Painfully bored: the role of negative urgency and history of Non-Suicidal Self-Injury in Self-Administering painful stimuli

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Abstract
The current study aims to examine the causal effect of boredom on non-suicidal self-injury (NSSI), expanding prior experimental research by including an anger induction to compare to a boredom induction, and additionally measuring whether participants specifically seek painful stimulation. In a sample of mostly undergraduate students (N = 146), emotional state was manipulated through video induction, and NSSI behavior was simultaneously measured, operationalized through self-administration of electric shocks. Participants’ pain thresholds were measured beforehand. NSSI history and negative urgency were included as potential moderators. Results showed that boredom increased both frequency and intensity of self-administered electric shocks, especially in participants with an NSSI history. Negative urgency was not a significant moderator. No causal anger-NSSI link was found, possibly due to the anger induction not being sufficiently effective. Clinical implications are considered through suggestions of boredom coping skills training as an intervention strategy in NSSI populations.

Keywords NSSI · Self-injury · Boredom · Anger · Self-harm · Negative urgency

Introduction
Boredom is an emotion which people find unpleasant and negative, and is most commonly defined as “the aversive experience of wanting, but being unable, to engage in satisfying activity” (Eastwood et al., 2012, p. 483). People who feel bored easily, show lower general performance in work and study (O’Hanlon, 1981; Tze et al., 2016), and boredom is additionally related to depression (Goldberg et al., 2011; Sommers & Vodanovich, 2000). Moreover, boredom can lead to impulsive behaviors like binge eating, binge drinking, gambling and drug use (Biocati et al., 2016; Moynihan et al., 2015). Likely, these impulsive behaviors are used to break out of boredom. The behavior does not need to be of a positive valence: for example, people prefer to view negatively evaluated novel pictures over neutral pictures which they have seen several times and perceived as boring (Bench & Lench, 2019). It seems therefore that people prefer even negatively evaluated stimuli over the tedious experience of being bored.

Self-injurious behavior may be one such negatively evaluated stimulus. Indeed, lab studies demonstrate that participants even voluntarily apply mild electric shocks to themselves due to a boredom induction (Havermans et al., 2015; Nederkoorn et al., 2016; Wilson et al., 2014). Furthermore, in situations where people cannot escape boredom, like prisons, solitary confinement and sensory deprivation, prevalence of self-injurious behaviors is high (Casiano et al., 2013; Kaba et al., 2014). Vice versa, participants with a history of non-suicidal self-injury (NSSI) score higher on alienation and boredom (Silverman et al., 2018) and boredom is among the emotions self-reported by female inmates as motivation to engage in NSSI (Chapman & Dixon-Gordon, 2007). NSSI is defined as “the deliberate destruction of one’s own body tissue in the absence of intent to die” (Nock et al., 2009, p. 78). One of the most comprehensive conceptual models of NSSI is the benefits and barriers model (Hooley & Franklin, 2018). According to this model, NSSI benefits consist of (1) emotion improvement through reduction of negative emotion and/or increase in positive emotion, (2) gratification of self-punishment desires, (3) peer group affiliation, and (4) ability to communicate distress or...
strength. In contrast, the model posits that barriers preventing individuals from using NSSI to regulate emotion consist of (1) lack of awareness of the positive effects of NSSI, (2) positive view of the self, (3) physical pain, (4) aversion to NSSI stimuli (e.g., blood or wounds), and (5) social norms. Additionally, Hooley and Franklin (2018) propose that any single barrier will be sufficient in preventing NSSI behavior. Particularly relevant to the current study is the emotion-improving benefit of NSSI behavior, as this would support a boredom-NSSI link, especially considering the aforementioned studies demonstrating that people are highly motivated to escape boredom even through negatively evaluated means. By engaging in NSSI, the negative emotional state of monotonous boredom may be reduced, and positive emotions may be increased. NSSI is demonstrated to improve emotions in a number of possible ways, including gratification of self-punishment desires, distraction from negative thoughts and emotions, and pain-offset relief (i.e., relief experienced after removal of pain). The specific mechanism(s) at play in the potential boredom-NSSI link is beyond the scope of the current study, and readers are referred to Hooley and Franklin (2018) for a comprehensive overview of all emotion-improving mechanisms of NSSI.

Of course, boredom is not the only emotion that could lead to NSSI. For example, a 14-day diary study (Bresin & Gordon, 2013) found that daily sadness was related to increased NSSI urge in a large sample of college students. Another experience sampling study (Selby et al., 2013) of individuals reporting past NSSI behaviors found that sadness significantly predicted daily NSSI reports. Self-reports by members of the Dutch Self-Harm Support Group (Kamphuis et al., 2007) specifically highlighted that psychological tension was high immediately before NSSI. In a previous study (Nederkoorn et al., 2016) examining a non-clinical sample, participants were randomly assigned to a neutral, sadness or boredom condition and could voluntarily self-administer mild electric shocks, as a proxy for NSSI behavior. Although negative emotion was equally high in the sadness and boredom condition, only the boredom condition led to a significant increase of administration of electric shocks, whereas the sadness condition did not. The negative emotion in and of itself was thus not enough to elicit self-shocking. As a critical note, it should be mentioned that perhaps the sadness induction in this study was not strong or relevant enough to prompt NSSI behavior. The current study, however, focuses on anger, which similarly to boredom is a frustrating and negative experience (Kuppens et al., 2007). Anger is also one of the most often reported emotions eliciting NSSI (Hepp et al., 2020; Klonsky, 2007; Muehlenkamp et al., 2013). For example, self-report studies in samples of female inmates (Chapman & Dixon-Gordon, 2007) and patients with eating disorders (Claes et al., 2010; Paul et al., 2002) demonstrated that anger was a common antecedent to NSSI behavior. Additionally, a diary study of male inmates (Humber et al., 2013) found that anger was associated with high levels of concurrent self-harm ideation. Thus, two possible routes to NSSI will be examined: anger and boredom. Comparing these two emotional states will help clarify the importance of boredom in NSSI: if its effect on NSSI is comparable to or even stronger than the commonly reported effect of anger, this may suggest the need for an additional focus in NSSI intervention on individual boredom experiences.

