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ORIGINAL ARTICLE

The Structure of Suicidal Beliefs: A Bifactor Analysis of the Suicide Cognitions Scale

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Abstract
The Suicide Cognitions Scale (SCS) was developed to measure a broad spectrum of suicidogenic cognitions collectively referred to as the suicidal belief system. Prior confirmatory factor analyses have suggested both a unidimensional and multidimensional structure and high intercorrelations among identified factors, suggesting the possible influence of an underlying general factor. The present study used bifactor analysis in a clinical sample of 97 treatment-seeking Army personnel with recent suicide ideation and a nonclinical sample of 193 military personnel and veterans with a lifetime history of suicide ideation or attempts. Results supported the strong influence of a general factor in addition to several specific factors that aligned with constructs articulated by several theories of suicide, and suggested the SCS is best interpreted as a unidimensional measure. Results suggest that narrower suicidogenic cognitions are influenced in large part by a strong general latent variable.

Keywords Suicide · Suicidal belief system · Suicide Cognitions Scale · Military · Assessment

Introduction

Suicidogenic cognitions play a prominent role in several leading theories of suicide. Hopelessness, in particular, has played a central role in suicide research and is a commonly-recommended treatment target for clinicians working with suicidal individuals (e.g., Bryan and Rudd 2006; Wenzel et al. 2009). According to the hopelessness theory of suicide, suicidal behaviors occur when an individual expects that highly desired outcomes will not occur and perceives that he or she is unable to change the likelihood of these outcomes (Abramson et al. 1989). The hopelessness theory of suicide has served as an especially influential conceptual model, and plays a prominent role in most models of suicide. For example, Shneidman (1993) argued that suicidal behaviors result from unresolved psychache, which refers to unbearable and unresolved psychological pain. Although the specific nature of psychache can vary from person to person, a presumed common factor is the perception that one's painful psychological state is unbearable and will never end. According to Shneidman, suicidal behaviors emerge as a result of the combination of cognitive styles characterized by hopelessness and perceived unbearability.

Joiner's (2007) interpersonal psychological theory subsequently introduced and articulated two new cognitive states: perceived burdensomeness, which refers to the perception that one is a liability to others, and thwarted belongingness, which refers to the perception that one is alone and disconnected from others. According to this theory, suicidal behaviors occur when an individual possesses both perceived burdensomeness and thwarted belongingness, and perceives these psychological states as persisting and/or unmodifiable. According to this model, suicidal behaviors emerge as a result of the combination of cognitive styles characterized by hopelessness, perceived burdensomeness, and thwarted belongingness.

More recent conceptual and empirical work has aimed to explicitly integrate these various perspectives. For example, O'Connor's (2011) integrated-volitional model of suicide conceptualizes hopelessness, perceived burdensomeness, and thwarted belongingness as "motivational moderators" of entrapment, which refers to a perceived sense of urgency to escape from an unbearable situation from which there is no perceived escape. As a construct, entrapment therefore overlaps with the aforementioned constructs of unbearability and hopelessness. According to this model, suicidal behaviors

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emerge when an individual who feels that he or she cannot escape from an unbearable situation also perceives that he or she is a burden on others, is disconnected from others, and does not expect that desired outcomes are achievable. Klonsky and May (2015) have also proposed the three-step theory of suicide, which aims to integrate hopelessness with Shneidman's concept of psychache and Joiner's concept of thwarted belongingness. Specifically, suicidal behaviors are believed to emerge when an individual experiences both intense psychological pain and hopelessness that exceeds his or her sense of connectedness with others.

