Predicting status along the continuum of suicidal thoughts and behavior among those with a history of nonsuicidal self-injury

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ABSTRACT

Nonsuicidal self-injury (NSSI) and suicidal thoughts and behavior often co-occur, representing a growing public health concern. Despite extensive research examining suicidal thoughts and behavior among those who engage in NSSI, there is a lack of research investigating factors that, when considered together, can differentiate individuals along the continuum of suicidal thoughts and behavior (no history, suicidal ideation, suicide plan, suicide attempt). This study sought to address this question using a sample of 1178 college students with NSSI history (68.70% female). Discriminant function analysis was conducted including the following predictors: NSSI characteristics, negative affect difficulties, and behavioral and demographic risk factors for suicidal thoughts and behavior. Results suggest that self-disclosure of suicidal ideation, number of lifetime NSSI methods, NSSI frequency, depressive symptoms, and age most parsimoniously differentiate study groups. Those who use a greater number of NSSI methods and acts, paired with higher depressive symptoms and repeated self-disclosure of suicidal ideation are most likely to have a suicide attempt history; decreases in these variables suggest membership within less severe groups. Furthermore, older age may be related to greater suicidality. Findings suggest that the evaluation and co-occurrence of these variables may contribute to a more accurate suicide risk assessment.

1. Introduction

Suicide is a leading cause of death worldwide (World Health Organization (WHO, 2014), with 804,000 deaths by suicide occurring globally in 2015 (WHO, 2017). Cross-nationally, approximately 2.7% have made a suicide attempt, with an even higher prevalence of suicide plan (3.1%) and suicidal thoughts (9.2%; Nock et al., 2008). Young adults are at a particularly high risk for suicidal thoughts and behavior, with suicidal ideation spiking during adolescence and young adulthood (Nock et al., 2008, 2013) and completed suicide a leading cause of death among those aged 15–29 (WHO, 2014). Across the lifespan, this age group also represents a period of high prevalence of engagement in nonsuicidal self-injury (NSSI), the intentional and direct self-destruction of bodily tissue without the intent to kill oneself, with 14–35% of college students reporting a history (e.g., Knorr et al., 2013; Whitlock et al., 2006). Indeed, most individuals engaging in NSSI also report a history of suicidal ideation (Brausch and Guttierez, 2010; Paul et al., 2015; Wilcox et al., 2012) and suicide plan (Paul et al., 2015; Whitlock and Knox, 2007), with up to 70% of those with a NSSI history attempting suicide (Nock et al., 2006; Paul et al., 2015). Fifty years of longitudinal research found that NSSI history serves as one of the

strongest risk factors for suicide attempt (for a review, Franklin et al., 2017; Kiekens et al., 2018). In line with major theories of suicide, both cross-sectional and longitudinal research have evidenced a greater overall acquired capability for enacting a lethal suicide attempt and greater willingness to endure physical pain among those with a NSSI history (e.g., Baer et al., 2018; Franklin et al., 2011; Germain and Hooley, 2013; Willoughby et al., 2015). Although NSSI and suicidal thoughts and behavior often co-occur, little research has investigated characteristics that distinguish those with a history of more severe suicidal thoughts and behaviors from less severe within this population. This line of research is imperative to inform intervention strategies to decrease suicide risk among this high-risk population.

The "ideation-to –action" framework accentuates the importance of investigating suicidal thoughts and behavior as distinct entities to identify factors contributing to the transition of one form of suicidal thoughts and behavior to a more severe one (Klonsky and May 2014). Previous research has employed a framework in which suicidal ideation, suicide planning, and suicide attempt form a continuum of suicidal thoughts and behavior (e.g., Burke et al., 2018; Konick and Gutierrez, 2005; Lewinsohn et al., 1996; Nock et al., 2010; Subramaniam et al., 2014), all serving as precursors to death by suicide (Franklin et al.,

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2017) with each point along the continuum predicting a successive step (e.g. suicidal ideation predicting suicide plan, which predicts suicide attempt; Borges et al., 2006; Nock et al., 2013; also see Ribeiro et al., 2016). Several ideation-to-action theories exist with proposed models for distinguishing individuals across the continuum of suicidal thoughts and behavior, including the Interpersonal Theory of Suicide (IPTS; Joiner, 2005), the Three-Step Theory (3ST; Klonsky and May 2015), and the Integrated Motivational-Volitional Model of Suicidal Behaviour (IMV; O'Connor, 2011; see Klonsky et al., 2018 for a review). These theories share a common view that two main mechanisms interact, and at the highest levels these components lead to a suicide attempt: (1) an acquired capability/physical capacity for enacting a lethal suicide attempt, with painful and provocative events serving as one contributor, and (2) emotional distress, which each theory characterizes differently, ranging from interpersonal distress to difficulties coping (Joiner et al., 2005; Klonsky and May 2015; Klonsky et al., 2018; O'Connor, 2011; Wenzel and Beck, 2008). A component of this emotional distress that has received less attention, despite theoretical support (i.e. Fluid Vulnerability Theory; Rudd, 2006), is emotion regulation deficits.

Thus, several theories of suicide exist that can inform the study of those with varying histories of suicidal thoughts and behavior. Although cross-sectional research cannot investigate the transition from thoughts to behavior, distinguishable characteristics can be identified across the continuum. Research has identified several independent correlates of suicidal thoughts and behavior, including specific NSSI characteristics, affective functioning, behavioral risk factors for suicidal thoughts and behavior, and demographic characteristics. There is some evidence that these factors may differentially characterize individuals when grouped by history of suicidal thoughts and behavior, with some literature providing support for the function of particular variables within the context of current suicide theory.

