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Dhingra, Katie, Boduszek, Daniel and Klonsky, David

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Empirically derived subgroups of self-injurious thoughts and behaviour: Application of latent  
class analysis

Katie Dhingra, PhD, Daniel Boduszek, PhD, E. David Klonsky, PhD

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#### Author Note

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Correspondence concerning this article should be addressed to Katie Dhingra, Leeds  
Beckett University, Calverley Building, Portland Way, Leeds, LS1 3HE, United Kingdom,  
contact: [K.J.Dhingra@leedsbeckett.ac.uk](mailto:K.J.Dhingra@leedsbeckett.ac.uk)

### **Abstract**

Latent class analysis was applied to the data to identify homogenous subtypes or classes of self-injurious thoughts and behaviour (SITB) based on indicators indexing suicide ideation, suicide gesture, suicide attempt, thoughts of nonsuicidal self-injury (NSSI), and NSSI behaviour. Analyses were based on a sample of 1,809 healthy adults. Associations between the emergent latent classes and demographic, psychological, and clinical characteristics were assessed. Two clinically relevant subtypes were identified, in addition to a class who reported few SITBs. The classes were labelled: 'low SITBs' (25.8%), 'NSSI and ideation' (25%), and 'suicidal behaviour' (29.2%). Several unique differences between the latent classes and external measures emerged. For instance, those belonging to the 'NSSI and ideation' class compared with the 'suicidal behaviour' class reported lower levels of entrapment, burdensomeness, fearlessness about death, exposure to the attempted suicide or self-injury of family members and close friends, and higher levels of goal disengagement and acute agitation. SITBs are best explained by three homogenous subgroups that display quantitative and qualitative differences. Profiling the behavioural and cognitive components of suicidal and non-suicidal self-injury is potentially useful as a first step in developing tailored intervention and treatment programmes.

**Keywords:** Latent class analysis; Self-injurious Thoughts and Behaviour; Suicide; Nonsuicidal self-injury; Heterogeneity.

Empirically derived subgroups of self-injurious thoughts and behaviour: Application of latent class analysis

Self-injury remains a significant behavioural health concern for adolescents and young adults. One impediment to progress with respect to the understanding and treatment of self-injury has been the lack of consistency in how these behaviours are conceptualised, defined, and classified (Nock, 2010). Central to this lack of clarity is debate regarding whether self-injurious behaviour (SIB) is most accurately conceptualised as a dimensional or categorical construct, and whether self-injury with suicidal intent (suicide attempts) differs in aetiology and prognosis from behaviours performed with an absence of suicidal intent (i.e., non-suicidal self-injury [NSSI]) (Mars, Heron, & Crane, 2014). Thus, accurately delineating the relationship between NSSI and suicidal behaviour (ideation, plans, gestures, and attempts) — both their distinctiveness and overlap—is essential for research and intervention efforts (Klonsky, May & Glenn, 2013).

Several important differences have been found between suicide attempts and NSSI including differences in prevalence, frequency, lethality of methods, and attitudes towards life and death (e.g., Klonsky & Muehlenkamp, 2007; Mars *et al.*, 2014; Muehlenkamp & Kerr, 2010). Moreover, studies have shown that suicidal self-injurious behaviours are associated with greater levels of psychological and psychosocial impairment compared with NSSI alone (e.g., Claes, Muehlenkamp, & Vandereycken *et al.*, 2010; Jacobson, Muehlenkamp, Miller, & Turner *et al.*, 2008). Consequently, some researchers argue that a clear distinction can be made between acts of self-injury that occur with intent to die and those that occur with no intent to die (e.g., Muehlenkamp & Kerr, 2010; Nock, 2010). However, despite being conceptually and characteristically distinct from each other, many individuals engage in both behaviours (Andover, Morris, Wren, & Bruzese, 2012; Bryan, Bryan, May, & Klonsky, 2015; Jacobson *et al.*, 2008; Klonsky *et al.*, 2013). There are also a

number of similarities in the risk factors and correlates of suicide attempts and NSSI (Andover *et al.*, 2012; Mars *et al.*, 2014). Furthermore, in prospective studies, NSSI has been found to predict future suicide ideation and attempts beyond the effects of other risk factors (e.g., Asarnow, Porta, & Spirito *et al.*, 2011; Bryan & Bryan, 2014; Guan, Fox, & Prinstein, 2012). For these reasons, some researchers have regarded all forms of self-injurious behaviour as falling along a continuum regardless of intent (e.g., Kapur, Cooper, O'Connor, & Hawton, 2013; Stanley, Winchel, & Molcho, *et al.*, 1992).

