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Functions of Non-Suicidal Self-Injury in Late Adolescence: A Latent Class Analysis

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This study employed latent class analysis utilizing an array of features of non-suicidal self-injury (NSSI) in order to identify distinct subgroups of self-injurers. Participants were 359 undergraduates with NSSI history. Indicator variables were lifetime and last year frequency rates, number of methods, scarring, pain during self-injury, and functions of NSSI. Analyses yielded mild/experimental NSSI, moderate NSSI, moderate multiple functions NSSI, and severe NSSI groups, endorsing low, moderate, moderate multiple functions, and high frequencies of self-injury and presence of functions, respectively. Following class assignment, groups differed on self-esteem, social support and belongingness, internalizing symptoms, suicidal ideation and behaviors, and additional NSSI constructs. These subtype analyses emphasize matching phenotypes of NSSI to specific interventions considering dimensions of clinical functioning.

Non-suicidal self-injury (NSSI), the deliberate destruction of one's body tissue without intent to die, is relatively common, occurring in approximately 15–20% of youth (Muehlenkamp et al., 2012; Swannell, Martin, Page, Hasking, & St John, 2014). Previous research has found that individuals who engage in NSSI vary on multiple factors (Anestis, Khazem, & Law, 2015; Bracken-Minor, McDevitt-Murphy, & Parra, 2012), such as the type and number of methods employed to engage in self-injury, frequency of engagement, pain experienced during engagement, and the medical severity of

engagement. Additionally, research suggests that individuals report a broad range of interpersonal (e.g., autonomy, interpersonal boundaries, interpersonal influence, peer-bonding, revenge, self-care, sensation seeking, and toughness) and intrapersonal (e.g., affect regulation, anti-dissociation, anti-suicide, marking distress, and self-punishment) functions of NSSI (Klonsky & Glenn, 2009; Klonsky, Glenn, Styer, Olino, & Washburn, 2015). Therefore, reducing the heterogeneity of NSSI presentations by identifying subgroups of individuals who engage in self-injury has important implications for improving

our understanding of correlates and developing personalized interventions for NSSI.

Given the heterogeneity in individuals who self-injure, a small body of research has examined variability in individuals who engage in NSSI using latent class analysis (LCA). LCA is a method of classifying heterogeneous individuals into homogenous subgroups (Muthén & Muthén, 2000) based on patterns of traits and/or behaviors. In the first LCA on NSSI, Klonsky and Olino (2008) found four groups of individuals engaging in self-injurious behaviors. The first was an experimental NSSI group, where members experimented with NSSI on a few occasions. The second was a mild NSSI group, with members engaging in NSSI more frequently than the experimental group. The third was a multiple functions/anxious NSSI group, with members utilizing a variety of NSSI methods and endorsing a number of interpersonal and intrapersonal functions. Finally, the fourth was an automatic functions/suicidal NSSI group, with members almost exclusively cutting themselves in private for intrapersonal (automatic) functions, with high clinical symptom severity and high levels of suicidal ideation and behaviors.

Since that initial LCA, there have been several attempts to replicate and extend this work by including additional features of NSSI behaviors, current psychiatric symptoms, suicide-related risk factors, and participation in health-risk behaviors as indicator variables for classes (e.g., Barrocas, Giletta, Hankin, Prinstein, & Abela, 2015; Bracken-Minor et al., 2012; Dhingra, Boduszek, & Klonsky, 2016a; Herres, Kodish, Fein, & Diamond, 2017; Somer et al., 2015). The majority of classes found in these studies conceptually replicate those found by Klonsky and

Olino, although several unique classes have been identified in other studies. For instance, Somer et al. (2015) found three classes congruent with those from Klonsky and Olino. However, a unique fourth class (high rates of multiple NSSI behaviors) was identified, with a relatively high likelihood of endorsing the frequent use of a variety of NSSI methods serving both inter- and intrapersonal functions. Additionally, Bracken-Minor et al. (2012) found four classes congruent with Klonsky and Olino's, but also identified a fifth class characterized by a more severe profile they labeled as a multi-method group. Individuals in this group had higher levels of psychopathology than all other groups, as well as the highest rate of endorsement of suicide risk factors, with approximately 94% of members endorsing suicidal ideation.

Although the previously described studies have utilized specific NSSI features as class indicators, other studies have investigated characteristics linked to NSSI in addition to features of NSSI as indicators of class membership, such as childhood experiences of physical and sexual abuse, neglect, and family violence (Vaughn, Salas-Wright, Underwood, & Gochez-Kerr, 2015), psychosocial adjustment (Hamza & Willoughby, 2013), general lifetime victimization (Dhingra, Boduszek, & Sharratt, 2016b), and additional NSSI traits (Dhingra et al., 2015; Whitlock, Muehlenkamp, & Eckenrode, 2008; Xin et al., 2016). Taken together, these LCA studies provide empirical evidence for heterogeneity in NSSI behaviors, functions, and characteristics. Yet, there have been several noteworthy limitations to this growing body of research.

First, these studies have used narrow definitions of NSSI characteristics. For example, previous studies have focused on

the functions of NSSI within the broader interpersonal and intrapersonal domains. However, as most individuals who self-injure endorse multiple functions across both interpersonal and intrapersonal domains (Nock & Prinstein, 2004), examining specific functions as individual indicators may help us understand the extent to which different functions co-occur, and could influence the classification of self-injurers into distinct subgroups. Second, prior NSSI LCAs have not taken into account the physical consequences of NSSI, including the presence of scarring resulting from self-injury, in the development of NSSI subgroups. We have previously found that number of scars resulting from NSSI is associated with current suicidal ideation, even after accounting for NSSI severity indicators (e.g., NSSI frequency, method, medical severity [Burke et al., 2016]). This suggests that scarring also may contribute to the distinctions between subgroups of individuals with NSSI.