Several aspects of NSSI predict individual forms of suicidal thoughts and behavior including the number of NSSI methods used, NSSI frequency, and age of NSSI onset. The use of multiple NSSI methods is associated with a history of suicide attempt (DiCorcia et al., 2017; Matney et al., 2018; Nock et al., 2006), more severe suicidal behavior, presence and frequency of past year suicidal ideation, and greater suicide risk, even when controlling for several additional factors (Turner et al., 2013; Victor et al., 2015). Furthermore, some research suggests that as the number of utilized NSSI methods increases, the severity of suicidal thoughts and behavior also increases, such that those with a history of suicide attempt report the use of more NSSI methods (Lloyd-Richardson et al., 2007), relative to those with suicidal ideation without suicide attempt (Zlotnick et al., 1997). Research has supported the relationship between a greater diversity of NSSI methods and an acquired capability for suicide (Joiner, 2005; Mbroh et al., 2018; Matney et al., 2018). Some research suggests that NSSI frequency is also associated with the presence and frequency of suicidal ideation and suicide attempt (Andover and Gibb, 2010; Darke et al., 2010; Prinstein et al., 2008), with maximal predictive effects occurring when NSSI is mild to moderate (e.g. less than 50 acts; Whitlock et al., 2013). Extant research has supported the relationship between greater NSSI frequency and both greater acquired capability for suicide and suicidal desire (Assavedo and Anestis, 2015; Willoughby et al., 2015). Although, negative results for the NSSI frequency – suicidal thoughts and behavior relationship have also been found (DiCorcia et al., 2017; Nock et al., 2006; Turner et al., 2013), reflecting mixed results on the role of NSSI frequency in the occurrence of suicidal thoughts and behavior. Finally, past research has investigated the role of NSSI age of onset in suicide risk. An earlier age of onset may depict a greater history of painful and provocative events, given that this variable is associated with more severe NSSI behavior, (e.g., a greater number of NSSI acts, methods, and NSSI-related hospital visits; Somer et al., 2015; Ammerman et al., 2018). However, research has found that later age of NSSI onset, not earlier, serves as a risk factor for both suicide attempt and suicide (Tidemalm et al., 2015; Bryan et al., 2015). Further depicting mixed

results on the role of NSSI age of onset in distinguishing suicide risk, a recent study found that NSSI age of onset was not associated with current suicidal ideation (Victor et al., 2015).

Apart from NSSI characteristics, several other variables have been identified as risk factors for suicidal thoughts and behavior among the general population. Difficulties with negative affect are strongly related to suicidal thoughts and behavior (Franklin et al., 2017). Not surprisingly, those with a history of suicide attempt have a lower tolerance for psychological pain (Meerwijk and Weiss, 2018). Global emotion dysregulation has shown to consistently characterize those with a history of suicidal ideation and suicide attempt, with mixed results regarding whether these groups significantly differ (Khazem and Anestis, 2016; Zlotnick et al., 1997; for a review, see Law et al., 2015); although, those with no suicidal thoughts and behavior have been shown to have significantly lower levels than those with suicidal ideation or suicide attempt history (Khazem and Anestis, 2016). When considering specific facets of emotion dysregulation, emotional non-acceptance distinguished multiple attempters from controls, with multiple and single suicide attempters reporting higher levels of perceived limited access to emotion regulation strategies than control participants (Rajappa et al., 2012). Emotional non-acceptance, an aversion to experiencing "bad" or negative emotions such as ones experienced when upset (Gratz and Roemer, 2004), reflects a mentality of self-criticism (Feliu-Soler et al., 2017) which has been positively associated with emotional distress (Campos et al., 2018). A lack of emotional clarity and limited access to emotion regulation strategies have also been identified as predictors of suicidal ideation and suicide attempt (Neacsiu et al., 2017; Pisani et al., 2013; Rajappa et al., 2012; Weinberg and Klonsky, 2009). Research suggests that a greater lack of emotional clarity is related to less emotional attentiveness (for a review, Boden and Thompson, 2017), suggesting a tendency of emotional suppression which may be distress-invoking during a suicidal crisis—a situation in which emotional suppression may be difficult to achieve. Furthermore, in the presence of heightened emotional pain and distress, greater perceived limitations to accessing emotion regulation strategies may contribute to a greater willingness to attempt suicide in the absence of other available coping strategies, a notion supported by the IMV (O'Connor, 2011). In further support of the role of these emotion dysregulation facets in suicide attempt, recent research has found that psychache (e.g. emotional pain) and escape are commonly endorsed motivations for suicide and that intrapersonal motivations are associated with a greater intention to die (May and Klonsky, 2013).