As Nock, Borges, and Bromet *et al.* (2008) noted, further research is warranted on how to best classify self-injurious thoughts and behaviour. Statistical modelling in the form of latent class analysis (LCA) offers a particularly promising avenue for pursuing this agenda. LCA is a person-centred approach which assumes that heterogeneous individuals from a population can be “typed” or grouped into smaller relatively homogenous subgroups with similar patterns of behaviours or trait endorsements. Subtyping has potential implications for guiding research on aetiology, enhancing clinical management by improving diagnostic practices and prevention approaches, and developing tailored or differential treatment strategies. The identification of meaningful typologies is particularly appealing in this context given the public health significance and economic burden of self-injurious thoughts and behaviour (Knapp, McDaid, & Parsonage, 2011). LCA has been widely used in psychiatric nosology to empirically derive subtypes of disorders including posttraumatic stress disorder (e.g., Elklit, Hyland, & Shevlin, 2014), psychopathy (e.g., Dhingra, Boduszek, & Kola-Palmer, 2015), and pathological gambling (e.g., McBride, Adamson, & Shevlin, 2010). Applications of this technique to SITBs are only beginning to emerge (Bracken-Minor, McDevitt-Murphy, & Parra, 2012; Dhingra, Boduszek, Palmer, & Shevlin, 2014; Hamza & Willoughby, 2013; Klonsky & Olino, 2008; Somer, Bildik, & Kabukçu-Başay *et al.*, 2015; Whitlock, Muehlenkamp, & Eckenrode, 2008).

Klonsky and Olino (2008) identified four classes of self-injurers based on severity of NSSI method, descriptive features and functions of self-injury. These classes were labelled “experimental NSSI”, “mild NSSI”, “multiple functions/anxious NSSI”, and “automatic functions/ suicidal NSSI”, with the most severe symptoms and behaviours seen in the fourth latent class. Similar findings have been reported in subsequent studies (Bracken-Minor *et al.*, 2012; Somer *et al.*, 2015). Whitlock *et al.* (2006) defined three subgroups in terms of frequency, forms, and severity of NSSI behaviour. Hamza and Willoughby (2013) used characteristics of NSSI (e.g., lifetime frequency, most recent engagement) and suicidal behaviour (e.g., lifetime suicidal ideation and suicidal attempts) as class indicators to define three subgroups. The classes were labelled as “an infrequent NSSI/not high risk for suicidal behavior group”, “a frequent NSSI/not high risk for suicidal behavior group,” and “a frequent NSSI/high risk for suicidal behavior group”. Dhingra *et al.* (2014) identified two classes of self-injurers (high and low self-injury risk classes) based on Data from the MacArthur Violence Risk Assessment Project and the following items: thoughts of hurting the self, attempt to hurt the self, self-injured alone, acts to gain help during or after self-injury, final acts in anticipation of death, and writing a self-injury note.

These above findings provide support for the heterogeneity of self-injurious thoughts and behaviours (SITBs). However, subgroups were derived largely on the basis on of NSSI characteristics rather than a range of different SITBs. Thus, these studies did not examine the potential co-occurrence of NSSI, suicidal thoughts, and suicide gestures. Assessing relations among these different SITBs is important because it can help clinicians and researchers better understand how these different constructs are related. Such work may also help to prevent unnecessary and potentially iatrogenic hospitalisations, inaccurate case conceptualisation and treatment planning, misallocation of resources, or overlooking valuable indicator(s) of suicide risk (Klonsky *et al.*, 2013).

### **The current research**

As most prior research on SITBs has focussed on one-dimensional outcomes, e.g., NSSI behaviour *vs.* suicide attempt, or suicide ideation *vs.* suicide attempt, thus neglecting more complex patterns, this study aims to examine whether distinct, homogenous subtypes of SITBs can be defined. The second aim is to validate the emergent typology by reference to key risk factors cited in the extant literature (O'Connor & Nock, 2014). As this is the first study to examine latent classes of a full range of SITBs, we did not have specific hypotheses about the number of subgroups that would be derived from the data or predictors of class membership.

## **Method**

### **Sample**

Participants were  $N = 1,809$  (476 male and 1,333 female) university students recruited from various faculties from three UK universities. Participants were aged between 18 and 66 years ( $M_{age} = 24.05$ ;  $SD = 8.09$ ). Most students identified themselves as White (80.9%), were currently in a relationship (52.6%), and described their sexual orientation as heterosexual /straight (84.4%).

### **Materials**

**Defeat.** Feelings of defeat were assessed using the Defeat Scale (Gilbert & Allan, 1998). This is a 16 item self-report measure of perceived failed struggle and loss of rank (e.g. 'I feel defeated by life'). Respondents indicate on a five point Likert-type scale the extent to which each item describes their feelings ( $0 = not\ at\ all$  to  $4 = extremely$ ) over the past 7 days. This scale has been found to have good psychometric properties (Gilbert & Allan, 1998; Gilbert, Allen, & Brough *et al.*, 2002).

**Entrapment.** Entrapment represents a sense of being unable to escape feelings of defeat and rejection, and is measured by the Entrapment Scale (Gilbert & Allan, 1998). This

16 item self-report measure assesses motivation to escape (e.g., “I am in a situation I feel trapped in”) (Gilbert & Allan, 1998). Items are rated on a five-point scale; higher scores indicate more feelings of entrapment. The Entrapment Scale has good psychometric properties (Gilbert & Allan, 1998; Gilbert *et al.*, 2002).

