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Investigating the Role of the Intensity and Duration of Self-Injury Thoughts in Self-Injury with
Ecological Momentary Assessment

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Abstract

This study utilized ecological momentary assessment (EMA) to sharpen understanding of whether non-suicidal self-injury (NSSI) thought intensity and duration impacts NSSI behavior and potential alternative behaviors to NSSI. Self-injuring adolescents and young adults (N = 47) were randomly prompted using EMA to complete measures of NSSI thoughts (i.e., occurrence, intensity, duration) and behavior (i.e., engagement, frequency, duration, and methods) for two weeks. The most common NSSI thought duration was 1-30 minutes. Individuals with higher NSSI thought intensity were more likely to self-injure. NSSI thought intensity and duration interacted to predict NSSI frequency, duration, the number of NSSI methods, and the likelihood of cutting such that the positive relationship between NSSI thought intensity and these outcomes became stronger at longer NSSI thought durations. The most commonly endorsed non-NSSI behaviors following NSSI thoughts were pushing thoughts away, talking to others, and distraction (e.g., going out). Participants rarely endorsed using social media or online NSSI support groups in lieu of NSSI. Resisting intense NSSI thoughts over prolonged time periods may deplete the self-regulatory resources required to terminate NSSI episodes once they have begun, leading to greater NSSI frequency, longer NSSI duration, and more NSSI methods. Bolstering social support may help to reduce NSSI.

Keywords: self-harm; self-injury; suicide; ecological monetary assessment; experience sampling; ambulatory monitoring

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1. Introduction

Non-suicidal self-injury (NSSI; directly and deliberately harming body tissue with no intent to die; Chapman, Gratz, & Brown, 2006; Favazza, 1998) is a public health problem associated with psychopathology (e.g., Kerr & Muehlenkamp, 2010) and suicide (e.g., Castellvi et al., 2017) that affects 5.9% of individuals (Klonsky, 2011). Researchers have attempted to identify NSSI precipitants that could be targeted in interventions using ecological momentary assessment (EMA), which captures real time NSSI in context (e.g., Rodriguez-Blanco, Carballo, & Baca-Garcia, 2018). This study utilized EMA to sharpen understanding of how NSSI thoughts influence NSSI behavior.

1.1. Clarifying Active Components of NSSI Thoughts

Arguably the clearest precipitant of NSSI is NSSI thoughts, including generally thinking about NSSI, making plans to engage in it, experiencing mental images of NSSI, or NSSI urges. In EMA studies, individuals who engage in NSSI report thinking about NSSI more than those who do not (Andrewes, Hulbert, Cotton, Betts, & Chanen, 2017). Further, NSSI urges predict NSSI in borderline personality disorder and depression groups (Ammerman, Olino, Coccaro, & McCloskey, 2017). Therefore, broadly defined NSSI thoughts likely actively influence NSSI. However, it is unclear which specific NSSI thought qualities impact NSSI.

1.1.1. NSSI thought intensity. EMA and daily diary studies suggest that greater NSSI thought intensity, or higher occurrence of “intense” NSSI urges, predicts the engagement and frequency of NSSI (Hughes et al., 2019; Nock, Prinstein, & Sterba, 2009; Turner, Baglole, Chapman, & Gratz, 2018). However, there are multiple components to NSSI beyond whether

and with what frequency NSSI occurs. It remains unclear whether NSSI thought intensity influences *for how long* (duration) and *how* (methods) NSSI occurs, which is quintessential to understanding whether NSSI thought intensity predisposes individuals to engage in more dangerous or damaging NSSI.

1.1.2. NSSI thought duration. In addition to variability in NSSI thought intensity, individuals vary in how long they think about NSSI prior to its engagement. For example, one EMA study in self-injuring individuals suggested that the duration of NSSI thoughts (broadly defined) is normally distributed, and most commonly lasts between either 5-60 seconds or 1-30 minutes, regardless of whether or not NSSI was engaged in afterwards (Nock, Prinstein, & Sterba, 2009). Other studies suggest that the most common NSSI thought duration periods prior to NSSI are 5 seconds or less (Turner, Cobb, Gratz, & Chapman, 2016) or approximately 5 minutes (Maxfield & Pepper, 2018). These studies may lack consensus regarding typical NSSI thought durations because of their distinct samples, which varied from young adults/adolescents with an NSSI history (Nock et al., 2009), young adults with an NSSI history and disordered eating (Turner et al., 2016), and students (Maxfield & Pepper, 2018). Further examination into the topography of NSSI thought duration is required to identify which NSSI thought durations are typical in those who do and do not engage in NSSI.

Preliminary research suggests that NSSI thought duration may influence NSSI behavior, but findings are inconsistent. Nock and colleagues (2009) found that individuals with a shorter NSSI thought duration were more likely to engage in NSSI than those with a longer duration. In contrast, in another daily diary study, brief NSSI thoughts did not related to NSSI frequency, and instead persistent NSSI thoughts (i.e., occurring most of the time or 3-6 times per day, or for 3+ hours) predicted lower NSSI frequency (Turner et al., 2018). Finally, in undergraduates, longer

NSSI thought duration did not correlate with NSSI frequency, but positively predicted the use of more NSSI methods (Maxfield & Pepper, 2018). These findings underscore the importance of examining multiple components of NSSI behavior (i.e., engagement, frequency, duration, and methods), as the impact of NSSI thought intensity or duration may be distinct across them. However, this study did not control for the confounding influence of NSSI thought intensity. It is possible that NSSI thoughts last for long periods of time when they are more intense and thus take longer to attenuate, thereby accounting for the relationship between NSSI thought duration and the number of NSSI methods used. It is also unclear if NSSI thought duration predicts NSSI duration or specific NSSI methods. Such information is pertinent to understanding whether NSSI thought duration increases risk for more or less destructive NSSI behavior.

