# Frustration with feeling: Latent classes of non-suicidal self-injury and emotion regulation difficulties

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ABSTRACT

Although emotion regulation has been identified as a key function of non-suicidal self-injury (NSSI), it is unclear how specific indices of emotion regulation are associated with particular NSSI methods as markers of risk. This study used latent class analysis (LCA) to identify subgroups of individuals who engage in NSSI and their patterns of emotional regulation difficulties. Undergraduate students in the southeastern United States ($N$ = 326) completed an online survey. LCA was used to identify subgroups of individuals engaging in NSSI and their associated emotion regulation difficulties. These subgroups were then compared across a variety of behavioral health outcomes (e.g. impulsive behavior, disordered eating, problematic alcohol use, suicide attempt history) to characterize specific risk profiles. The LCA revealed four subgroups who engage in NSSI and have specific emotion regulation difficulties. These subgroups were differentially associated with behavioral health outcomes, including suicide risk, disordered eating, and impulsive behavior. Results of this research could aid in clinical identification of at-risk individuals.

## 1. Introduction

A strikingly large percentage of young adults engage in non-suicidal self-injury (NSSI), with a meta-analysis reporting a lifetime prevalence rate of 13.4% (Swannell et al., 2014). NSSI can be defined as the deliberate destruction of bodily tissue in the absence of suicidal intent (Nock, 2010). In and of itself, engaging in NSSI is associated with significant psychosocial, academic, and occupational difficulties (Nock et al., 2006). Additionally, research has shown that individuals who engage in NSSI are more likely to have a future suicide attempt and tend to have poorer treatment prognoses (Ribeiro et al., 2016; Asarnow et al., 2011; Wilkinson et al., 2011). Considering these negative outcomes, plus the high percentage of young adults who display NSSI behaviors, understanding who is at risk for engaging in NSSI is paramount.

Many studies have examined predictors of NSSI, but very few factors with strong predictive ability have been identified (Fox et al., 2015), likely due to the small amount of variance in NSSI occurance explained by individual predictors. Some variables that have been identified as predictive of NSSI behavior in young adults include depressive symptoms, anxiety symptoms, female sex, affective dysregulation, and ruminative cognitive styles (Hankin and Abela, 2011; Hoff and Muehlenkamp, 2009; Jacobson and Gould, 2007; Wilcox et al., 2012). Despite the research on NSSI predictors, there is still much that remains unknown about NSSI. Past research has predominantly focused on NSSI in a more general manner, looking at overall frequency of self-injurious behaviors and neglecting to consider the type of behavior or frequency of specific behaviors performed (Burke et al., 2015; Guan et al., 2012; Selby et al., 2010; Whitlock et al., 2013), which may lead us to miss important information that can contribute to assessment of risk.

Given that a recent meta-analysis of 365 articles examining 50 years of research found NSSI to be the strongest predictor of suicide attempt (Franklin et al., 2017) and suicide remains the second leading cause of death for young adults (Centers for Disease Control and Prevention, 2016), it seems imperative to understand this phenomenon in more depth to enhance suicide prevention efforts. Recent research using latent class analysis (LCA) has provided evidence for subgroups of individuals who engage in NSSI, with each subtype displaying unique suicide risk profiles. LCA is a person-centered statistical technique whereby a heterogeneous group of individuals can be subdivided into smaller homogenous groups with similar traits. Using this approach, Hamza and Willoughby (2013) identified three subgroups of

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individuals who engaged in NSSI, each with varying degrees of suicide risk. Among the two groups with a high frequency of NSSI, only one was at an increased risk for suicidal behavior, and this high NSSI frequency/high suicide risk group displayed significantly greater impairment on a variety of psychosocial indices compared to the groups at low risk for suicidal behaviors. Similarly, Klonsky and Olino (2008) performed LCA with young adults who engaged in NSSI and found evidence for four distinct groups, each engaging in differing NSSI methods for varying social and automatic functions, and with differing age of onset, depression and anxiety symptoms, borderline personality disorder symptoms, lifetime suicidal ideation, and number of lifetime suicide attempts. Another study found three subgroups of individuals based upon frequency, type, and severity of NSSI behaviors (Whitlock et al., 2008). Lastly, Dhingra et al. (2016) provided evidence for a three-subgroup model in a sample of university students who endorsed a range of self-injurious thoughts and behavior, including suicidal and non-suicidal thoughts and suicide attempts. The first group endorsed high levels across the range of suicidal and non-suicidal thoughts and behaviors (except performing behaviors that may be indicative of suicide desire, even though no desire is present), the second group endorsed high suicidal ideation and high NSSI thoughts and behaviors, and the third group endorsed low levels of suicidal and non-suicidal self-injurious thoughts and behaviors.

In light of the evidence for varying NSSI subgroups with distinct risk factors, it is surprising more research has not been done on other variables that would help distinguish these groups. Despite being cited as one of the primary reasons why individuals engage in NSSI (Chapman et al., 2006; Nock, 2009; Klonsky, 2007; Taylor et al., 2017), there is limited understanding of how specific features of emotion regulation are associated with methods of NSSI. Identifying such features may inform tailored intervention and prevention programming for suicide risk. *Emotion regulation* has been defined as a complex process that involves being aware of/understanding emotions, the acceptance of emotions, the ability to control impulsive behaviors and act in accordance to one's goals in the face of emotional experience, and the ability to utilize appropriate emotion regulation strategies to modulate one's emotions (Gratz and Roemer, 2004). Theory suggests that when certain individuals experience difficulties with modulating emotions, normal coping mechanisms may not be distracting or regulating enough to reduce negative emotion; therefore, NSSI may be a behavior that is intense enough to serve as a coping mechanism, albeit a maladaptive one (Selby and Joiner, 2009). Indeed, empirical research has demonstrated that the top reason why individuals engage in NSSI is to regulate emotional/physical experiences (Nock and Prinstein, 2004).

Numerous other studies in young adults have found an association between emotion regulation difficulties and NSSI (Emery et al., 2016; Heath et al., 2008; Muehlenkamp et al., 2010; Kranzler et al., 2016; Tatnell et al., 2017). In addition to NSSI, emotion regulation difficulties are also related to a number of non-specific behavioral health risks, such as depression, anxiety, substance use, and disordered eating (Aldao et al., 2010; Berking and Wupperman, 2012; Ehring et al., 2008; Tull and Roemer, 2007; Whiteside et al., 2007). Furthermore, research suggests that there are also likely subgroups of emotion regulation difficulties (Labouliere, 2009), and that certain patterns of emotion regulation may mediate treatment response, both for NSSI treatment (Slee et al., 2008) as well as more generally (Berking et al., 2008). However, it remains unclear whether those with specific emotion regulation difficulties have different risk profiles for other behavioral health outcomes. Additionally, despite the research showing a relationship exists between NSSI and emotional dysregulation in general, it remains unknown if certain methods of NSSI are associated with specific aspects of emotion regulation (i.e. non-acceptance of emotional responses; difficulties in engaging in goal-directed behavior; impulse control difficulties; lack of emotional awareness; limited access to emotion regulation strategies; and lack of emotional clarity).