**Brooding rumination.** Brooding, defined as the extent to which individuals passively focus on the reasons for their distress (e.g., “Think, ‘Why can’t I handle things better?’”), was measured using the five items from the Response Styles Questionnaire (RSQ; Nolen-Hoeksema, 1991). Treynor, Gonzalez, and Nolen-Hoeksema (2003) have reported the internal reliability and discriminant validity of this brooding ruminative response style scale.

**Perceived burdensomeness and thwarted belongingness.** Perceived burdensomeness and thwarted belongingness were measured with the 12-item version of the Interpersonal Needs Questionnaire (INQ; Van Orden, Witte, & Gordon *et al.*, 2008). The INQ assesses respondent’s current beliefs about feeling connected to others (i.e., thwarted belongingness; e.g., “I feel disconnected from other people”) and feeling like a burden on the people in their lives (i.e., perceived burdensomeness; e.g., “The people in my life would be better off if I were gone”). Seven items measure belongingness, and five items measure burdensomeness. Items are rated on a Likert-type scale ranging from 1 (“*not at all true of me*”) to 7 (“*very true for me*”), with higher scores reflecting higher levels of thwarted belongingness and burdensomeness. The two subscales correlate in the expected directions with measures of mood, psychological symptoms, and social connectedness, and incrementally predict past and current suicidal ideation and behaviours above and beyond other risk factors for suicide (Bryan, Morrow, Anestis, & Joiner, 2010; Van Orden *et al.*, 2008).

**Goal Reengagement and Disengagement.** The goal adjustment scale (GAS; Wrosch, Scheier, & Miller *et al.*, 2003) is a 10-item instrument that consists of two subscales: (i) goal

disengagement (4 items) and, (ii) goal reengagement (6 items). Goal disengagement measures one's perceived difficulty in reducing effort and relinquishing commitment toward unobtainable goals (e.g., "It's easy for me to reduce my effort toward the goal" [reverse scored]). The goal reengagement subscale taps one's perceived ability to reengage in other new goals if they face constraints on goal pursuits (e.g., "I think about other new goals to pursue"). Items are scored on 5-point Likert-type scales ranging from 1 (*not at all*) to 5 (*certainly*).

**Hopelessness.** Hopelessness was measured using the 20-item Beck Hopelessness Scale (BHS; Beck, Weissman, Lester, & Trexler, 1974). Respondents are asked to indicate either agreement or disagreement with statements that assess pessimism for the future. This is a reliable and valid measure that has been shown to predict eventual suicide (e.g., Beck & Steer, 1989). Confirmatory factor analysis (Boduszek & Dhingra, in-press) supported Beck *et al.*'s (1974) three-factor solution: Factor 1 (Feelings about the future), Factor 2 (Loss of Motivation), and Factor 3 (Future Expectations).

**Discomfort intolerance.** The Discomfort Intolerance Scale (DIS; Schmidt, Richey, Cromer, & Buckner, 2007) is a five-item self-report index of the degree to which individuals tolerate physical discomfort, including pain (e.g., "I can tolerate a great deal of physical discomfort" [reverse scored]). Participants rate the questions on a scale ranging from 0 ("*not at all like me*") to 6 ("*extremely like me*"). The scale has demonstrated adequate psychometric properties in other research (e.g., Ribeiro, Witte, Van Orden *et al.*, 2014).

**Fearlessness about Death.** The Acquired Capability for Suicide Scale (ACSS; Van Orden *et al.*, 2008) was originally developed as a 20-item self-report measure to assess both fearlessness about death (FAD) and pain insensitivity. However, a recent psychometric investigation of the ACSS supports the use of a 7-item subscale of the ACSS to assess FAD (e.g., "I am very much afraid to die") (ACSS-FAD; Ribeiro *et al.*, 2014). In the current study,

the ACSS-FAD subscale was utilised as a measure of FAD. Items were rated on a 5-point scale, with higher scores indicating greater FAD. The scale showed good reliability, discriminant and convergent validity (Van Orden *et al.*, 2008).

**Exposure to suicidal behaviour.** Respondents were asked the following two questions about self-harm by close friends and family: ‘Has anyone among your close friends [your family] attempted suicide or deliberately harmed themselves?’ Items were drawn from research by O’Connor, Rasmussen, and Hawton (2012).

**Acute agitation.** The Brief Agitation Measure (BAM; Ribeiro, Bender, & Selby *et al.*, 2011) is a brief 3-item self-report measure designed to index subjective agitation levels. Items are rated on a seven-point likert scale from 0 (“not *at all true for me*”) to 6 (“very *much true for me*”). Higher total scores indicate greater severity of agitation. The measure has demonstrated solid psychometrics with respect to reliability and validity in both young adults and clinical outpatients (Ribeiro *et al.*, 2011).

**Anxiety and Depression.** The Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983) was employed to measure anxiety (e.g., “I feel tense or ‘wound up’”) and depression (e.g., “I feel as if I am slowed down”). It consists of 14 questions, seven each to measure depression and anxiety. The HADS is a reliable and valid measure of affect (Bjelland, Dahl, Haug & Neckelmann, 2002).