In the few earlier mentioned studies examining the causal boredom-NSSI link through experimental study of self-administered electric shocks (Havermans et al., 2015; Nederkoorn et al., 2016; Wilson et al., 2014), it was unclear whether participants actually sought painful stimulation (i.e., subjective pain experience was not measured). Moreover, these prior studies showed a large variety in whether people voluntarily applied an electric shock or not, how often they applied electric shocks and the intensity of the shock they selected (Havermans et al., 2015; Nederkoorn et al., 2016; Wilson et al., 2014). The current study aims to provide clarification on this issue by examining participants’ individual pain thresholds in addition to shock frequency in the self-shocking paradigm: this allows us to confirm whether participants indeed used painful, as opposed to non-painful, self-shocking to break monotony.

The large variety in self-administered electric shocks found in previous studies prompts consideration of personal characteristics in the effect of boredom on this behavior: apparently, not everyone needed to self-administer electric shocks to stimulate themselves. In other words, it seems like individual characteristics determine if people seek external stimulation to diminish boredom or not. Havermans et al. (2015) examined sensation seeking and boredom proneness in the boredom-self-shocking link, but found that neither predicted frequency nor intensity of electric stimulation during boredom. However, Nederkoorn et al. (2016) found that participants with a history of NSSI at least once in their life applied more electric shocks within the first 15 min than people who never performed NSSI behavior. Prior experiences of NSSI may have resulted in participants having higher pain thresholds, as well as increased pain endurance (i.e., duration of willingness to experience pain), leading to increased self-shocking compared to participants without an NSSI history. Lab studies have indeed demonstrated that having a history of NSSI correlates with diminished pain perception: for example, one study (Franklin et al., 2012) using the cold pressor task (a painful task that involves placing a hand in cold water) in a college sample demonstrated that participants with an NSSI history showed a higher pain threshold, pain tolerance, and lower pain intensity ratings.
than participants without an NSSI history. Thus, prior NSSI experiences may have lowered barrier #3, i.e., physical pain, in self-administering painful stimuli. Additionally, a history of NSSI may have made participants in Nederkoorn et al. (2016)’s study more familiar with the ‘benefits’ of NSSI behavior, making the self-shocking behavior more accessible (Hooley & Franklin, 2018). History of NSSI however did not explain the number of electric shocks within the whole emotion induction period of one hour. It seems therefore that other variables are needed to explain this variation.

One personality factor that could explain shocking out of boredom is negative urgency, which is a sub-construct of impulsivity (Lynam et al., 2006). Negative urgency refers to the tendency to engage in impulsive action in response to negative emotions, like depression, boredom, and stress, with a focus on immediate relief from distress. Negative urgency has been found to predict different types of rash behaviors like drug and alcohol use (Smith & Cyders, 2016) and gambling (Cyders et al., 2014). Moreover, Glenn & Klonsky (2010) found that self-injurers scored significantly higher on self-reported negative urgency compared to non-injurers, while another self-report study (Lynam et al., 2011) also found that NSSI behavior was positively associated with negative urgency. A meta-analysis (Hamza et al., 2015) further showed that while not all measures of impulsivity were related to NSSI, the most consistent effects were found for measures of negative urgency. Thus, in addition to examining participants’ history of NSSI, the current study also included negative urgency as a personal characteristic influencing the boredom-NSSI link.

The current experiment will examine the effect of boredom and anger on self-administration of electric shocks, which is used as a proxy for NSSI behavior and thus expected to have the same emotion-improving benefit as this behavior. We will test (1) whether more electric shocks are applied in a boredom compared to an anger and neutral condition, and whether this effect will be positively moderated by NSSI history and negative urgency, and (2) whether participants will voluntarily shock themselves with an intensity above their personal pain threshold, seeking more painful stimulation, in a boredom compared to an anger and neutral condition, and whether this effect will be positively moderated by NSSI history and negative urgency.

### Methods

#### Participants

The current study was approved by the Ethical Research Committee of the Faculty of Psychology and Neuroscience, Maastricht University, approval code Master_188_09_02_2018. The sample size was based on previous research with comparable experimental designs and samples, using boredom video induction in combination with a self-shocking paradigm, in which large and moderate-to-large effects were found for the main effect of boredom and the interaction effect between boredom and history of NSSI (effect sizes ranging from $\eta^2_{\text{partial}} = 0.13$ to 0.41; Havermans et al., 2015; Nederkoorn et al., 2016). For our power analysis, using G*Power 3.1 (Faul et al., 2009) and selecting “Linear multiple regression: Fixed model, R² increase”, a moderate effect size of $f = 0.15$, an alpha rejection criterion of 0.05, power of 0.95, 4 tested predictors and 8 total predictors (due to the use of 2 separate dummy variables for condition, see statistical analyses), we needed 129 participants for the current research design. We therefore aimed to test a minimum of 129 and a maximum of 150 participants to account for potential drop out (e.g., technical difficulties). Participants were recruited via standard study advertisements at Maastricht University. We did not target participants specifically familiar with NSSI. A total of 147 participants registered, at least 88% of which were undergraduate university students (the remaining sample did not specify whether they were a student or not). After registration, participants were informed about the exclusion criteria for the current study (neural and cardiovascular disorders, pregnancy). No participants were excluded. There was incomplete data for one participant in the neutral condition, who was excluded from all analyses. Mean age of the remaining 146 participants was 22.33 years, SD = 3.66, and 74.66% of participants was female (n = 109). Of the total sample, 54.79% of participants reported a history of performing NSSI at least once in their life.