Diagnostically, major depressive disorder, with severe negative affect as a cardinal symptom, is a major risk factor for suicidal ideation, suicide attempt, and completed suicide (e.g., Arsenault-Lapierre et al., 2004; Brown et al., 2000; Neeleman, 2001; Nock et al., 2010, 2013), with cross-national data highlighting the influential role of mood disorders in the suicide ideation-to-action transition (Nock et al., 2008). While some research utilizing non-NSSI samples has found that depression predicts suicidal ideation but not suicide attempt (Borges et al., 2008; Nock et al., 2010) and that those with suicidal ideation and suicide attempt history have similar levels of depression (Khazem and Anestis, 2016), there is research to suggest that a co-occurring history of current depression and NSSI history predicts suicide attempt and greater suicide risk in both retrospective and prospective studies (Asarnow et al., 2011; Chesin et al., 2017; Knorr et al., 2016; Wilkinson et al., 2011), even when controlling for past suicidal ideation and suicide attempt (Asarnow et al., 2011; Wilkinson et al., 2011). Research has also found that those with both NSSI and suicide attempt history report experiencing more depressive symptoms than those with NSSI history alone (Dougherty et al., 2009; Jacobson et al., 2008). Greater depressive symptoms may reflect greater psychological and emotional pain, which is posited to differentiate varying histories of suicidal thoughts and behavior (Klonsky et al., 2016), consistent with Shneidman's theory (Shneidman, 1993) and the 3ST (Klonsky and May 2015). Notably, research has found high levels of psychological pain among

those experiencing depression (Mee et al., 2011).

There are also relevant demographic and behavioral predictors of suicidal thoughts and behavior. Age is associated with suicidal ideation, suicide plan, and suicide attempt history across the continuum, with those below age 25 at greater risk than their older counterparts (Baetens et al., 2011; Darke et al., 2010; Kessler et al., 2005; Kessler et al., 1999; Tang et al., 2011), although current suicide theory has not described how age may play a role in the transition from suicidal thoughts to behavior. The literature has also identified self-disclosure of suicidal ideation as a warning sign of imminent suicide attempt, with approximately 60–70% of individuals giving a verbal warning in the month prior to attempt (Beautrais et al., 1998; Popenhagen and Qualley, 1998). Among those who died by suicide, those in the general population have a history of disclosing suicidal ideation to others 22–26% of the time, depending on age, with soldiers self-disclosing as frequently as 58% of the time (Choi et al., 2017; Nock et al., 2017). Therefore, research suggests that self-disclosure of suicidal ideation functions as a behavioral indicator of emotional distress. Yet, little is known regarding how those with suicidal ideation, suicide plan, and suicide attempt history may differ in the frequency of self-disclosure of suicidal ideation. Thus, we have evidence of several NSSI and non-NSSI predictors of suicidal ideation and suicide attempt, with little research investigating how these non-NSSI predictors may differentiate suicidal thoughts and behavior histories in samples with NSSI history, especially when these predictors are considered collectively. Notably, there is a dearth of NSSI and non-NSSI research investigating how these variables may characterize those reporting lifetime suicide plan as the most severe form of suicidal thoughts and behavior.

The primary aim of this study was to investigate which risk factors most precisely distinguish suicidal thoughts and behavior status at each point along the continuum in a sample of individuals with a history of NSSI. Predictors of suicidal thoughts and behavior included in this study were NSSI characteristics (i.e., lifetime NSSI methods, lifetime NSSI frequency, NSSI age of onset), negative affect difficulties (i.e., dimensions of emotion dysregulation, depressive symptomatology), and behavioral and demographic indicators of suicidal thoughts and behavior (i.e., self-disclosure of suicidal ideation and age). It was hypothesized that group differences on suicidal thoughts and behavior would emerge when each of these variables were evaluated separately. When examined in combination, however, it was hypothesized that number of NSSI methods, depressive symptoms, non-acceptance of emotions, limited access to emotion regulation strategies, and lack of emotional clarity would compose a model of predictors most influential in discriminating study groups, given that research suggests these variables may (1) parsimoniously distinguish those engaging in NSSI by history of suicidal thoughts and behavior and (2) serve functions that uniquely contribute to the development of an acquired capability for suicide or emotional distress, in line with suicide theory.

2. Methods

2.1. Participants

The current sample consisted of 1174 undergraduates from an urban university with a history of NSSI, defined as at least one lifetime act of NSSI. Due to missing data, the final sample consisted of 1065 participants between the ages of 18–35 (M = 20.63, SD = 2.73) and was 68.70% female. Participants were 66.10% white, 11.20% Asian, 9.30% Black, and 13.40% identified as another race or chose not to answer. Past studies have classified patients by the most severe form of lifetime suicidal thoughts and behavior reported (Burke et al., 2018; Konick and Gutierrez, 2005; Lewinsohn et al., 1996; Nock et al., 2010; Subramaniam et al., 2014); therefore, in the same manner the current study divided participants into four groups: 288 participants reported no suicidal thoughts or behaviors; 386 reported suicidal ideation; 237 reported having a suicide plan; and 154 participants responded that

they had at least one suicide attempt.

2.2. Measures

2.2.1. The form and function of self-injury scale (FAFSI; Jenkins et al., 2011)

The FAFSI was used to assess the lifetime frequency of NSSI acts, number of lifetime NSSI methods, and NSSI age of onset. The FAFSI is a 56-item measure of NSSI frequency, methods, and function that assesses 13 different NSSI behaviors (e.g. cutting, skin carving, burning). Past research on the FAFSI has demonstrated good internal consistency of the 13 dichotomous items, with KR-20 = 0.82 (Jenkins et al., 2011). The FAFSI was used in the current study to specifically assess the lifetime frequency of NSSI acts, number of lifetime NSSI methods, and NSSI age of onset.