Given the centrality of suicidogenic cognitions to most theories and conceptual models of suicide, it is unsurprising that suicidogenic cognitions also play a central role in treatments and interventions designed to reduce suicidal thoughts and behaviors such as dialectical behavior therapy (Linehan 1993), cognitive behavioral therapy for suicide prevention (Bryan and Rudd 2018; Rudd et al. 2004; Wenzel et al. 2009), the attempted suicide short intervention protocol (Michel and Gysin-Maillart 2015), the Collaborative Assessment and Management of Suicidality (Jobes 2016), and mentalization based therapy (Allen and Fonagy 2006). Although these treatments do not necessarily prioritize or elevate one particular type of suicidogenic cognition over another, each cognitive construct is conceptualized as a specific manifestation of what Rudd (2006) has called the *suicidal belief system*. The concept of the suicidal belief system suggests that cognitive constructs like hopelessness, burdensomeness, thwarted belongingness, entrapment, unbearability, and other suicidogenic cognitions are best conceptualized as a network of related thought processes that reflect the underlying suicidal belief system, akin to being members of a family (e.g., each family member possesses unique qualities and characteristics while also sharing many qualities and characteristics of other family members owing to their common background and origin).

In light of the presumed importance of the suicidal belief system, a number of measurement scales have been developed to measure specific suicidogenic cognitions. For example, the Beck Hopelessness Scale (Beck and Steer 1988) assesses hopelessness, the Interpersonal Needs Questionnaire (Van Orden et al. 2012) assesses perceived burdensomeness and thwarted belongingness, and the Entrapment Scale (Gilbert and Allan 1998) assesses entrapment. These (and other) scales have been widely used by suicide researchers seeking to understand and describe the associations among suicidogenic cognitions with a range of clinical outcomes including suicidal thoughts and behaviors. Researchers have consistently found significant associations between each specific construct and the full range of suicide-related outcomes (e.g., Beck et al. 1990, 1989; Bryan et al. 2014; Cukrowicz et al. 2011; Kovacs and Garrison 1985; O'Connor et al. 2013; Van Orden et al. 2006), and have also found moderate to strong correlations among the various constructs (e.g., Bryan 2011; Bryan et al. 2014; Cukrowicz et al. 2011; Van Orden et al. 2006). Taken together, these findings suggest that suicidogenic cognitions are separate but overlapping constructs, a pattern that aligns with the perspective that they represent distinct manifestations of an underlying latent construct: the suicidal belief system.

In contrast to construct-specific measures of suicidogenic cognitions, the Suicide Cognitions Scale (SCS; Bryan et al. 2014) was designed to assess the suicidal belief system more broadly. The scale therefore includes items that assess a range of suicidogenic cognitions including perceived burdensomeness (e.g., *The world would be better off without me*), thwarted belongingness (e.g., *I am completely unworthy of love*), hopelessness (e.g., *Nothing can help solve my problems*), unbearability (e.g., *It is unbearable when I get this upset*), and entrapment (e.g., *Suicide is the only way to solve my problems*). The scale also includes statements often verbalized by suicidal individuals that reflect other suicidogenic cognitions like self-hatred (e.g., *There is nothing redeeming about me*) and self-punishment (e.g., *I don't deserve to live another moment*). Factor analytic work conducted on the SCS to date suggests the scale's items load strongly onto a single factor, although two- and three-factor solutions yield better fit statistics (Bryan et al. 2014, 2017; Ellis and Rufino 2015; Gupta and Pandy 2015). Studies comparing these various factor structures have alternately supported a two-factor model (Bryan et al. 2014; Gupta and Pandy 2015) and a three-factor model (Bryan et al. 2017; Ellis and Rufino 2015), although it is notable that one-, two- and three-factor models all yield acceptable fit statistics. Regardless of the final model specification (i.e., two- or three-factor), factor analyses have consistently yielded a six-item factor that aligns with the construct of unbearability. In the three-factor model, the remaining 12 items are split evenly across a six-item unlovability factor (reflecting item content focused on self-hatred, perceived burdensomeness, and thwarted belongingness) and a six-item unsolvability factor (reflecting item content focused on hopelessness and entrapment), whereas in the two-factor model, these 12 items load onto a single factor that has also been termed unlovability. Factor scores tend to have moderate to large intercorrelations, suggesting considerable shared variance across factors. In light of these mixed results, uncertainties exist about how to best use the SCS in research and clinical settings.