Third, previous NSSI LCAs have been limited in their consideration of the variables used to better understand clinical differences between identified NSSI subgroups. Some variables, such as the presence of comorbid diagnoses, suicidal ideation and behavior, and other related NSSI constructs, have been utilized as correlates within models, but defined narrowly. For example, most NSSI LCAs to date have utilized measures of general anxiety and worry rather than social anxiety in their analyses, even though prior research has suggested that social phobia is strongly associated with deliberate self-harm (Chartrand, Sareen, Toews, & Bolton, 2012). Additionally, several studies relying on LCA have examined the relationship between NSSI and suicide-related outcomes (Hamza & Willoughby, 2013;

Herres et al., 2017; Xin et al., 2016); however, few of these studies have considered the full spectrum of suicidal behaviors (e.g., ideation, aborted suicide attempts, and interrupted suicide attempts). Finally, most previous NSSI studies have not considered class differences related to self-injurers' experience of NSSI, such as the amount of time elapsed between the urge to self-harm and acting on that urge and social context of the behavior. Thus, beyond NSSI behaviors, dimensions of psychopathology or internalizing symptoms, suicidal ideation and behaviors, and characteristics about NSSI processes or additional NSSI constructs may be important to consider when identifying typologies of NSSI, to better address the heterogeneity in self-harming behaviors.

Finally, some constructs that are consistently associated with psychopathology, such as self-esteem or social support and belongingness, have not been examined in previous LCA studies of NSSI subtypes; further, specific constructs, such as social comparison and social appearance anxiety, have not previously been examined in the context of NSSI. However, previous research has found that adolescents with NSSI score lower on measures of self-esteem, such as self-evaluations of academic intelligence, physical attractiveness, and social skills, than adolescents without NSSI (Cawood & Huprich, 2011; Claes, Houben, Vandereycken, Bijttebier, & Muehlenkamp, 2010). Similarly, previous work has established that low body investment represents a risk factor for NSSI in adolescents, and that it mediates the relationship between negative affect and NSSI (Muehlenkamp & Brauschand, 2012). Finally, initial onset of NSSI has been found to be associated with poor social support from family (Andrews, Martin, Hasking, & Page, 2014), engagement in

NSSI is related to lower social support from peers (Heath, Ross, Toste, Charlebois, & Nedecheva, 2009), and adolescents who engage in NSSI report greater loneliness than adolescents without a history of the behavior (Glenn & Klonsky, 2013). As such, social support and belongingness also should be considered when attempting to delineate psychosocial factors associated with NSSI typologies. Understanding the role that such variables play in the presentation of NSSI can further our understanding of the risk and resilience correlates of identified classes.

CURRENT STUDY

The current study contributes to the preceding literature on NSSI in two ways. First, it utilizes LCA to identify latent classes of self-injurers based on an extensive set of indicators, employing similar indicators to those used in previous NSSI LCAs including NSSI methods or behaviors, the number of NSSI methods, amount of pain experienced when self-injuring, and lifetime and last year frequency rates (Bracken-Minor et al., 2012; Hamza & Willoughby, 2013; Klonsky & Olino, 2008; Somer et al., 2015; Whitlock et al., 2008; Xin et al., 2016). We also included several additional indicators that have previously been unexamined, including each individual function of NSSI behavior, as well as the presence of NSSI scarring. Second, it examines novel or extended correlates of NSSI class membership, including self-esteem, social support and belongingness, internalizing symptoms, a wide range of suicidal behaviors, and other related NSSI constructs such as social context, time from urge to action, and desire to cease self-injury. Prior LCAs on NSSI have examined subsets of

predictor and outcome variables, thus neglecting more complex and heterogeneous characteristics of individuals engaging in these behaviors. Therefore, we hypothesized that our inclusion of additional constructs for both class derivation and validation would enhance the assignment of individuals into NSSI classes, while allowing for examination of how novel indicators might inform class descriptions. Based on previous NSSI LCAs conducted with similar populations (Bracken-Minor et al., 2012; Somer et al., 2015; Vaughn et al., 2015), we hypothesized that a 4-class model would best fit the nature of these classes. Additionally, we hypothesized that the inclusion of numerous functions for NSSI would differentiate between LCA subgroups, such that individuals endorsing few functions would fit into "experimental" NSSI categories, whereas individuals endorsing a greater presence of functions would fit into "habitual" or chronic NSSI categories.

METHODS

Procedure

Temple University students were recruited using advertisements (e.g., class announcements and fliers). Interested individuals were directed to a consent form and an online questionnaire provided via Fluid survey systems. Following consent, participants completed a series of online questionnaires. Upon completion of the online questionnaire, participants were granted research credits necessary for course fulfillment. An Institutional Review Board at Temple University approved all study procedures. The current study was advertised to all students. However, only students with a history of engagement in

NSSI (as defined by one or more previous NSSI acts) were included in the current study sample.

Participants

Of 1,082 total participants, the current sample consisted of 359 undergraduates who had a history of engagement in NSSI (M_{age} = 20.4, SD = 3.3). The racial background of the sample was 64% (n = 228) Caucasian, 13% (n = 47) African American, 7% (n = 24) East Asian, and 5% (n = 18) South Asian. Of the total sample, 7% (n = 25) identified as biracial, and 5% (n = 17) identified with another racial background.

Indicator Variable Measures

Indicator variables of the LCA included the type of methods of NSSI behaviors over one's lifetime (e.g., cutting, burning with a cigarette, burning with a lighter, carving words, carving pictures, scratching, biting, stabbing with sharp objects, banging, punching, interfering with wound healing), number of methods used over one's lifetime, lifetime frequency rates, last year frequency rates, number of scars resulting from NSSI, amount of pain experienced when self-injuring, and the 13 functions of NSSI (affect regulation, anti-suicide, interpersonal boundaries, self-punishment, self-care, anti-dissociation/feeling-generation, sensation-seeking, peer-bonding, interpersonal influence, toughness, marking distress, revenge, and autonomy).

The Deliberate Self Harm Inventory (DSHI; Gratz, 2001) was administered to assess methods of NSSI behaviors, lifetime and last year frequency of NSSI, and scarring resulting from engagement in NSSI. The scale inquires whether participants have engaged in any of 16 specific types of NSSI behaviors, such as cutting, carving, burning, biting, and head banging, as well as one write-in. In the current sample, five behaviors were not endorsed (rubbing sandpaper on body; dripping acid onto skin; using bleach, Comet, or oven cleaner to scrub skin; rubbing glass into skin; and breaking own bones), and thus were excluded from the model. The total number of methods endorsed was summed for each participant. For frequency rates of NSSI, participant responses were grouped into the following categories: 0 times (last year frequency only), 1 time, 2–5 times, 6–20 times, 21–50 times, and 51+ times. The DSHI has demonstrated internal consistency, test-retest reliability, and construct, discriminant, and convergent validity in a university-student sample (Fliege et al., 2006; Gratz, 2001). Finally, an additional question was added to the DSHI to determine whether an individual's engagement in NSSI ever resulted in a visible scar or permanent mark. If engagement in NSSI did result in a scar or permanent mark, participants reported how many scars they have resulting from their engagement in NSSI.