It is additionally unknown if the impact of NSSI thought duration on NSSI behavior is moderated by NSSI thought intensity. Perhaps shorter NSSI thought durations predispose individuals to NSSI particularly when thought intensity is high and thus difficult to resist. Alternatively, NSSI thought intensity may be less impactful on NSSI engagement under conditions of longer thought durations because even low intensity thoughts may exhaust individuals' capacity to resist such urges over prolonged periods of time. Identifying the conditions under which NSSI thought duration impacts NSSI behavior, and which specific components of NSSI are impacted, is pertinent to understanding how NSSI thoughts impact NSSI behavior.

1.1.3. NSSI in the absence of NSSI thoughts. All aforementioned questions presume that NSSI thoughts precede and prompt NSSI behavior. However, another critical predictor of NSSI is impulsivity (i.e., acting quickly without plans or consideration of consequences; Moeller, Barratt, Dougherty, Schmitz, & Swann, 2001). While the presence of NSSI thoughts

often precludes and predicts NSSI, NSSI may also occur in the absence of full awareness of NSSI thoughts. Indeed, given that briefer NSSI thought durations are associated with NSSI behavior in some studies (Nock et al., 2009), NSSI that occurs in the absence of a perception of thoughts may arise as a function of non-cognitive urges (e.g., physiology) or in those with poor insight. However, it is unclear whether NSSI behavior varies based on the presence of NSSI thoughts.

1.2. Alternative Behaviors to NSSI

Finally, as not all instances of NSSI are preceded by thoughts, not all instances of NSSI thought convert to NSSI. For example, in Nock and colleagues (2009), participants reported an average of five NSSI thoughts per week, but only 1.6 episodes of NSSI. However, common alternative ways of responding to NSSI thoughts other than NSSI have rarely been studied. It seems that only Nock and colleagues' (2009) measured which behaviors are frequently engaged after NSSI thoughts in lieu of NSSI, finding that frequent alternative behaviors to NSSI thoughts included talking to someone or going out. However, whether individuals typically use online platforms that either pertain to NSSI (i.e., online self-help groups) or not (i.e., social media) in lieu of NSSI is unclear. Given the substantive role of online technologies in adolescents' and young adults' lives, examining what online platforms, if any, individuals use to avoid acting on NSSI thoughts is important for future research.

The present study aimed to sharpen understanding of the specific qualities of NSSI thoughts that influence NSSI. We investigated whether NSSI thought intensity and duration individually or interactively predict: (a) the engagement, (b) frequency, (c) duration, (d) number of methods, and (e) specific methods, of NSSI. We hypothesized that individuals with higher NSSI thought intensities and shorter NSSI durations would exhibit a greater likelihood of NSSI

engagement, higher NSSI frequencies, longer NSSI durations (Nock et al., 2009), and less NSSI methods (Maxfield & Pepper, 2018). We also examined whether the presence of NSSI thoughts predict NSSI frequency, duration, and methods in instances of NSSI. Given a dearth of research we considered these investigations exploratory, as well as ones examining the interaction between NSSI thought intensity and thought duration, and common alternative behaviors to NSSI.

2. Methods

The present study involved secondary analysis from a larger parent dataset examining NSSI in youth (see Kranzler et al. (2018), for a comprehensive methods description).

2.1. Subjects

In brief, 47 actively self-injuring adolescents/young adults between 15-21 years old were recruited. Inclusion criteria required that participants engaged in active NSSI, defined as 2+ times in the past 2 weeks. Participants were excluded if they had imminent suicidality, a psychotic-spectrum disorder, life-threatening eating disorder, or developmental delay, or did not speak English. Participant demographics are in Table 1.

2.2. Procedure

An Institutional Review Board approved all study procedures, and all participants provided informed consent, and assent in the case of minors. Participants were screened for study criteria in person prior to enrollment. If eligible, the participant downloaded the Track It! App onto their phone and was trained in its use. Participants completed two practice days on the app before being monitored for two weeks. Participants were randomly prompted to complete the below measures five times per day within previously-determined time intervals and were instructed to initiate a response if they self-injured.

2.3. Measures

All measures examined in the present study were administered via EMA. EMA questions were developed for the present study but informed by one of the first NSSI EMA studies (Nock et al., 2009). At each data point, participants were asked to indicate whether they had thought about and/or engaged in NSSI (i.e., “any instance where you purposely enact physical harm to your body, without any intent to die”; Nock, 2010; Selby et al., 2013) since the last assessment. For NSSI thoughts specifically, participants were asked “Since the last assessment, have you had any thoughts or urges to self-injure?” If participants endorsed NSSI thoughts (including urges), they were asked questions about their “thoughts of self-injury”, including their intensity (i.e., “how intense were your thoughts of self-injury?”) from 0 (lowest) to 10 (highest) and their duration (i.e., “How long did these thoughts of self-injury last?”) as either less than 5 seconds, 5-60 seconds, 1-30 minutes, 30-60 minutes, 1-5 hours, and more than 5 hours. If participants endorsed NSSI behavior, they were asked how many times they engaged in NSSI since the last assessment (i.e., frequency; “since the last entry, how many times did you engage in self-injury?”), and for how long (i.e., NSSI duration; “For how long did you self-injure?”), based on the same categories of time used with NSSI thoughts. They were also provided with a list of NSSI methods and asked to indicate which ones they had engaged in since the last assessment: cutting, burning, punching, scratching, physically fighting, biting, pulling their hair, head banging, hitting themselves, or other. Participants were allowed to endorse multiple NSSI methods (i.e., yes/no). Finally, if participants reported thinking about NSSI but *not* engaging in it, they were provided with a list of activities and asked which of them they did instead of NSSI (i.e., yes/no): watched television, social media, talked to someone, sleep, played music, pushed the NSSI thoughts away, went out, homework, something distracting they enjoyed, an internet

support group, relaxation, or tried to change their NSSI thoughts. Participants were allowed to endorse multiple activities.