The combination of evidence supporting both a unidimensional and multidimensional structure for the SCS, competing multidimensional factor solutions, and strong correlation coefficients amongst extracted factors suggests the SCS may simultaneously reflect an underlying general factor as well as multiple subdomains reflecting narrower constructs (Hammer and Toland 2016). Under such circumstances, each item of the SCS would represent a general factor (i.e.,

the suicidal belief system) to some degree and one or more subdomain (i.e., hopelessness, perceived burdensomeness, thwarted belongingness unbearability, entrapment) to some degree (see Fig. 1). Some items may therefore primarily reflect the general suicidal belief system, other items may primarily reflect a specific suicidogenic cognition, and other items may partially reflect the suicidal belief system and partially reflect a specific suicidogenic cognition. Under such circumstances, a bifactor structural model is better suited for representing construct-relevant multidimensionality (Reise et al. 2010).

Bifactor analysis differs from the more commonly used confirmatory factor analytic (CFA) approach because bifactor analysis assumes that items are potentially influenced by multiple latent variables, specifically a general latent variable as well as a separate and narrower construct, whereas CFA assumes that each item reflects only the narrow construct (see Fig. 2). In other words, CFA models ignore the variance of each item that could be explained by a common underlying factor. CFA models are therefore nested within the bifactor model because they are a special class of bifactor models wherein there is no influence of an underlying general factor on the items (i.e., general factor loadings equal to zero). The application of bifactor modeling for the SCS could provide useful information about the underlying structure of the SCS as a measure of suicidogenic cognitions and an indicator of suicide risk more generally. Conceptually, the results of such analyses could also lead to improved understanding of how suicidogenic cognitions and thought processes are interrelated, which could inform