#### Materials

##### Emotional state induction

Participants were randomly assigned to the neutral, boredom or anger condition. In the neutral condition, participants watched a 42-minute fragment of the documentary “In Search of Memory”, showing the life and research on memory of Nobel Laureate and neuroscientist Eric Kandel (Seegers, 2009). The participants of the boredom condition watched a 36s fragment of the same documentary that was constantly repeated for 42 min. The participants in the anger condition watched a 42-minute fragment of 12 Years a Slave (McQueen et al., 2014). This film tells the story about Solomon Northup, a free African American man, who was kidnapped and sold into slavery in 1841. The film fragments used in the neutral and boredom condition were used before in our lab and shown to be effective in inducing a neutral or boring state (Havermans et al., 2015; Nederkoorn et al., 2016).
The movie to induce anger was not used before in this length (another study used a 5-minute clip; Magdin et al., 2021), therefore we performed a pilot test. Twelve participants watched the selected fragment and showed significant increases in anger and negative emotional states, as measured on 100 mm VAS scales (increase in anger $M = 47.20$, $t(11) = 5.10$, $p < .001$; increase in negative emotional states $M = 37.10$, $t(11) = 3.50$, $p < .005$).

### Emotional state

Before and after the emotional state induction, participants rated their emotional states on visual analogue scales that ranged from 0 (*does not describe my feelings*) to 100 (*clearly describes my feelings*). They were asked how bored, angry, sad, frustrated, negative, positive, relaxed, happy, and aroused they felt in the current moment.

### Pain threshold

Two 8 mm electrodes (filled with hypertonic gel; spaced 2 cm apart) were applied to the inside of the non-dominant lower arm. In this way, participants were connected to a bipolar constant current stimulator (DS5, Digitimer, Hertfordshire, UK), which was able to deliver a 300ms electric shock, sinus wave: 50 Hz, between 0.5 and 10 mA. Pain threshold represented the point at which participants first labelled the electric shock as painful, and was determined using a stepwise calibration procedure. An electric stimulation was applied with increasing intensity (in 0.5 steps from 0.5 to 10mA). After each step, the participant was asked whether he/she considered the present intensity to be painful or not. If not, a higher intensity (+ 0.5 mA) was applied. If a participant indicated it was painful, a shock with a higher level and another with a lower level was applied again, to check whether the correct level was chosen as the pain threshold.

### NSSI behavior

While watching the film fragments, participants could voluntarily administer electric shocks. The intensity of the shock started with 0.5 mA and for successive shocks, participants could select a shock with a higher (increase with 0.5 mA, maximum level = 10mA), equal, or lower intensity (decrease with 0.5 mA), or return to the start level of 0.5 mA. This way, increase in intensity was always stepwise, which prevented an unwanted or unexpected high increase in intensity. Intensity was selected via the arrow keys on the keyboard. Instructions were given at the start of the film and participants received a written instruction as reminder. The amount of self-administered electric shocks and the highest chosen intensity of the shock (the highest current) were recorded (Nederkoorn et al., 2016).

### Negative urgency

Negative urgency was measured through the short version of the Urgency, Premeditation (lack of), Sensation Seeking, Positive Urgency (UPPS-P) Impulsive Behavior Scale (Cyders et al., 2014). This is a self-report scale, which measures five aspects of impulsivity: Negative Urgency, Lack of Perseverance, Lack of Premeditation, Sensation Seeking and Positive Urgency. For research purposes outside of the current project, the entirety of this self-report scale was used, though only the Negative Urgency subscale was included in the current analyses. Participants rated 20 statements (four for each aspect) on a 4-point Likert-scale, which ranges from 1 (*agree strongly*) to 4 (*disagree strongly*). Reliability of the Negative Urgency subscale in the current study was moderate, with McDonald’s $\omega = 0.66$.

### History of NSSI

History of NSSI was measured with the Self-Injury Questionnaire (SIQ, Claes & Vandereycken 2007). This scale contains questions about five types of non-suicidal self-injurious behaviour (scratching, cutting, burning, bruising, and biting) and gives participants the opportunity to add a sixth. Of each behaviour, the incidence is asked on a 5-point scale, ranging from 1 (*last week*) to 5 (*never*). Only when participants report the occurrence of a behaviour within the last month, more questions about the behaviour are asked. In the present study, participants are dichotomously identified as having a history of NSSI or not (0–1). Participants with at least one type of NSSI, performed once or more, in their life, were identified as having a history of NSSI. In the freely described sixth NSSI behaviour, nail biting (mentioned four times), scab picking (mentioned twice) and itch scratching because of eczema/skin allergy (mentioned twice) were not considered as self-injurious behaviour. The other described behaviours – stabbing (mentioned twice), head banging against the wall (mentioned once), and putting lemon juice on a wound just for pain (mentioned once) – were classified as self-injurious behaviour.

### Procedure

After entering the lab, the procedure and exclusion criteria were explained, and participants were asked to sign informed consent. Next, electrodes were attached to the participants’ arm and individual pain threshold was determined as described in the Materials section. Afterwards, participants were asked to fill out an online survey, including…
questions on demographics, the UPPS-P and the baseline measures of emotional state. Next, the participants watched the neutral, boring or angry film-fragments, depending on the condition they were randomly assigned to. The participants were explained that during the film, they were free in their choice to apply electric stimuli if they wished, or to refrain from doing this. No further information regarding the reasons or effect of self-shocking, nor the contents of the film, were given to participants. After the film, the electrodes were removed and participants were asked to fill out an online survey again, which included the post measures of emotional state and the SIQ. At the end of the study, participants were fully debriefed and could choose course credits or a 10-euro gift certificate as a reward for participation.

