A Text Mining Approach to Characterizing Interpersonal Stress among Individuals with a Nonsuicidal Self-Injury History

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Abstract

Objective: Interpersonal difficulties are salient among those with a history of NSSI and precede NSSI urges and behaviors. Yet, limited research has focused on identifying which aspects of interpersonal stress may confer risk for NSSI. **Method:** The current study aimed to leverage data from two samples (combined n=206; n=114 with NSSI history) of participant-driven interviews regarding a recent interpersonal stressor to enhance the field's knowledge of interpersonal difficulties in relation to NSSI risk. **Results:** Using topic modeling to extract thematic information, analyses identified four main topics: daily difficulties; family members; adjectives/verbal fillers; and friendship/romantic relationships. Relationships between the topics and three predictors (i.e., NSSI history, emotion dysregulation, sample) were examined. In one sample, the proportion of 'adjectives/verbal fillers' was greater for participants with a NSSI history and at higher levels of emotion dysregulation. Across samples, for participants with a NSSI history, 'adjectives/verbal fillers' and 'friendship/romantic partners' increased with levels of emotion dysregulation. **Conclusion:** Findings highlight a greater use of adjectives and verbal fillers among individuals with a history of NSSI and higher levels of emotion dysregulation. This pattern of language may serve as an indicator of a specific aspect of emotion regulation difficulties that confers risk for NSSI.

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Conclusion: Findings highlight a greater use of adjectives and verbal fillers among individuals with a history of NSSI and higher levels of emotion dysregulation. This pattern of language may serve as an indicator of a specific aspect of emotion regulation difficulties that confers risk for NSSI.

Keywords: interpersonal difficulties; emotion dysregulation; text mining; topic modeling

Introduction

Nonsuicidal self-injury (NSSI) is of growing clinical concern due to high prevalence rates across numerous age ranges (e.g., Gillies et al., 2018; Swannell et al., 2014) and evidence that NSSI engagement may be increasing (e.g., Duffy et al., 2019; Wester et al., 2018). Given the negative outcomes associated with NSSI, including psychological and social difficulties (e.g., Plener et al., 2015), as well as suicidal behaviors (Franklin et al., 2017), there is a need to better understand the contextual factors that contribute to behavior engagement. While theoretical (e.g., Nock, 2009) and empirical (i.e., Hepp et al., 2020) research highlights that the majority of individuals engage in NSSI to cope with negative affect, little is known regarding the events or circumstances that may produce negative emotion states among those who engage in NSSI.

It has been found that individuals who engage in NSSI experience more interpersonal difficulties than their peers (Adrian et al., 2011; Tatnell et al., 2014). Consequently, a cognitive vulnerability-stress model of NSSI may be a useful lens to view the relationship between interpersonal difficulties and NSSI. From this framework we can posit that individuals who engage in NSSI may be more likely to experience high arousal during interpersonal difficulties, thus increasing their need for a (maladaptive) coping mechanism (i.e., NSSI; Guerry & Prinstein, 2009). Supporting this, individuals with a history of NSSI report more subjective distress after an interpersonal stressor (Kim et al., 2015) and interpersonal conflict has been shown to precede the occurrence of NSSI urges (Nock et al., 2009; Victor et al., 2018) and NSSI engagement (Turner et al., 2016). Furthermore, negative affect states specific to interpersonal stress, such as feeling rejected and angry towards others, have been shown to rise in the hours preceding NSSI acts and decrease afterwards (Snir et al., 2015), as well as predict NSSI engagement (Nock et al., 2009).

Despite mounting evidence highlighting the impact of interpersonal stress on NSSI, limited recent research has focused on identifying which aspects, or characteristics, of interpersonal stress may confer risk for NSSI. Prior research has demonstrated that specific relationships may be more salient in understanding risk for NSSI: those engaging in NSSI were found to have less daily contact with family members or friends as compared to romantic partners (Turner et al., 2016). It is likely that this extends to the effects of stress within these relationships. Beyond the relationship itself, it may be that interpersonally-relevant negative affect states are also important in risk for NSSI. Subjective reports of rejection, but not criticism, were found to uniquely predict later NSSI urges (Victor et al., 2019). Together, these findings provide initial support for the notion that consideration of nuanced aspects of interpersonal stress may improve NSSI risk prediction and prevention."

Research in this area has potentially been limited by traditional assessment methodologies. While studies examining interpersonal stress and NSSI have utilized numerous study designs (i.e., cross-sectional, experimental, intensive longitudinal; Adrian et al., 2011; Kim et al., 2015; Snir et al., 2015; Tattnel et al., 2014; Turner, et al., 2016; Victor et al., 2018), they have heavily relied upon validated, but often static or trait-like, Likert-type self-report items to assess interpersonal contexts and stress. These approaches may be failing to capture important aspects of interpersonal relationships that haven't been a focus of past research, but may be important in conferring NSSI risk (i.e., relationship characteristics; cognitive-affective or behavioral responses to behavioral stress). One way to advance our understanding of the particular aspects of interpersonal stress that may be salient for those engaging in NSSI is by examining participant-driven dialogue. This approach affords the application of text-based analyses, which have the flexibility to highlight the information deemed important by those with lived experience. Such analysis has demonstrated initial promise within the suicide literature (e.g., Jacobucci et al., 2021) and thus has a natural extension to understanding NSSI risk.