2.2.2. The suicide behavior questionnaire-revised (SBQ-R; Osman et al., 2001)

The SBQ-R is a 4-item questionnaire that assesses four aspects of suicide. Two items were used in the current study to assess lifetime suicidal thoughts and behavior (i.e., suicidal ideation, plan, and attempts) and history of self-disclosure of suicidal ideation. Responses from the first item were used to classify participants by most severe lifetime suicidal thoughts and behavior, including: no suicidal thoughts and behavior, suicidal ideation, suicide plan, and at least one suicide attempt. The second item asked, "Have you ever told someone that you were going to commit suicide, or that you might do it?", which was used to assess self-disclosure of suicidal ideation. Consistent with the validated scoring of this item, response options were scored on a continuous scale of: 1 = *No*, 2 = *Yes, at one time, and really wanted to die*, and 3 = *Yes, more than once, and really wanted to do it*. In the current study, self-disclosure of suicidal ideation was utilized as a continuous variable, as indicated above, and also as a categorical variable, coded as 0 = no disclosure, and 1 = any disclosure. When using all items, the measure's internal consistency has been established in other undergraduate samples, α = 0.76–0.78 (Hirsch and Barton, 2011; Osman et al., 2001).

2.2.3. The difficulties in emotion regulation scale (DERS; Gratz and Roemer, 2004)

The DERS is a 36-item self-report measure that assesses emotion regulation difficulties, with higher scores reflecting greater emotional dysregulation. The DERS encompasses six subscales of emotion dysregulation: Nonacceptance of emotional responses, difficulties engaging in goal-directed behavior, impulse control difficulties, lack of emotional awareness, perceived limited access to emotion regulation strategies, and lack of emotional clarity. The DERS has demonstrated strong internal consistency and test-retest reliability, as well as adequate construct and predictive validity (Gratz and Roemer, 2004). In the current sample, the DERS subscales had good reliability: nonacceptance, α = 0.91.; goals, α = 0.88; impulse control, α = 0.87; awareness, α = 0.84; strategies, α = 0.83; clarity, α = 0.83. In line with past research, the current study utilized the DERS subscales independently (Neacsiu et al., 2017; Pisani et al., 2013; Rajappa et al., 2012; Weinberg and Klonsky, 2009).

2.2.4. The quick inventory of depressive symptomatology-16 item self report (QIDS-16; Rush et al., 2003)

The QIDS measures the nine symptom domains of a major depressive episode (American Psychiatric Association, 2013). Each domain is scored from 0 to 3; higher scores reflect increasing levels of pathology, with possible scores ranging from 0 to 27. The QIDS-16 has shown good reliability and validity (Rush et al., 2003; Trivedi et al., 2004). In the current sample, Cronbach's α = 0.81 for the QIDS total score.

Table 1
Correlation table for study variables.

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
1. NSSI methods	1												
2. NSSI frequency	0.63[b]	1											
3. Depression symptoms	0.29[b]	0.28[b]	1										
4. Suicidal ideation disclosure	0.23[b]	0.19[b]	0.22[b]	1									
5. NSSI onset	−0.29[b]	−0.40[b]	−0.07[a]	−0.06[a]	1								
6. Non-acceptance	0.24[b]	0.22[b]	0.45[b]	0.23[b]	−0.12[b]	1							
7. Goals	0.16[b]	0.12[b]	0.40[b]	0.15[b]	−0.03	0.40[b]	1						
8. Impulse control	0.17[b]	0.17[b]	0.45[b]	0.19[b]	−0.03	0.50[b]	0.54[b]	1					
9. Strategy	0.24[b]	0.21[b]	0.56[b]	0.26[b]	−0.07[a]	0.69[b]	0.62[b]	0.67[b]	1				
10. Awareness	0.00	0.07[a]	0.12[b]	−0.02	−0.03	0.09[a]	−0.07[a]	0.06	−0.04	1			
11. Clarity	0.15[b]	0.15[b]	0.46[b]	0.13[b]	−0.03	0.42[b]	0.31[b]	0.42[b]	0.44[b]	−47[b]	1		
12. Gender	0.13[b]	0.11[b]	0.08[a]	0.13[b]	−0.06[a]	0.05	0.06	0.06[a]	0.08[a]	−0.07[a]	0.05	1	
13. Age	−0.01	−0.02	−0.03	0.03	0.08[a]	−0.10[b]	0.10[b]	−0.04	−0.85[a]	−0.08[a]	−0.14[b]	−0.05	1

Note:
[a] $p < 0.05$.
[b] $p < 0.001$.

2.3. Procedure

Participants completed a battery of questionnaires for course credit as part of a larger study examining correlates of emotion regulation. Informed consent was provided by all participants and all procedures were approved by the Institutional Review Board.

2.4. Data analysis

An inter-item correlation analysis was conducted including study variables. Chi-square analysis was then conducted to examine differences in race and gender across groups of suicidal thoughts and behavior. Column proportions based on z-tests and adjusted standardized residuals were used for post-hoc analyses using Bonferroni correction. Next, a series of one-way analysis of variance (ANOVA) tests were performed with post-hoc Tukey tests to examine differences across groups of suicidal thoughts and behavior for the variables of age, NSSI age of onset, lifetime NSSI frequency, number of lifetime NSSI methods, self-disclosure of suicidal ideation, the six dimensions of emotion dysregulation, and depressive symptomatology. For any ANOVA model violating the assumption of homogeneity of variance, as indicated by Levene's test, results from a Welch ANOVA with Games-Howell post-hoc analysis are presented. Continuous variables that emerged as a function of suicidal thoughts and behavior were included in primary study analyses (i.e. discriminant function analysis).