**Self-injurious thoughts and behaviour.** Participants’ history of SITBs was assessed using items drawn from the self-report version of the Self-Injurious Thoughts and Behaviors Interview (SITBI; Nock, Holmberg, Photos, & Michel, 2007). These items asked participants to indicate the presence of the following: (a) suicide ideation (“Have you ever had thoughts of killing yourself?”), (b) suicide plan (“Have you ever actually made a plan to kill yourself?”), (c) suicide gesture (“Have you ever done something to lead others to believe you wanted to kill yourself when you really had no intention of doing so?”), (d) suicide attempt

(“Have you ever made an actual attempt to kill yourself in which you had at least some intent to die?”), (e) NSSI thoughts (“Have you ever had thoughts of purposely hurting yourself without wanting to die? (for example, cutting or burning)”, (f) NSSI behaviour (“Have you ever done something to purposely hurt yourself without intending to die?”).

### **Procedure**

The research protocol was reviewed and approved by the institutional ethics panels of all three participating universities. Participants were recruited via an email invite to participate in a study of suicide. Within this email it was made clear to potential participants that they did not need to have experienced suicidal thoughts and behaviours to take part. The study was also advertised on the websites of two of the participating university’s websites. Participants completed the study online using Qualtrics, a Web interface that allows for secure remote data collection through the distribution of anonymous secure links to the protocol. Participants were required to consent before the survey was presented online. Participation in the current study was voluntary and no inducements or obligations were used. All participants were debriefed and given phone numbers for local mental health services.

### **Analysis**

Data were analysed using Mplus version 6 (Muthen & Muthen, 2007). Latent class analysis (LCA) is a statistical method used to identify homogeneous groups (or classes) from categorical multivariate data. Frequently described as a categorical variant of factor analysis, LCA assumes that associations among a set of observed categorical variables can be explained by a finite number of mutually exclusive classes. LCA is particularly well suited to the aims of this study as: (i) it is exploratory in nature and data-driven, meaning that *a priori* assumptions are not made concerning the number of latent classes present; and (ii) it does not assume independence among indicators.

Currently there is no consensus regarding a single statistical index that identifies the most appropriate number of classes within a given population (Nylund, Asparouhov, & Muthén, 2007). Consequently, through an iterative process, models with a successive number of classes are specified. Extraction of latent classes ceases when there is little empirical or substantive support for the inclusion of a further class. Model fit is evaluated on the basis of goodness of fit statistical and parsimony considerations. Statistical indices reported here include: Akaike Information Criterion (AIC; Akaike, 1974); Bayesian Information criterion (BIC; Schwarz, 1978); sample size adjusted BIC (SSABIC; Sclove, 1987); Lo–Mendell–Rubin likelihood ratio test (LMR-LRT; Lo, Mendell, & Rubin, 2001); and entropy (Ramaswamy, DeSarbo, Reibstein, & Robinson, 1993).

AIC, BIC and SSABIC are goodness of fit indices commonly used for comparison across competing models: lower values reflect better-fitting models and, accordingly, extraction of latent classes should cease when these indices reach their lowest values. Recent simulation studies indicate that BIC is one of the most reliable indicators of the correct number of latent classes (Nylund *et al.*, 2007). Another useful tool for class enumeration is the LMR-LRT, which assesses the improvement in fit between competing models: a non-significant value ( $p > .05$ ) suggests that the model with one fewer class provides a more parsimonious fit to the data. Based on the posterior class membership probabilities, entropy evaluates how well each of the classes is separated and represented by the data; values range from 0 to 1, with high values preferred. Finally, selection of the best-fitting model was based on whether the model reflected coherent, distinct, and conceptually meaningful subgroups and adequately accounts for the heterogeneity in the sample.

Following identification of the best-fitting latent class solution, covariates (defeat, entrapment, hopelessness, fearlessness about death, brooding rumination, goal reengagement and disengagement, anxiety, depression, acute agitation, discomfort intolerance, perceived

burdensomeness, thwarted belongingness, exposure to self-injurious behaviours of friends and family members, and gender) were included in the model to help describe the heterogeneity in self-injurious thoughts and behaviour and to substantiate the validity of the emergent classes or subtypes. Muthén's (2003) recommends that, "The estimated prediction of class membership is a key feature in examining predictions of theory. If classes are not statistically different with respect to covariates that, according to theory, should distinguish classes, crucial support for the model is absent" (p. 373). Odds ratios (ORs) and accompanying confidence intervals (CIs) were calculated to evaluate these associations. Odds ratios reflect the proportionate change in odds of membership of a given class, relative to the reference class, associated with a one-unit change in the covariate. When comparing class 1 with class 2, coefficients from the logistic regression were transformed to odds-ratios (ORs) by exponentiation for ease of interpretation. Similar transformations were made of the coefficients plus-minus 1.96 standard errors to generate 95% confidence intervals (95% CIs) of the ORs. Cohen's *d* statistic (Cohen, 1988) is reported in instances where significant differences between the classes emerged.