The current study aimed to leverage participant-driven interview data, in which participants discussed a

recent interpersonal stressor, as a way to enhance the field's knowledge of interpersonal difficulties in relation to NSSI. As there are known differences in interpersonal relationships across developmental stages (Wrzus et al., 2013), interviews from two different samples were utilized: undergraduate students and adults recruited from the community. The first aim of this study was to examine the nuanced aspects of interpersonal stress identified through participant-driven interviews across samples. We hypothesized that through the extraction of latent topics from the interview dialogue, a range of topics (i.e., stressor content, interpersonal target, and cognitive-affective response) would be modeled. Second, we aimed to investigate whether these topics were*uniquely* related to NSSI history. Given the strong association between NSSI and emotion regulation (i.e., Andover & Morris, 2014), and the heightened distress following an interpersonal stressor experienced by those with a NSSI history (Kim et al., 2015), we considered the impact of emotion dysregulation in these models. We hypothesized, based on prior research (i.e., Victor et al., 2019; Turner, Wakefield et al., 2016), that specific affective states and interpersonal targets (identified via the first aim) would be associated with the presence of NSSI history; we also expected that the specifics of these associations would differ based on sample. Finally, as our third aim, we examined how valence of participant dialogue impacted the above associations; however, no specific predictions were made.

Method

Sample 1: Undergraduate Students

Participants and Procedures

Participants were 41 undergraduate students, aged 18-30 (M = 20.41, SD = 2.42); 85.4% identified as women; 61.5% identified as White. Exclusion criteria for all participants included: (a) history of psychosis, intellectual disabilities, or traumatic brain injury with loss of consciousness for more than 60 minutes; (b) a score of greater than 15 on the Quick Inventory of Depression Symptoms (Rush et al., 2003); (c) severe alcohol or substance use disorder (as defined by DSM-5; American Psychiatric Association, 2013); or (d) past week suicidal ideation. As part of a larger, experimental study examining interpersonal stress and NSSI, participants were invited to the lab, where they completed a series of self-report measures followed by the interpersonal stressor interview. The interview was conducted in a private room and was administered by a trained graduate research assistant. All participants providing informed consent and all procedures were approved by the Institutional Review Board.

Measures

Nonsuicidal Self-injury. Inventory of Statements about Self-Injury (ISAS; Klonsky & Glenn, 2009) was used to determine the presence of NSSI history. The ISAS is a self-report measure that assesses lifetime NSSI engagement across 12 forms of NSSI (i.e., self-cutting, self-burning, etc.); participants were determined to have a lifetime history of NSSI if they reported at least two NSSI acts. The psychometric properties of the ISAS have been supported (Klonsky & Glenn, 2009; Glenn & Klonsky, 2011).

Emotion Dysregulation. The Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004) is a self-report measure that assesses six dimensions of emotion dysregulation; for the present study only the overall index of emotion dysregulation was utilized. The DERS internal consistency, re-test reliability, and construct and predictive validity have been supported (Gratz & Roemer, 2004). Total scores in this sample demonstrated adequate internal consistency (α = .90).

Interpersonal Stressor Interview. Consistent with past research (Gratz et al., 2011), participants completed a semi-structured interview about a recent upsetting interpersonal conflict (i.e., where they were "very upset or angry"), wherein they were asked specific details about the event (e.g., location), as well as specific emotions, physical sensations, and thoughts that occurred at the time of the conflict. Each interview took approximately 10 minutes to complete. All interviews were transcribed verbatim for use in the current study.

Sample 2: Community Adults

Participants and Procedures

Participants were 165 community members aged 18-52 ($M = 23.5$,$SD = 6.97$); 84.2% identified as women; 69.8% identified as White. Participants for this study were recruited from the community; 47.9% were full-time students. Data collection took place as part of a larger study on borderline personality disorder (BPD), and over half of the appointment slots were reserved for those with elevated BPD features (i.e., 5+ criteria endorsed on a preliminary screening [First, et al., 2015] and/or a score of 38 or higher on the personality assessment inventory – borderline scale [Morey et al., 1991]). Inclusion criteria included being 18 - 55 years of age, a fluent English speaker, and able to read/complete online questionnaires; exclusion criteria included: (a) current or recent (past year) psychotic symptoms; and (b) these symptoms were determined to be serious enough to interfere with an individual's ability to adequately complete all study procedures. Following screening protocols (assessing BPD features), participants were invited into the lab to complete the interpersonal stressor interview and self-report questionnaires. These interviews were conducted by trained graduate research assistants in a private room. All participants provided informed consent and all procedures were approved by the Institutional Review Board.