A forward stepwise discriminant function (DF) analysis was then conducted to determine which combination of variables most precisely and economically differentiated across the groups of suicidal thoughts and behavior. As opposed to an analysis of variance test, a DF analysis uses continuous predictors as "independent" variables and a categorical grouping variable as the "outcome" variable (e.g., Field, 2009; Jimerson et al., 2000; Muehlenkamp and Brausch, 2016). A DF analysis builds a predictive model, including predictors that, when concurrently considered, can best predict group membership of each case (i.e., participant). An emerging DF can be thought of as a latent variable with the emerging r value for each variable representing the correlation between that predictor and the DF. DF analysis determines if the emerging model can achieve an accuracy above and beyond that of chance classification (e.g., rolling a four-sided die to determine group membership, with each side indicating a different group of suicidal thoughts and behavior). As the true group membership of each case included in analysis is already known, as indicated by the categorical outcome variable, DF analysis uses this data to report the model's accuracy of correctly classifying each case based solely on the predictors emerging within the identified model. Therefore, this test provides a metric of how this model may perform if used to classify newly introduced cases, if data for each predictor in the model were provided.

Our stepwise DF analysis used Wilks' Lambda criterion, a procedure that continuously selects predictor variables to enter the model until the inclusion of additional variables fails to add significantly to the discriminating power of the model (Matson et al., 2008). Therefore, DF analysis discards predictor variables which ineffectively distinguish groups. As DF analysis only allows for the inclusion of continuous predictors, as mean values are utilized in this analysis, self-disclosure of suicidal ideation was included as a continuous predictor, with additional descriptive statistics included in the Results to further describe this variable categorically. Results from the stepwise DF analysis showed a Box's M value of 404.64 and was significant, $p < .001$, indicating that the assumption of equality of covariance matrices was violated. Given the large sample, this issue was not anticipated as a problem; however, analyses were run using both separate variance-covariances and pooled variances. Results were similar across analyses; therefore, the results using the pooled variances are presented for simplicity. Due to significant outliers and non-normality of lifetime NSSI frequency (skew = 32.63, kurtosis = 4.80), the values of thirty participants were winsorized to the value equal to three standard deviations above the mean (812). To further address non-normality, we conducted a $\log_{10}$ transformation on the winsorized NSSI frequency variable, which improved normality within acceptable limits (skew = 0.63, kurtosis = −0.03; Kline, 2011); this variable was used in analyses, with the back-transformed results presented for ease of interpretation. Due to the relative inequality of group sizes, the DF analysis was set to compute from group sizes, rather than considering all groups equal. Additional analyses were conducted when considering groups as equal and results did not differ. For simplicity, only those based on group sizes are presented. All analyses were conducted using SPSS statistical software Version 20 (SPSS Inc. Chicago, IL, 2011).

3. Results

3.1. Univariate analyses

Inter-correlations among predictor variables are presented in Table 1. Table 2 displays by-group values for each study variable and results from the Chi-square and one-way ANOVA tests.

3.1.1. Inter-correlations

Depressive symptoms, self-disclosure of suicidal ideation, NSSI methods, NSSI frequency, and earlier age of NSSI onset were inter-related, as were the DERS scales with one another (with the exception of the DERS awareness scale, which was negatively associated with goals and unrelated to impulse control or strategy). The DERS scales were

Table 2
By-group comparisons of study variables.

Variables	No history (N = 288)	Suicidal ideation (N = 386)	Suicide plan (N = 237)	Suicide attempt (N = 154)	F / χ^2
Race (%) (n)					16.84
White	64.60%	70.20%	67.90%	55.80%	
Asian	11.80%	9.10%	10.10%	16.90%	
Black	11.80%	8.30%	6.80%	11.00%	
Other	11.80%	12.40%	15.20%	16.20%	
Female% (n)	55.20%[a,b,c]	72.30%[a]	73.00%[b]	78.60%[c]	35.71**
Age	20.48 (2.65)	20.44 (2.34)[a]	20.73 (2.92)	21.23 (3.37)[a]	2.75*
NSSI methods	1.48(0.87)[a,b,c]	1.98 (1.33)[a,d,e]	2.70 (1.73)[b,d]	3.06 (1.77)[c,e]	59.99**
NSSI frequency	4.44 (3.78)[a,b,c]	8.27 (4.66)[a,d,e]	17.32 (5.53)[b,d]	18.13 (5.53)[c,e]	46.46**
NSSI onset	14.42 (3.18)[a,b]	14.00 (3.00)[c]	13.22 (3.08)[a,c]	13.38 (2.79)[b]	8.34**
Goals	15.28 (4.47)[a,b,c]	16.59 (4.82)[a]	17.01 (4.90)[b]	16.58 (4.97)[c]	6.74**
Impulse control	12.95 (4.96)[a,b]	13.12 (4.87)[c,d]	14.27 (5.21)[a,c]	15.24 (5.79)[b,d]	8.26**
Strategy	18.89 (6.04)[a,b,c]	21.04 (6.24)[a,d,e]	22.90 (6.75)[b,d]	23.32 (6.48)[c,e]	24.31**
Clarity	11.85 (3.69)[a,b,c]	12.80 (4.12)[a]	13.09 (4.60)[b]	13.27 (4.04)[c]	6.51**
Awareness	15.33 (4.65)	15.01 (5.01)	14.87 (4.94)	14.86 (5.03)	0.51
Non-acceptance	13.38 (5.28)[a,b,c]	15.02 (5.89)[a,d]	16.68 (6.24)[b,d]	16.54 (6.49)[c]	17.67**
Depressive symptoms	6.52 (4.49)[a,b,c]	8.44 (4.58)[a,d,e]	9.75 (5.21)[b,d]	10.86 (5.68)[c,e]	31.65**
Suicidal ideation disclosure	1.15 (0.38)[a,b,c]	1.37 (0.59)[a,d,e]	1.84 (0.73)[b,d]	1.93 (0.81)[c,e]	89.66**

Note. *p < 0.05, two-tailed; ** p < 0.001, two-tailed; Superscripts of the same letter denote group differences at the *p* < 0.05 level.

associated with several non-demographic risk factors in the expected direction. Additionally, age was positively associated with NSSI age of onset and goals, and negatively associated with strategy, emotional awareness, and clarity. Female gender was associated with greater NSSI methods, NSSI frequency, depressive symptoms, self-disclosure of suicidal ideation, impulse control, and strategy, and male gender was associated with a higher NSSI age of onset and greater lack of emotional awareness.