## Results

### Descriptive Statistics and Correlations

Descriptive statistics, including means ( $M$ ) and standard deviations ( $SD$ ) for all measures are presented in Table 1, along with Cronbach's alphas.

*Table 1:* Descriptive statistics for all continuous variables.

<b>Variable</b>	<b><math>M</math></b>	<b><math>SD</math></b>	<b>Min</b>	<b>Max</b>	<b>Cronbach's <math>\alpha</math></b>
Defeat	35.87	12.23	15	75	.95
Entrapment	34.49	34.49	16	78	.96
Hopelessness 1	2.74	2.74	0	7	.88
Hopelessness 2	1.65	1.81	0	7	.80
Hopelessness 3	2.42	1.87	0	7	.73
Fearlessness about death	21.90	7.07	7	35	.83
Brooding rumination	12.64	3.64	5	20	.78
Goal disengagement	10.76	3.44	4	20	.82
Goal reengagement	20.58	4.96	6	30	.91
Anxiety	16.72	4.49	7	28	.83
Depression	12.26	4.09	7	26	.83
Discomfort intolerance	16.85	4.64	5	30	.73
Acute agitation	9.69	5.89	3	21	.90
Burdensomeness	17.26	10.34	7	49	.93
Belongingness	22.74	7.81	5	35	.86

*Note:* Hopelessness 1 = Feelings about the Future, Hopelessness 2 = Loss of Motivation, Hopelessness 3 = Future Expectations.

### Prevalence of the SITB indicators

The proportion of participants endorsing each of the six SITB items is presented in Table 2. The majority of participants reported a lifetime history of suicide ideation (63.1%) and NSSI thoughts (52.4%). The remaining indicators were endorsed by between 15.7% and 39.7% of participants.

*Table 2:* Endorsement rates of SITB items

<b>Item</b>	<b>Frequency</b>	<b>%</b>
Suicide ideation	813	63.1
Suicide plan	354	27.5
Suicide gesture	202	15.7
Suicide attempt	230	17.9
NSSI thoughts	675	52.4
NSSI behaviour	510	39.7

### Estimation of the number of latent classes

Three latent class models were fitted to the data, beginning with the most parsimonious two-class model through to a four-class model. The goodness of fit indices, provided in Table 3, suggest that the best-fitting model was a three-class solution. The AIC, BIC, and SSABIC were markedly lower for the three-class model compared to the two-class model. The non-significant LRT further confirmed that the four-class model was not a

significant improvement over the three-class model. The entropy measure (0.88) similarly suggests that the data was well defined by a three-class solution.

*Table 3: Fit indices for the latent class analysis of self-injurious thoughts and behaviour*

<b>Model</b>	<b>AIC</b>	<b>BIC</b>	<b>SSABIC</b>	<b>LRT</b>	<b><i>p</i></b>	<b>Entropy</b>
2 classes	5654.35	5808.50	5710.04	1873.17	<.001	.87
3 classes	5366.97	5645.44	5467.57	335.45	<.001	.88
4 classes	5337.10	5739.88	5482.61	79.42	.24	.85

*Note:* AIC = Akaike information criterion, BIC = Bayesian information criterion, SSABIC = sample size adjusted BIC, LRT = Lo-Mendell-Rubin's adjusted likelihood ratio test.

### **Latent profiles**

A comparison of profile plots suggested the three-class solution was more conceptually meaningful. Individuals were assigned to each of the three latent classes on the basis of their response profile and the estimated probabilities of endorsing the six items indexing self-injurious thoughts and behaviour. To facilitate interpretation, Figure 1 depicts the endorsement probabilities associated with the three-class model; these are useful for adding substantive meaning to the latent classes (Nylund *et al.*, 2007). As these profiles indicate, the three latent classes are primarily characterised by qualitative differences, suggesting they do not simply reflect a spectrum of severity.

Latent class one (29.9% of participants) comprised of individuals who highly endorsed five of the six items, with item-response probabilities ranging from .62 for suicide attempts to .86 for both suicide plan and NSSI thoughts. Item-response probabilities are the

probability of a particular observed response on a particular variable conditional on latent class membership. Item three (suicide gesture) was endorsed by few participants in this class (probability of .27). Consequently, this class is best characterised as a ‘suicidal behaviour’ class. Members of the second class (25.0% of participants), had high item-response probabilities of endorsing suicide ideation (.75), NSSI thoughts (.99), and NSSI behaviour (.71) and a low probability of endorsing a suicide plan (.03), gesture (.19), or suicide attempt (.01). This class was thus considered the ‘NSSI and ideation’ group. The third class (45.8% of participants) was characterised by participants who reported relatively low endorsement of all SITB items (conditional probabilities are all below .06, apart from suicide ideation (item-response probability of .34) and, as such, this class was considered as a ‘low SITB’ class.