Measures

Nonsuicidal Self-injury. The Deliberate Self-Harm Inventory (DSHI; Gratz, 2001) was used to determine the presence of NSSI history. The DSHI is a behaviorally-based self-report questionnaire that assesses the lifetime frequency, severity, duration, and type of NSSI behaviors across 16 methods (e.g., cutting, burning, severe scratching, etc.); participants were determined to have a lifetime history of NSSI if they reported having ever engaged in NSSI during their lifetime. The psychometric properties of the DSHI have been supported (Gratz, 2001).

Emotion Dysregulation. The Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004) total score was also utilized in this sample. Total scores in this sample demonstrated adequate internal consistency ($\alpha = .89$).

Interpersonal Stressor Interview. As part of a larger procedure to develop an idiographic emotion induction script (Dixon-Gordon, Waite, et al., 2021) and consistent with past research (Gratz et al., 2011), participants were asked to describe a recent upsetting interpersonal conflict, and were encouraged to describe an interaction in the context of an ongoing relationship. Participants underwent a semi-structured interview about a recent upsetting interpersonal conflict, wherein they were asked specific details about the event (e.g., location), as well as specific emotions, physical sensations, and thoughts that occurred at the time of the conflict. Each interview took approximately 20 to 45 minutes to complete. All interviews were transcribed verbatim for use in the current study.

Data Analysis

Similar to extracting latent variables that capture the covariance among psychological scales, topic models (for a review, see Blei, 2012) extract thematic information across text responses. While alternative analysis approaches to text responses exist (i.e., sentiment analysis), these approaches are limited because they cannot disambiguate multiple word meanings, motiving the use of data-driven methods such as a topic modeling framework to obtain a finer and more nuanced representations of semantic concepts (e.g., Pennebaker et al., 2003; Kjell et al., 2019): topic models perform by modeling word usage across participant responses in an attempt to find groups of words (i.e., "topics") that commonly co-occur. One of the most common forms of topic models is latent Dirichlet allocation (LDA; Blei et al., 2003). In comparison to other algorithms for computing topics, LDA has been found to generally produce more coherent topics (Stevens et al., 2012). LDA is an*unsupervised* model, similar to a latent class model, because there is no explicit outcome or predictor in the model. To relate topics to predictors or covariates of interest, structural topic model (STM; Roberts et al., 2016) are used, which model text with latent topics while allowing the prevalence of each topic to be predicted by a set of exogenous variables. In a STM model, the topic proportions are regressed on the predictors, allowing researchers to determine whether topic prevalence is affected by or associated with the predictors. All topic modeling analyses were performed using the *psychtm* (Wilcox, 2020), *stm* (Roberts et al., 2019), and *DirichletReg*(Maier, 2021) packages in the R statistical environment (R Core Team, 2020).

Topical coherence (Mimno et al., 2011), topical exclusivity (Roberts et al., 2019), residual dispersion, and hold-out likelihood (using 50% of the data for training and 50% for model evaluation) were used as goodness-of-fit metrics to choose the optimal number of topics, ranging from 2 to 10 topics. Coherence has been shown to correlate strongly with human ratings of topic interpretability (Mimno et al., 2011), while exclusivity provides a measure of the uniqueness of the words prevalent in each topic. Ideally, a good solution would provide higher coherence and higher exclusivity scores.

The *stm* (Roberts et al., 2019) R package approximates the relationships between predictors and topic proportions by a sequence of "one vs. all" linear regressions instead of estimating and testing with a canonical generalized linear model, which are more appropriate for nonlinear relationships. Given this, we instead used Dirichlet regression implemented in the *DirichletReg* (Maier, 2021) R package to jointly model relationships between NSSI history, emotion dysregulation, and the two samples. The Dirichlet regression model included the main effect of NSSI history (-0.5 = no history, 0.5 = history), emotion dysregulation (mean-centered) as a linear predictor, the main effect of sample (-0.5 = undergraduate, 0.5 = community), the three two-way interactions between NSSI history and emotion dysregulation, and the three-way interaction between NSSI history, emotion dysregulation, and sample to model the topic proportions.

To assess our final aim – whether the information accounted for by the topics was related, in part, to narrative valence – we studied the relationship between topic prevalence and narrative valence. Valence was scored using the *sentimentr* (v2.9.0; Rinker, 2021) R package given its ability to account for valence shifting features, such as negation and amplification (i.e., words that modify the intensity of meaning; e.g., "really"; "hardly"). Each participant's narrative was scored with respect to valence, where higher, positive values indicate positive valence and lower, negative values indicate negative valence; a score of zero is neutral (M = -0.01, SD = 0.37, Min= -1.18, Max = 1.13).