While LCA seems a promising approach for determining profiles of NSSI and emotion regulation difficulties, the studies to date using this technique have all suffered from methodological issues. Although Klonsky and Olino (2008) measured both NSSI and emotion regulation, their measure of emotion regulation was embedded within a larger measure assessing a variety of functions of NSSI, with only three items measuring emotion regulation. These items were then collapsed with other variables to create an "automatic reinforcement" variable that was used to extract the latent classes, thereby obscuring the unique contribution of emotion regulation outside of other automatic reinforcers. Alternatively, other researchers using LCA to classify NSSI behaviors (Hamza and Willoughby, 2013; Whitlock et al., 2008), did not include measurement of emotion regulation at all when extracting latent classes.

Given that both NSSI and emotion regulation are interconnected, multifaceted constructs that have subtypes with differential prognoses, research examining these constructs in isolation or not breaking constructs into their relevant subtypes likely obscured critical details and limited our understanding. Identifying groups of individuals who experience different types and frequency of NSSI and different aspects of emotion regulation difficulties would be extremely informative for NSSI prediction, assessment, and treatment. Additionally, determining if persons with specific types or frequencies of NSSI behaviors or emotion regulation difficulties displayed higher levels of suicidality could help clinicians better identify clients at elevated risk and enhance current suicide prevention strategies. The present study aimed to address these gaps by using LCA to identify latent classes based on the frequency of different types of NSSI behavior and specific aspects of emotion regulation. We hypothesized that diverse classes would have distinct differences in the frequency of types of NSSI behavior performed and in specific emotional regulation difficulties. We also hypothesized that suicide-related factors (acquired capability for suicide, history of suicide attempts) would differ between classes. Lastly, it was hypothesized that classes would be differentially associated with behavioral health outcomes, such as impulsive behavior, problematic alcohol use, and disordered eating.

## 2. Method

### 2.1. Participants

Participants in this project were recruited from a larger study of college study risk behaviors (*N* = 1221; Labouliere, 2013); data reported in this study were those of the participants endorsing lifetime NSSI (26.7% of the total sample). Participants were undergraduate college students from the southeastern United States. In order to participate in the study, participants had to be age 18 or older, able to speak and read English, and be registered as a full- or part-time undergraduate student. Three-hundred sixty-nine participants endorsed a history of NSSI behavior; of these 369, 327 had complete data on the frequency of specific NSSI behaviors and were thus included in analyses. One participant was removed due to having extreme outlier values (e.g., over three standard deviations above the mean for certain rare NSSI behaviors), resulting in a final analysis sample of 326 participants. Approximately 75% were female (*n* = 244) and their ages ranged from 18 to 51, with a mean age of 21.33 (SD = 4.16 years). Nearly 39% of the sample identified as Hispanic or Latinx; 70.4% identified as Caucasian or European American, 11.3% Black or African American, 4.7% Asian or Asian American, 6.9% another racial group, and 6.6% multiracial. Nearly 79% reported more than one episode of NSSI in their lifetime, 33.4% reported engaging in NSSI within the past two years, and 8.0% reported NSSI severe enough to require medical attention.

## 2.2. Measures

### 2.2.1. Demographics

Information on participants' age, year in school, and racial and ethnic identities were gathered.

### 2.2.2. Deliberate self-harm inventory (DSHI)

The *DSHI* (Gratz, 2001) is a 17-item self-report measure that assesses the presence, frequency, duration, and types of different NSSI behaviors, including cutting, burning, scratching, banging, and other NSSI behaviors. For each type of self-harm behavior, participants are asked whether they have ever engaged in that behavior (yes/no); for each endorsed NSSI behavior, participants are also asked to respond with age of onset, number of total times they have engaged in that specific behavior (frequency), their most recent engagement in the behavior, total number of years engaging in the behavior (duration), and if they have ever required medical attention following a given NSSI episode (Gratz, 2001). Participants were included in the sample if they endorsed lifetime engagement in any of the 17 NSSI behaviors; frequency scores were utilized in all LCA analyses. The measure has strong internal consistency in college samples (Gratz, 2001; Gratz and Roemer, 2004; α = 0.82 in this sample), and has been shown to have good test-retest reliability and construct validity.

### 2.2.3. Difficulties in emotion regulation scale (DERS)

The *DERS* (Gratz and Roemer, 2004) is a 41-item self-report measure that assesses clinically-significant difficulties in emotion regulation, utilizing a 5-point Likert scale ranging from "almost never" (1) to "almost always" (5). Six distinct subscales of emotion regulation difficulties can be derived from the scale: non-acceptance of emotional responses; difficulties in engaging in goal-directed behavior; impulse control difficulties; lack of emotional awareness; limited access to emotion regulation strategies; and lack of emotional clarity. The DERS has established reliability and validity for total and subscale scores in both clinical and community samples (Gratz and Roemer, 2004; total α = 0.93 and subscale range = 0.82–0.92 in this sample).

### 2.2.4. Suicide-related factors

Acquired capability and suicide attempt history were examined using the *Acquired Capability for Suicide Scale* (ACSS; Bender et al., 2007) and the *Self-Harm Behavior Questionnaire* (SHBQ; Gutierrez et al., 2001) respectively. The ACSS is composed of 5 items assessing an individual's fearlessness surrounding lethal self-injury, utilizing a 5-point Likert scale ranging from "not at all like me" (1) to "very much like me" (5). The ACSS shows adequate reliability and validity (Bender et al., 2007; Van Orden et al., 2008; α = 0.79 in this sample). Suicide attempt history was measured using the question assessing presence or absence of a suicide attempt from the SHBQ suicide attempts subscale. The full SHBQ is a 32-item self-report questionnaire assessing suicide-related thoughts and behaviors across four domains (intentional non-suicidal self-harm, suicide attempts, suicide threats; and suicide ideation) and gathers information on frequency, age of onset, recency, disclosure, and whether medical attention was required. The SHBQ has demonstrated good reliability and validity (Fliege et al., 2006; Gutierrez et al., 2001; α subscale range = 0.87–0.98 in this sample).

### 2.2.5. Behavioral health factors

Other behavioral health variables used for class validation included impulsive behavior as assessed by the *UPPS Impulsivity Scale* (UPPS; Whiteside and Lynam, 2001), problematic alcohol use as assessed by the *Alcohol Use Disorders Identification Test* (AUDIT; Saunders et al., 1993) and disordered eating as assessed by the *Eating Disorders Examination Questionnaire* (EDE-Q; Fairburn and Beglin, 1994). The *UPPS* is a 59-item self-report measure assessing five distinct facets of impulsivity: negative urgency; positive urgency; lack of premeditation; lack of perseverance; and sensation-seeking. The measure utilizes a 4-

point Likert scale ranging from "agree strongly" (1) to "disagree strongly" (4), and has well-established psychometrics in both community and clinical samples (Whiteside and Lynam, 2001; Whiteside et al., 2005; α subscale range = 0.84–0.95 in this sample).The *AUDIT* is a 10-item self-report measure assessing alcohol consumption, drinking behavior, and alcohol-related problems, where items are scored on a 5-point scale ranging from 0 to 4, with higher numbers reflecting a higher likelihood of problematic alcohol use. The AUDIT has strong psychometrics established in both domestic and international clinical and community samples (Allen et al., 1997; Reinert and Allen, 2002; Saunders et al., 1993; α = 0.83 in this sample). Lastly, the *EDE-Q* is a 41-item self-report measure assessing disordered eating, where items are scored on a 7-point scale ranging from 0 to 6, with higher numbers representing a higher frequency of disordered eating behaviors. The EDE-Q has good psychometrics in both clinical and community samples (Fairburn and Beglin, 1994; Grilo et al., 2001; Passi et al., 2003; α = 0.81 in this sample).