2.4. Data Analysis

To examine the impact of NSSI thought duration and intensity on NSSI, we ran six sets of generalized estimating equations models (GEE; Burton, Gurrin, & Sly, 1998). GEE uses semi-parametric methods to analyze repeated measures and is robust to covariance structure misspecification. Each analysis was run with autoregressive, exchangeable, and unstructured covariance structures, selecting the model with the lowest Quasilikelihood Information Criterion, or the unstructured or autoregressive convergence structure (in the case of convergence issues), for multinomial analyses. Six analyses were run predicting: (1) NSSI engagement (i.e., yes/no) of the entire sample (binomial distribution); (2) NSSI frequency in instances of NSSI engagement (negative binomial distribution to accommodate the positively skewed (skew statistic = 3.46) and count nature of the data; Hilbe, 2011); (3) NSSI duration in instances of NSSI engagement (multinomial distribution, cumulative logit link); and (4) the number of NSSI methods used in instances of NSSI engagement (normal distribution; skew statistic = 1.34, considered acceptable). The NSSI methods varied greatly. Cutting (40.7% of instances) and punching (32.4% of instances) were endorsed the most frequently, followed by other (20%), scratching (17.9%), and all other methods being endorsed at a frequency of less than 10%. We therefore constrained our NSSI method analyses to focus on the two most prevalent methods of NSSI, specifying a binomial distribution to examine the impact of NSSI thought intensity and duration on (5) the use of cutting versus not and (6) the use of punching versus not.

For all analyses, two predictors were specified: 1) NSSI thought intensity (grand mean centered) was entered as a continuous predictor, and 2) NSSI thought duration was entered as a

categorical predictor. NSSI thought duration \times NSSI thought intensity interactions were entered into each model. NSSI thought duration categories at the low and high ends of the scales had particularly low rates of endorsement. For example, in instances of NSSI engagement, only 2.7% endorsed thinking about NSSI for less than 5 seconds and 1.8% endorsed thinking about it for 5+ hours. Similarly, NSSI durations of 1-5 hours were rarely endorsed (2.8%) and 5+ hours was never endorsed. To yield more interpretable results while avoiding loss of meaningful variability, we collapsed categories with less than 5% endorsement, in instances of NSSI engagement¹, which in practice were dispersed to either end of duration length, to the categories most adjacent to them yielding four NSSI thought duration groups: shortest (<60 seconds; 26.1%), moderate-short (1-30 minutes; 40.5%), moderate-long (30-60 minutes; 20.7%) and longest (1+ hours; 12.6%). A similar approach yielded four groups of NSSI duration: shortest (<5 seconds; 11%), moderate-short (5-60 seconds; 33.1%), moderate-long (1-30 minutes; 47.6%), and longest (30+ minutes; 8.3%).

To examine whether the occurrence of NSSI thoughts in instances of NSSI behavior is associated with distinct NSSI frequencies, duration, and methods, we also conducted similar GEE analyses in instances of NSSI behavior with the outcomes and distributions listed above. The occurrence of NSSI thoughts (yes or no) was entered as the only categorical predictor.

3. Results

There were 3,356 valid entries, 85.12% of participants responded to prompts 80% of the time or more, and 85.1% and 100% reported engaging in NSSI and NSSI thoughts at least once,

¹ The majority of analyses were run with a subsample of cases that involved NSSI engagement, and therefore rates of endorsement of NSSI thought durations in instances of NSSI engagement specifically (rather than regardless of NSSI engagement) were used to determine thought duration categories.

respectively. During 143 NSSI total episodes, 536 NSSI thoughts and 442 NSSI behaviors were recorded. Participants reported NSSI thoughts 76.6% and 13.2% of the time when they did and did not engage in NSSI, respectively. See Table 2 for descriptive information regarding NSSI thoughts and behavior. See Table 3 for NSSI thought intensity, NSSI frequency, NSSI thought duration, and NSSI duration by NSSI method.

The duration of NSSI thoughts when NSSI was and was not engaged in are presented in Table 4. The most common NSSI thought duration was 1-30 minutes across all groups except in instances of punching, wherein 5-60 seconds was the most commonly endorsed NSSI thought duration (34.29%) followed by 1-30 minutes (31.6%). The least common NSSI thought durations across groups were <5 seconds and/or 5+ hours.

3.1. Impact of NSSI Thoughts on NSSI

GEE analyses are in Table 5. Higher NSSI thought intensity, but not NSSI thought duration or the NSSI thought duration \times NSSI thought intensity interaction, predicted a greater likelihood of NSSI engagement ($b = .65$, $SE = .31$), $\chi^2(1) = 4.54$, $p = .03$, $OR = 1.92$.

An NSSI thought duration \times NSSI thought intensity interaction predicted NSSI frequency (see Figure 1). In the shortest NSSI thought duration group, there was a negative but non-significant effect of NSSI thought intensity on NSSI frequency ($b = -.05$, $SE = .05$), $\chi^2(1) = 1.29$, $p = .26$. However, there was a significantly more positive relationship between NSSI thought intensity and the NSSI frequency in the moderate-short ($b = .20$, $SE = .08$), $\chi^2(1) = 6.30$, $p = .01$, $RR = 1.22$, and longest ($b = .40$, $SE = .20$), $\chi^2(1) = 4.08$, $p = .04$, $RR = 1.49$, NSSI thought duration groups compared to the shortest group. Furthermore, the impact of NSSI thought intensity was more positive in the longest NSSI duration group than in moderate-long group, ($b = .35$, $SE = .18$), $\chi^2(1) = 4.04$, $p = .04$. Comparisons of the impact of NSSI thought intensity on NSSI frequency

between all other NSSI thought duration groups were non-significant. These estimates generally indicate that more intense NSSI thoughts predicted higher frequency of NSSI to a greater extent in groups with longer NSSI thought durations than those with shorter NSSI durations.

An NSSI thought duration \times NSSI thought intensity interaction predicted NSSI behavior duration (see Figure 2). At the shortest NSSI thought duration, there was a negative but non-significant effect of NSSI thought intensity on NSSI duration ($b=-.06$, $SE=.07$), $\chi^2(1)=.79$, $p=.37$. However, there were more positive relationships between NSSI thought intensity and NSSI duration in moderate-short ($b=.35$, $SE=.15$), $\chi^2(1)=5.77$, $p=.02$, $RR=1.42$, and the longest ($b=.96$, $SE=.27$), $\chi^2(1)=12.79$, $p<.001$, $RR=2.61$, thought duration categories relative to the shortest one. There were less positive relationships between NSSI thought intensity in the moderate-short ($b=-.61$, $SE=.29$), $\chi^2(1)=4.29$, $p=.04$, $RR=.54$, and moderate-long ($b=-.74$, $SE=.31$), $\chi^2(1)=5.65$, $p=.02$, $RR=.49$, thought duration categories relative to the longest thought duration category. Comparisons of differences of the impact of NSSI thought intensity on NSSI duration between other NSSI thought duration groups were non-significant. These findings generally indicate that greater NSSI thought intensity prolonged NSSI duration to a greater extent in the context of longer NSSI thought durations.