Data pre-processing . Two participants (5%) in Sample 1 (undergraduate sample) had missing scores on the measure of emotion dysregulation. Scores were imputed for these participants using stochastic regression imputation (e.g., Enders, 2010) in the *mice*(van Buuren, 2011) R package using NSSI history, participant subjective rating of level of distress as a result of the interpersonal stressor (i.e., "How upsetting or distressing was this event?"; response options 1 = *not at all distressing* to 10 = *most upset or distressed I've ever been*), and their interaction as predictors during imputation.

Before modeling the narrative responses, the raw text was pre-processed using standard practices in computational linguistics (e.g., Manning et al., 2008; Roberts et al., 2014) by (a) correcting misspellings; (b) removing commonly used "stop words"11We used the stop word list from the NLTK Python text mining library (Bird et al., 2009), although negation words ("no", "nor", "not", "don't", "hasn't", "haven't", "isn't", "shouldn't", "wasn't", "weren't", "won't", "wouldn't") were not removed from the responses. (e.g., the, to, a, an) and words in the question prompts; (c) removing numbers, punctuation, and symbols; and (d) removing any words that were used fewer than five times in the entire corpus. Narrative responses throughout the semi-structured interview were concatenated into a single response for each participant and experimenter utterances were removed. One participant in the community sample did not complete the interview and was excluded from analysis. This resulted in a total of 3,647 words in the undergraduate sample and 45,633 words in the community sample. After pre-processing, the average participant narrative length was 89 words (SD = 23, $Median$ = 87, Min = 48, Max = 158) in the undergraduate sample and 275 words (SD = 162,$Median$ = 246, Min = 22, Max = 1189) in the community sample. Topic models and semantic measures were computed using unigrams (i.e., individual words rather than multi-word phrases).

Results

Preliminary Analysis

In the undergraduate sample, approximately half of the participants (56.1%, n = 23) reported a lifetime history of NSSI. The mean score on emotion dysregulation was 84.60 (SD = 25.23), with those having a NSSI history reporting significantly higher scores,t (37) = -3.29, p =.002 (NSSI history, M = 95.50,SD = 18.26; no NSSI history, M = 73.65, SD = 23.15). In the community sample, approximately half of participants

(55.2%, $n = 91$) reported a lifetime history of NSSI. The mean score on the measure of emotion dysregulation was 105.88 (SD = 19.30), with those having a NSSI history reporting significantly higher scores, t (163) = -2.53, p = .01 (NSSI history, M = 109.25, SD = 18.81; no NSSI history, M = 101.74, SD= 19.22). The two samples did not significantly differ with regard to percent of the sample endorsing NSSI, χ^2 (1, N= 206) = .01, p = .91; however, samples did significantly differ on mean levels of emotion dysregulation, t (204) = -5.58, p<.001, with the community sample endorsing higher levels of emotion dysregulation.

Aim One

Goodness-of-fit metrics suggested that a four-topic model was optimal (see Supplemental Table 1). The most strongly representative words (measured by term score11Because some words are highly probable across all or several topics, word probabilities alone are not always sufficient to interpret a topic. Term scores emphasize words that*uniquely* represent each topic by downweighting words that are highly probable across many topics.; Blei & Lafferty, 2009) associated with each topic are shown in Table 1. Face validity of the topics were assessed third and last author. Topic 1 corresponded to discussion of daily difficulties (i.e., tax, staff, homeless); Topic 2 corresponded to discussion regarding family members (i.e., dad, mom, sister); Topic 3 corresponded to the use of adjectives often used as verbal fillers (i.e., like, really, things); and Topic 4 corresponded to discussion of friendships and romantic relationships (i.e., friends, talking, meet, dating).

Aim Two

We next examined the regression relationships between the four topics and three predictors: NSSI history, emotion dysregulation, and sample. We report likelihood ratio tests (LRT) and Cox and Snell (1989) pseudo-R^2 measures (R^2_{CS}) for tests of main effects and interactions (see Supplemental Table 2). Regression coefficients (b) are reported on the natural logarithm scale (i.e., a log-link function was used) in Table 2.

First, the three-way interaction among sample, NSSI history, and emotion dysregulation was not statistically significant, LRT (4) = 9.05,p = .060, R^2_{CS} = .042.

Second, there was a significant overall interaction between NSSI history and sample, LRT (4) = 17.27, p = .002,R^2_{CS} = .08, when holding emotion dysregulation constant (see Figure 1). This interaction was primarily driven by a significant interaction between sample and NSSI history for usage of Topic 3, Z = 3.96, p < .001. In the undergraduate sample, the proportion of Topic 3 was significantly greater for participants with a history of NSSI (94%) than those without a history of NSSI (83%), Z = 3.87, p< .001, while there was not a significant difference in the community sample (14% for participants with or without a history of NSSI), Z = -0.99, p = .323. This interaction was not statistically significant for Topics 1, 2, and 4, all p> .10.

Third, there was a significant overall interaction between emotion dysregulation and sample, LRT (4) = 19.04, p = .001,R^2_{CS} = .09 (see Figure 2). This interaction was primarily driven by a significant interaction between emotion dysregulation and sample for usage of Topic 3, Z = -3.62,p < .001. In the undergraduate sample, the proportion of Topic 3 increased significantly as emotion dysregulation increased,Z = 4.30, p < .001, while there was no significant change in the community sample, Z = 1.30, p = .194. This interaction was not statistically significant for Topic 1, 2, and 4, all p > .50.