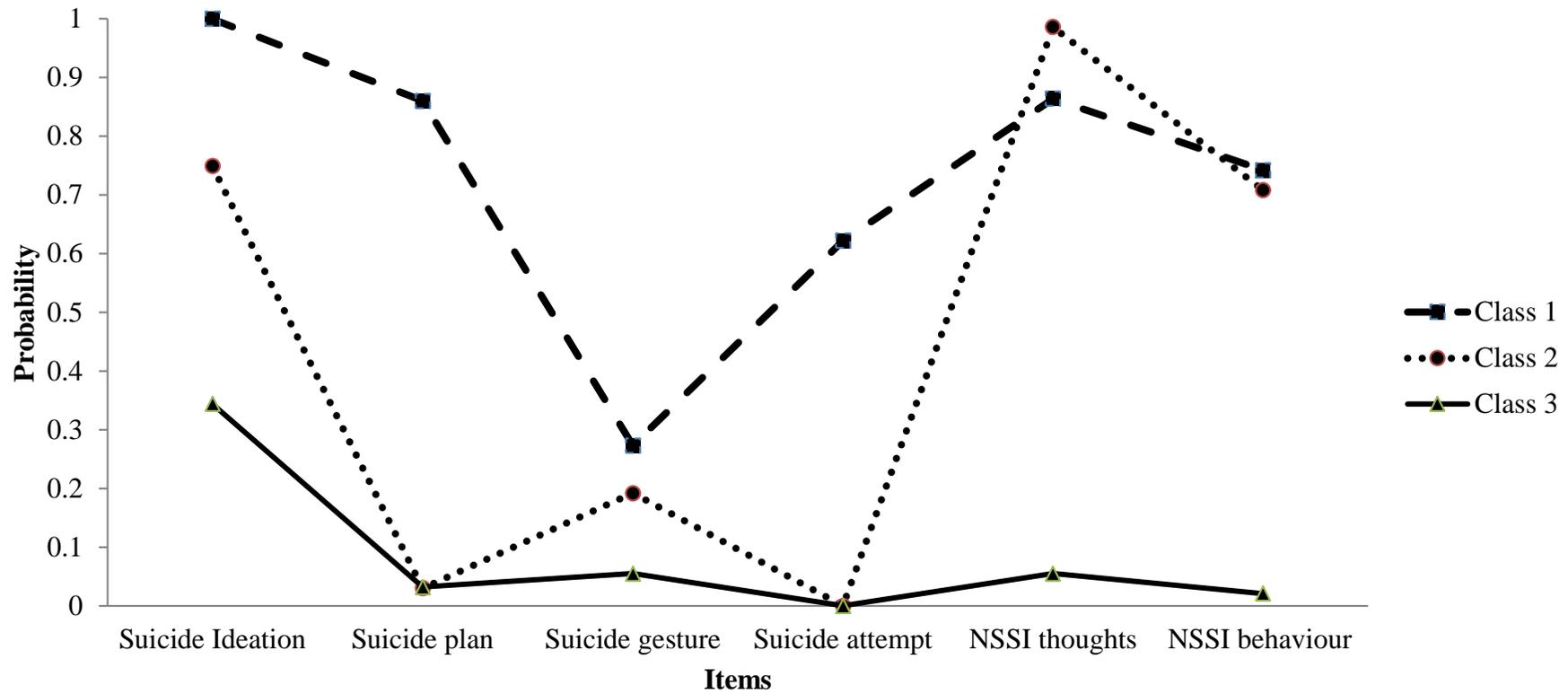
### **Validity of the latent classes**

To validate the measurement model and to help describe the heterogeneity in SITBs, associations between the emergent latent classes and defeat, entrapment, hopelessness (3 factors), fearlessness about death, brooding rumination, goal reengagement and disengagement, anxiety, depression, acute agitation, discomfort intolerance, perceived burdensomeness, thwarted belongingness, exposure (2 items), and gender were examined using multinomial logistic regression.

The first column in Table 4 has the outcome of class one membership (‘suicidal behaviour’) compared to the reference category (class three; ‘low SITB’). Results indicate that those participants who reported lower levels of belongingness (OR = .93) and higher levels of entrapment (OR = 1.05), fearlessness about death (OR = 1.06), perceived burdensomeness (OR = 1.06), were exposed to suicide or NSSI in a close friend (OR = 5.30) or family member (OR = 2.52) were significantly more likely to belong to this class while controlling for all covariates. Females were more likely to belong to this class (OR = 2.42). The second column in Table 3 has the outcome of ‘NSSI and ideation’ class (class 2)

compared to low SITB (reference category, class 3). The results suggest that higher goal disengagement (OR = 1.08), anxiety (OR = 1.10), exposure 1 (OR = 3.09) significantly increase the probability of membership in class 2. Additionally, females were more likely to belong to this class (OR = 2.13). The last column in Table 3 has the outcome of ‘NSSI and ideation’ (class 2) compared to ‘suicidal behaviour’ (class 1). The results suggest that lower entrapment (OR = .97), perceived burdensomeness (OR = .97), fearlessness about death (OR = .95), exposure to suicide or NSSI in a close friend (OR = .58) or family member (OR = .50), and greater goal disengagement (OR = 1.08) and acute agitation significantly increase the probability of membership in class 2 while controlling for all covariates.