## 2.3. Procedure

Participants were recruited through a university online recruiting system and data collection software and received psychology course credit for participation. The study was advertised as a general study on mental health and risk behaviors; no specific information was provided regarding the focus on NSSI. Study information was posted online and undergraduate students who met inclusion criteria were allowed to participate. Participants provided informed consent electronically, then completed all self-report measures, which were presented in random order. After completing a measure, participants were not allowed to go back and alter their responses. Depending on their responses, completion of the study took between 30–45 min. After completion of all measures, a debriefing page informed participants of the purpose of the study, along with contact information for the principal investigator and local mental health services. All data were de-identified and assigned a random identifier code prior to analysis. This study was approved by the Institutional Review Board of the University of South Florida.

## 2.4. Data analyses

Descriptive statistics were used to evaluate statistical assumptions such as normality. Variables which violated statistical test assumptions (e.g., scratching, skin piercing, cutting, and burning NSSI behavior) were log-transformed to approximate normality. Due to high levels of collinearity between NSSI behavior types, exploratory factor analysis utilizing an oblique rotation was used to distill endorsement of individual NSSI behavior items from the DSHI into factors for analysis. This resulted in five factors identified through eigen values >1, scree plot, and conceptual relevance (see Supplemental Table 1): *scratching and skin piercing* (e.g., severely scratching, sticking pins/staples into, or biting the skin to the point of bleeding), *cutting* (e.g. cutting parts of the body or carved words/pictures into the skin), *banging or bruising* (e.g., punching the body or another object, banging head or body part to the point of bruising), *burning* (e.g., burning the skin with a lighter, match, or cigarette), and *use of implements* (e.g. rubbing sandpaper on the body, dripping acid on the skin, or irritating skin with bleach/other noxious chemicals). Although internal consistency for individual subscales was low, this is not unexpected when there is limited variability in endorsement for each item. As well, item composites may more broadly describe components of NSSI due to the greater diversity of behaviors covered (Boyle, 1991).

Latent class analyses were run using M*plus* Version 8, using the Mixture model function (Muthén and Muthén, 1998–2017). The Mixture model handles missing data using maximum likelihood with robust standard errors (Muthén and Muthén, 1998–2017). Frequency of different types of NSSI behavior (DSHI)[1] and levels of different emotion regulation difficulties (DERS) were used to characterize classes.

Initially, data were fit to a one-class model to calculate baseline fit indices. Relative model fit was evaluated using standard fit indices recommend in the literature, including the Akaike information criteria (AIC), Bayesian information criteria (BIC), sample-size-adjusted Bayesian information criteria (adj-BIC), the parametric bootstrapped likelihood test (LRT), and entropy values (Nylund et al., 2007). A model was deemed to have relatively better fit if there were significant decreases in AIC, BIC, and adj-BIC values, a significant LRT, and increases in entropy values in comparison with the prior class solution (Nylund et al., 2007). We also evaluated posterior probabilities developed from each class solution (near 1.0) and interpretability of classes.[2] The number of classes was added iteratively (e.g. one versus two class solution) until there were no more significant improvements in fit and all class solutions were readily interpretable and distinct.

To identify specific sources of variation characterizing each class, one-way analysis of variance (ANOVA) was used to evaluate differences in demographic factors, suicide risk, and other negative mental health outcomes across classes. To control for multiple comparisons, family-wise modified Bonferroni corrections were utilized for all class characterization post-hoc testing, and Cohen's $d$ was calculated to quantify the strength of significant differences between classes (small: $0.5 > d \geq 0.2$; medium: $0.8 > d \geq 0.5$; large: $d \geq 0.8$; Cohen, 1988). Due to the exploratory nature of class validation analyses, no further statistical corrections were applied.

## 3. Results

### 3.1. Latent class analyses

Based on iterative LCAs, the best fitting model was the four-class solution, which fit significantly better than one, two, or three class solutions (see Table 1). Five- and six-class solutions were also evaluated but could not be specified due to poor fit. The four-class solution also demonstrated very strong posterior probabilities (0.91–1.00; see Table 2). The largest class was Class 4 ($n = 238$, 73%), followed by Class 2 ($n = 67$, 21%), Class 3 ($n = 12$, 4%), and Class 1 ($n = 8$, 2%). Although Classes 1 and 3 were small, attempts to collapse these participants into another class were unsuccessful, as they continued to separate into unique classes in the solutions with fewer classes. Based on these results and the classes' clinical and conceptual relevance, Classes 1 and 3 were retained for further analyses.

### 3.2. Class characterization

Several NSSI behavior types (scratching and skin piercing, cutting, and burning) did not meet normality assumptions; log transformations were used to achieve normality for these variables. However, as results

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[1] Frequency data were selected for inclusion in latent class analyses as the data had greater variability and was more normal distributed in our sample than either number of NSSI methods utilized or duration of NSSI behavior.

[2] While concerns are sometimes raised when classes are retained that include less than 5% of the sample, considerable debate remains within the field as to the how the number of classes should best be selected, and size is only one of many characteristics to be considered (Nylund et al., 2007). A common reason for concern over small class sizes is that these small classes may not actually represent a true separate class, just several outliers from the other classes that happened to look similar. A way to determine whether small classes actually represent a distinct group is to examine posterior probabilities, which show the certainty of class membership for participants in each class. If posterior probabilities for small classes are strong, this suggests that the smaller classes represent distinct groups. Such a decision is further supported when the inclusion of smaller classes improves model fit (i.e., suggesting that the classes represent important variance in the data) and interpretability (i.e., classes show significantly different patterns of associations that would be obscured by collapsing the smaller classes; Collins and Lanza, 2010; Geiser, 2012).

from analyses using transformed and non-transformed variables did not differ significantly, non-transformed results are presented to facilitate interpretation. Based on Bonferroni-corrected one-way ANOVAs, the classes were characterized as: moderate emotion regulation difficulties with elevated frequency of cutting and burning behavior (Class 1); high emotion regulation difficulties with elevated frequency of scratching/skin piercing, banging or bruising, and cutting behaviors (Class 2); moderate levels of emotion regulation difficulties with elevated scratching/skin piercing behaviors and low levels of using implements (Class 3); and low emotion regulation difficulties with low frequency of all NSSI types (Class 4). There were no demographic differences between classes (see Table 3 for descriptive statistics).