Fourth, there was a significant overall interaction between NSSI history and emotion dysregulation, LRT (4) = 15.34, p = .004,R^2_{CS} = .07, as shown in Figure 3. This interaction was primarily driven by a significant interaction between NSSI history and emotion dysregulation for usage of Topic 3,Z = 4.31, p < .001, and Topic 4, Z = 2.39, p = .017. For participants without a history of NSSI, the proportion of Topic 3 did not change significantly with emotion dysregulation, b = 0.001 (SE = 0.005), Z = 0.18,p = .855, 95% CI: [-0.009, 0.011]; for participants with a history of NSSI, the proportion of Topic 3 increased significantly as emotion dysregulation increased, b = 0.046 (SE = 0.009),Z = 5.00, p < .001, 95% CI: [0.028, 0.064]. For participants without a history of NSSI, the proportion of Topic 4 did not change significantly with emotion dysregulation, b = 0.0002 (SE = 0.011), Z = 0.02, p = .982, 95% CI: [-0.018, 0.004]; for participants with a history of NSSI, the proportion of Topic 4 increased significantly as emotion dysregulation increased, b = 0.013 (SE = 0.006), Z = 2.08,p = .037, 95% CI: [0.001, 0.026]. This interaction was not statistically

significant for Topic 1 and or Topic 2, both $p > .10$.

As reflected above, there was a significant main effect of sample, $LRT\ (4) = 158.34$, $p < .001$, $R^2_{CS} = .53$, a significant main effect of NSSI history, $LRT\ (4) = 14.16$, $p = .007$, $R^2_{CS} = .07$, and a significant main effect of emotion dysregulation, $LRT\ (4) = 29.44$, $p < .001$, $R^2_{CS} = .13$. Because the main effects of sample and NSSI history were not robust in the presence of the interactions involving Topics 3 and 4 (as described above), we do not interpret them further. There was a significant marginal relationship between Topic 1 and emotion dysregulation, $b = 0.012$ ($SE = 0.004$), $Z = 2.64$, $p = .008$, 95% CI: [0.003, 0.021], suggesting that usage of Topic 1 increased significantly as emotion dysregulation increased, regardless of sample or NSSI history.

Aim Three

To test whether topic use was related to narrative valence, we used a regression model of sentiment scores with the topic proportion estimates as predictors, as well as sample, NSSI history, emotional dysregulation, and the second- and third-order interactions among sample, NSSI history, and emotion dysregulation. By comparing this model to a model without the four topic proportions, we found that the topics were not significantly related to narrative valence, $F\ (3,\ 196) = 0.63$, $p = 0.595$, $R^2 = .009$. Only NSSI history was a significant predictor of narrative valence; participants with a history of NSSI used significantly more negatively-valenced language in their narratives than those without a history of NSSI, M_{diff} = -0.21 (SE) = 0.08, $t\ (196)$ = -2.64, $p = .009$, *95% CI* : [-0.37, -0.05].

Conclusions

The overarching aim of this study was to harness participant-driven descriptions of recent interpersonal stressors to better understand the experiences of interpersonal difficulties as it relates to NSSI. Specifically, we hypothesized that a range of categories of interpersonal stress experiences would emerge. We also hypothesized that NSSI history and emotion dysregulation would be associated with latent topics in participant narratives of their interpersonal stressor (i.e., Victor et al., 2019; Turner, Wakefield et al., 2016). Finally, we explored whether the emotional tone (i.e., valence) of the narrative was related to the latent topics, or with NSSI and emotion dysregulation.

Regarding our first study aim, topic modeling indicated that a four-topic model was optimal. As anticipated, a range of topics emerged, including the interpersonal target, as reflected in Topic 2 (family members) and 4 (friends, romantic partners). We also identified a topic likely indicative of stressor content (Topic 1), which centered around the discussion of daily or life difficulties (i.e., taxes, staffing, homelessness). While a topic related to cognitive-affective or behavioral responses to the interpersonal conflict was not apparent, a topic related to speech-patterns, specifically involving the use of adjectives and verbal-fillers (Topic 3), did emerge. These findings lend some insight into both the targets and content of stressful interpersonal interactions. Indeed, in highlighting a distinction between family members and friends or romantic partners as targets in the interpersonal interaction, findings are in line with prior research demonstrating differences in daily communication patterns within specific relationship types among those with a history of NSSI (Turner et al., 2016)