Figure 1: Latent profile plot of self-injurious thoughts and behaviour.



Note: Class 3 = low SITB (45.8% of participants); Class 2 = NSSI and ideation (25% of participants); Class 1 = suicidal behaviour (29.2% of participants).

Table 4. Associations between SITB classes and covariates.

Variable	Class 1 with 3 OR (95% CI)	Cohen's <i>d</i>	Class 2 with 3 OR (95% CI)	Cohen's <i>d</i>	Class 2 with 1 OR (95% CI)	Cohen's <i>d</i>
Gender	2.42** (1.32/4.43)	.49	2.13** (1.28/3.54)	.42	.86 (.46/1.62)	-
Defeat	1.03 (.97/1.07)	-	1.00 (.97/1.03)	-	.98 (.94/1.01)	-
Entrapment	1.05*** (1.02/1.08)	.03	1.01 (.99/1.04)	-	.97** (.94/.99)	.02
Brooding rumination	1.03 (.95/1.11)	-	1.06 (.98/1.13)	-	1.02 (.95/1.11)	-
Burdensomeness	1.06*** (1.03/1.10)	.03	1.03 (.99/1.07)	-	.97* (.94/1.00)	.02
Belongingness	.93*** (.90/.97)	.04	.95** (.92/.99)	.03	1.02 (.99/1.06)	-
Goal disengagement	1.00 (.94/1.07)	-	1.08* (1.01/1.15)	.04	1.08* (1.01/1.15)	.04
Goal reengagement	.99 (.95/1.05)	-	.99 (.96/1.04)	-	1.01 (.96/1.05)	-
Hopelessness 1	1.11(.95/1.30)	-	1.08 (.93/1.26)	-	1.01 (.85/1.21)	-
Hopelessness 2	.93 (.79/1.11)	-	.86 (.73/1.02)	-	.91 (.79/1.06)	-
Hopelessness 3	.86 (.72/1.04)	-	1.02 (.87/1.19)	-	1.18 (.96/1.45)	-
Distress tolerance	1.01 (.96/1.06)	-	1.03 (.98/1.07)	-	1.01 (.97/1.06)	-
Fearlessness about death	1.06*** (1.03/1.10)	.03	1.01 (.98/1.04)	-	.95*** (.92/.98)	.03
Exposure (friend)	5.30*** (3.18/8.83)	.92	3.09*** (2.03/4.71)	.62	.58* (.34/.98)	.30
Exposure (family member)	2.32*** (1.48/3.62)	.46	1.19 (.76/1.85)	-	.50*** (.33/.75)	.38
Acute agitation	.98 (.93/1.04)	-	1.03 (.98/1.08)	-	1.06* (1.00/1.12)	.03
Anxiety	1.05 (.98/1.12)	-	1.10** (1.03/1.17)	.05	1.05 (.98/1.12)	-
Depression	.98 (.91/1.05)	-	.96 (.89/1.03)	-	.98 (.91/1.06)	-

Note. Class 1 = 'suicidal behaviour' class, Class 2 = 'NSSI and ideation' class, Class 3 = 'low SITB' class, Gender - female is reference category, Hopelessness 1 = Feelings about the Future, Hopelessness 2 = Loss of Motivation, Hopelessness 3 = Future Expectations. OR = Odds Ratio, 95% CI = Confidence Interval. \*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$ .

## Discussion

This study aimed to empirically derive and validate a typology of SITBs based on endorsement of six items indexing a range of self-injurious thoughts and behaviours (i.e., suicide ideation, suicide plan, suicide gesture, suicide attempt, NSSI thoughts, and NSSI behaviour). The LCA identified two clinically relevant homogeneous subgroup of SITBs, as well as a third subgroup of respondents that reported few SITBs. The ‘suicidal behaviour’ subgroup comprised respondents who exhibited high endorsement rates across all items, apart from suicide gestures. The second subgroup (‘NSSI and ideation’) was characterised by high endorsement of suicide ideation, NSSI thoughts, and NSSI behaviour. Finally, respondents belonging to the ‘low SITBs’, the largest subgroup, reported low endorsement of all SITBs.

The parallel profiles of the three latent classes, and the fact that the odds ratios did not always decline from class 1 to class 3 in the regression analysis, indicates that the groups are not distinguished primarily by the extent of item endorsement. In other words, the latent classes are not differentiated by their location along a continuum of severity linking a broad range of thoughts and behaviour but instead by unique profiles. This result complements recent findings of important difference in the predictors of a range of suicidal and non-suicidal behaviour (e.g., Dhingra, Boduszek, & O’Connor, 2015; Klonsky & Muehlenkamp, 2007; Mars *et al.*, 2014; Muehlenkamp & Kerr, 2010; Nock *et al.*, 2008) and argues against incorporating a dimensional conceptualisation. Importantly, however, the results do not preclude the possibility that for some individuals, NSSI and suicidal behaviour exist concurrently, and potentially on the same dimension.