The Inventory of Statements About Self-Injury (ISAS; Klonsky & Glenn, 2009) was administered to evaluate pain experienced during NSSI as well as functions of NSSI. As a modification to the original ISAS, we adapted the pain question to assess an individual's overall experience of pain during NSSI rather than their experience of pain only in response to their main form of NSSI. Additionally, the ISAS evaluated the functions of NSSI, with participants rating each question on a scale from 0 (*not relevant)* to 2 (*very relevant)*. Each subscale, which represents a type of NSSI function, had adequate to high internal consistency in this sample,

including affect regulation (α = .85), anti-dissociation (α = .80), anti-suicide (α = .88), marking distress (α = .79), self-punishment (α = .87), autonomy (α = .71), interpersonal boundaries (α = .74), interpersonal influence (α =.70), peer bonding (α =.60), revenge (α =.79), self-care (α =.61), sensation seeking (α =.58), and toughness (α =.68).

Outcome Variable Measures

Self-Esteem. The Rosenberg Self-Esteem Scale (SES; Rosenberg, 1965) is a 10-item self-report measure assessing self-esteem, with constructs including self-worth, usefulness, and failure. Participants rate items on a 4-point Likert scale, ranging from 0 (*strongly agree*) to 3 (*strongly disagree*). The SES is a widely used measure of self-esteem that has demonstrated good reliability and validity across a variety of sample types (Gray-Little, Williams, & Hancock, 1997; Hills & Baker, 1992; Rosenberg, 1965; Rosenfield, 1997). Internal consistency in this sample was α = .91.

The Body Investment Scale (BIS; Orbach & Mikulincer, 1998) is a 24-item self-report measure evaluating emotional investment in the body. Participants rate each item on a 5-point Likert scale ranging from 1 (*do not agree at all*) to 5 (*strongly agree*). Internal consistency in this sample for the total scale was good (α = .84), and ranged from adequate to high for subscales such as feelings and attitudes about the body (α = .92), comfort with physical touch (α = .78), body care (α = .71), and body protection (α = .59). This scale has displayed reliability and validity in nonclinical and clinical samples (Orbach & Mikulincer, 1998; Orbach, Stein, Shan-Sela, & Har-Even, 2001).

The Social Comparison Rating Scale (SCRS; Allan & Gilbert, 1995) is an 11-item self-report measure assessing how individuals view themselves socially in relation to others, where participants rate each item on a 10-point Likert scale, with greater scores indicating more positive social comparisons. The SCRS has demonstrated good consistency across undergraduate and clinical samples (Allan & Gilbert, 1995). Internal consistency in this sample was α = .91.

The Social Appearance Anxiety Scale (SAAS; Hart et al., 2008) is a 17-item self-report measure that examines overall appearance evaluation. Items are rated on a 5-point Likert scale, ranging from 0 (*not at all*) to 4 (*extremely*). The SAAS has proven excellent convergent and divergent validity when analyzed with related self-report measures, such as measures of self-esteem and trait anxiety (Levinson & Rodebaugh, 2011). The SAAS also has demonstrated good factor structure and test-retest reliability (Hart et al., 2008; Levinson & Rodebaugh, 2011). Internal consistency in this sample was α = .95.

Social Support and Belongingness. The Multidimensional Scale of Perceived Social Support (MSPSS; Zimet, Dahlem, Zimet, & Farley, 1988) is a 12-item self-report measure that assesses subjective appraisal of social support received from others, including family, friends, and significant others. Participants rate items on a 7-point Likert scale, ranging from 0 (*very strongly disagree*) to 7 (*very strongly agree*), with greater total scores indicating greater perceived social support. The scale has demonstrated good reliability and validity (Canty-Mitchell & Zimet, 2000; Zimet, Powell, Farley, Werkman, & Berkoff, 1990; Zimet et al., 1988). Internal consistency in this sample was excellent, for the total scale (α = .95) as well as for the

family ($\alpha = .95$), friends ($\alpha = .97$), and significant others ($\alpha = .97$) subscales.

The Loneliness Scale (UCLA-R; Russell, Peplau, & Cutrona, 1980) is a 20-item self-report scale that assesses perceptions of loneliness and isolation. The scale consists of straightforward worded items rated on a 4-point Likert scale, ranging from 0 (*never*) to 4 (*often*). The UCLA-R has demonstrated good reliability and validity (Russell et al., 1980). Internal consistency in this sample was $\alpha = .91$.

Internalizing Symptoms. The Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996) is a 21-item self-report measure that assesses severity of depressive symptoms, including sadness, hopelessness, guilt, loss of pleasure, and crying. Participants rate each item on a 4-point Likert scale, with higher scores signifying greater symptom severity. The BDI-II is a widely used assessment of depressive symptoms that has proven excellent test-retest reliability and strong convergent validity (Beck et al., 1996; Storch, Roberti, & Roth, 2004). Internal consistency in this sample was $\alpha = .93$.

The Social Interaction Anxiety Scale (SIAS; Mattick & Clarke, 1998) is a 20-item self-report measure that assesses social anxiety in interpersonal situations. Participants rate each item on a 5-point Likert scale ranging from 0 (*not at all characteristic of me*) to 4 (*extremely characteristic of me*). As previous researchers have found that the reverse-worded items are less valid indicators of social anxiety than the straightforward worded items (for review, see Rodebaugh et al., 2011), only the scores from the straightforward worded items were included in the analyses. The SIAS is a well-established measure for the assessment of social anxiety and has demonstrated good construct and factorial

validity as well as reliability (Brown et al., 1997; Mattick & Clarke, 1998; Rodebaugh, Woods, & Heimberg, 2007; Rodebaugh, Woods, Heimberg, Liebowitz, & Schneier, 2006; Safren, Turk, & Heimberg, 1998). Internal consistency in this sample was $\alpha = .95$.