The primary pattern of findings demonstrates greater use of language consistent with Topic 3, which is most represented by adjective and verbal-fillers, for undergraduate students with a history of NSSI and higher levels of emotion dysregulation. Greater use of Topic 3 among those with a history of NSSI and higher levels of emotion dysregulation, regardless of sample, was also found. While this result was surprising, it is possible that greater use of these "filler" words may be representative of specific aspects of emotion regulation difficulties. For example, the measure utilized to assess emotion dysregulation in both studies is comprised of six dimensions, including lack of emotional clarity and lack of emotional awareness. If any individual has difficulty identifying their emotional reactions or arousal, particularly when talking about a negatively-valanced event, they may be more likely to use verbal fillers while trying to articulate their experience. Work related to linguistics and NSSI is limited, but findings within the suicide literature may lend insight. While research related to verbal exchanges, specifically the predictive power of acoustic properties of speech (i.e.,

France et al., 2000; for review see Cummins et al., 2015) and properties of dyadic interactions (Nasir et al., 2017) have been implicated in suicide risk, findings examining online content from individuals at heightened suicide risk may have greater relevance to the current findings. Indeed, it has been found that online posts associated with greater suicide risk used more quantifies, prepositions, and adverbs (Ji et al., 2018; O'Dea et al., 2017). The current study is the first of our knowledge to extend these results in relation to speech and among those with a history of NSSI.

Notably, we did not see the same pattern of finding related to Topic 3 and NSSI history and emotion dysregulation among the community sample. Initially, we consider that this distinction may be driven by differences in emotion dysregulation between the samples. However, the community sample reported higher levels of emotion dysregulation (likely due to overrecruitment for BPD features; Glenn & Klonsky, 2009) and the three-way interaction between NSSI, emotion dysregulation, and sample was not significant. Another potential explanation is differences in valence of responses between samples; but we found that only those with and without a history of NSSI differed on narrative valence. It is possible that other sample characteristics (i.e., age, gender, education level) may help explain our findings; however, such explorations are beyond the scope of the current study and we encourage future research to consider these relationships.

Consistent with the extraction of topics that distinguished between family and friends / romantic partners, results demonstrated that among individuals with a history of NSSI, there was a greater use of Topic 4 – which was largely represented by words related to friends and romantic partners – as emotion dysregulation scores increased; but this was not the case with the topic centered around family. These findings may indicate that participants with a history of NSSI experience unique stress in interpersonal relationships with friends or romantic partners. Findings are in line with recent experience sampling research that found NSSI urges were more likely to occur in close proximity to interactions with friends and romantic partners as compared to parents or other family members (Hepp et al., 2021). Moreover, prior research has demonstrated that emotion regulation difficulties may mediate the association between negative romantic relationship dynamics and NSSI among college students (Silva et al., 2017).

Finally, in examining the emotional tone of participant dialogue, this study showed that participants with a history of NSSI utilized more negatively valanced language (such as "hardly"). This supports prior research in the suicide literature, finding that online posts from individuals at elevated suicide risk have different linguistic properties, including greater use of negative emotion words (i.e., O'Dea et al., 2017), as well as findings that those with a NSSI history have a greater emotional response to interpersonal stressors (Kim et al., 2015). Beyond the implications for emotional arousal, it may also be that negatively valanced language is a way to undermine one's own description of a stressful event, which may be indicative of self-invalidation. These findings would be consistent with associations between NSSI and self-invalidation seen in prior research (Flett et al., 2012). Greater work is needed in this area to better understand the nuances of language among those with a NSSI history as a way to disentangle such potential mechanisms.

This study is not without its limitations. First and foremost, both the undergraduate and community samples are relatively homogenous (predominantly white women), limiting the generalizability of findings and our ability to examine the pattern of results by demographic characteristics. Although we categorize our samples as an undergraduate sample and a community sample, these samples cannot easily be differentiated this way; there is a large proportion of full-time students in the community sample, which may make it more difficult to fully disentangle sample differences. On the other hand, there are also notable differences between our samples that may impact findings. First, the community sample was both larger with regard to sample size and document length (i.e., number of words provided by each participant) than the undergraduate sample. Second, the community sample was oversampled for BPD features as part of a larger study, which resulted in a significant difference in emotion dysregulation between the two samples, with the community sample, regardless of NSSI status, reported elevated emotion dysregulation scores. Finally, while participants were asked to recall a recent interpersonal event, it is possible this experience occurred weeks beforehand, limiting participant's ability to accurately recall their cognitive-affective experiences, which may be why such a representative topic did not emerge; it may be beneficial to consider a more proximal investigation

of interpersonal events, including situations that occurred shortly before a participant engaged in NSSI. It will be important for future research to replicate these findings, as well as probe some nuances, in a more diverse sample, both with regard to demographics and NSSI history severity.

Despite these limitations, this study offers new insight into the experiences of interpersonal stressors among those with and without a history of NSSI. By using participant-driven dialogue and topic modeling, we identified four topics related to stressful interpersonal interactions and their unique relationships with clinically relevant features (i.e., NSSI, emotion dysregulation). Notably, these findings highlight a key distinction between relationships with one's family, as opposed to friends or romantic partners, with the latter seeming to hold greater significance among those with a history of NSSI. Consequently, future research examining interpersonal stress that also aims to differentiate relationship context may be particularly important. We also found differences in language use among those with a history of NSSI; while these findings are in need of greater exploration, they offer a novel avenue for assessment and identification of risk for NSSI.