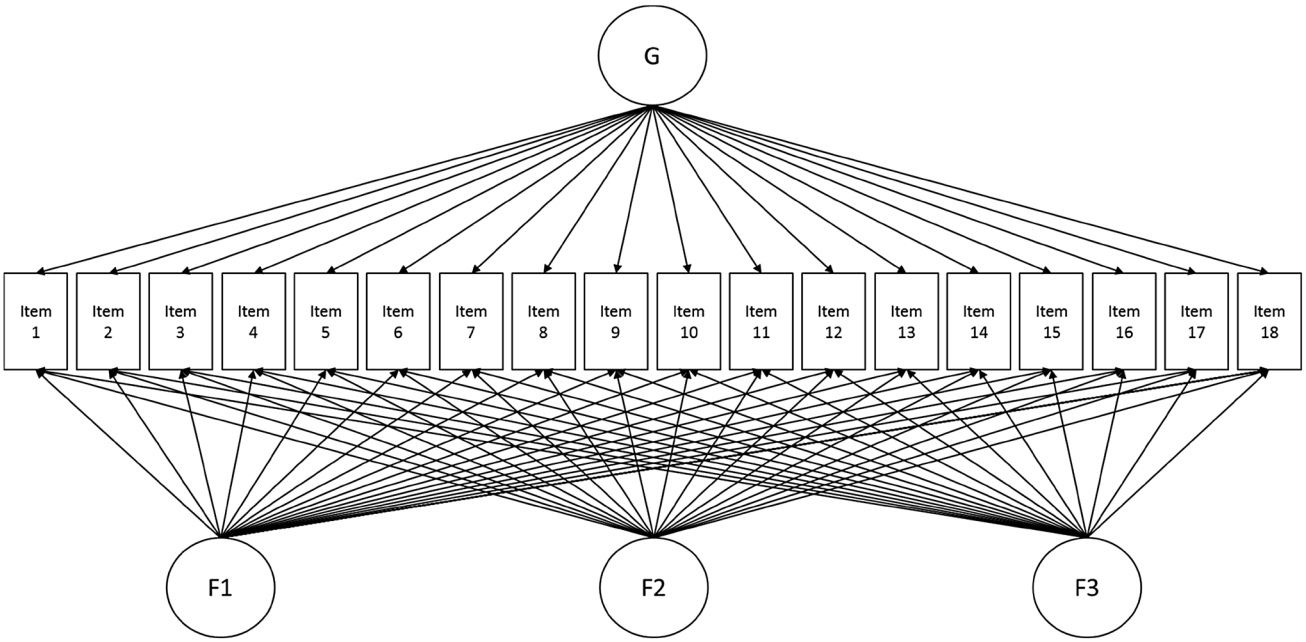

Fig. 1 Sample bifactor model

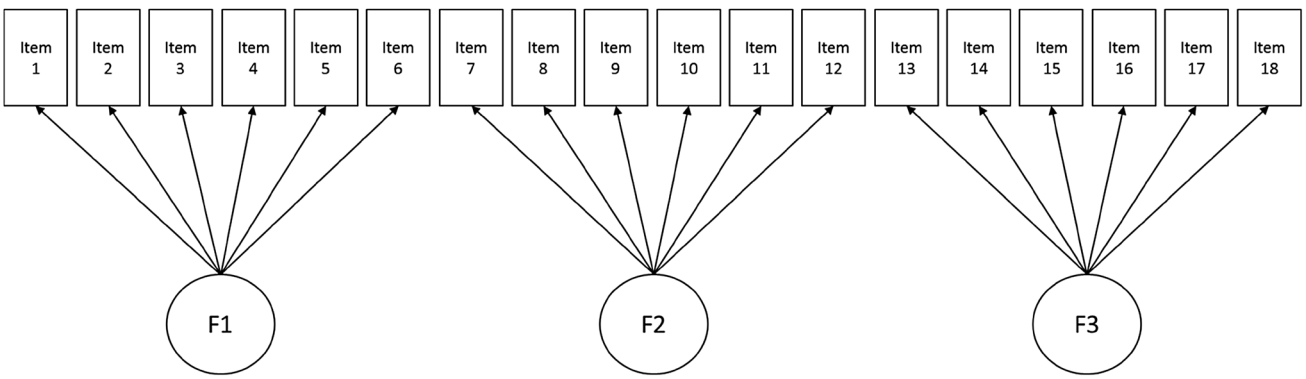

Fig. 2 Sample confirmatory factor model

conceptual and theoretical research as well as inform clinical practice specific to the assessment and treatment of suicidal individuals, which typically focuses on the broad spectrum of suicidogenic cognitions rather than only one or a handful of specific constructs.

The primary aim of the present study was to determine if the structure of the suicidal belief system, as measured by the SCS, was best represented as a general factor combined with multiple specific subdomains. Consistent with this aim, our first hypothesis was that a bifactor structure would best account for item covariation for the SCS. In light of previous research indicating a unidimensional solution for the SCS yields acceptable fit statistics and multidimensional solutions have high subscale intercorrelations, our second hypothesis was that explained common variance estimates would suggest the SCS should be primarily viewed as unidimensional, meaning there is a larger influence of the general factor on scale items relative to each specific subdomain.

Method

Participants

Sample 1

Participants included 97 active duty U.S. Army personnel who voluntarily presented to an emergency department or behavioral health clinic for an unscheduled emergency behavioral health appointment. Participants were 78% male with a mean age of 26.1 (SD = 6.4) years. Self-identified racial background was 74% white, 18% black, 4% Asian, 3% Pacific Islander, 8% Native American, and 2% other. In addition, 7% self-identified as Hispanic or Latino ethnicity. Participants had served in the military for a mean of 5.4 (SD = 5.2) years, and had deployed a mean of 1.2 (SD = 1.2) times. Military rank was 75% junior enlisted (E1–E4), 16% noncommissioned officer (E5–E6), 4% senior noncommissioned officer (E7–E9), and 5% officer. Fifty-four (56%) of participants had a history of one or more suicide attempts, and all participants reported suicide ideation within the preceding week. Inclusion criteria included active duty status in the U.S. Army, age 18 years or above, and a lifetime history of suicide attempt and/or suicide ideation within the past week. The only exclusion criterion was an inability to provide informed consent due to a medical or psychiatric condition that impaired mental status.