Suicidal Ideation and Behaviors. The Beck Scale for Suicide Ideation (BSS; Beck, Steer, & Ranieri, 1988) is a 19-item self-report measure that assesses suicidal ideation and suicide planning within the past week. Participants rate items on a 3-point scale with higher scores signifying greater presence of each behavior; the total score of these items constitutes a measure of suicidal ideation. The self-report scale has been found to have good psychometric properties in an undergraduate sample (Chioqueta & Stiles, 2006). Internal consistency in this sample was $\alpha = .80$.

History of suicide attempts was assessed by asking participants, "Have you ever attempted to kill yourself?" In order to assess history of interrupted and aborted suicide attempts, as well as preparatory acts or behavior, we adapted interview prompts from the Columbia-Suicide Severity Rating Scale (Posner et al., 2011). History of interrupted suicide attempts was assessed by asking participants, "Has there been a time when you started to do something to end your life but someone or something stopped you before you actually did anything?" History of aborted suicide attempts was assessed by asking participants, "Has there been a time when you started to do something to try to end your life but you stopped yourself before you actually did anything?" History of preparatory behavior was assessed by asking participants, "Have you taken any steps towards making a suicide attempt or preparing to kill yourself (such as collecting pills,

getting a gun, giving valuables away or writing a suicide note)?" Additionally, in the current study, two additional questions were included by researchers related to additional suicidal-related behaviors, including suicide planning and hospitalization for suicide risk. Finally, one question was adapted from the Self-Injurious Thoughts and Behaviors Interview (SITBI; Nock, Holmberg, Photos, & Michel, 2007) to assess self-reported likelihood of attempting suicide in the future (suicide behavioral forecast).

Additional NSSI Constructs. The ISAS (Klonsky & Glenn, 2009) also evaluated further subjective experiences of engagement in NSSI, including age at onset, date of most recent NSSI engagement, the presence of others during NSSI (social context of NSSI), time elapsed from urge to action, and desire to stop NSSI. Similar to the ISAS modification for pain experienced during NSSI described above, we also adapted these questions to assess an individual's overall experience of NSSI rather than their experience only in response to their main form of NSSI. Finally, we included one additional item assessing the individual behavioral forecast of future engagement in any form of NSSI.

Data Analysis

LCA was performed using Mplus Version 7.4 (Muthén & Muthén, 2000) for models with up to nine classes. Model fit was approximated using suggested criteria (Muthén & Muthén, 2000), including the Akaike Information Criterion (AIC), the corrected AIC (AICC), the Bayesian Information Criterion (BIC), and the Sample-Size-Adjusted BIC (aBIC), with lower values representing better model fit. Models were also compared using

bootstrapped likelihood tests (BLRTs), which test whether the solution with $k + 1$ classes is a better fit to the data than the solution with k classes. Finally, we considered entropy as a measure of the precision of class assignment, with higher values suggesting better classification. After a preferred solution was identified, class comparisons were conducted using post-hoc tests for continuous variables, and chi-squared tests for categorical variables. This was implemented in Mplus using the auxiliary variable specification option and the BCH analysis option. This test statistic examines mean differences in variables across classes using pseudoclass random draws, a method using many random draws from each person's posterior probability distribution to determine their class (Asparouhov and Muthén, 2007).

RESULTS

Extraction of Latent Classes

LCAs were conducted and tested up to nine classes. As described above, several characteristics were considered when evaluating model fit, such as fit statistics, entropy, and BLRTs. First, although the AIC, AICC, and BIC indicated that further class divisions were preferred, the AICC indicated that the four-class model was the best fit for these data. Second, entropy values were comparable across LCA models, with values >.90 signifying excellent fit. Additionally, BLRTs indicated that the four-class model was a better fit for these data than the three-class model ($p<.001$), whereas the five-class model was not superior to the four-class model ($p>.05$). Finally, in the four-class model, each class constituted greater than 5% of the total sample, as a means of guarding against retaining a class that is unlikely to

TABLE 1. **Fit Statistics for LCA Models Specifying 1–9 Classes**

Classes	LL	AIC	BIC	aBIC	AICC	Parameters	Entropy
1	−11756.36	23620.73	23830.43	23659.11	23640.27	54	–
2	−11034.76	22261.53	22634.32	22329.76	22332.61	96	0.94
3	−10718.99	21713.99	22249.88	21812.08	21888.37	138	0.96
4	**−10560.77**	**21481.54**	**22180.54**	**21609.49**	**21847.61**	**180**	**0.91**
5	−10398.42	21240.85	22102.94	21398.65	21968.87	222	0.97
6	−10205.74	20939.48	21964.67	21127.13	22427.99	264	0.96
7	−10082.74	20777.47	21965.77	20994.98	24390.62	306	0.96
8	−9821.03	20338.05	21689.45	20585.42	44628.45	348	0.94
9	−9907.43	20594.85	22109.35	20872.08	11064.23	390	0.96

Bolded row refers to the selected four-class model.

replicate; although this was true of models with up to four classes, models with five or more classes had groups that constituted less than 5% of the total sample (for instance, in the five-class model, one group was composed of eight individuals, or 2.2% of the total sample). Based on these characteristics, the four-class model was selected as the best fit for these data. Fit statistics across the nine models are reflected in Table 1.

The four-class solution is presented in Figure 1. Class 1, which comprised 39% of our sample, was characterized by low lifetime frequency of NSSI behaviors and low number of NSSI methods employed, and compared to the sample mean, had low last year frequency rates, low scar presence, low levels of pain experienced during self-injury, and low levels of identification with ISAS functions. This class was labeled as a mild/ experimental NSSI group. Class 2, which comprised 29% of our sample, endorsed cutting as a primary NSSI method and on average used one to two methods, and compared to the sample mean, had slightly elevated lifetime and last year frequency rates of NSSI, low scar presence, higher levels of pain experienced during self-injury, and lower levels of identification with ISAS functions, excluding affect regulation. This

class was labeled as a moderate NSSI group. Class 3, which comprised 8% of our sample, endorsed cutting as a primary NSSI behavior and on average used two methods, and compared to the sample mean, had slightly elevated lifetime and last year frequency rates of NSSI, slightly higher scar presence, lower levels of pain experienced during self-injury, and significantly greater levels of identification with all ISAS functions. This class was labeled as a moderate multiple functions NSSI group. Finally, Class 4, which comprised 24% of our sample, endorsed cutting as a primary NSSI behavior and on average used three methods, and compared to the sample mean had very high lifetime and last year frequency rates, very high scar presence, very high levels of pain experienced during self-injury, and greater levels of identification with specific ISAS functions, including affect regulation, anti-suicide, self-punishment, self-care, anti-dissociation, and marking distress. This class was labeled as a severe NSSI group.