3.1.2. Demographic variables

There was a significantly smaller proportion of females in the no suicidal thoughts and behavior group compared to other groups ($p < 0.001$). Regarding age, those in the suicidal ideation group were significantly younger than those in the suicide attempt group (95% CI -1.56 to -0.03, $p < 0.05$). There were no significant differences for self-reported race across groups, $p = 51$.

3.1.3. Self-disclosure of SI

Those in the no suicidal thoughts and behavior group had significantly lower levels of self-disclosure of suicidal ideation when compared to those in the suicidal ideation (95% CI -0.31 to -0.12, $p < 0.001$), suicide plan (95% CI -0.83 to -0.56, $p < 0.001$), and suicide attempt(95% CI -0.96 to -0.60, $p < 0.001$) groups. Those in the suicidal ideation group had significantly lower levels of self-disclosure compared to those in the suicide plan (95% CI -0.62 to -0.33, $p < 0.001$) and suicide attempt (95% CI -0.75 to -0.38, $p < 0.001$) groups. When considering self-disclosure of suicidal ideation as a categorical variable, results indicated that 63.6% of those with a past suicide attempt reported self-disclosure of suicidal ideation in the past, with 64.6% from the suicide plan group and 31.3% from the suicidal ideation group also reporting self-disclosure.

3.1.4. NSSI characteristics

Those in the no suicidal thoughts and behavior group used significantly fewer methods compared to those in the suicidal ideation (95% CI -0.75 to -0.30, $p < 0.001$), suicide plan (95% CI -1.60 to -0.93, $p < 0.001$), and suicide attempt (95% CI -2.10 to-1.23, $p < 0.001$) groups. Those in the suicidal ideation group also used significantly fewer NSSI methods than those in the suicide plan (95% CI -1.09 to -0.38, $p < 0.001$) and suicide attempt (95% CI -1.59 to -0.69, $p < 0.001$) groups. Those in the no suicidal thoughts and behavior group engaged in significantly fewer lifetime NSSI acts than those in the suicidal ideation (95% CI -0.39 to -0.15, $p < 0.001$), suicide plan (95% CI -0.74 to -0.44, $p < 0.001$), and suicide attempt

(95% CI -0.79 to -0.43, $p < 0.001$) groups. Those with suicidal ideation also engaged in significantly fewer lifetime NSSI acts compared to the suicide plan (95% CI -0.47 to -0.17, $p < 0.001$) and suicide attempt (95% CI -0.52 to -0.16, $p < 0.001$) groups. Those with no suicidal thoughts and behavior had a significantly older age of NSSI onset compared to those in the suicide plan (95% CI 0.52 to 1.89, $p < 0.001$) and suicide attempt (95% CI 0.26 to 1.82, $p < 0.05$) groups. Those in the suicidal ideation group had a significantly older age of NSSI onset than those in the suicide plan group (95% CI 0.14 to 1.43, $p < 0.05$).

3.1.5. Depressive symptoms

Those in the no suicidal thoughts and behavior group had significantly less severe depressive symptoms compared to the suicidal ideation (95% CI -2.83 to -1.01, $p < 0.001$), suicide plan (95% CI -4.34 to -2.12, $p < 0.001$), and suicide attempt (95% CI -5.71 to -2.98, $p < 0.001$) groups. Those in the suicidal ideation group also had significantly less severe depressive symptoms compared to those in the suicide plan(95% CI -2.37 to -0.25, $p < 0 05$) and SA (95% CI -3.76 to -1.10, $p < 0.001$) groups.

3.1.6. Emotion regulation

Those with no suicidal thoughts and behavior had significantly lower levels of non-acceptance of emotional responses compared to those in the suicidal ideation (95% CI -2.76 to -0.53, $p < 0.05$), suicide plan (95% CI -4.62 to -1.99, $p < 0.001$), and suicide attempt (95% CI -4.74 to -1.59, $p < 0.001$) groups. Those in the suicidal ideation group also had significantly lower levels of emotional non-acceptance compared to those in the suicide plan group (95% CI -2.96 to -0.36, p < 0.05). Those in the no suicidal thoughts and behavior group had significantly lower levels of difficulties engaging in goal-directed behavior compared to those in the suicidal ideation(95% CI -2.26 to -0.35, $p < 0.05$), suicide plan (95% CI -2.80 to -0.65, $p < 0.001$), and suicide attempt(95% CI -2.52 to -0.07, $p < 0.05$) groups. Those with no suicidal thoughts and behavior reported significantly fewer difficulties with impulse control compared to those in the suicide plan (95% CI -2.47 to -0.17, $p < 0.05$) and suicide attempt (95% CI-3.72 to -0.87, $p < 0.001$) groups. Those with suicidal ideation also reported significantly fewer difficulties with impulse control when compared to the suicide plan (95% CI -2.23 to -0.07, $p < 0.05$) and suicide attempt (95% CI -3.48 to -0.75, $p < 0.001$) groups.