**Class 1** had high frequencies of cutting and burning behaviors, moderate frequencies of banging/bruising and scratching/skin piercing behaviors, and no endorsement of using implements. Participants in Class 1 endorsed significantly higher frequencies of cutting ($d = 0.67$) and burning ($d = 5.40$) behavior than Class 4, the class with low emotion regulation difficulties and low frequency of all NSSI types. Class 1 also endorsed significantly higher frequency of burning behaviors than Classes 2 ($d = 4.82$) and 3 ($d = 4.78$; see Table 3).

**Class 2** had high frequency of scratching/skin piercing behaviors, moderate frequencies of banging/bruising and cutting behaviors, and very low or no endorsement of burning behavior and using implements. Participants in Class 2 endorsed significantly higher frequencies of scratching/skin piercing ($d = 0.60$), banging or bruising ($d = 0.51$), and cutting ($d = 0.52$) behaviors than Class 4. Class 3 had high levels of scratching/skin piercing behavior, low levels of cutting, banging/bruising behavior, and using implements, and very low or no endorsement of burning behavior. Participants in Class 3 endorsed significantly higher frequencies of implement use for NSSI than Classes 1 ($d = 2.41$), 2 ($d = 2.41$), and 4 ($d = 2.41$). Class 4 had low levels scratching/skin piercing, banging/bruising, and cutting behaviors, and very low or no endorsement of burning behavior or using implements. Participants in Class 4 endorsed significantly lower rates of: cutting ($d = 0.67$) and burning ($d = 5.40$) behavior than Class 1; scratching/skin piercing ($d = 0.60$), banging/bruising ($d = 0.51$), and cutting ($d = 0.52$) behaviors than Class 2; and using implements ($d = 2.41$) than Class 3 (see Table 3 and Fig. 1).

Participants in Class 2 had significantly higher endorsement of non-acceptance of their emotional responses ($d = 1.56$) and lack of emotional clarity ($d = 1.16$) than Class 4, and greater difficulty in engaging in goal-directed behavior (1: $d = 2.19$; 3: $d = 0.96$; and 4: $d = 1.56$), impulse control difficulties (1: $d = 1.37$; 3: $d = 1.68$; and 4: $d = 1.01$), and limited access to coping strategies (1: $d = 1.78$; 3: $d = 2.05$; and 4: $d = 2.72$) than all classes. No other significant differences in emotion regulation difficulties were present between classes (See Table 3 and Fig. 2).

### 3.3. Class validation

#### 3.3.1. Suicide-related factors

There was a significant difference between classes in acquired capability for suicide, wherein Class 1 was significantly higher than all other classes (2: $d = 0.25$, 3: $d = 1.34$; and 4: $d = 0.53$; see Table 4). However, although Class 1 demonstrated significantly higher acquired capability, they did not display a significantly higher rate of suicide attempts; rather, only Class 2 had significantly greater likelihood of suicide attempt than Class 4 ($\chi^2_{3, N = 326} = 15.37$, $p < 0.005$; $\varphi = 0.21$, $p < 0.05$), although we may have been underpowered to detect significant differences, as Class 1 had the highest proportion of individuals with a suicide attempt history (37.5%). There were no other significant differences between classes.

#### 3.3.2. Behavioral health factors

Classes showed additional significant differences in behavioral health factors. For impulsive behavior, there were significant

**Table 1**

Fit indices for the latent class analysis of different types of NNSI behaviors and emotion regulation difficulties.

| Number of classes | df | AIC | BIC | adj-BIC | Entropy | Bootstrapped LRT, p-value | Significant change in fit? |
|---|---|---|---|---|---|---|---|
| One | 22 | 15,344.67 | 15,427.99 | 15,358.20 | N/A | N/A | N/A |
| Two | 34 | 14,766.9 | 14,895.66 | 14,787.81 | 0.9 | 601.77, $p < 0.001$ | Yes |
| Three | 46 | 14,382.06 | 14,556.25 | 14,410.35 | 0.94 | 408.84, $p < 0.001$ | Yes |
| Four | 58 | 14,035.45 | 14,255.09 | 14,071.11 | 0.96 | 370.61, $p < 0.001$ | Yes |
| Five | | Could not be specified | | | | | |
| Six | | Could not be specified | | | | | |

$N = 326$. A model was deemed to have better fit if there were significant decreases in AIC, BIC, and adj-BIC values, a significant LRT, and increases in entropy values in comparison with the prior class solution. Df, degrees of freedom; AIC, akaike information criteria; BIC, Bayesian information criteria, adj-BIC = sample-size-adjusted Bayesian information criteria; LRT, parametric bootstrapped likelihood test.

**Table 2**

Classification posterior probabilities.

| Class | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1 | 1.00 | 0.00 | 0.00 | 0.00 |
| 2 | 0.00 | 0.91 | 0.00 | 0.09 |
| 3 | 0.00 | 0.00 | 1.00 | 0.00 |
| 4 | 0.00 | 0.01 | 0.00 | 0.99 |

### 3.3.3. Summary

Based on the class validation analyses, it was determined that Classes 1 and 2 conferred the most significant adverse outcomes. Participants in Class 1, who experienced moderate emotion regulation difficulties with elevated frequency of cutting and burning behavior, also had significantly higher levels of acquired capability for suicide and impulsive sensation-seeking. Participants in Class 2, who experienced high emotion regulation difficulties with elevated frequency of scratching/skin

**Table 3**

Descriptive statistics.