The differential relationships between class membership and various external measures provides support for the validity of these classes. Specifically, individuals belonging to the ‘suicidal behaviour’ class were significantly more likely to report higher levels of entrapment, perceived burdensomeness, fearlessness about death, and exposure to

the attempted suicide or self-injury of family members and close friends and lower levels of belongingness, than individuals belonging to the ‘low SITBs’ class. Those belonging to the ‘NSSI and ideation’ class were significantly more likely to report higher levels of anxiety, goal disengagement, and exposure to the attempted suicide or self-injury of a close friend as well as lower levels of perceived belongingness than the ‘low SITBs’ class. These findings are consistent with prior research (e.g., Asarnow *et al.*, 2011; Claes *et al.*, 2010) which suggests that adults who report both NSSI and suicidal behaviour may be a more severe group and are at greater risk for psychopathology and psychosocial impairment than individuals who engage in NSSI only. Finally, those belonging to the ‘NSSI and ideation’ class compared with the ‘suicidal behaviour’ class reported lower levels of entrapment, burdensomeness, fearlessness about death, exposure to the attempted suicide or self-injury of family members and close friends, and higher levels of goal disengagement and acute agitation. The magnitude of the differences between these two classes was very small, however, except for the two exposure variables. This suggests that these two groups are largely the same on traditional suicide risk factors (e.g., anxiety, depression, and hopelessness), and supports the growing literature that suggests that the factors associated with suicidal ideation formation are distinct from those factors concerned with behavioural enactment (e.g., Klonsky & May, 2014; O’Connor, 2011; O’Connor & Nock, 2014).

Clinically, our results suggest that individuals belonging to class two (the ‘NSSI and ideation’ class) would benefit from interventions that highlight the importance relinquishing commitment to particular goals in the face of adversity (i.e., goal disengagement). This may be particularly true for those individuals who struggle with re-engaging with new goals (O’Connor, O’Carroll, Ryan, & Smyth, 2012), although the interaction between goal disengagement and reengagement was not tested in the present study. Individuals belonging to this class would also likely benefit from emotional regulation training. For participants

belonging to class 1 (the 'suicidal behaviour' class), our results suggest that more intensive intervention is needed. In particular, cognitive and behavioural strategies designed to reduce the desire for suicide (Joiner, Van Orden, Witte, & Rudd, 2009; O'Connor, 2011) despite increased acquired capability (e.g., fearlessness about death) and exposure to the attempted suicide or self-injury of family members and close friends warrant further consideration.

Strengths of this study include the large sample, use of well-established and valid measures, and the application of LCA to document the presence and characteristics of homogeneous subgroups of SITBs. Nevertheless, certain limitations should be considered when interpreting the findings. First, since all information was collected via self-report, reporting biases including recall error and under-reporting cannot be ruled out. Nonetheless, since objective measures of SITBs do not exist, most assessments tend to rely to some extent on self-report data. Second, an inherent limitation associated with LCA is that it precludes analysis of within-class heterogeneity, including individual differences in recency, frequency and severity of cognitions and/or behaviour. Notwithstanding this, LCA is less restrictive than other clustering techniques in that it does not assume homogeneity of variance, linear relationships, or underlying normal distributions (e.g., cluster analysis). Furthermore, it has the advantages of assigning respondents to groups based on probabilities estimates from the model and yielding statistical fit indices to evaluate competing models (e.g., Hagenaars & Halman, 1989). Third, there is an absence of additional sources of information concerning the identified subtypes (e.g., based on follow-up studies or linkage analysis), which are needed to validate these findings. Fourth, the typology that emerged in the analysis was based on a student sample, thus, the results may not extrapolate to clinical or forensic samples or to cultures where views regarding suicide are different. Basing a typology on data from treated populations (samples derived from psychiatric hospitals, outpatient clinics, and primary care practices) may, however, introduce selection bias since individuals in clinical settings do not

represent a random sample of those affected in the population and are likely to display greater symptom severity. It follows that such typologies may not generalise to the wider population, thereby limiting their utility in terms of public health initiatives. Finally, there were variations in the assessment periods between the different measures (i.e., over the previous 7 days, lifetime, and so on), thus there is greater potential for recall bias for constructs considered over a lifetime, and a possibility that different findings would emerge in studies that assess current or more recent SITBs.

Notwithstanding these limitations, the present study highlights the utility of LCA in elucidating the heterogeneity in self-injurious thoughts and behaviour, and provides empirical support against a dimensional conceptualisation of self-injury. The results suggest that rather than adopting a generic one-size-fits-all approach, profiling patterns of SITBs may be a potentially useful first step in informing tailored intervention and treatment strategies. Given that SITBs are transitory in nature (e.g., Nock, Prinstein, & Sterba, 2009), future research efforts should be directed towards prospectively examining typologies of self-injurers over time, observing movement of members between classes, and outcomes of the subtypes. The application of latent transition analysis, in particular, holds promise for examining class transitions over time and contributing to the prediction of outcome.

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