Comparison of Classes

Overall group and pairwise comparisons are presented in Table 2. General trends in these data suggested that the mild/experimental NSSI group had more
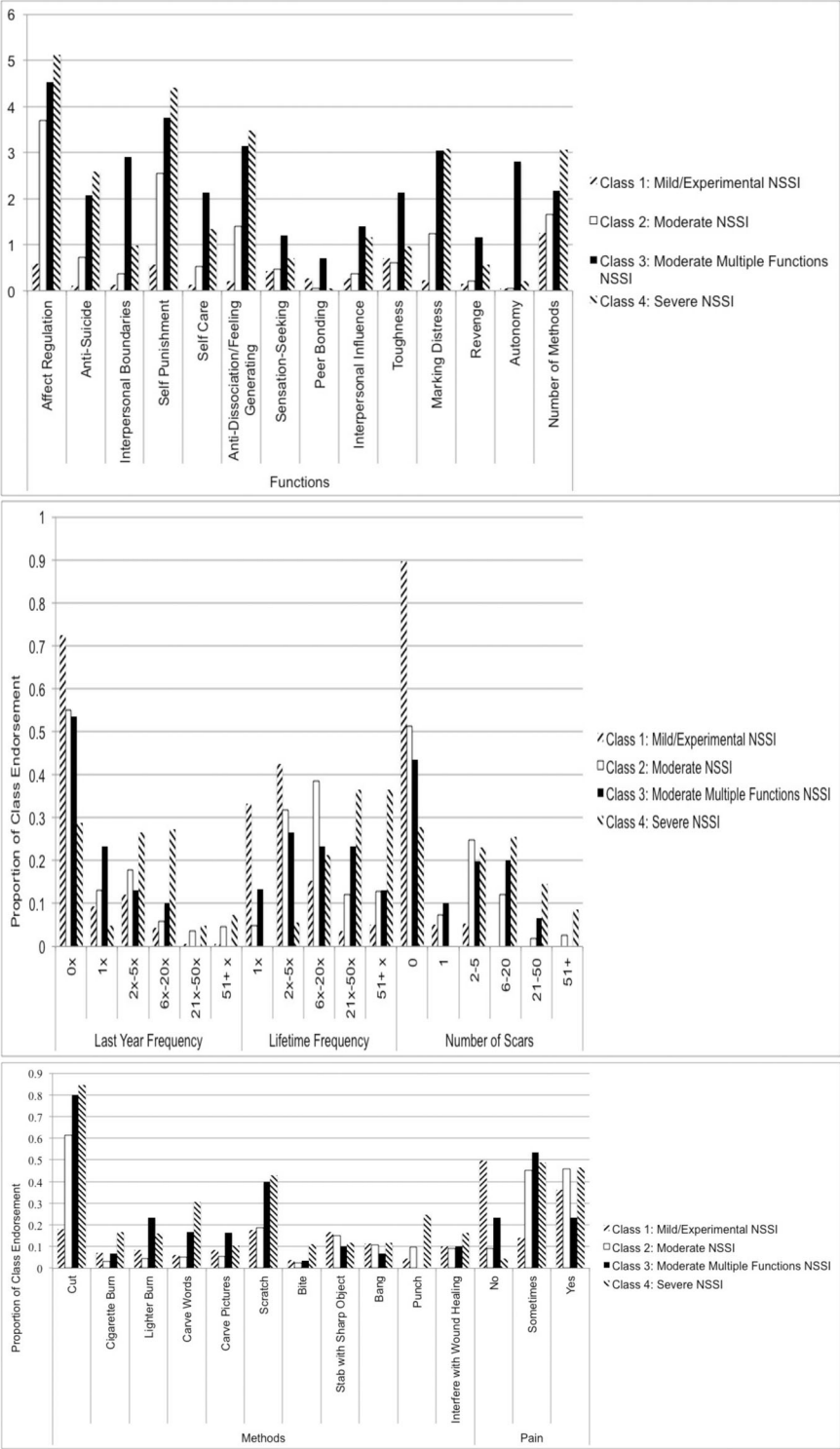
FIGURE 1. *Continuous variables presented as means of each class for each category, and categorical variables presented as proportions of class members who endorsed each category.*