| | Total (N = 326) | Range | 1 (n = 8) | 2 (n = 67) | 3 (n = 12) | 4 (n = 231) | Statistical testing | Group differences |
|---|---|---|---|---|---|---|---|---|
| **Demographics** | | | | | | | | |
| **Gender** | | | | | | | | |
| Female | 244 (75%) | – | 4 (50%) | 51 (76%) | 10 (83%) | 179 (75%) | $\chi^2_{(3,N=326)} = 3.14, p = 0.37$ | N/A |
| Male | 82 (25%) | | 4 (50%) | 16 (24%) | 2 (17%) | 60 (25%) | | |
| Age[a] | 21.33 (4.16) | 18–51 | 21.75 (3.66) | 21.04 (4.30) | 23.17 (5.08) | 21.31 (4.08) | $F_{3,322} = 0.92, p = 0.43$ | N/A |
| **Ethnicity** | | | | | | | | |
| Hispanic or Latinx | 123 (38%) | – | 4 (50%) | 22 (33%) | 6 (50%) | 91 (39%) | $\chi^2_{(3,N=318)} = 2.10, p = 0.55$ | N/A |
| Not Hispanic or Latinx | 203 (62%) | | 4 (50%) | 45 (67%) | 6 (50%) | 140 (61%) | | |
| **Race** | | | | | | | | |
| Caucasian | 224 (69%) | – | 7 (88%) | 41 (61%) | 9 (75%) | 167 (72%) | $\chi^2_{(18,N=318)} = 27.03, p = 0.08$ | N/A |
| Black or African–American | 25 (11%) | | 0 (0%) | 5 (8%) | 3 (25%) | 28 (12%) | | |
| Asian or Asian–American | 15 (5%) | | 0 (0%) | 8 (12%) | 0 (0%) | 7 (3%) | | |
| Another race | 22 (8%) | | 1 (12%) | 7 (10%) | 0 (0%) | 14 (6%) | | |
| Multiracial | 21 (7%) | | 0 (0%) | 6 (9%) | 0 (0%) | 15 (7%) | | |
| **Frequency by type of NSSI behavior** | | | | | | | | |
| Scratching/Skin piercing | 11.40 (30.22) | 0–270 | 9.25 (19.65) | 29.01 (52.93) | 27.92 (47.23) | 5.70 (14.90) | $F_{3,322} = 12.91, p < 0.001$ | 2 > 4 |
| Banging/Bruising | 6.00 (15.31) | 0–100 | 15.13 (22.90) | 13.75 (26.70) | 3.50 (5.68) | 3.65 (8.93) | $F_{3,322} = 9.32, p < 0.001$ | 2 > 4 |
| Cutting | 5.60 (14.66) | 0–108 | 22.63 (39.06) | 11.49 (18.91) | 5.25 (11.54) | 3.39 (10.90) | $F_{3,322} = 9.75, p < 0.001$ | 1, 2 > 4 |
| Burning | 0.75 (2.71) | 0–20 | 15.75 (3.99) | 0.76 (1.85) | 0.92 (1.83) | 0.23 (0.79) | $F_{3,322} = 383.64, p < 0.001$ | 1 > 2, 3 |
| Using implements | 0.05 (0.29) | 0–3 | 0.00 (0.00) | 0.00 (0.00) | 1.33 (0.78) | 0.00 (0.00) | $F_{3,322} = 330.82, p < 0.001$ | 3 > 1, 2, 4 |
| Emotion regulation difficulties | 2.38 (0.65) | 1.11–4.42 | 2.39 (0.78) | 3.33 (0.39) | 2.46 (0.45) | 2.11 (0.43) | $F_{3,325} = 140.38, p < 0.001$ | 2 > 1, 3, 4 |
| | | | | | | | | 3 > 4 |
| Non-acceptance | 2.31 (0.98) | 1.00–5.00 | 2.46 (1.17) | 3.35 (0.96) | 2.50 (0.80) | 2.00 (0.76) | $F_{3,321} = 48.10, p < 0.001$ | 2 > 4 |
| Goal-directed activities | 3.01 (0.98) | 1.00–5.00 | 2.25 (0.98) | 4.04 (0.61) | 2.73 (0.74) | 2.76 (0.87) | $F_{3,321} = 45.62, p < 0.001$ | 2 > 1, 3, 4 |
| Impulse control | 2.13 (0.91) | 1.00–4.83 | 2.17 (1.06) | 3.40 (0.72) | 2.17 (0.74) | 1.78 (0.60) | $F_{3,321} = 111.86, p < 0.001$ | 2 > 1, 3, 4 |
| Awareness | 2.37 (0.80) | 1.00–4.67 | 2.98 (0.73) | 2.61 (0.75) | 2.74 (0.77) | 2.26 (0.79) | $F_{3,321} = 6.11, p < 0.001$ | n.s.[1] |
| Coping strategies | 2.30 (0.90) | 1.00–5.00 | 2.14 (0.96) | 3.60 (0.65) | 2.26 (0.66) | 1.94 (0.57) | $F_{3,321} = 132.42, p < 0.001$ | 2 > 1, 3, 4 |
| Emotional clarity | 2.29 (0.80) | 1.00–5.00 | 2.43 (1.12) | 2.94 (0.74) | 2.50 (0.57) | 2.09 (0.72) | $F_{3,3215} = 24.71, p < 0.001$ | 2 > 4 |

$N = 326$. All total and class values represent $M(SD)$ for continuous variables and $n$(%) for categorical variables, unless otherwise denoted.

[a] Omnibus testing suggested significant differences between classes, but these differences did not remain significant after modified Bonferroni correction.

differences between classes, in that Class 2 had significantly higher levels of negative urgency than Classes 3 ($d = 0.75$) and 4 ($d = 0.86$), and higher levels of positive urgency ($d = 0.66$), lack of premeditation ($p < 0.05$), and lack of perseverance ($d = 0.55$) than Class 4. Class 1 had higher levels of sensation seeking than Classes 3 ($d = 1.55$) and 4 ($d = 1.19$); there were no other significant differences between classes in impulsivity. For disordered eating, there was a significant difference between classes in that Class 2 had significantly higher levels of disordered eating than Class 4 ($d = 0.53$). No significant differences between classes were found for problematic alcohol use (See Table 4 for all class validation statistics).

piercing, banging or bruising, and cutting behaviors, also had significantly higher endorsement of suicide attempts, disordered eating, and specific facets of impulsive behavior, including negative and positive urgency and a lack of premeditation and perseverance. Although Participants in Class 3 endorsed high levels of scratching/skin piercing behavior, had higher endorsement of using implements than other classes, and had significantly higher emotion regulation difficulties than Class 4, Class 3 mostly was not distinguishable from Class 4 in regard to behavioral health factors. Both Classes 3 and 4 conferred relatively lower risk for suicide-related factors, impulsive behavior, and disordered eating. Problematic alcohol use was endorsed at low rates in this sample and did not differentially associate with specific classes.
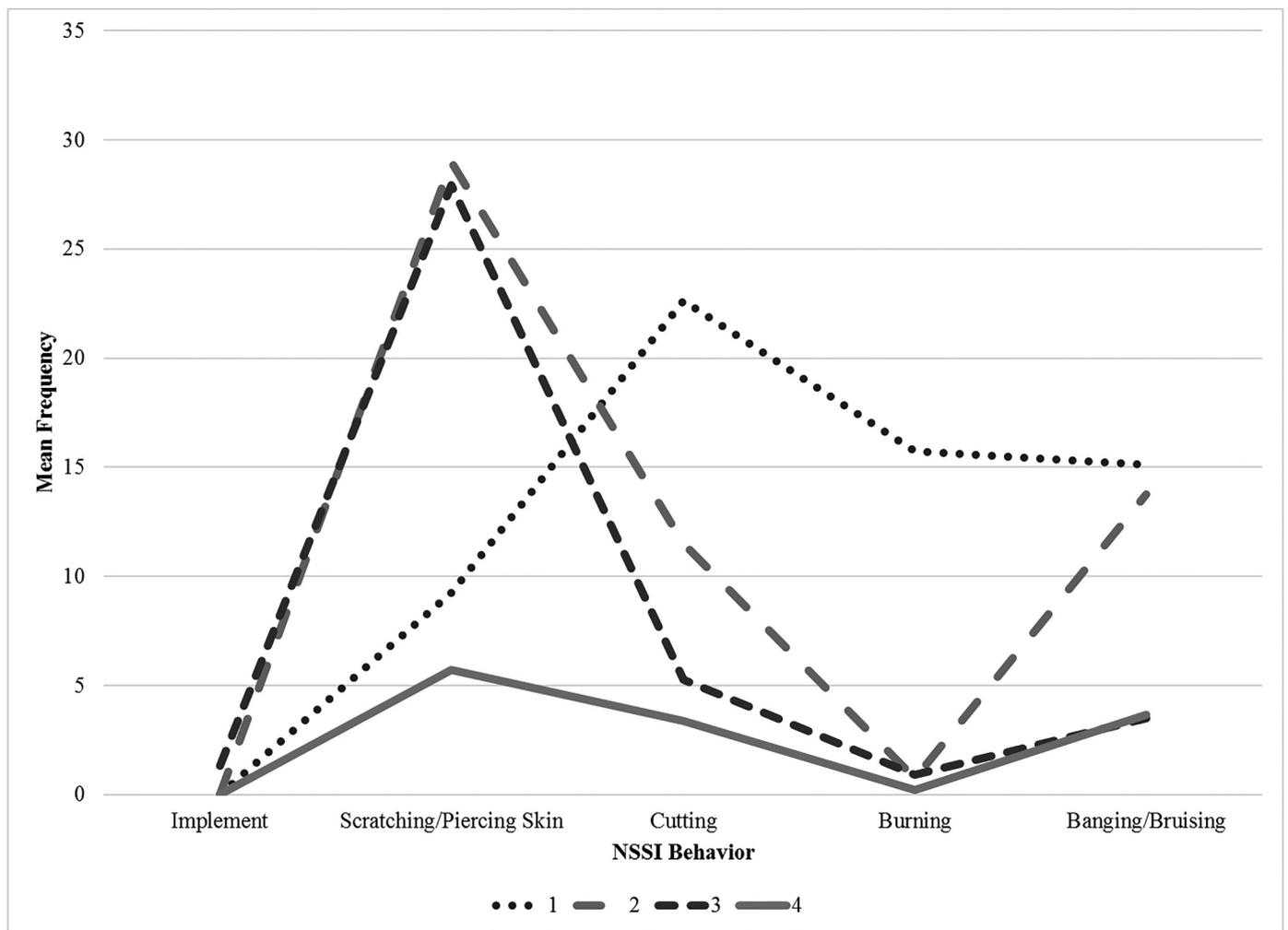
**Fig. 1.** NSSI behavior profiles.