Those in the no suicidal thoughts and behavior group reported significantly less limited access compared to those in the suicidal

ideation (95% CI −3.42 to −0.88, $p < 0.001$), suicide plan (95% CI −5.44 to −2.58, $p < 0.001$), and suicide attempt (95% CI −6.06 to −2.81, $p < 0.001$) groups. Those with suicidal ideation also had significantly lower levels of limited access to emotion regulation strategies compared to those in the suicide plan (95% CI −3.21 to −0.52, $p < 0.05$) and suicide attempt (95% CI −3.84 to −0.73, $p < 0.05$) groups. Those in the no suicidal thoughts and behavior group had significantly lower levels of a lack of emotional clarity compared to all three other groups (suicidal ideation: 95% CI −1.72 to −0.17, $p < 0.05$; suicide plan: 95% CI −2.19 to −0.28, $p < 0.05$; suicide attempt: 95% CI −2.43 to −0.41, $p < 0.05$). There were no significant group differences for emotional awareness, $p = 0.68$.

3.2. Multivariate analyses

The results of the DF analysis indicated one primary DF containing variables that, when collectively considered, best account for differences between the four study groups, $p < .001$, eigenvalue = 0.43. The DF consisted of self-disclosure of suicidal ideation, $r = 0.75$, Wilks' $\lambda = 0.80$, $F_{(3,1061)} = 87.53$, $p < 0.001$; number of lifetime NSSI methods, $r = 0.60$, Wilks' $\lambda = 0.71$, $F_{(3,1061)} = 61.27$, $p < .001$; depressive symptoms, $r = 0.45$, Wilks' $\lambda = 0.70$, $F_{(3,1061)} = 43.90$, $p < 0.001$; NSSI frequency, $r = 0.53$, Wilks' $\lambda = 0.70$, $F_{(3,1061)} = 34.49$, $p < 0.001$; and age, $r = 0.13$, Wilks' $\lambda = 0.69$, $F_{(3,1061)} = 28.46$, $p < 0.001$. All five predictors emerging in the DF model collectively explained 96.4% of the variance, canonical $R^2 = 0.55$. All other study variables were not entered into the final model as they did not contribute added variance. The cross-validation classification showed that, overall, 45.60% of participants were correctly classified by group using the identified DF. This hit ratio accounts for a 65.94% increase of correct classification, above and beyond that of proportional chance classification (27.48%).

4. Discussion

The current study sought to identify risk factors that differentiate across the continuum of suicidal thoughts and behavior among individuals with a history of NSSI. Study hypotheses were partially supported with the number of NSSI methods and depressive symptoms emerging as variables comprising the identified DF. Self-disclosure of suicidal ideation, NSSI frequency, and age also emerged as variables in the final model, with self-disclosure having the greatest contribution to the DF across all variables.

In this sample of those with NSSI history, self-disclosure of suicidal ideation distinguished those across the continuum of suicidal thoughts and behavior, with self-disclosure significantly more frequent in the suicide plan and suicide attempt groups, compared to the other groups. While previous research has found that self-disclosure of suicidal ideation often occurs proximal to a suicide attempt (Beautrais et al., 1998; Popenhagen and Qualley, 1998), no other research, to our knowledge, has shown self-disclosure to distinguish groups categorized by history of suicidal thoughts and behavior (e.g., Franklin et al., 2017). These results emphasize the importance of differentiating between a desire to die (e.g., suicidal ideation) and a desire to enact suicidal self-harm (e.g., intent) when someone expresses he/she might or will attempt suicide. These findings illustrate the potential utility of closely monitoring the frequency and nature of an individual's disclosure of suicidal thoughts by clinicians and loved ones, and the value of communicating this information within a support system to provide a comprehensive view of the development and course of a patient's suicidal desire. Furthermore, this study provides preliminary evidence that greater self-disclosure of suicidal ideation may serve as a behavioral indicator of greater emotional pain (including a greater desire to die), which is proposed by extant theory as distinguishing those who will and will not carry out a suicide attempt (Joiner, 2005; Klonsky and May 2015).

The number of NSSI methods also differentiated groups in our sample, with increased diversity of NSSI methods associated with increasing severity of suicidal thoughts and behavior. Those in the suicide attempt and suicide plan groups used a significantly greater number of NSSI methods as compared to those reporting a history of less severe forms of suicidal thoughts and behavior. In line with the IPTS, an increase in the number of NSSI methods used may facilitate suicidal thoughts and behavior indirectly by increasing the number, and variety, of painful events one may experience, while also directly increasing pain tolerance through habituation (Joiner, 2005; Law et al., 2015; Mbroh et al., 2018; Matney et al., 2018).

As hypothesized, depressive symptoms also discriminated between the groups of suicidal thoughts and behavior, with those in the suicide plan and suicide attempt groups reporting greater levels of depressive symptoms, compared to those in the suicidal ideation and no suicidal thoughts and behavior groups. These results accentuate the role of more severe depressive affect, anhedonia, worthlessness, guilt, and corresponding physical symptoms as a signal of increased suicide risk, especially among those experiencing comorbid risk factors. Our results extend past research (Muehlenkamp and Gutierrez, 2007), as well as more recent work showing that versatility of NSSI (willingness to engage in a variety of NSSI methods) and depression may interact to predict suicide risk (Turner et al., 2013). These results are also in line with research of those aged 50 or greater who died by suicide, indicating that those with a history of depression were more likely to disclose suicidal ideation before death (Choi et al., 2017). These results provide preliminary support for the potential function of depressive symptoms as a measure of emotional pain, in line with current suicide theory (Klonsky and May 2015; Shneidman, 1993). Although those with depression report greater emotional pain than controls, future research should investigate whether depressive symptom severity can be used as an accurate marker of emotional pain intensity (Mee et al., 2011).