Sample 2

Participants included 193 U.S. military personnel and veterans recruited across the United States through online advertisements. Participants were 77% male with a mean age of 41.6 (SD = 10.3) years. Self-identified racial background was 78% white, 12% black, 3% Hispanic or Latino, 1% Asian, 1% Native American, and 5% other. Participants reflected all branches of service: 68% Army, 13% Air Force, 7% Navy, and 11% Marines. Eighty percent of participants reported a lifetime history of suicide ideation, 33% reported suicide ideation within the previous week, and 20% reported a lifetime history of one or more suicide attempts. Inclusion criteria included current or past service in the U.S. military, English-speaking, age 18 years or above, and a lifetime history of suicide ideation, suicide attempts, or nonsuicidal self-injury. Respondents were excluded if they were unable to correctly answer a screening question regarding military job codes and were unwilling to provide contact information for the purposes of a follow-up assessment. No respondent was excluded for these reasons.

Procedures

Sample 1

Soldiers presenting to a military emergency department or behavioral health clinic for an unscheduled emergency behavioral health appointment who reported active suicide ideation or a history of suicide attempts on routine screening forms were referred to a research staff member for eligibility determination. Referred Soldiers were first interviewed using the Scale for Suicide Ideation (Beck and Steer 1991). Soldiers endorsing a history of suicide attempts and/or receiving a total score greater than 5 on this scale were invited to enroll in the study. After providing informed consent, participants completed an assessment battery including a combination of self-report measures and clinician-administered interviews. Participants were then randomized to receive one of three crisis interventions and completed follow-up assessments at one, three, and six months postbaseline. Additional details about the parent trial are reported in Bryan et al. (2017). For the present study, data from the baseline assessment were used.

Sample 2

An online survey was advertised in various internet communities, social media websites (e.g., Facebook, Twitter, Reddit), and Craigslist. Participants initially completed a 26-item study screener regarding lifetime history of suicidal thoughts and behaviors to assess eligibility using items from the Self-Injurious Thoughts and Behaviors Interview (Nock et al. 2007). Once qualified, participants received an email from a trained researcher at the University of Utah with a link to complete an online survey via Qualtrics. The survey was completed at two time points; data from the current design includes data from the first assessment only because

the SCS was not administered at follow-up. Participants were compensated $15 in Amazon.com gift cards for their participation ($5 for completion of the time 1 survey, $10 for completion of the time 2 survey).

Instrument

The Suicide Cognitions Scale (SCS) is an 18-item self-report measure containing a series of statements that reflect common perspectives and beliefs expressed by suicidal patients, consistent with the notion of the suicidal belief system (see Table 1). Participants rate the extent to which they agree or disagree with each item on a five-point scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Items are summed to provide an overall metric of the intensity of the suicidal belief system, with higher scores reflecting more severe suicidal beliefs. As noted above, previous research suggests the SCS can be used as a unidimensional scale, although evidence has also supported a two-dimensional and three-dimensional model (Bryan et al. 2014, 2017; Ellis and Rufino 2015; Gupta and Pandy 2015). SCS total scale scores and subscores have been shown to possess good internal consistency (> 0.85), correlate strongly with measures of suicide ideation, differentiate patients with and without a history of suicide attempts, and prospective predict suicide attempts (Bryan et al. 2014, 2017; Ellis and Rufino 2015; Gupta and Pandy 2015).

Data Analytic Approach

The internal structure of the SCS was tested via a series of measurement models using Mplus version 7.4 (Muthen and Muthen 1998–2015). A total of eight models were examined: unidimensional, two-dimensional, three-dimensional oblique, and five bifactor models. For the two oblique models, exploratory structural equation modeling (ESEM) was used instead of confirmatory factor analysis (CFA) because ESEM is less restrictive with respect to cross-loading items (Asparouhov and Muthen 2009), an expected feature of the suicidal belief system (e.g., an item loading onto a hopelessness factor might also load on an entrapment factor). For similar reasons, the exploratory bifactor analysis described by Jennrich and Bentler (2011) was used instead of a confirmatory bifactor analysis. Exploratory bifactor models with one to five specific factors were examined. All models used a robust weighted least squares estimator to account for potential skew in item distributions. Model fit was evaluated using the robust χ^2 statistic, root mean square error of approximation (RMSEA), comparative fit index (CFI), and standard root mean square residual (SRMR). The following fit criteria were used: RMSEA < 0.05, CFI > 0.95, and SRMR < 0.08 for good fit and RMSEA < 0.10, CFI > 0.90, and SRMR < 0.10 for acceptable fit (Weston and Gore 2006). Corrected/scaled Chi square difference tests were used to compare models.