## 4. Discussion

This study presents an initial exploration of the associations between subtypes of NSSI behavior and emotion regulation difficulties. Notably, four classes were identified that showed different patterns of emotion regulatory capacity, distinct rates of NSSI behavioral subtypes, and unique profiles of associated risk (e.g. suicide attempt history, disordered eating symptoms, impulsivity). As NSSI is a prevalent form of maladaptive coping and predictive of serious, negative long-term outcomes (Gratz and Roemer, 2004; Franklin et al., 2017; Hasking et al., 2008; Whitlock et al., 2006), these findings inform our understanding of potential associated mental health risks within this heterogeneous population, and will improve appropriate identification, referral, and treatment for those at highest risk.

As expected, latent classes showing higher levels of emotion regulation difficulties also had higher frequencies of NSSI behaviors and a greater diversity of NSSI behavior types. This is congruent with past literature finding that emotion regulation difficulties are positively associated with NSSI behavior frequency and diversity (Gratz and Chapman, 2007; Jenkins and Schmitz, 2012). Clinicians should be aware of how greater emotion regulation difficulties may indicate greater risk for engagement in NSSI. Similarly, individuals who report a greater diversity of NSSI methods and higher frequency of engagement may benefit from additional support to improve emotion regulation. Future research should further explore the degree to which these associations between emotion regulation difficulties and NSSI behavior frequency and diversity impact treatment outcomes.

When considering specific classes, emotion regulation difficulties and number of NSSI methods appeared to describe a continuum of risk. Interestingly, Class 2 (high emotion regulation difficulties with elevated frequency of scratching/skin piercing, banging or bruising, and cutting behaviors) had a more severe risk profile than other classes (i.e. significantly higher rates of suicide attempt, disordered eating, and impulsivity). As Class 2 was the second largest class in the sample, clinicians should be aware of this more severe risk profile when working with clients exhibiting high emotion regulatory difficulties and elevated frequency of scratching/skin piercing, banging or bruising, and cutting NSSI behaviors, as these individuals may be at even greater risk of negative outcomes due to their higher associated impulsive behavior. While cutting behaviors are frequently studied, past research on banging/bruising and scratching/skin piercing behaviors has been limited and predominantly focused on individuals with developmental disabilities (Favazza and Rosenthal, 1993; Rojahn et al., 2001). In light of the elevated levels of emotion regulation control difficulties and impulsivity, individuals displaying features of Class 2 (moderate-to-high scratching, cutting, banging and bruising) may benefit from improved distress tolerance skills to decrease NSSI frequency and suicide risk, such as skills involving building greater emotional awareness, acceptance of discomfort, and diversifying positive coping skills (Linehan, 2014). Future studies should further explore the function and characteristics of such behaviors to better understand these behaviors in other clinical populations and inform specific intervention strategies.

Two classes with moderate emotion regulation difficulties represented small proportions of the sample (Class 1 (2.4%): moderate
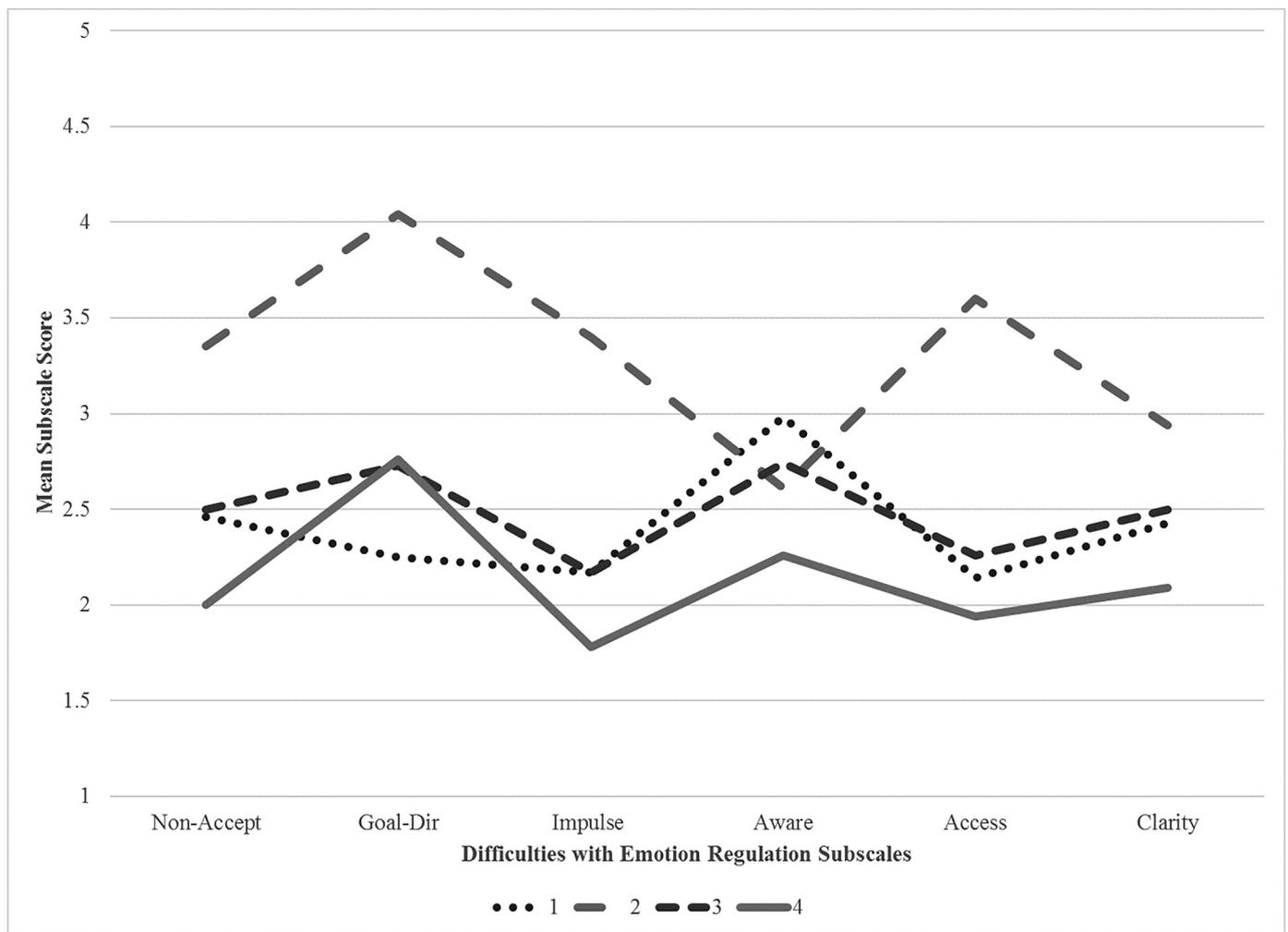
**Fig. 2.** Emotion regulation profiles.