TABLE 2. Class Comparisons for Outcome Measures

Outcome Measures M (SE)	Class 1	Class 2	Class 3	Class 4	F	Group-level p
Self-Esteem						
RSES	21.060 (0.521) [a***, b***, c***]	17.828 (0.629) [a***, c***]	15.899 (1.050) [b***]	14.747 (−0.639) [c***, e***]	64.766	<0.001
Attitude about Body total	3.596 (−0.074) [a***, b***, c***]	3.017 (−0.112) [a***, e*]	2.850 (−0.184) [b***]	2.660 (−0.11) [c***, e*]	59.317	<0.001
Comfort Touch total	3.517 (0.061)	3.382 (0.080)	3.250 (0.145)	3.466 (0.085)	3.717	0.294
Body Care	4.099 (−0.058) [b**]	3.996 (−0.07)	3.686 (−0.147) [b**, f**]	4.108 (−0.074) [f**]	7.854	0.049
Body Protection	3.596 (−0.074) [a***, b***, c***]	3.017 (−0.112) [a***, c*]	2.850 (−0.184) [b***]	2.660 (−0.11) [c***, e*]	59.317	<0.001
SCRS	65.582 (−1.651) [a***, b***, c***]	55.745 (−1.68) [a***, e*]	50.360 (−3.133) [b***]	50.431 (−1.735) [c***, e*]	46.484	<0.001
SAAS	31.466 (−1.156) [a***, b***, c***]	40.109 (−1.847) [a***, d*, e**]	47.943 (−3.385) [b***, d*]	47.738 (−2.135) [c***, e**]	61.816	<0.001
Social Support and Belongingness						
MSP Total	5.317 (0.145)	4.978 (0.169)	4.850 (0.228)	5.084 (0.158)	3.845	0.279
MSP Social	5.425 (0.163)	5.317 (0.197)	5.325 (0.298)	5.315 (0.213)	0.263	0.967
MSP Family	5.154 (0.162)	4.647 (0.196)	4.549 (0.308)	4.861 (0.198)	5.133	0.162
MSP Friends	1.791 (0.050)	1.657 (0.064)	1.558 (0.096)	1.692 (0.066)	5.795	0.122
Loneliness	39.721 (−0.92) [a**,b***, c***]	44.104 (−1.139) [a***, d*]	49.310 (−1.817) [b***, d*]	46.452 (−1.274) [c***]	32.688	<0.001
Internalizing Symptoms						
Depressive Symptoms	9.940 (−0.759) [a**, b*, c***]	13.335 (−1.086) [a**, e***]	16.366 (−1.683) [b*]	19.832 (−1.368) [c***, e***]	45.564	<0.001
Social Anxiety Symptoms	17.734 (−1.204) [a**, b***, c***]	24.309 (−1.6) [a**, e*]	29.373 (−2.873) [b***]	29.389 (−1.771) [c***, e*]	37.797	<0.001
Suicidal Ideation and Behaviors						
Actual SA	0.038 (−0.018) [a**, c***]	0.167 (−0.039) [a**, e*]	0.100 (−0.055) [f**]	0.303 (−0.053) [c***, e*, f**]	28.685	<0.001
Interrupted SA	0.084 (−0.025) [c***]	0.122 (−0.035) [e**]	0.133 (−0.062) [f*]	0.318 (−0.054) [c***, e**, f*]	15.848	0.001

(Continued)

TABLE 2. (Continued).

Outcome Measures M (SE)	Class 1	Class 2	Class 3	Class 4	F	Group-level p
Aborted SA	0.097 (−0.026) c***	0.189 (−0.042) e***	0.166 (−0.068) f***	0.490 (−0.058) c***, e***, f***	38.65	<0.001
Preparatory Behavior	0.039 (−0.018) a*, c***	0.145 (−0.037) a*, e**	0.100 (−0.055) f**	0.329 (−0.054) c***, e**, f**	30.268	<0.001
Suicide Planning	0.040 (−0.018) a*, c**	0.128 (−0.035) a*	0.066 (−0.046)	0.192 (−0.045) c**	13.064	0.005
Hospitalization by Another	0.028 (−0.015) c***	0.055 (−0.025) c**	0.033 (−0.033) f***	0.222 (−0.047) c***, e**, f***	15.906	0.001
SA	0.075 (−0.028) c***	0.163 (−0.049) e*	0.100 (−0.055) f**	0.366 (−0.083) c***, e*, f**	12.446	0.006
Suicidal Behavioral Forecast (BSS)	0.570 (−0.202) a**, b*, c***	1.777 (−0.361) a**, e**	2.098 (−0.669) b*, f*	3.898 (−0.625) c***, e**, f*	33.058	<0.001
Additional NSSI Constructs						
Social Context	0.956 (−0.084) a***, b***, c***	1.781 (−0.059) a***	1.666 (−0.128) b***	1.814 (−0.052) c***	81.428	<0.001
Time from urge to action	2.423 (−0.213) a***, c***	1.190 (−0.208) a***	1.735 (−0.384)	1.113 (−0.198) c***	24.59	<0.001
Desire to cease NSSI	0.864 (0.030)	0.865 (0.036)	0.900 (0.055)	0.884 (0.037)	0.457	0.928
NSSI Behavioral Forecast	1.076 (−0.038) a***, b***, c***	1.544 (−0.087) a***, c***	1.699 (−0.171) b***, f***	2.282 (−0.132) c***, e***, f***	102.264	<0.001
NSSI Onset Age	13.327 (0.338)	13.275 (0.419)	12.631 (0.674)	13.679 (0.448)	1.684	0.641

RSES: Rosenberg Self-Esteem Scale; SCRS: Social Comparison Rating Scale; SAAS: Social Anxiety Appearance Scale; MSP: Multi-dimensional Scale of Perceived Social Support; SA: Suicide Attempt; BSS: Beck Scale for Suicide Ideation; NSSI: Non-Suicidal Self-Injury.
[a] Differences between classes 1 and 2; [b] differences between classes 1 and 3; [c] differences between classes 1 and 4; [d] differences between classes 2 and 4; [f] differences between classes 3 and 4.
*Classes differ at the $p < .001$ level; **classes differ at the $p < .01$ level; *classes differ at the $p < .05$ level.
***Classes differ at the $p < .001$ level; **classes differ at the $p < .01$ level; *classes differ at the $p < .05$ level.

protective factors against NSSI, whereas the severe NSSI group had more risk factors for NSSI. For instance, for self-esteem constructs, the mild/experimental NSSI group scored significantly higher than all other groups. For social support and belongingness constructs, no pairwise differences were found for any forms of perceived social support, though the mild/experimental NSSI group scored significantly lower than all other classes on loneliness. For internalizing symptom constructs, the mild/experimental NSSI group scored significantly lower than all other classes on internalizing symptoms. For suicidal ideation and behaviors, the severe NSSI group scored significantly higher than other classes on all variables (e.g., interrupted suicide attempts, aborted suicide attempts, suicidal preparatory behaviors, hospitalization by another person for suicide concern, suicidal attempt behavioral forecast, and suicidal ideation) excluding suicide planning, for which it scored significantly higher than the mild/experimental NSSI group, but did not differ significantly from the moderate and moderate multiple functions groups. Finally, for additional NSSI constructs, the mild/experimental NSSI group scored significantly lower than other classes, and the severe NSSI group was significantly more likely to endorse hurting themselves as a way to cope when feeling bad in the future.