An NSSI thought duration \times NSSI thought intensity interaction predicted the number of NSSI methods used (see Figure 3). In the shortest NSSI thought duration group, there was a negative but non-significant effect of NSSI thought intensity on the number of NSSI methods ($b=-.003$, $SE=.03$), $\chi^2(1)=.01$, $p=.93$. However, there were significantly more positive relationships between NSSI thought intensity and the number of NSSI methods used in the moderate-long NSSI duration group compared to the shortest, ($b=.20$, $SE=.07$), $\chi^2(1)=7.73$, $p=.01$, $RR=1.22$, and the moderate-short, ($b=.22$, $SE=.07$), $\chi^2(1)=10.38$, $p=.001$, $RR=1.25$, NSSI

duration groups. Comparisons of differences of the impact of NSSI thought intensity on number of NSSI methods between other NSSI thought duration groups were non-significant. These estimates indicated that more intense NSSI thoughts predicted a higher number of NSSI methods to a greater extent in the context of longer NSSI thought durations.

An NSSI thought duration \times NSSI thought intensity interaction also predicted the engagement of cutting. In the shortest NSSI thought duration group, there was a negative but non-significant effect of NSSI thought intensity on the likelihood of cutting ($b=-.17$, $SE=.12$), $\chi^2(1)=1.95$, $p=.16$. However, there was a more positive relationship between NSSI thought intensity and the probability of cutting in the longest NSSI thought intensity group compared to the shortest ($b=1.19$, $SE=.34$), $\chi^2(1)=12.37$, $p<.001$, $OR=3.29$, moderate-short, ($b=.99$, $SE=.34$), $\chi^2(1)=8.47$, $p=.004$, $OR=2.69$, and moderate-long, ($b=.99$, $SE=.30$), $\chi^2(1)=10.88$, $p=.001$, $OR=2.69$, groups. Comparisons of differences of the impact of NSSI thought intensity on the probability of cutting between all NSSI thought duration groups were non-significant. These estimates indicated that, in instances of NSSI, more intense NSSI thoughts predicted a higher likelihood of engaging in cutting specifically in the context of longer NSSI durations.

There were no main effects of NSSI thought intensity, duration, or interactions between the two predicting the likelihood of punching in instances of NSSI.

3.2. Relationship of NSSI characteristics to presence or absence of NSSI thoughts

In instances of NSSI engagement, the presence of NSSI thoughts predicted higher NSSI frequency ($b=.44$, $SE=.19$), $\chi^2(1)=5.06$, $p=.03$, $OR=1.55$. However, the presence of NSSI thoughts did not predict NSSI duration, $\chi^2(1)=.45$, $p=.50$, NSSI methods, $\chi^2(1)=.82$, $p=.33$, the engagement of cutting, $\chi^2(1)=.19$, $p=.67$, or the engagement of punching, $\chi^2(1)=.75$, $p=.39$.

3.3. Alternative Behaviors to NSSI

See Table 6 for frequencies of behaviors engaged in instead of NSSI. The most frequent activities were listening to music, talking to someone, doing homework, and sleeping. The least frequent activities were internet support groups, relaxation, changing NSSI thoughts, and going out.

4. Discussion

This study sought to identify the qualities of NSSI thoughts associated with NSSI. It also aimed to identify whether NSSI characteristics are differentially associated with the presence or absence of NSSI thoughts in instances of NSSI, and to describe alternative responses to NSSI thoughts. We hypothesized that individuals with higher NSSI thought intensity and shorter NSSI duration would be more likely to engage in NSSI, and report higher frequencies, longer durations, and fewer methods of NSSI. Participants reported experiencing NSSI thoughts 76.6% of the time prior to NSSI, supporting their role as antecedents of NSSI. Consistent with Nock and colleagues (2009), the most common NSSI thought duration regardless of NSSI engagement was 1-30 minutes, followed by 5-60 seconds, suggesting that NSSI thoughts tend to be brief.

Partially consistent with hypotheses, when NSSI thoughts occurred, individuals with more intense NSSI thoughts, but not longer NSSI thought durations, were more likely to engage in NSSI. Related, in instances of NSSI engagement, participants who had NSSI thoughts exhibited higher NSSI frequencies. These findings therefore do not suggest that “impulsive” NSSI behavior (i.e., without thoughts, or shorter thought durations) is associated with more, longer, or specific forms of, NSSI.

Several studies corroborate that higher intensity NSSI thoughts predispose individuals to engage in NSSI (Hughes et al., 2019; Nock et al., 2009; Turner et al., 2018). Further, while some works suggest that NSSI thought duration impacts NSSI engagement (Nock et al., 2009), others

suggests that it does not (Maxfield & Pepper, 2018). Our results suggest that the intensity of NSSI thoughts is more highly associated with NSSI than their duration. It is possible that NSSI thought duration did not predict the engagement of NSSI behavior because the way it was measured obscured distinct responses to NSSI thoughts. NSSI thoughts may be brief because they are fleeting and easily ignored or dismissed, or because NSSI is engaged immediately following them, then terminating the thought. These two distinct variations of brief NSSI thought duration may exert opposing effects on the occurrence of NSSI, masking meaningful relationships between NSSI thought duration and behavior. We did not collect information about why NSSI thoughts ended, and therefore cannot disentangle these nuances.