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Table 1

Most Representative Fifteen Words for Each Topic by Term Score

Topic 1: Daily Difficulties Word	Topic 1: Daily Difficulties Term Score	Topic 2: Family Word	Topic 2: Family Term Score	Topic 3: Adjectives / Fillers Word
Tax	.262	Dad	.447	Like
Rank	.261	Mom	.443	Really
League	.260	Sister	.394	No
Staff	.221	Brother	.351	Things
Sexual	.186	Spanish	.219	Lot
B*tch	.145	Cousin	.182	Feel
Homeless	.129	Police	.168	Even
Tampon	.128	Surgery	.156	Facial
Son	.125	Suboxone	.155	Stuff
Leader	.118	Driveway	.152	Friend
Know	.106	Force	.148	Cat
Board	.105	Cake	.123	Roommates
Post	.105	Wear	.114	Controlling
Derby	.100	Send	.110	Coaches
Men	.096	Upstairs	.109	Oven

Note. The most representative fifteen words for each topic are shown in descending order with their corresponding term scores where higher term scores indicate a word that is more distinctive to a single topic (Blei & Lafferty, 2009).

Table 2

Dirichlet Regression Model of Topic Proportions for Sample, NSSI History, and Emotional Dysregulation (DERS)

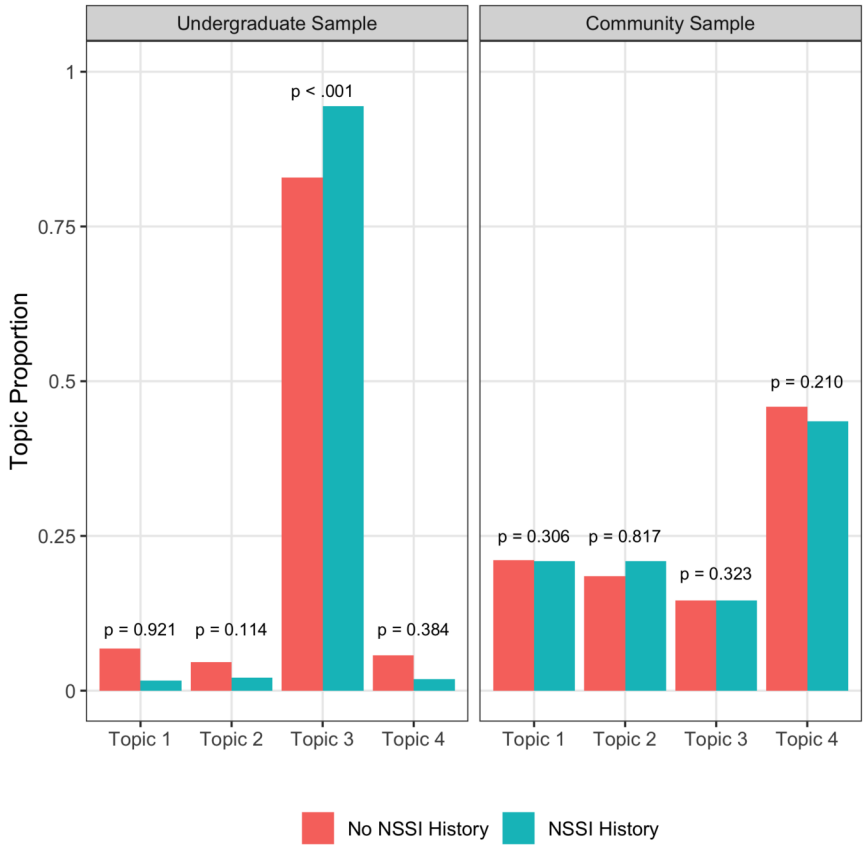
Effect	Topic	Estimate (b)	*SE*	*95% CI*	p
Sample x NSSI History x DERS	1	-0.015	0.018	[-0.051, 0.021]	.410
	2	-0.022	0.019	[-0.059, 0.015]	.240
	3	-0.061	0.021	[-0.102, -0.020]	.003
	4	-0.001	0.017	[-0.034, 0.033]	.970
Sample x NSSI History	1	-0.213	0.457	[-1.109, 0.683]	.641
	2	-0.730	0.468	[-1.648, 0.187]	.119
	3	-1.774	0.447	[-2.651, -0.896]	$< .001$
	4	0.575	0.447	[-1.452, 0.301]	.198