DISCUSSION

Previous research has found considerable variability in individuals who engage in NSSI. In this study, we identified four subgroups of individuals engaging in NSSI, differing significantly on rates of NSSI behaviors as well as on functions of these behaviors. Three of our four classes were comparable to classes distinguished in Klonsky and Olino (2008), Somer et al. (2015), and Bracken-Minor et al. (2012). However, we also identified a fourth class distinct from those in the previous NSSI LCA literature. Furthermore, we found differences between our four classes on multiple domains of clinical functioning.

Our mild/experimental class had the lowest rates of last year and lifetime NSSI (e.g., two to five lifetime acts), low levels of scarring, and on average used one method of NSSI, while endorsing few ISAS functions of their behaviors. This class was consistent with Klonsky and Olino's experimental NSSI group. Our moderate class had higher rates of last year and lifetime NSSI (e.g., between five and 20 lifetime acts) as well as scarring than the mild/experimental class, and on average used two methods of NSSI, while endorsing more ISAS functions of their behaviors than our mild/experimental class. This class was distinct from those identified in previous NSSI LCAs. Our moderate multiple functions NSSI class had similar rates of last year and lifetime NSSI, scar presence, and NSSI methods as our moderate class, while endorsing the greatest number of ISAS functions of their behaviors (specifically interpersonal functions such as interpersonal boundaries, sensation-seeking, peer bonding, toughness, revenge, and autonomy) than all other classes. This class was consistent with Klonsky and Olino's multiple functions/anxious NSSI group. Finally, our severe NSSI class had the highest rates of last year and lifetime NSSI (e.g., over 50 lifetime acts), high levels of scarring, and on average used three methods of NSSI, while endorsing the greatest identification with several interpersonal ISAS functions (specifically affect regulation, anti-suicide, and self-punishment) compared to all other

classes. This class was consistent with Klonsky and Olino's automatic functions/suicidal NSSI group. Therefore, our findings are in line with prior work utilizing LCA to identify unique subgroups of individuals who engage in self-injury.

Previous research on intrapersonal versus interpersonal functions of NSSI substantiates the model identified in this study. For instance, prior work considering intrapersonal functions has suggested that these factors are most salient in the maintenance of NSSI (e.g., Tatnell, Kelada, Hasking, & Martin, 2014). Given that our severe NSSI class had the highest endorsement of all intrapersonal functions (affect regulation, anti-suicide, self-punishment, anti-dissociation/feeling generating, and marking distress), it follows that these individuals also had the highest rates of both lifetime and last year NSSI frequency. Furthermore, prior research considering interpersonal functions has suggested that these factors play a role in self-injury in individuals with personality disorders. Specifically, research has demonstrated a relationship between interpersonal dysfunction and borderline personality disorder (BPD) symptoms, a syndrome with marked emotion dysregulation and self-injury (Santangelo et al., 2017). For instance, Muehlenkamp, Ertelt, Miller, and Claes (2011) found that unstable interpersonal relationships in BPD were associated with the presence of NSSI. Such findings suggest that individuals with BPD may utilize NSSI in order to communicate with or to elicit affection or attention from a loved one (Klonsky, 2007; Nock, 2008). In our study, the moderate multiple functions NSSI group had the highest endorsement of all interpersonal functions of NSSI behaviors (autonomy, interpersonal boundaries, interpersonal influence, peer-bonding, revenge, self-care, sensation seeking, and toughness). Given that interpersonal dysfunction is a common feature of BPD (Brodsky, Groves, Oquendo, Mann, & Stanley, 2006), it is possible that there were further underlying shared features in our moderate multiple functions NSSI class, or that this group may be categorized by additional personality factors or psychopathology not assessed in our study, such as symptoms of BPD. We expect that such factors also contributed to the differentiation between our moderate and moderate multiple functions NSSI groups.

Interestingly, when examining functions discretely and within each class, we found that for the moderate, moderate multiple functions, and severe NSSI groups, the most commonly endorsed functions were affect regulation, self-punishment, and anti-dissociation. Notably, all of these functions do belong on the intrapersonal domain, suggesting that in the current model, intrapersonal functions were particularly salient for the more acute NSSI classes. Indeed, this is a notion commonly reflected in the NSSI literature, where intrapersonal functions of NSSI have been shown to significantly and positively predict NSSI severity (e.g., Brausch & Muehlenkamp, 2018). Additionally, intrapersonal functions have been found to be more strongly associated with repetitive NSSI (Muehlenkamp, Brausch, Quigley, & Whitlock, 2013). This finding, along with others in the current body of NSSI literature (e.g., Kortge, Meade, & Tennant, 2013), highlight the importance of examining individual functions, in addition to the superordinate interpersonal and intrapersonal domains of NSSI functions, in order to best understand NSSI typologies.

Finally, our study reconciles mixed findings in prior research on pain and self-injury. Some studies have shown that individuals who engage in self-injury have a

higher pain tolerance than those who do not (McCoy, Fremouw, & McNeil, 2010) and that among individuals who self-injure, those with longer histories of self-injury have higher pain thresholds (Hooley, Ho, Slater, & Lockshin, 2010). However, other research has suggested that individuals with higher levels of emotion dysregulation more frequently engage in NSSI due to an increased willingness to experience the pain involved in self-injury (Franklin, Aaron, Arthur, Shorkey, & Prinstein, 2012). In line with this finding, our severe NSSI class endorsed both the greatest level of identification with the ISAS affect regulation function as well as the highest levels of pain experienced during NSSI. Considering these findings, we posit that through repeated acts of NSSI, members of our severe NSSI class have habituated to pain induced by NSSI over time, and so may escalate the severity of their NSSI acts in order to maintain a high level of pain during self-injury, similar to previous findings on pain and NSSI severity (Ammerman, Burke, Alloy, & McCloskey, 2016). Therefore, these NSSI acts may become more intense over time, such as in the severity of the injury inflicted. We would thus expect that a greater intensity of NSSI engagement would lead to increased tissue damage during self-injury, ultimately resulting in higher scar numbers. This notion is confirmed by a significant portion (72%) of the severe NSSI class, compared to 10% of the mild/experimental NSSI class, endorsing the presence of scarring resulting from engagement in NSSI.