We also found that higher NSSI thought intensity predicted increased NSSI frequency, longer NSSI durations, a higher number of NSSI methods, and a higher likelihood of engaging in cutting to a greater extent in the context of longer NSSI thought durations. Thus, although NSSI thought duration is not associated with *if* NSSI occurs, it acts in tandem with NSSI thought intensity to indicate *how much, for how long, and how* it occurs. Theorists suggest that resisting urges to engage in a particular behavior (i.e., NSSI) demands cognitive resources, which become depleted over time (Baumeister, Bratslavsky, Muraven, & Tice, 1998). Similar cognitive resources may be required to inhibit problem behavior once it has begun (i.e., terminate NSSI). Perhaps resisting higher intensity thoughts over long periods of time is particularly depleting of cognitive resources and dampens individual's ability to terminate NSSI behavior once it has been initiated, leading to increased NSSI frequency, durations, and, by virtue of longer NSSI duration, more NSSI methods. Such a conceptualization of NSSI thoughts is consistent with NSSI theories implicating progressive amplification of thought intensity in NSSI (Selby & Joiner, 2009; Selby et al., 2019).

It is also possible that the behaviors that individuals engage in to address NSSI thoughts inadvertently heighten their intensity and prolong their duration, leading to a greater frequency, duration, and number of methods of, NSSI. For example, suppressing unwanted thoughts elicits and intensifies them (Abramowitz, Tolin, & Street, 2001). Perhaps individuals who engage in NSSI frequently and for longer periods of time feel greater regret after NSSI episodes and consequently attempt to suppress subsequent NSSI thoughts, which inadvertently intensifies and prolongs them, leading to more frequent and prolonged NSSI. Alternatively, the relationship between NSSI thoughts and behavior may be reciprocal, wherein individuals who engage in NSSI with greater frequency and duration subsequently contemplate it with greater intensity and duration, which in turn leads to more, longer, and more varied, NSSI. Unfortunately, as we were unable to examine whether each specific instance of NSSI thoughts preceded and pertained to each endorsed instance of NSSI behavior, we cannot confidently determine that NSSI thoughts, or the potential behaviors associated with them, *lead* to NSSI behavior. Future longitudinal studies should more closely examine the temporal relationship between these variables, including potentially reciprocal ones.

It is unclear why NSSI thought intensity and duration interacted to predict a higher likelihood of cutting but not punching. Given that cutting is the most common form of NSSI, its likelihood may generally increase as a function of increases in NSSI frequency, duration, and methods. Alternatively, perhaps other NSSI methods require less deliberation and thought because they do not involve tools (e.g., knives), planning (i.e. to hide the behavior as in cutting), can be acted on more quickly, and are therefore less impacted by NSSI thought intensity and durations. The preparation required by cutting may make it more contingent upon longer and more intense deliberation periods.

4.1. Alternative Behaviors to NSSI

Although NSSI thoughts impacted NSSI behavior, 13.2% of the time that individuals reported NSSI thoughts, they did not engage in NSSI. The most common alternatives to NSSI included talking to someone, suggesting a potentially buffering role of social support in thwarting NSSI thoughts. Individuals also endorsed distracting activities in lieu of NSSI such as sleeping, music, or homework. It is not clear whether individuals intentionally used these strategies to avoid NSSI or for other reasons and inadvertently distracted themselves from NSSI thoughts. Future research should examine whether intentionality in alternative behavior use impacts effectiveness in thwarting NSSI thoughts.

It is also notable that internet-based behaviors (i.e., social media or online NSSI support groups) were not frequently endorsed. Social media and internet use can increase distress (Huang, 2010) and promote NSSI (Daine et al., 2013; Lewis, Heath, Michal, & Duggan, 2012), and individuals desiring to avoid NSSI may therefore have appropriately avoided internet use. The low frequency use of online NSSI support groups has important implications given the emergence of online mental health interventions for internalizing problems and related suicidal behavior (e.g., Christensen, Batterham, & O’Dea, 2014; Lai, Maniam, Chan, Ravindran, 2014; Perry et al., 2016; Reyes-Portillo et al., 2014), suggesting that lack of engagement may obstruct use of online mental health interventions for NSSI. Further examinations of the contexts in which individuals consider using online NSSI support groups, their efficacy, and their desirability could illuminate when, why, and how they may be useful.

4.2. Limitations, Future Directions, and Implications

There are number of limitations in this study. First, several qualities of NSSI thoughts beyond intensity and duration were not studied and may relate to NSSI such as perceived ability

to resist NSSI thoughts and ways of responding to them (e.g., with suppression, acceptance). Related, NSSI thoughts were broadly defined, which may compromise meaningful variability in distinct forms of NSSI thoughts (e.g., urges, planning, passive thoughts, reflection, images). It is unclear if the present findings are specific to the forms of NSSI thoughts that precede and elevate risk for NSSI behavior (e.g., urges), or reflect a broader and more heterogeneous category of cognitive experiences that may not necessarily relate to behavioral outcomes. Second, although the present work assessed whether NSSI thoughts occurred, their frequency, and their duration, it did not examine the extent to which they recur within a given time period. It is possible that some individuals repeatedly experience and suppress NSSI thoughts, whereas others experience thoughts that do not recur. Although the frequency of NSSI thoughts was assessed, whether this variable reflects “new thoughts” prompted by unique antecedents, or recurrences of an existing thought or urge, is unclear. Third, we were not able to examine whether NSSI thoughts specifically preceded NSSI behavior, only whether thoughts and/or behavior occurred within the same time frame since the last assessment. Therefore, when both NSSI thoughts and behavior were endorsed, it remains unclear whether NSSI thoughts actually preceded and pertained to behavior, co-occurred with it, or followed it. As a result, a causal or temporally precedent role of NSSI thoughts on NSSI behavior remains speculative. Future studies should therefore examine the temporal relationships between NSSI thoughts and behavior with more granularity. Fourth, this study is strengthened by its assessment of alternative behaviors that individuals engaged in in lieu of NSSI. However, whether or not these behaviors were specifically employed intentionally to resist NSSI thoughts remains unclear. Perhaps the effectiveness of alternative behaviors is specific to whether or not they were engaged with such intentionality. Fifth, we did not assess whether individuals who had NSSI thoughts and did engage in NSSI behavior

attempted to engage in alternative behavior first, and thus whether there are meaningful differences to the alternative behaviors engaged in when individuals do or do not successfully avoid NSSI behavior. Future research should thus conduct more fine-grained analyses of which specific behaviors help people resist acting on NSSI thoughts and the contexts and motives that render them more or less effective. Related and finally, because there remains no gold standard in NSSI measurement in EMA studies, the EMA questions utilized in this study are preliminary. Future research may determine more concise or preferential questions for use in assessment of NSSI thoughts and duration of those thoughts.