Sample x DERS	1	-0.006	0.009	[-0.024, 0.012]	.498
	2	0.005	0.009	[-0.013, 0.024]	.570
	3	-0.038	0.010	[-0.058, -0.017]	< .001
	4	-0.000	0.008	[-0.017, 0.017]	.994
NSSI History x DERS	1	0.009	0.009	[-0.009, 0.027]	.338
	2	0.016	0.009	[-0.003, 0.034]	.099
	3	0.045	0.010	[0.025, 0.065]	< .001
	4	0.020	0.008	[0.004, 0.037]	.017
Sample	1	0.070	0.228	[-0.377, 0.518]	.757
	2	0.069	0.234	[-0.390, 0.528]	.767
	3	-3.584	0.224	[-4.022, -3.145]	< .001
	4	0.834	0.224	[0.396, 1.272]	< .001
NSSI History	1	-0.064	0.228	[-0.512, 0.384]	.779
	2	0.327	0.234	[-0.132, 0.786]	.163
	3	0.723	0.224	[0.284, 1.161]	.001
	4	0.072	0.224	[-0.367, 0.510]	.749
DERS	1	0.012	0.004	[0.003, 0.021]	.008
	2	-0.005	0.005	[-0.014, 0.005]	.320
	3	0.023	0.005	[0.013, 0.034]	< .001
	4	0.003	0.004	[-0.005, 0.012]	.446
Intercept	1	-0.754	0.114	[-0.978, -0.530]	
	2	-0.819	0.117	[-1.048, -0.590]	
	3	0.705	0.112	[0.486, 0.924]	
	4	-0.381	0.112	[-0.600, -0.162]	

Note. p = P-value for likelihood ratio test. Regression coefficient estimates are on a natural logarithmic scale.

Figure 1

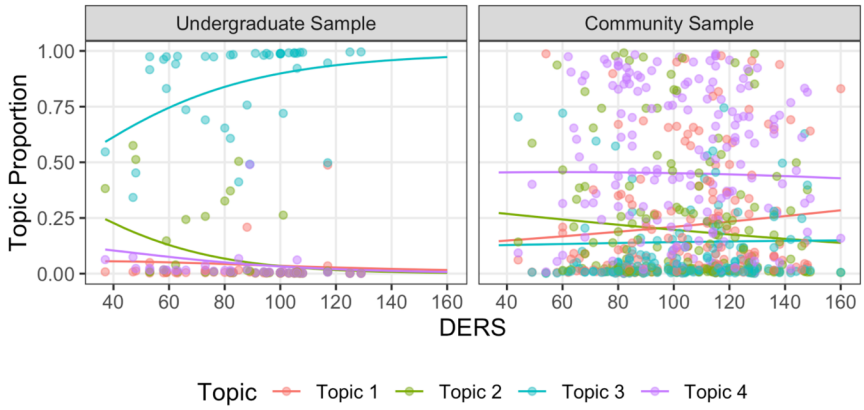
Interaction Between NSSI History and Sample for the Four Topics.



Note . NSSI = nonsuicidal self-injury; All topic proportions sum to one for each combination of Sample and NSSI history. The Dirichlet regression estimates of the four topic proportions are shown. P-values correspond to tests of comparisons of the topic proportions between participants with a history of NSSI vs. participants with no history of NSSI.

Figure 2

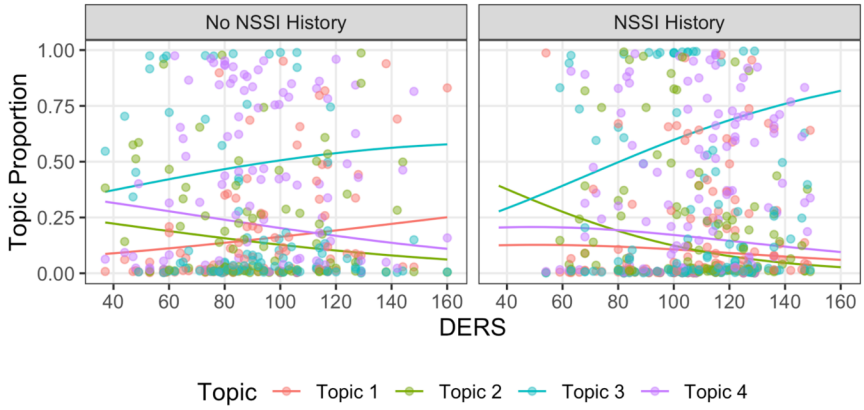
Interaction Between Emotional Dysregulation and Sample for the Four Topics.



Note . DERS = Difficulties in Emotion Regulation Scale (i.e., emotion dysregulation). The topic proportions sum to one for each Sample at each value of DERS. The Dirichlet regression curve estimates are shown for the four topic proportions with the estimated topic proportions and DERS scores for each participant overlaid as points.

Figure 3

Interaction Between NSSI History and Emotional Dysregulation for the Four Topics.



Note . NSSI = nonsuicidal self-injuyr; DERS = Difficulties in Emotion Regulation Scale (i.e., emotion dysregulation). The topic proportions sum to one for participants with no history of NSSI and participants with a history of NSSI at each value of DERS. The Dirichlet regression curve estimates are shown for the four topic proportions with the estimated topic proportions and DERS scores for each participant overlaid as points.