Statistical analyses

As a manipulation check, a MANOVA was used, testing the emotional state changes (post- minus pre-induction emotional state scores on the nine VAS scales), with condition as between-subjects variable. For significant results, post hoc tests were performed, Bonferroni corrected. Effects of condition on all measured emotional states were analysed to ensure not only effectiveness, but also specificity of the inductions. In other words, examining all emotional states allows us to check whether our manipulations indeed targeted the specific emotional states they were intended to target.

As in previous studies, there were some outliers on the dependent variable of number of voluntary applied shocks (>3.00 SD of the mean within the condition): two in the boredom condition and one in the neutral condition. To reduce the effects of these influential cases, we winsorized the data and replaced the value of the outliers with the nearest value within the condition (Wilcox, 2005). Before replacing outliers, no significant effects were found, neither main nor interaction effects. The two outliers in the boredom condition were considered an effect of the manipulation, rather than an error, thus justifying replacement of these values. The single outlier in the neutral condition was more than 11.00 SD above the sample mean, making it an extremely influential case, which also explains the initial lack of significant findings. Results after exclusion of these outliers replicated results after replacement.

Pearson correlations were calculated between negative urgency, boredom change (boredom post-induction minus boredom pre-induction), and anger change on one hand, and frequency and intensity of electric shocks on the other hand. Correlations were separately calculated for participants with and without NSSI history, in line with Nederkoorn et al. (2016)’s study.

To test our first hypothesis, i.e., differences in shock frequency, and whether history of NSSI and negative urgency moderated this effect, linear regression analyses were performed using the SPSS macro PROCESS (Hayes, 2017). Condition (neutral, boredom and anger) was entered as the multicategorical predictor (x) variable through indicator (i.e., dummy) coding, and shock frequency as outcome (y) variable. History of NSSI and negative urgency were entered as moderator (w and z) variables in a single model (model number 2 in the PROCESS dialog box). Scores for negative urgency were mean centered to reduce multicollinearity. Considering that History of NSSI was a dichotomous variable, mean centering was not necessary. For all regression analyses, interaction (moderator x condition) terms were initially included in the tested model, and in case they were non-significant, the same analysis was run again excluding non-significant interaction terms, in order to still test the main effect of boredom on self-shocking.

To test our second hypothesis, i.e., differences in shock intensity, and whether history of NSSI and negative urgency moderated this effect, the same analyses were performed again, this time with shock intensity as outcome variable. Additionally, only participants who applied shocks were included. To adjust for differences in pain threshold, a difference score was calculated (highest intensity minus pain threshold).

Results

Sample characteristics

The three experimental groups did not differ significantly in any of the sociodemographic variables (see Table 1). Table 2 shows the mean levels of negative urgency and numbers of participants with and without a history of NSSI across experimental groups. A statistically significant difference was found in proportions of participants with and without a history of NSSI between experimental groups, $p = .03$. Post-hoc analysis involved pairwise comparisons using z-test of two proportions with Bonferroni-correction, and indicated that the proportion of participants with a history of NSSI was significantly higher in the boredom condition than in the neutral ($p < .05$) and anger condition ($p < .05$). No difference in proportion was found between the neutral and anger condition. Of all participants, 54.11% ($n = 79$) applied at least 1 electric shock while watching a film fragment.

See Table 2 for an overview of descriptives of the current trait study variables.
1. Boredom, F(2, 143) = 41.58, p < .001, η² partial = 0.37, with participants becoming more bored in the boredom condition, compared to both the neutral (p < .001) and anger condition (p < .001). The anger and neutral condition did not significantly differ (p = .60).

### Table 1: Demographic information of study sample

| Condition | Total group (N=146) | Neutral (N=48) | Boredom (N=49) | Anger (N=49) | Analysis |
|-----------|---------------------|----------------|---------------|--------------|----------|
|           | M/n SD/ %           | M/n SD/ %      | M/n SD/ %     | M/n SD/ %    | F/χ² p   |
| Age (years) | 22.33 3.66 | 22.42 3.23 | 22.35 4.77 | 22.22 2.75 | 0.03 0.97 |
| Gender | 1.02 0.94 | 1.02 0.94 | 1.02 0.94 | 1.02 0.94 | 0.12 0.94 |
| Female | 109 74.66 | 35 72.92 | 37 75.51 | 37 75.51 | 4.41 0.35 |
| Male | 37 25.34 | 13 27.08 | 12 24.49 | 12 24.49 | 1.68 0.79 |
| Nationality | | | | | |
| Dutch | 29 19.86 | 7 14.58 | 14 28.57 | 8 16.33 | 0.03 0.97 |
| German | 57 39.04 | 20 41.67 | 15 30.61 | 22 44.90 | 0.03 0.97 |
| Other | 60 41.10 | 21 43.75 | 20 40.82 | 19 38.78 | 0.03 0.97 |
| Education | | | | | |
| Less than high school | 0 - | 0 - | 0 - | 0 - | 0.03 0.97 |
| High school graduate | 83 56.85 | 26 54.17 | 30 61.22 | 27 55.10 | 0.03 0.97 |
| Bachelor degree | 37 25.34 | 11 22.92 | 12 24.49 | 14 28.57 | 0.03 0.97 |
| Master degree | 26 17.81 | 11 22.92 | 7 14.29 | 8 16.33 | 0.03 0.97 |
| Doctorate | 0 - | 0 - | 0 - | 0 - | 0.03 0.97 |

### Table 2: Descriptives of trait study variables

| Condition | Total group (N=146) | Neutral (N=48) | Boredom (N=49) | Anger (N=49) | Analysis |
|-----------|---------------------|----------------|---------------|--------------|----------|
|           | M/n SD/ %           | M/n SD/ %      | M/n SD/ %     | M/n SD/ %    | F/χ² p   |
| History of NSSI | 6.86* | -7.60 14.06 | 6.33 22.53 | 22.69 24.33 | 25.71** 0.26 |
| Absent | 66 45.21 | 27 56.25 | 15 30.61 | 24 48.98 | 6.86* 0.68 |
| Present | 80 54.79 | 21 43.75 | 34 69.39 | 25 51.02 | 1.48 0.24 |
| Negative urgency | 2.33 0.61 | 2.27 0.54 | 2.45 0.70 | 2.27 0.57 | 1.69** 0.05 |
| Shock frequency | 14.75 27.87 | 8.63 15.55 | 29.33 41.33 | 6.16 8.51 | 11.69** 0.05 |
| Shock intensity | -1.70 5.18 | -2.69 4.31 | -0.69 7.00 | -1.73 3.47 | 1.82 0.05 |

Note. NSSI = non-suicidal self-injury. *p < .05. **p < .001. Shock intensity = maximum intensity relative to pain threshold, calculated by subtracting pain threshold from the maximum intensity selected by participants.