The present study also presents significant clinical implications. First, they corroborate other work suggesting that NSSI thoughts are typically of short durations (i.e., 30 minutes or less), and thus interventions that are designed to intercede NSSI thoughts and behaviors must be able to be situated within this narrow timeframe, fast acting, and readily available. In addition, when conducting assessments of NSSI risk, clinicians should assess both NSSI thought intensity and duration, given their ability to predict whether, how much, for how long, and how NSSI will occur. Clinicians are also advised to identify ways to reduce NSSI thought intensity and interrupt its duration, particularly when intense, in order to reduce NSSI. Finally, preliminary findings suggest that emphasizing talking to others to resist NSSI thoughts, along with distraction-based strategies (e.g., music, homework), may help individuals avoid engaging in NSSI. They also suggest that there is greater need to understand why individuals who engage in NSSI do not commonly access online NSSI support resources, and to refine these interventions to expand their accessibility. Taken together, these findings underscore the importance of NSSI thoughts to the engagement of NSSI behavior, and highlight that distinct NSSI thought qualities (i.e.,

intensity, duration) can uniquely impact specific components of NSSI behavior (i.e., engagement, frequency, duration).

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Table 1

Participant demographics

Age (Mean, Standard Deviation)		19.07 (1.77)
Sex		
	Male	29.8%
	Female	68.1%
	Transgender	2.1%
Race/Ethnicity		
	White/Caucasian/European	38.3%
	Asian	19.1%
	African	14.9%
	American/Black/Caribbean	
	Hispanic/Latino	17.0%
	Multi-racial	10.6%
Sexual Orientation		
	Straight/Heterosexual	66.0%
	Bisexual	17.0%
	Gay/Lesbian/Homosexual	6.4%
	Other	6.4%
	Don't know/do not wish to report	4.3%
Previous diagnosis of psychological/psychiatric disorder		38.3%

Table 2

Descriptive information regarding NSSI behaviors and thoughts

Mean number of times participants reported NSSI	3.09 (SD = 2.91)
Mean number of times participants reported NSSI thoughts	11.40 (SD = 9.41)
Mean intensity of NSSI thoughts	5.86 (SD = 2.45)
NSSI duration (%)	
Less than 5 seconds	11%
5-60 seconds	33.1%
1-30 minutes	47.6%
30+ minutes	8.3%
NSSI methods (%)	
Cutting	40.7%
Burning	9%
Punching	32.4%
Scratching	17.9%
Physically fighting	.7%
Biting	9.7%
Hair pulling	7.6%
Head banging	3.4%
Hitting self	3.4%
Other	20%

Note. SD = standard deviation

Table 3

NSSI thought intensity, NSSI thought duration, and NSSI duration by NSSI method

	Cutting	Not Cutting	Punching	Not Punching
Thought Intensity	7.55 (2.21)	7.08 (1.91)	7.24 (1.90)	7.32 (2.14)
NSSI frequency	3.81 (4.89)	2.52 (2.35)	2.66 (3.80)	3.23 (3.58)
NSSI thought duration				
Less than 5 seconds	0%	4.8%	5.3%	1.4%
5-60 seconds	14.3%	30.6%	34.2%	17.8%
1-30 minutes	38.8%	41.9%	31.6%	45.2%
30-60 minutes	26.5%	16.1%	18.4%	21.9%
1-5 hours	16.3%	6.5%	10.5%	11.0%
More than 5 hours	4.1%	0%	0%	2.7%
NSSI duration				
Less than 5 seconds	3.4%	16.3%	25.5%	4.1%
5-60 seconds	20.3%	41.9%	40.4%	29.6%
1-30 minutes	66.1%	34.9%	29.8%	56.1%
30-60 minutes	6.8%	4.7%	2.1%	7.1%
1-5 hours	3.4%	2.3%	2.1%	3.1%
More than 5 hours	0%	0%	0%	0%

Table 4

NSSI thought duration when individuals did not versus did engage in NSSI

	Did not engage in NSSI	Engaged in NSSI
Less than 5 seconds	7.8%	2.7%
5-60 seconds	27.1%	23.4%
1-30 minutes	43.8%	40.5%
30-60 minutes	16.5%	20.7%
1-5 hours	4.7%	10.8%
More than 5 hours	.2%	1.8%

Note. Percentages reflect number of NSSI thought instances across the sample

Table 5

Generalized estimating equations analyses examining the impact of NSSI thought duration on the engagement, the frequency, and duration of NSSI

	χ^2	df	p-value
Outcome: NSSI engagement^a regardless of presence of NSSI thoughts			
Intercept	46.47	1	<.001
NSSI thought duration	.87	3	.83
NSSI thought intensity	15.00	1	<.001
NSSI thought duration × NSSI thought intensity	1.77	3	.62
Outcome: Frequency of NSSI^b			
Intercept	21.18	1	<.001
NSSI thought duration	2.77	3	.43
NSSI thought intensity	2.58	1	.11
NSSI thought duration × NSSI thought intensity	8.99	3	.03
Outcome: Duration of NSSI^c			
NSSI thought duration	18.66	3	<.001
NSSI thought intensity	13.06	1	<.001
NSSI thought duration × NSSI thought intensity	18.47	3	<.001
Outcome: Number of NSSI methods used			
Intercept	323.99	1	<.001
NSSI thought duration	7.88	3	.05
NSSI thought intensity	2.30	1	.13
NSSI thought duration × NSSI thought intensity	10.55	3	.01

Outcome: Cutting^a			
Intercept	2.29	1	.13
NSSI thought duration	6.36	3	1.00
NSSI thought intensity	3.76	1	.05
NSSI thought duration × NSSI thought intensity	13.10	3	.004
Outcome: Punching^a			
Intercept	1.48	1	.22
NSSI thought duration	1.95	3	.58
NSSI thought intensity	.20	1	.67
NSSI thought duration × NSSI thought intensity	3.72	3	.29

^a Modeled with a binomial distribution, with avoidance of NSSI/not cutting/not punching as the reference category.