Our class comparisons also provided valuable information about ways in which our identified NSSI subgroups differed from each other, with a tendency that the mild/experimental group scored highest on protective factors and lowest on risk factors

for future engagement in NSSI, and the severe group scored lowest on protective factors and highest on risk factors for future NSSI engagement. For instance, our mild/experimental group scored highest on constructs of self-esteem, body attitude, body protection, and social comparison, and lowest on social appearance anxiety, whereas our severe NSSI group scored lowest on constructs of self-esteem, body attitude, and body protection. These findings are consistent with previous research on self-esteem and NSSI, namely that self-esteem is inversely related to frequency of NSSI engagement (Cawood & Huprich, 2011), and may act as a protective factor against NSSI (Claes et al., 2010).

Additionally, no group differences were found for perceived social support. Although engagement in NSSI has been shown to be related to lower social support from peers, when exploring the direct relationship between social support and lifetime frequency of NSSI, Andrews et al. (2014) found there to be no significant relationship between either social support from parents and lifetime frequency of NSSI, or social support from close friends and lifetime frequency of NSSI. Therefore, even though our classes differed in lifetime frequency of NSSI, we would not necessarily expect them to differ in self-reports of social support. Furthermore, our mild/experimental NSSI group had the lowest scores for loneliness, whereas our moderate multiple functions NSSI group had the highest scores for loneliness. This finding, however, is congruent with the model, given the high endorsement of interpersonal functions of NSSI by our moderate multiple functions NSSI class.

We also found that the mild/experimental NSSI group had the lowest scores for social anxiety and depression (internalizing symptoms), consistent with findings

from previous LCA studies of NSSI (Bracken-Minor et al., 2012; Dhingra et al., 2015; Hamza & Willoughby, 2013; Klonsky & Olino, 2008; Somer et al., 2015; Xin et al., 2016). Additionally, our severe NSSI group scored significantly higher on internalizing symptoms than our moderate NSSI group, but not than our moderate multiple functions NSSI group. Given that our moderate multiple functions NSSI class may be categorized by symptoms of BPD—and that there are high rates of comorbidity between depression, social anxiety, and BPD symptomatology (Abela, Payne, & Moussaly, 2003; Bellino et al., 2005; Zanarini et al., 1998)—this may explain the similarities in internalizing symptoms between the severe and moderate multiple functions NSSI classes.

Additionally, our severe NSSI group scored significantly higher than all other classes on multiple markers of suicide risk. Nock and Prinstein (2005) found that self-injurers who endorse intrapersonal functions as opposed to interpersonal functions for NSSI exhibit greater suicidal behaviors. As our severe NSSI class had higher rates of endorsement on intrapersonal functions of NSSI, their highest endorsement of suicidal behaviors was expected. Notably, the suicidal behaviors measured in this study are significantly more expansive than those typically investigated. Specifically, this study examined interrupted suicide attempts, aborted suicide attempts, suicidal preparatory behaviors, suicide planning, hospitalization by another person for suicide concern, suicide attempt behavioral forecast, and suicidal ideation, whereas previous researchers typically have studied limited suicide behavior, such as intent and attempts (Bracken-Minor et al., 2012; Dhingra et al., 2016b; Hamza & Willoughby, 2013; Whitlock et al., 2008; Xin et al., 2016). Further, excluding

suicide planning, our severe NSSI group scored significantly higher than other groups on all above markers of suicide risk.

Finally, our severe NSSI group scored significantly higher than all other classes on NSSI severity constructs, whereas our mild/experimental NSSI group scored significantly lower on these constructs, including social context, time from urge to action, and behavioral forecast. Interestingly, our groups did not differ significantly in NSSI onset age. Although previous research has suggested that individuals with earlier engagement in NSSI typically experience a more severe trajectory for self-injurious behaviors, these patterns have been shown in individuals with NSSI onset before 12 years of age (Ammerman, Jacobucci, Kleiman, Uyeji, & McCloskey, 2017). Therefore, as our mean onset age for each group was greater than 12, we may not expect to see differences in onset age between our groups based on group severity.

There were several limitations to the current study. First, using a sample of undergraduate students may limit the generalizability of our study across other stages of development; therefore, replication in larger community or clinical samples may allow for stronger examinations of subgroups. Second, our use of self-report scales to assess all constructs measured in the current study may have led to a greater likelihood of finding class differences due to relying on a single method. Third, recent studies have shown differences in research on self-injury dependent on the use of implicit versus explicit measures of behavior (Cha et al., 2016). Based on this concern, future studies could use a multi-method approach to assess NSSI behaviors. Finally, we compared classes on multiple constructs resulting in many tests and did not apply corrections for multiple comparisons. However, class

differences were highly significant and we interpreted the overall pattern of results, rather than individual findings.

Despite limitations, the current study presents several noteworthy strengths. For instance, our use of a larger set of indicators in our model, such as a greater number of methods and specific functions of NSSI, as well as the inclusion of a novel severity indicator of NSSI, or scarring, led to superior fit statistics for our model. Additionally, our study included specific functions of NSSI as indicators, which further contributed to class membership, informed our class descriptions, and allowed for a more nuanced examination of how functions may interact with each other in specific typologies of NSSI. Finally, our study also examined novel or extended correlates of class membership in NSSI, including self-esteem, social support, belongingness, internalizing symptoms, a wide range of suicidal behaviors, and other related NSSI constructs. Consideration of comprehensive correlates provides us with greater insight into related constructs that may influence the maintenance of engagement in NSSI. Future directions for our research include replication of this class comparison at a later time point to assess the stability of these subgroups, and whether these profiles longitudinally predict NSSI outcomes for these individuals. Future studies could also aim to identify additional indicators, such as other psychopathological symptom or behavioral correlates of NSSI, in order to more comprehensively subtype NSSI individuals.

CONCLUSION

In sum, this NSSI LCA offers an important extension of the existing literature by using novel indicator variables as well as correlates to achieve a better fit of classifying individuals in NSSI groups. Notably, by expanding both the indicator and correlate variables utilized in LCA models, it may be possible for interventions to be more finely tailored to those engaging in self-injury. Additionally, our study highlights the importance of considering independent functions for self-injurious behaviors, rather than classifying them by their broader taxonomies of interpersonal versus intrapersonal domains. In this way, the current study further identifies and classifies individuals who engage in NSSI based on the heterogeneity of NSSI behaviors, a task of critical importance for research on and treatment of these behaviors in adolescence.

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