### Table 3: Changes in affective states in the neutral, anger and boredom conditions

| Condition | Total group (N=146) | Neutral (N=48) | Boredom (N=49) | Anger (N=49) | Analysis |
|-----------|---------------------|----------------|---------------|--------------|----------|
|           | M SD | M SD | M SD | M SD | F η² partial |
| Negative | 7.24 24.13 | -7.60 14.06 | 6.33 22.53 | 22.69 24.33 | 25.71** 0.26 |
| Relaxed | -10.28 24.90 | 5.00 21.45 | -13.78 25.21 | -21.76 20.15 | 18.22** 0.20 |
| Angry | 14.40 25.42 | 2.00 14.70 | 8.47 22.19 | 32.47 26.93 | 26.17** 0.27 |
| Bored | 17.86 34.25 | 6.92 26.92 | 46.69 31.14 | -0.24 23.69 | 41.58** 0.37 |
| Sad | 9.64 25.82 | 1.63 18.31 | -3.53 15.11 | 30.65 27.67 | 37.44** 0.34 |
| Aroused | -3.96 21.89 | 1.71 22.64 | -9.12 17.74 | -4.35 23.91 | 3.06* 0.04 |
| Happy | -13.10 25.50 | -2.27 23.78 | -10.90 21.74 | -25.92 25.46 | 12.38** 0.15 |
| Positive | -17.72 27.14 | -3.33 23.81 | -17.71 21.55 | -31.82 28.19 | 16.15** 0.18 |
| Frustrated | 15.03 28.87 | -2.21 16.25 | 20.92 31.15 | 26.04 28.84 | 15.83** 0.18 |

Note. *p < .05. **p < .001. Mood change scores were calculated by subtracting mood scores pre-induction from mood-scores post-induction.
2. Anger, F(2, 143) = 26.17, p < .001, η² partial = 0.27, with participants becoming more angry in the anger condition, compared to both the neutral (p < .001) and boredom condition (p < .001). The boredom and neutral condition did not significantly differ (p = .44).

3. Sadness, F(2, 143) = 37.44, p < .001, η² partial = 0.34, with participants becoming more sad in the anger condition, compared to both the neutral (p < .001) and boredom condition (p < .001). The boredom and neutral condition did not significantly differ (p = .69).

4. Frustration, F(2, 143) = 15.83, p < .001, η² partial = 0.18, with participants becoming more frustrated in the anger condition (p < .001) and boredom condition (p < .001), both compared to both the neutral condition. The boredom and anger condition did not significantly differ (p = 1).

5. Negativity, F(2, 143) = 25.71, p < .001, η² partial = 0.26, with participants becoming more negative in the anger condition, compared to both the neutral condition (p < .001) and boredom condition (p < .001). Participants also became more negative in the boredom compared to both the neutral condition (p < .01).

6. Arousal, F(2, 143) = 3.06, p < .05, η² partial = 0.04, with participants becoming less aroused in the boredom condition, compared to the neutral condition (p < .05). The anger condition did not differ from both the neutral (p = .51) and boredom condition (p = .83).

7. Happy, F(2, 143) = 12.38, p < .001, η² partial = 0.15, with participants becoming less happy in the anger condition, compared to both the neutral condition (p < .001) and boredom condition (p < .01). The boredom and neutral condition did not significantly differ (p = .23).

8. Positivity, F(2, 143) = 16.15, p < .001, η² partial = 0.18, with participants becoming less positive in both the anger (p < .001) and boredom condition (p = .014), compared to the neutral condition. Participants in the anger condition became less positive compared to the boredom condition (p = .016).

9. Relaxation, F(2, 143) = 18.22, p < .001, η² partial = 0.20, with participants becoming less relaxed in both the anger (p < .001) and boredom condition (p < .001), compared to the neutral condition. The boredom and anger condition did not significantly differ (p = .24).

### Intercorrelations

Boredom change (boredom post-induction minus boredom pre-induction) showed a small (r ± .10 = small, r ± .30 = medium, r ± .50 = large; Field, 2013) significant positive correlation with both frequency and intensity of electric shocks (Table 4). When looking at participants with a history of NSSI specifically, similar correlations were found. In participants without a history of NSSI, however, no significant correlations were found between boredom change and frequency or intensity of electric shocks. Overall, anger change was not related to shocking behavior. Negative urgency showed a medium significant correlation with frequency, but not intensity, of electric shocks in the total sample and specifically in participants with a history of NSSI. After correcting for multiple testing, i.e., adjusting α to 0.0028, only the correlations between shock frequency with boredom change and negative urgency in the entire sample remained significant.