^b Modeled with a negative binomial distribution.

^c Modeled with a multinomial distribution

Table 7

Behaviors engaged instead of engaging in NSSI when self-injury thoughts did not manifest into behavior

	Percent endorsed
Watched television	19.1%
Went on social media	14.8%
Talked to someone	33%
Went to sleep	22.2%
Listened to music	34.3%
Pushed the thoughts away	32.4%
Went out	6.5%
Did homework instead	23.5%
Did something you enjoy to distract yourself	16%
Visited internet group for support	.6%
Used relaxation strategy	5.6%
Tried to change the thoughts	6.5%

Note. Percentages reflect the number of NSSI thought instances across the sample

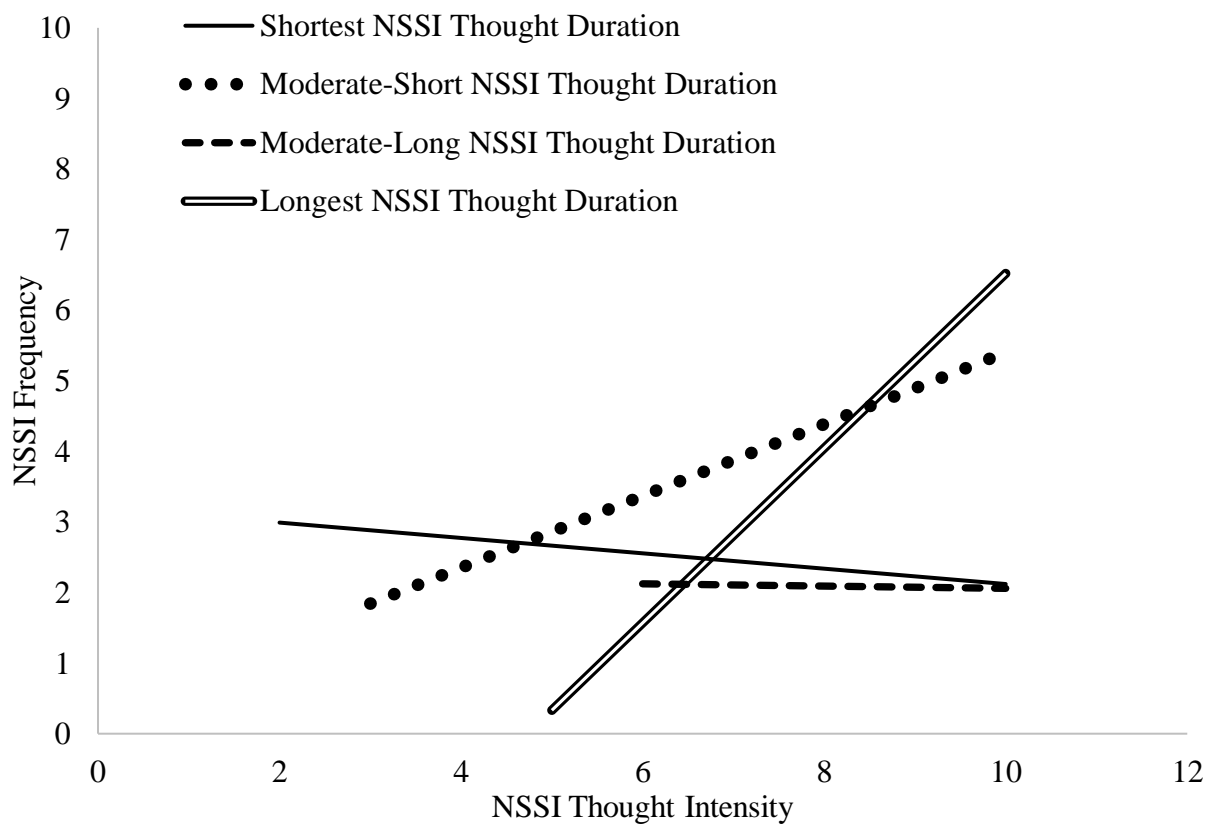


Figure 1. Graphical depiction of NSSI thought duration \times NSSI thought intensity interaction predicting NSSI frequency.