To determine if the SCS represents a unidimensional versus multidimensional measure, item explained common variance (IECV), percent of explained common variance (ECV), percent of uncontaminated correlations (PUC), and coefficient omega hierarchical (ωH) values were calculated (Reise et al. 2010). IECV values provide the extent to which an item's response are accounted for by variation on the general dimension alone, with higher IECV values (i.e., greater than 0.80) suggesting a unidimensional item reflecting the content of the general dimension. The PUC represents the overall percentage of covariance that reflects variance from the general dimension, the ECV is the proportion of all common variance explained by a factor, and the ωH reflects the percentage of systematic variance attributable to individual differences on the general factor or, for the specific factor, the proportion of reliable systematic variance of a subscale score after partitioning out variability attributed to the general factor. When ECV is greater than 0.70 and PUC is less than 0.70, the common variance can be regarded as unidimensional (Rodriguez et al. 2016). When PUC values are lower than 0.80, general ECV values greater than 0.60, and ωH values are greater than 0.70, there is evidence of some multidimensionality, although not to a sufficient degree to rule out unidimensionality (Reise et al. 2013).

Construct replicability and factor determinacy were also calculated. High construct replicability values (i.e., greater than 0.80) suggest a well-defined latent construct (Reise et al. 2013) whereas high factor determinacy values (i.e., greater than 0.90) suggest that factor score estimates could be used as subscales (Gorsuch 1983). Finally, relative parameter bias was calculated using the methods described by Rodriguez et al. (2016) to determine the degree of difference between item loadings on the general factor in a bifactor model and item loadings on the single, unidimensional factor. Smaller bias values, especially values below 0.10, provide greater support for a unidimensional interpretation.

Regarding statistical power, simulation studies have shown that power for factor analysis increases as the item-to-factor ratio, communality level, and magnitude of factor loadings increase (de Winter et al. 2009; MacCallum et al. 2001, 1999), such that 80% power can be achieved even with relatively small sample sizes. The SCS is characterized by high communality and factor loading values, and item-to-factor ratios tested in the present study ranged from 18:1 to 3:1. Such conditions yield 100% admissible solutions with a sample size of N = 100 (MacCallum et al. 1999) and can provide satisfactory factor recovery even in samples as small as N = 24 (de Winter et al. 2009).

Table 1 Item-factor loadings resulting from previous factor analyses of the Suicide Cognitions Scale (SCS), the exploratory bifactor analysis of the SCS, and item explained common variance (IECV) values in a treatment-seeking sample of active duty Soldiers with recent suicidal ideation (N = 97) and a sample of military personnel and veterans with lifetime suicidal ideation and/or behaviors (N = 193)