### Regression analyses

Assumptions for normality, linearity, homoscedasticity, and absence of multicollinearity were checked, and met. Table 5
provides an overview of the moderation analyses results. To test our first hypothesis, shock frequency was examined first. Initially, main effects were found for history of NSSI and negative urgency on shock frequency, as well as interaction (i.e., moderation) effects of condition by history of NSSI (see Fig. 2). Since the moderating effect of negative urgency was nonsignificant, the analysis was run again without this interaction effect. For this second analysis, model number 1 (standard moderation) was selected in the PROCESS dialog box, and negative urgency was selected as a covariate. Results from this analysis showed that the main effect of negative urgency became nonsignificant. Thus, finally, a third analysis was run excluding negative urgency as a predictor. This resulted in history of NSSI retaining its significant main effect, in addition to its significant moderation of the effect of condition on shock frequency. Simple slopes analyses revealed that condition (boredom vs. neutral) and shock frequency were not significantly related in participants without a history of NSSI, $\tau(137) = 0.08, p = .94, B = 0.64$. In participants with a history of NSSI, condition (boredom vs. neutral) and shock frequency were significantly related, $\tau(137) = -4.21, p < .001, B = -28.84$. Additionally, simple slopes analyses revealed that in participants without a history of NSSI, condition (boredom vs. anger) and shock frequency were not significantly related, $\tau(137) = -0.09, B = 0.93$. In participants with a history of NSSI, condition (boredom vs. anger) and shock frequency were significantly related, $\tau(137) = -5.04, p < .001, B = -32.81$. Running the above-mentioned analyses again, this time with dummy coding adjusted such that the anger and boredom conditions were compared to the neutral condition (as this is not automatically done when selecting a multivariate variable in PROCESS), only the interaction between condition (neutral vs. boredom) and history of NSSI was found to be significant, as in the first set of analyses. In sum, the effect of boredom on increased shock frequency was positively moderated by NSSI history.

To test our second hypothesis, the maximum intensity participants selected relative to their own pain threshold (maximum intensity minus pain threshold) was also tested in a moderation analysis. This moderation analysis included only participants that applied at least one shock to themselves ($n = 79$). In this model, only the main effect of condition on shocking intensity was significant (see Table 5), showing that maximum intensity relative to pain threshold was different between the boredom group on the one hand and the neutral and anger group on the other hand. Neither NSSI history nor negative urgency were found to be significant moderators, and thus were excluded from the model. Running the above-mentioned analyses again, this time with dummy coding adjusted, no significant difference was found between the anger and neutral condition, and again no significant moderators were found. Lastly, the main effect of condition on maximum intensity was tested with an ANOVA. The model showed a significant main effect of condition ($F(2, 76) = 6.14, p = .003, \eta^2_{\text{partial}} = 0.139$, see Fig. 3), and post hoc tests, Bonferroni corrected, showed that participants selected a relatively higher intensity in the boredom condition, compared to the neutral condition ($p = .003$). The difference between the boredom and anger condition was not significant ($p = .063$), as was the difference between the neutral and anger condition ($p = 1$). See Fig. 3.

**Discussion**

The current study aimed to experimentally examine the causal effect of boredom on NSSI in a sample of mostly undergraduate students. In addition to a neutral and boredom condition, an anger condition was included. Emotional state was induced through use of video, and simultaneously, self-administration of electric shocks was used as a proxy measure of NSSI behavior. Furthermore, history of NSSI and negative urgency were examined as moderators in the effect of boredom on self-shocking.

The boredom manipulation was successful: state boredom increase was significantly higher when watching the boring film fragment compared to the neutral and angering film fragment. Additionally, participants in the boredom condition were significantly more frustrated than in the neutral condition. However, the anger manipulation led to a combination of sadness and anger. It was evaluated as highly negative (more so than the boredom condition), but rather low in arousal, while the intention was to induce a higher arousal emotional state, as that is suggested to be related more strongly to NSSI behavior (Muehlenkamp et al., 2013). One difference between the boredom and anger condition is that although both film fragments evoked negative emotional states, involvement and immersion in the film fragments, i.e., monotony, might have differed between the two conditions. While people in the anger condition reported negative emotional states, they still might have found the film interesting and experienced no need for emotion-improvement through self-shocking. Additionally, the anger they experienced was probably a more indirect experience, out of sympathy for the characters in the movie, which is less comparable to a first-hand aversive emotional response to a threat or insult aimed at the participants themselves. An earlier study (Lobbestael et al., 2008) indeed demonstrated that anger induction through film led to lower physiological indices of anger compared to direct induction methods such as harassment and punishment. Moreover, anger for an injustice on another person might even be experienced as
### Table 5  Results of moderation analyses using the PROCESS macro