**Table 4**
Class validation.

|  | Total (N = 326) | Range | 1 (n = 8) | 2 (n = 67) | 3 (n = 12) | 4 (n = 231) | Statistical testing | Group differences |
|---|---|---|---|---|---|---|---|---|
| **Suicide-related factors** | | | | | | | | |
| Acquired capability | 1.96 (1.02) | 0.00–4.00 | 3.19 (0.66) | 2.11 (1.10) | 1.72 (0.54) | 1.87 (0.98) | $F_{3,326} = 5.14, p < 0.01$ | 2 > 1, 2, 3 |
| History of suicide attempts | 53 (16.3%) | – | 3 (37.5%) | 20 (29.9%) | 2 (16.7%) | 28 (11.7%) | $\chi^2_{3,N=326} = 15.37, p < 0.01$ | 2 > 4 |
| **Behavioral health factors** | | | | | | | | |
| Impulsivity | | | | | | | | |
| Negative urgency | 2.41 (0.59) | 1.25–3.92 | 2.58 (0.75) | 2.82 (0.50) | 2.29 (0.66) | 2.26 (0.54) | $F_{3,226} = 15.26, p < 0.001$ | 2 > 3, 4 |
| Positive urgency | 1.94 (0.69) | 1.00–4.00 | 2.41 (0.77) | 2.24 (0.71) | 2.07 (0.92) | 1.80 (0.62) | $F_{3,226} = 7.65, p < 0.001$ | 2 > 4 |
| Lack of premeditation | 1.94 (0.48) | 1.00–3.82 | 2.26 (0.45) | 2.10 (0.53) | 1.73 (0.53) | 1.88 (0.43) | $F_{3,226} = 5.01, p < 0.01$ | 2 > 4 |
| Lack of perseverance | 1.96 (0.51) | 1.00–3.70 | 2.08 (0.50) | 2.32 (0.52) | 1.88 (0.34) | 1.82 (0.45) | $F_{3,226} = 15.98, p < 0.001$ | 2 > 4 |
| Sensation seeking | 2.87 (0.65) | 1.08–4.00 | 3.49 (0.35) | 2.87 (0.60) | 2.60 (0.73) | 2.86 (0.66) | $F_{3,226} = 3.03, p < 0.05$ | 1 > 3, 4 |
| Problematic alcohol use | 0.69 (0.60) | 0.00–2.80 | 0.91 (0.61) | 0.83 (0.79) | 0.71 (0.77) | 0.62 (0.49) | $F_{3,229} = 2.04, p = 0.11$ | n.s. |
| Disordered eating | 1.87 (1.49) | 0.00–5.65 | 2.25 (1.30) | 2.46 (1.74) | 2.07 (1.27) | 1.63 (1.35) | $F_{3,226} = 4.82, p < 0.01$ | 2 > 4 |

$N$ = 326. All total and class values represent $M(SD)$.

emotion regulation difficulties with elevated frequency of cutting and burning behavior; and Class 3 (3.7%): moderate levels of emotion regulation difficulties with elevated scratching/skin piercing behaviors and low levels of using implements). The small sizes of these classes is likely reflective of a lower prevalence of *moderate* emotion regulation difficulties among individuals who engage in NSSI; rather, those with frequent NSSI behaviors also tended to display greater emotion regulation difficulties, whereas those with low levels of NSSI endorsement also tended to endorse fewer emotion regulation difficulties. However, despite the smaller proportions associated with Classes 1 and 3, the

inclusion of these classes was important for satisfactory model fit, implying that they identify important variation in the data. Further, despite its small size, class 1 also conferred significant risk for adverse mental health outcomes (e.g., greater acquired capability for suicide and impulsive behavior). Given the importance of these small classes, future research may wish to recruit larger samples to better understand the NSSI experiences of individuals with moderate levels of emotion regulation difficulties.

Interestingly, although participants in Class 1 endorsed only moderate levels of emotion regulation difficulties, they also demonstrated

the highest level of acquired capability for suicide. Past research shows that emotion regulation difficulties are more closely associated with suicidal desire than with acquired capability (Anestis et al., 2011). It is possible that individuals with higher levels of emotion regulation may report suicidal ideation more frequently but be less likely to act on these thoughts. As acquired capability for suicide has been identified as important contributor to suicide attempt when an individual is experiencing suicidal desire, clinicians may wish to further assess acquired capability among individuals showing moderate levels of emotion regulation even if suicidal desire is not disclosed.

It is also possible individuals in Class 1 would be more likely to engage in risky behaviors due to their elevated levels of sensation seeking in comparison with other groups. Although a relatively smaller portion of the larger sample, clinicians may wish to be attentive to the constellation of higher frequencies of burning and cutting behaviors and elevated sensation seeking as potential markers for acquired capability. Use of lethal means counseling, a set of strategies for limiting access to lethal means during periods of distress (Johnson et al., 2011), may help to mitigate risk among this group who may engage quickly in suicidal behaviors when in distress. In addition, skills targeting mindfulness practice may help reduce impulsive NSSI in this group, as mindfulness-based practices have been associated with reductions in impulsive behaviors in other populations (Dixon et al., 2018).

Unexpectedly, there were no differences between classes on alcohol use. Although many individuals report using alcohol while engaging in NSSI, the extant literature shows only small associations between alcohol use and NSSI (Nock et al., 2009; Williams and Hasking, 2010). As past research shows alcohol use is associated with emotion regulation difficulties (Dvorak et al., 2014), it is possible that individuals who use alcohol to manage difficult emotions are a separate group from individuals engaging in NSSI. Within the current sample, our ability to detect associations with alcohol use were limited by a restricted range in alcohol use severity scores, with very few individuals screening positive for problematic alcohol use. In addition, we did not assess the use of other substances (e.g. marijuana, opioids) that may have impacted our ability to detect associations with substance abuse more broadly. Future studies should further better disentangle substance use-NSSI relationships and associated risk.

