-criticism indirectly predicted NSSI urge intensity through the activation of thoughts about deserving punishment. Similarly, the unique effect of daily guilt on NSSI behavior above other types of negative affect is consistent the use NSSI for self-punishment.

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Received: August 24, 2018
Accepted: March 22, 2019
Available online: 1 April 2019