|                          | Shock frequency (N = 146)                      | Maximum intensity (N = 79)                          |
|--------------------------|-----------------------------------------------|---------------------------------------------------|
|                          | B     | SE B  | t     | p       | CI              | B     | SE B  | t     | p       | CI              |
| Boredom versus Neutral   | -3.76 | 8.28  | -0.45 | 0.650  | [-20.14, 12.61] | -7.20 | 3.00  | -2.40 | 0.019  | [-13.19, -1.21] |
| Boredom versus Anger     | -5.00 | 8.36  | -0.60 | 0.551  | [-21.53, 11.53] | -6.08 | 2.91  | -2.09 | 0.040  | [-11.88, -0.28] |
| History of NSSI          | 24.53 | 8.62  | 2.85  | 0.005  | [7.48, 41.57]   | -3.57 | 2.96  | -1.21 | 0.232  | [-9.47, 2.33]   |
| Boredom versus Neutral x History of NSSI | -21.03 | 11.36 | -1.85 | 0.066  | [-43.49, 1.44]  | 4.28  | 3.46  | 1.24  | 0.220  | [-2.62, 11.19]  |
| Boredom versus Anger x History of NSSI | -23.58 | 11.12 | -2.12 | 0.036  | [-45.56, -1.59] | 4.44  | 3.43  | 1.30  | 0.199  | [-2.40, 11.28]  |
| Negative Urgency         | 11.99 | 5.76  | 2.08  | 0.039  | [0.60, 23.37]   | 0.95  | 1.35  | 0.70  | 0.488  | [-1.76, 3.65]   |
| Boredom versus Neutral x Negative Urgency | -12.13 | 8.93  | -1.36 | 0.177  | [-29.79, 5.54]  | -1.07 | 2.56  | -0.42 | 0.677  | [-6.17, 4.03]   |
| Boredom versus Anger x Negative Urgency | -9.24  | 8.48  | -1.09 | 0.278  | [-26.00, 7.52]  | -0.61 | 2.01  | -0.31 | 0.761  | [-4.62, 3.39]   |
| Model summary            | 0.27  | 6.12  | <0.001|        |                 | 0.16  | 1.70  | 0.115|        |                 |
| Boredom versus Neutral   | -0.36 | 7.94  | -0.05 | 0.964  | [-16.06, 15.34] | -6.67 | 2.73  | -2.45 | 0.017  | [-12.11, -1.23] |
| Boredom versus Anger     | -2.50 | 8.17  | -0.31 | 0.760  | [-18.65, 13.64] | -5.74 | 2.75  | -2.09 | 0.040  | [-11.22, -0.26] |
| History of NSSI          | 29.05 | 8.02  | 3.62  | <0.001 | [13.18, 44.92] | -3.12 | 2.72  | -1.15 | 0.256  | [-8.54, 2.30]   |
| Boredom versus Neutral x History of NSSI | -27.14 | 10.56 | -2.57 | 0.011  | [-48.02, -6.27] | 3.63  | 3.10  | 1.17  | 0.246  | [-2.56, 9.81]   |
| Boredom versus Anger x History of NSSI | -28.04 | 10.68 | -2.63 | 0.010  | [-49.16, -6.92] | 3.99  | 3.21  | 1.24  | 0.218  | [-2.41, 10.39]  |
| Negative Urgency         | 5.54  | 3.60  | 1.54  | 0.125  | [-1.56, 12.65]  | 0.53  | 0.90  | 0.59  | 0.558  | [-1.26, 2.32]   |
| Model summary            | 0.25  | 7.92  | <0.001|        |                 | 0.16  | 2.28  | 0.045|        |                 |
| Boredom versus Neutral   | 0.64  | 7.95  | 0.08  | 0.936  | [-15.08, 16.37] | -6.42 | 2.68  | -2.39 | 0.019  | [-11.76, -1.07] |
| Boredom versus Anger     | -0.76 | 8.13  | -0.09 | 0.926  | [-16.83, 15.31] | -5.36 | 2.66  | -2.01 | 0.048  | [-10.66, -0.06] |
| History of NSSI          | 32.95 | 7.65  | 4.30  | <0.001 | [17.81, 48.08] | -2.55 | 2.53  | -1.01 | 0.317  | [-7.60, 2.50]   |
| Boredom versus Neutral x History of NSSI | -29.48 | 10.50 | -2.81 | 0.006  | [-50.24, -8.73] | 3.23  | 3.01  | 1.07  | 0.287  | [-2.78, 9.24]   |
| Boredom versus Anger x History of NSSI | -32.05 | 10.41 | -3.08 | 0.003  | [-52.64, -11.47] | 3.43  | 3.05  | 1.12  | 0.265  | [-2.65, 9.51]   |
| Model summary            | 0.24  | 8.94  | <0.001|        | 0.16  | 2.70  | 0.027|        |                 |

Analyses run again with re-arranged indicator coding
may therefore have been more present. The lack of significant findings for the effect of anger on self-shocking in the current study could thus be explained by the mixed emotional state resulting from the anger induction combined with the indirect and probably less aversive nature of the current state anger compared to the anger reported in NSSI studies (Muehlenkamp et al., 2013).

Our first hypothesis was only partly confirmed. Although we failed to find evidence for the predicted model, i.e., history of NSSI and negative urgency as positive moderators in the effect of boredom on self-shocking frequency, boredom did lead to higher self-shocking frequency compared to a neutral and anger condition, be it only in participants with a history of NSSI. Our second hypothesis was also only partly confirmed: boredom led to higher intensity of stimulation in the boredom condition compared to the neutral condition. Again, we failed to confirm our predicted model, i.e., history of NSSI and negative urgency as positive moderators in the effect of boredom on self-shocking intensity. No significant difference was found in shock intensity between the boredom and anger condition. Nevertheless, the current study provides at least tentative support for a causal boredom-NSSI link, and additionally demonstrates for the first time that boredom led to self-administration of painful stimulation, regardless of whether participants had a history of NSSI or not. The study further adds to previous research demonstrating that boredom leads to an array of negative behaviors (e.g., Biolcati et al., 2016; Moynihan et al., 2015), as aversive as self-administered electric shocks (Havermans et al., 2015; Nederkoorn et al., 2016).

In concordance with the previous study by Nederkoorn et al. (2016), a history of NSSI could explain individual variance in frequency of shocking behavior. People with such a history applied more shocks, but only when experiencing boredom. Additionally, boredom change was positively correlated with frequency and intensity of self-administered electric shocks only in participants with a history of NSSI. Negative urgency did not explain additional variance. However, in line with previous studies demonstrating a positive

rather rewarding in some ways, as one study (Green et al., 2019) demonstrated an increasing effect of righteous anger on participants’ self-evaluated moral standing, i.e., anger was used for self-enhancement purposes. The boredom felt in the boredom condition was however a first-hand emotion and the need for distraction and breaking off the monotony may therefore have been more present. The lack of significant findings for the effect of anger on self-shocking in the current study could thus be explained by the mixed emotional state resulting from the anger induction combined with the indirect and probably less aversive nature of the current state anger compared to the anger reported in NSSI studies (Muehlenkamp et al., 2013).