This study had several limitations that impact interpretation of findings. First, the study was cross-sectional, thus precluding inferences regarding directionality, causality, or the ability to determine whether classes derived in this study are stable over time. The study was also reliant on self-report, and thus subject to associated biases including social desirability and inaccurate reporting on past events; however, all surveys were anonymous to facilitate honest reporting of mental health difficulties. Likewise, it is possible how the study was marketed could have influenced response rates. Although the study was advertised as a general study on "mental health and risk behavior" and no explicit information was provided regarding assessment of specific constructs (e.g., NSSI, affect regulation, suicide history, disordered eating, problematic alcohol use, or impulsive behavior), it is possible that participants could have inferred that some of these indicators may be included based on the descriptor "risk behavior" and thus been more or less likely to participate, resulting in some degree of selection bias. Indeed, participants endorsed NSSI represented 26.7% of the sample recruited for the large study of risk behavior. While this percentage is elevated compared with some studies conducted with young adults (12.8%, Kuentzel et al., 2012; 13.4%, Swannell et al., 2014; 14.7%, Muehlemkamp et al., 2013; 15.3%, Whitlock et al., 2011; 17%, Whitlock et al., 2006), it is lower than lifetime rates reported in other college samples (29.5%, Goldstein et al., 2009; 30%; Labouliere, 2009; 37%, Gratz, 2006; 38%, Gratz et al., 2002; 38.9%, Cerutti et al., 2012; 41%, Paivio and McCulloch, 2004; 44%, Gratz and Chapman, 2007). As such, we do not believe that how the study was advertised unduly influenced response rates, but it is possible that selection bias may have somehow influenced results. Furthermore, our measures of suicide-related factors were limited to acquired capability and a history of suicide attempt, which may not have been the strongest indicators of future suicide risk (e.g., Franklin et al., 2017) and may have neglected other theoretically-relevant constructs (i.e., thwarted belongingness, perceived burdensomeness, hopelessness, etc.). Future studies should utilize more thorough measurement of suicide-related factors when examining associations between NSSI, emotion dysregulation, and suicide risk.

Finally, our sample was relatively small, consisted of only college students, and had limited diversity. Thus, our ability to detect less common NSSI classes may have been impacted, and findings for small class sizes may not be as readily replicable or generalizable to other populations. While the general consensus for latent class analysis is often that classes should be larger than 5% of the sample, 5% is not considered a hard cut-off and there is considerable debate within the field as to the how the number of classes should be selected (Galfalvy and Hwei, 2018; Hooker, 2018; Nylund et al., 2007). Common reasons for concern over small class sizes is that models including small class sizes are less likely to converge (Nylund et al., 2007), and when they do, small classes may not actually represent a true separate class, just several outliers from other classes that happened to look similar. A way to determine whether small classes actually represent a distinct group is to examine posterior probabilities, which show the certainty of class membership for participants in each class. If posterior probabilities for small classes are strong, this suggests that the smaller classes represent distinct groups. Such a decision is further supported when the inclusion of smaller classes improves model fit (i.e., suggesting that the classes represent important variance in the data) and interpretability (i.e., classes show significantly different patterns of associations that would be obscured by collapsing the smaller classes; Geiser, 2012; see Houston et al., 2011 and Rodgers et al., 2014 for examples of research with small classes retained).

Given that our models converged easily and have superior fit to models using fewer classes, and the small classes in our data have very strong posterior probabilities, provide unique clinical risk information, and enhance conceptual clarity, we elected to retain the four-class solution as we were interested in exploring the full natural variation in a community sample. While representing only a small number of individuals and percentage of the sample, these small class sizes were differentially-associated with important clinical concerns: higher acquired capability for suicide and high rates of suicide attempt (class 1) and lower endorsement of sensation seeking and negative urgency (class 3), common targets of treatment for NSSI. Collapsing these categories would unnecessarily obscure potential clinical implications; for example, clinicians treating patients with frequent cutting and burning behavior may consider more frequent assessment of suicide risk, while clinicians treating patients with high implement use may want to explore additional functions and drivers of NSSI in treatment. While the numbers associated with these classes is small, it is to be expected that suicide risk may only be prevalent in a small percentage of college samples; nevertheless, identifying better, more nuanced approaches to detection of suicide risk is direly needed (Large et al., 2017).

Of course, these small classes should be interpreted with caution, given that small classes may be less reliable and generalizable to different samples and this is the first study of its kind to derive latent classes of NSSI behaviors and emotion regulation difficulties. Replication studies with new samples would be indicated before the validity of the class structure could be well-supported. In addition to replication studies, future research should also examine whether classes remain stable in both community and clinical samples and during other developmental stages (e.g., children, adolescents, older adults). This research will be vital for establishing reliable and valid indicators of risk based on NSSI and emotion regulation. However, so long as clinicians are cautious regarding the generalizability of these findings to their clients, it is likely that these results could help inform clinical decision-making and guide interventions.

In spite of these limitations, this study provided a first examination of the associations between different types of NNSI behavior and emotion regulation difficulties, as well as other behavioral health factors associated with these classes. Future research should consider recruitment of larger samples with a broader range of psychosocial measures to better inform our understanding of complex emotion regulation-NSSI relationships and determine the replicability of our findings. Additionally, longitudinal research would help to determine the stability of class membership over time and determine prospective associations with suicide risk. Lastly, we did not evaluate factors that may be protective against NSSI engagement, emotion regulation difficulties, and associated adverse mental health outcomes. For example, Class 4, which had the lowest associated risks, was also the largest class identified within our sample. It is possible that there are unique characteristics within Class 4 that mitigated risk and could inform future prevention programming and intervention development.

With regards to clinical practice, NSSI is a common reason for treatment referral and understanding of NSSI-ER associations will be inform assessment and treatment planning. Knowledge of class membership may better inform differential screening (i.e., suicide screening for classes 1 and 2 versus disordered eating for 2, etc.). Clinicians working with clients engaging in NSSI should comprehensively evaluate methods of NSSI, emotion regulation difficulties, impulsivity, and disordered eating to better understand a given individual's risk profile across the spectrum of maladaptive coping behaviors and associated features. Use of graphical methods may help to facilitate interpretation of risk profiles, inform case conceptualization, and enhance psychoeducation regarding suicide risk (see example; McCullough et al., 2016).

Future research is needed to replicate our findings which could inform specific treatment algorithms based on risk profiles. Such profiles may reduce workload and provide guidance on specific targets of intervention, as targeting emotion regulation difficulties may help a number of risky behaviors. Researchers should consider exploring optimal strategies for utilizing information on emotion regulation difficulties and NSSI behaviors for clinical decision making. In particular, it remains unclear if treatment tailored to risk profiles improves treatment outcomes and if such types of treatments are appetitive to clinicians and their clients.

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## Conflict of interest

The authors have no conflicts of interest to disclose.

## Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.psychres.2019.03.014.

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