NSSI frequency also emerged within the DF model. Results provide insight into differences of NSSI frequency across groups of suicidal thoughts and behavior, with NSSI frequency similar for suicide plan and suicide attempt groups, each representing significantly greater frequencies compared to other groups. This emergence of both NSSI frequency and NSSI methods is also in line with past research identifying an interaction between NSSI frequency and number of NSSI methods to predict suicidal behavior (Anestis et al., 2015). Findings also suggest that those with greater levels of suicidal thoughts and behavior engage in NSSI more frequently, starting at a younger age (e.g., Ammerman et al., 2018), a topic with relatively little research. This data is consistent with past research that implicates painful and provocative events as a pathway to increase one's capability for attempting suicide, and perhaps suicide planning (Assavedo and Anestis, 2015; Joiner, 2005; Joiner et al., 2012; Willoughby et al., 2015), in addition to the role of NSSI frequency in the transition from suicidal thoughts to behavior (Brackman et al., 2016). Future research should investigate the precision of a DF containing a specific measure of acquired capability.

Additionally, age emerged as a demographic consideration with substantially weaker correlations to the DF. However, it is likely that our sample's restricted age range limits a comprehensive examination of the role of age across the continuum of suicidal thoughts and behavior. When interpreting results, it should be noted that participants were not asked at what age they attempted suicide but rather their current age. Our findings suggest that age adds precision to participant classification of suicidal thoughts and behavior when concurrently considering other variables, while other singular predictors may be better suited for distinguishing suicide risk.

Contrary to hypotheses, emotion regulation facets did not emerge within the DF, although simple group differences were identified. Greater difficulties with impulse control and more limited access to emotion regulation strategies distinguished those with greater suicidal

thoughts and behavior. Conversely, and consistent with extant findings (e.g., Weinberg and Klonsky, 2009), there was no significant difference in reported DERS awareness scores across groups. It may be that those who engage in NSSI have a shared commonality of general difficulties with emotional awareness, regardless of history of suicidal thoughts and behavior. Notably, those in our sample had elevated levels of overall emotion dysregulation compared to other studies (Gratz and Chapman, 2007; Gratz and Roemer, 2008; Gratz et al., 2008; Tull et al., 2009), reflecting the suitability of our sample for such comparisons.

Limitations to the present study should be discussed. This study utilized a cross-sectional design, employing lifetime measures of NSSI and suicidal thoughts and behavior; therefore, future research should examine the utility of the proposed DF of suicide risk using prospective data from a sample of those who engaged in NSSI prior to the development of any suicidal thoughts and behavior. As this study utilized data from a larger study, this also limited the predictors that could be considered for inclusion in this study (e.g. the Acquired Capability for Suicide Scale). Additionally, the study's measure of depressive symptoms (QIDS-SR) assesses current presentation. Future research should examine the distinctive roles of lifetime vs. current depressive symptoms in concurrent contribution with number of NSSI methods, NSSI frequency and self-disclosure of suicidal ideation to categorize suicidal thoughts and behavior history. Notably, it is likely that many participants endorsing current depressive symptoms also experienced them in the past, as 70% with major depression report experiencing multiple episodes (Kessler et al., 1997). While a college sample represents the highest prevalence of NSSI across all age groups (Gratz, 2001; Knorr et al., 2013; Whitlock et al., 2006), future studies should investigate the generalizability of this study's findings to other age groups and clinical samples, in addition to those with varying levels of suicide attempt lethality history and those who died by suicide. Given that the current study utilized facets of emotion dysregulation, none of which emerged within the DF, future research should investigate whether a measure of global emotion dysregulation may distinguish suicide histories more precisely. Future research should also investigate whether the combination of more frequent self-disclosure of suicidal ideation, greater current depressive symptoms, and age (older) can concurrently identify those with a history of more severe suicidal thoughts and behavior within samples of no NSSI history and whether interaction terms would be useful within future DF models.

Findings from the current study increase our knowledge of how those engaging in NSSI differ across the continuum of suicidal thoughts and behavior, providing actionable data for what distinguishes those with a more severe history. Additionally, this study provides insight into which cluster of risk factors, when simultaneously considered, may differentiate individuals at varying levels of suicide risk. In particular, young adults with severe depressive symptoms, a greater number of NSSI methods used and NSSI acts, and a history of multiple efforts to self-disclose suicidal ideation may represent a profile of high suicide risk. These results provide important clinical implications. Clinical practitioners should take each self-disclosure of suicidal ideation seriously and this behavior should be heavily weighted in clinical risk assessment, particularly among those also experiencing more severe depressive symptoms. Finally, it is important to further highlight that many between-group differences emerged when considering 12 different variables, yet the DF model included only five variables that jointly differentiated groups categorized by suicidal thoughts and behavior. These results depict the importance of focusing research on identifying risk factor clusters and creating algorithms that can be used to evaluate suicide risk, even among complex patient presentations. Indeed, recent studies (Bhat and Goldman-Mellor, 2017; Walsh et al., 2017) have employed machine learning techniques to investigate how to improve suicide prediction. This line of research may highlight the most efficacious way of distinguishing those at the highest risk for suicide.

Declaration of interest

None.

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