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Table 5 (continued)

|                      | Shock frequency (N = 146) | Maximum intensity (N = 79) |
|----------------------|--------------------------|---------------------------|
|                      | B          | SE B     | t     | p     | CI          | B          | SE t     | p     | CI          |
| Model summary        |            |          |      |      |            |            |          |      |            |
| R²                   | 0.24       | 8.94     | <0.001 |      |            | 0.16       | 2.70     | 0.027 |            |
| F                    |            |          |      |      |            |            |          |      |            |
| p                    |            |          |      |      |            |            |          |      |            |

Note. NSSI = non-suicidal self-injury. Maximum intensity = maximum intensity minus pain threshold. Indicator coding was used for the multi-categorical X variable (condition). Condition labels were as follows: 1 = boredom, 2 = neutral, 3 = anger, making the boredom condition the reference level. Then, analyses were run again, with labels re-arranged; 1 = neutral, 2 = boredom, 3 = anger, to account for the comparison between the neutral and anger condition. For both sets of regression analyses, interaction (moderator x condition) terms were initially included in the tested model, and in case they were non-significant, the same analysis was run again excluding non-significant terms, in order to still test the main effect of boredom on self-shocking.

* p < .05

![Fig. 2](image_url) The number of shocks applied in the neutral, anger and boredom condition, by participants with and without a history of non-suicidal self-injury (NSSI)

![Fig. 3](image_url) Highest intensity minus pain threshold, applied by participants who shocked themselves
The current results partly fit the framework of the benefits and barriers model of NSSI behavior (Hooley & Franklin, 2018). If indeed a lack of awareness of NSSI benefits (barrier #1) had prevented individuals with high levels of negative urgency but without a history of NSSI from engaging in painful self-shocking, NSSI history would most likely have moderated the effect of boredom not only on frequency, but also on intensity (i.e., painfulness) of electric shocks. The next barrier to be broken down for NSSI to occur would be the positive view of the self, supported by research showing higher levels of self-criticism in people who engage in NSSI than people who do not (Glassman et al., 2007; Hooley & Germain, 2014). The third barrier is physical pain, supported by studies demonstrating a link between NSSI and increased pain reporting latency, tolerance, and endurance (Franklin et al., 2012; Germain & Hooley, 2013; Glenn et al., 2014). The latter is in line with the positive correlation found between boredom change and intensity of electric shocks in the NSSI history group; their experience with NSSI behavior suggests a possibly higher pain tolerance compared to participants without NSSI history, resulting in painful self-shocking out of boredom. The fourth barrier to NSSI behavior is aversion to NSSI stimuli, which is negatively associated with NSSI (Franklin et al., 2014; Plener et al., 2012). Lastly, unlike in real life, social norms surrounding NSSI most likely did not pose a barrier in the current context, considering that participants were placed in a situation where NSSI behavior was presented as an accepted behavior due to it being part of the experiment: thus, this barrier will most likely have broken down for all participants, regardless of their (lack of) history with NSSI.

A number of limitations must be mentioned. Firstly, while the self-shocking paradigm is among the more ecologically valid pain tasks due to participants self-selecting whether, when, and in what intensity they receive electric shocks (Ammerman et al., 2018), it is unclear to what extent self-administered electric shocks in a lab setting can be equated to NSSI. Self-injurious behavior in real life presents itself in various different forms and severities, and considering the discrepancies between pain experiences in a lab setting and in real life NSSI instances (Ammerman et al., 2018; Carpenter & Hepp, 2021), caution is needed in interpreting the current findings and their generalizability. Secondly, the current anger induction led to a mixed emotional state of anger and sadness, making it difficult to determine the specific effect of anger on NSSI behavior. Furthermore, the anger induction was intended to induce a high arousal form of anger, but led to a low arousal form, limiting its comparability to prior studies examining the link between anger and NSSI (Muehlenkamp et al., 2013). Another limitation is that individual pain threshold for participants was measured only once; it is unclear whether habituation or sensitization occurred throughout the experiment, especially considering that some participants shocked themselves frequently, whereas others shocked themselves occasionally. Fourthly, emotional state was only measured before and after the video induction, but not during, which would have provided insight into possible functions of self-shocking behavior (e.g., emotion improvement through pain-offset relief). Lastly, the current sample consisted of mostly undergraduate students, limiting the study’s generalizability to the general as well as clinical populations. Furthermore, males were underrepresented, making up only 25.34% of the total sample. Additionally, over 50% of the current sample reported having a history of NSSI, which is higher than prior studies using similar samples (e.g., 15%; Whitlock et al., 2011). A possible explanation would be the operationalization of NSSI history in the current sample, as all participants who engaged in NSSI even once in their lifetime were deemed as having NSSI history, whereas prior studies often measure NSSI history as the prevalence of NSSI during a specific period of time (e.g., past-year prevalence; Serras et al., 2010). Additionally, reviews of NSSI research have also demonstrated that prevalence rates are considerably higher (sometimes even doubled) when using lists (i.e., questionnaires) rather than single item measures (Heath et al., 2008; Muehlenkamp et al., 2012). The latter are widely-used, making it more difficult to determine the extent to which our findings deviate from the actual prevalence of NSSI.

The fact that boredom was a trigger for self-administering electric painful stimulation suggests boredom might be a risk factor for NSSI behavior, not only for people with a history of NSSI, but also for people without. This makes boredom a highly relevant emotion to consider in studies with non-clinical as well as clinical populations. Considering the latter, in clinical facilities and inpatient treatment, where distraction and stimulation can be very low, one might be careful not to induce too much monotony. Furthermore, everyday experiences of boredom for the non-clinical population require further examination considering that boredom can lead to self-administered pain even in people without a history of NSSI. Additionally, boredom may be a useful target in NSSI intervention, for example through training...
patients’ boredom coping skills and altering patients’ environment to reduce likelihood of boredom experiences.

In conclusion, the current study shows that boredom motivates people to seek stimulation, even painful stimulation. This is especially true for people with a history of self-injurious behavior. NSSI research has mainly focused on emotions such as anger, sadness, shame, and guilt, whereas the current study highlights the possible importance of boredom in this maladaptive behavior. Considering that boredom is a universal and common emotion, its negative consequences should not be underestimated.

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