Note. NSSI = non-suicidal self-injury

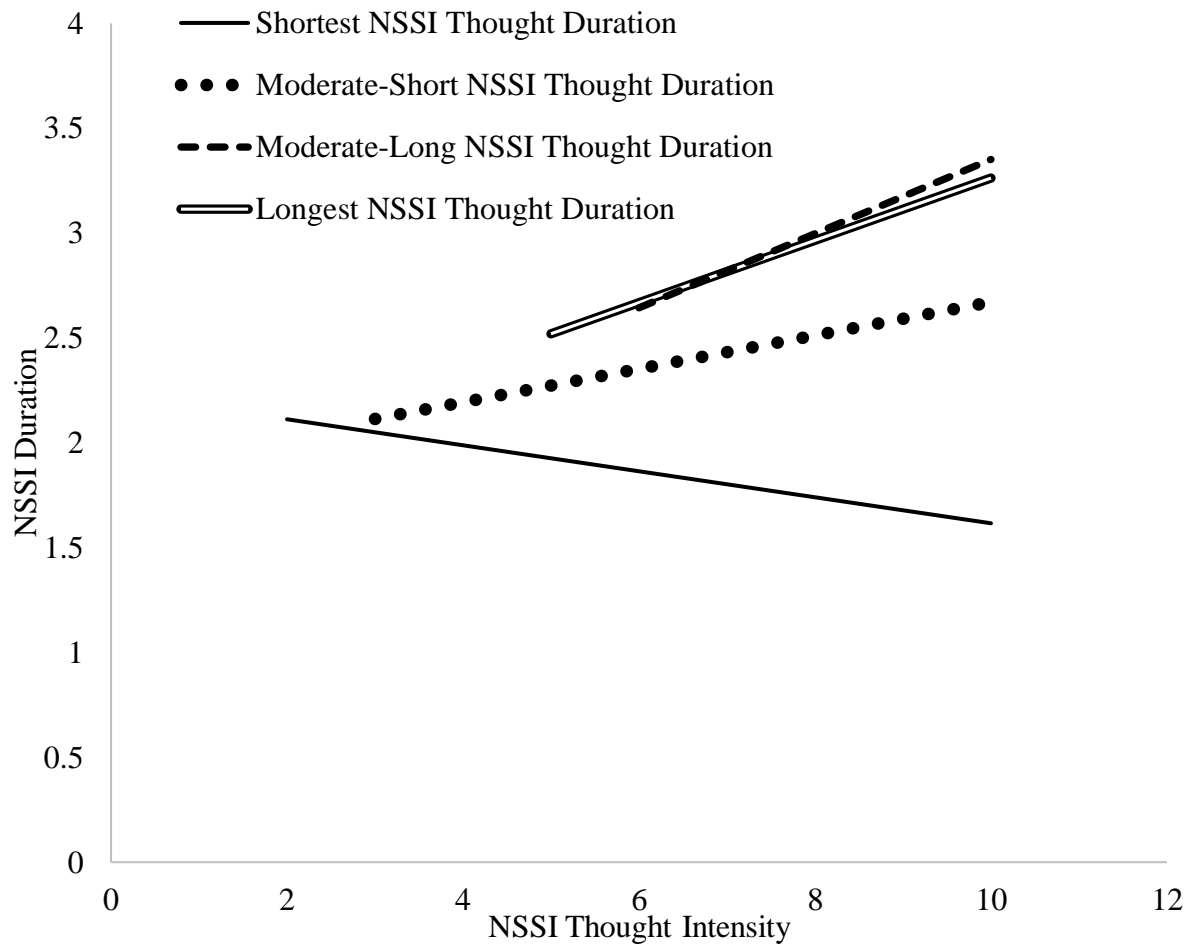


Figure 2. Graphical depiction of NSSI thought duration \times NSSI thought intensity interaction predicting NSSI duration.

Note. NSSI = non-suicidal self-injury

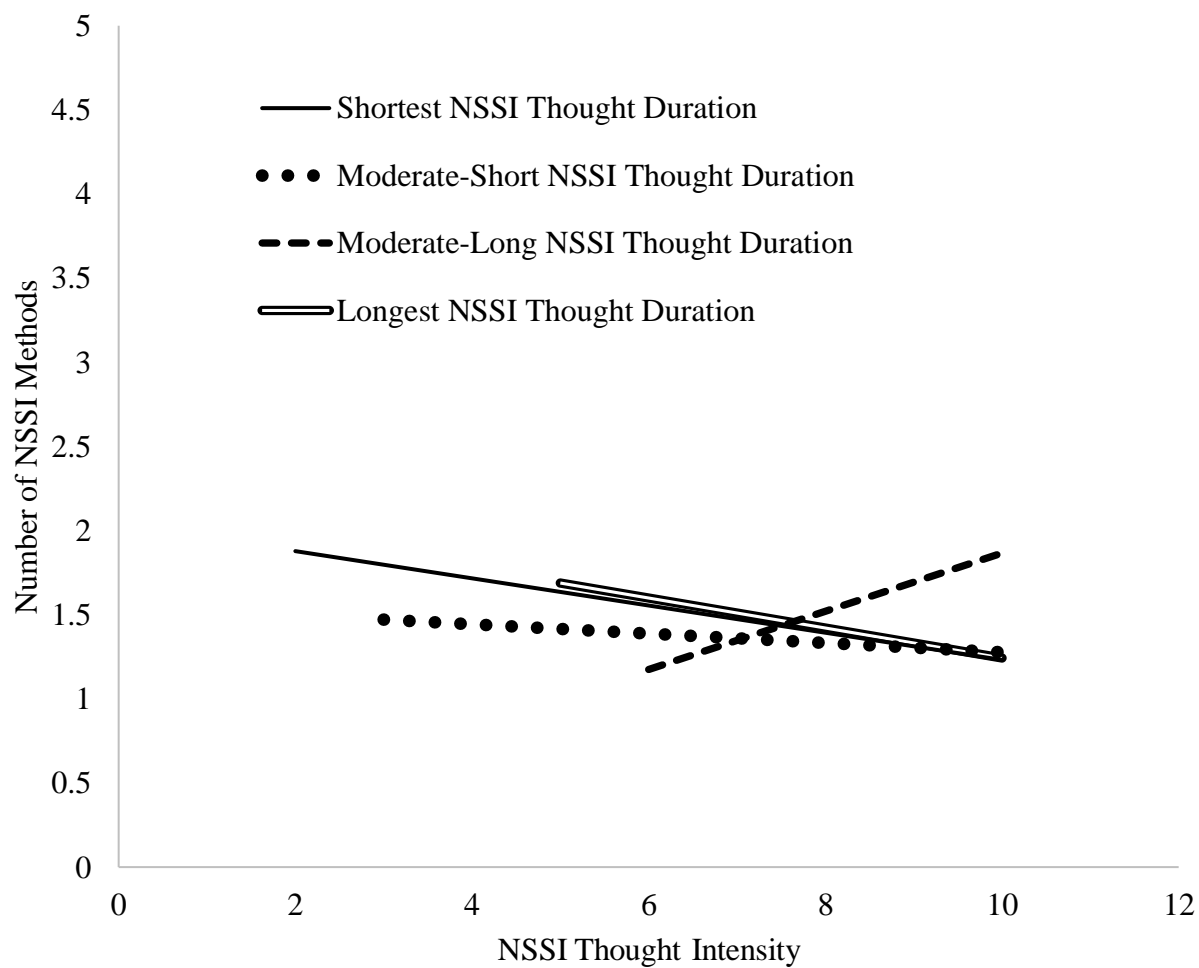


Figure 3. Graphical depiction of NSSI thought duration \times NSSI thought intensity interaction predicting number of NSSI methods used.

Note. NSSI = non-suicidal self-injury