Item	Factor						IECV
	Gen	1	2	3	4	5	
Sample 1							
The world would be better off without me	**0.682**	− 0.024	**0.359**	− 0.026	0.287	0.004	0.686
Suicide is the only way to solve my problems	**0.712**	− 0.048	0.001	− 0.059	**0.593**	0.050	0.585
I can't stand this pain anymore	**0.626**	**0.588**	**0.321**	− 0.021	− 0.002	0.019	0.466
I've never been successful at anything	**0.679**	0.198	0.013	0.091	0.107	**− 0.379**	0.695
I can't tolerate being this upset any longer	**0.486**	**0.746**	0.007	0.006	− 0.290	− 0.036	0.269
I can never be forgiven for the mistakes I have made	**0.686**	− 0.112	**0.311**	0.158	− 0.026	− 0.042	0.775
No one can help solve my problems	**0.527**	0.019	0.019	**0.701**	− 0.030	0.061	0.359
It is unbearable when I get this upset	**0.539**	**0.421**	− 0.032	0.043	0.088	0.208	0.557
I am completely unworthy of love	**0.813**	− 0.210	0.189	− 0.062	− 0.081	− 0.118	0.864
Nothing can help solve my problems	**0.769**	− 0.055	− 0.179	**0.450**	− 0.005	− 0.034	0.712
It is impossible to describe how badly I feel	**0.566**	0.095	− 0.041	0.098	0.004	**0.354**	0.687
I can't cope with my problems any longer	**0.729**	**0.488**	− 0.070	− 0.089	− 0.082	0.068	0.670
I can't imagine anyone being able to withstand this kind of pain	**0.651**	0.041	0.152	0.034	0.014	**0.669**	0.472
There is nothing redeeming about me	**0.879**	− 0.011	0.016	− 0.031	− 0.052	− 0.025	0.994
Suicide is the only way to end this pain	**0.765**	− 0.017	− 0.187	− 0.109	**0.544**	− 0.025	0.630
I don't deserve to live another moment	**0.785**	− 0.003	0.014	0.038	0.255	− 0.252	0.826
I would rather die now than feel this unbearable pain	**0.688**	0.096	0.024	0.084	**0.586**	− 0.021	0.568
No one is as loathsome as me	**0.804**	− 0.178	− 0.042	− 0.096	− 0.113	0.202	0.870
Sample 2							
The world would be better off without me	**0.824**	0.078	0.096	− 0.035	0.090	–	0.965
Suicide is the only way to solve my problems	**0.861**	− 0.045	− 0.009	**− 0.169**	**0.160**	–	0.929
I can't stand this pain anymore	**0.804**	**0.436**	− 0.014	− 0.068	− 0.009	–	0.768
I've never been successful at anything	**0.793**	0.013	− 0.079	**0.273**	0.117	–	0.869
I can't tolerate being this upset any longer	**0.855**	**0.328**	**− 0.123**	0.036	0.027	–	0.854
I can never be forgiven for the mistakes I have made	**0.783**	0.149	0.031	− 0.018	− 0.067	–	0.956
No one can help solve my problems	**0.737**	0.010	**0.587**	− 0.010	− 0.009	–	0.612
It is unbearable when I get this upset	**0.799**	**0.287**	0.104	− 0.027	− 0.091	–	0.862
I am completely unworthy of love	**0.837**	− 0.005	0.042	**0.184**	− 0.009	–	0.951
Nothing can help solve my problems	**0.857**	− 0.002	**0.240**	0.100	0.093	–	0.906
It is impossible to describe how badly I feel	**0.779**	**0.359**	0.068	0.080	0.012	–	0.812
I can't cope with my problems any longer	**0.906**	0.127	− 0.031	− 0.141	− 0.043	–	0.955
I can't imagine anyone being able to withstand this kind of pain	**0.864**	− 0.002	0.009	− 0.137	**− 0.143**	–	0.950
There is nothing redeeming about me	**0.885**	− 0.074	0.016	0.274	− 0.147	–	0.884
Suicide is the only way to end this pain	**0.869**	− 0.034	− 0.004	0.029	**0.393**	–	0.828
I don't deserve to live another moment	**0.897**	− 0.095	**− 0.133**	− 0.074	0.092	–	0.952
I would rather die now than feel this unbearable pain	**0.928**	− 0.014	0.009	**− 0.165**	− 0.008	–	0.969
No one is as loathsome as me	**0.905**	− 0.171	**− 0.099**	0.050	− 0.179	–	0.918

Values in bold are statistically significant at $p < .05$

IECV item explained common variance

Results

Fit statistics for each of the models are displayed in Table 2. Results indicated the two- and three-factor CFAs demonstrated marginal to acceptable fit, but the exploratory bifactor models demonstrated better fit. The bifactor models with four and five specific factors showed the overall best fit. Results of the corrected Chi square difference test indicated that, in Sample 1, the bifactor model with five specific factors yielded significantly better fit than the bifactor

Table 2 Fit statistics for measurement models of the Suicide Cognitions Scale among suicidal active duty military personnel (Sample 1) and military personnel and veterans with a lifetime history of suicidal thoughts and/or behaviors (Sample 2)

Model	*df*	Sample 1				Sample 2			
		χ^2	RMSEA	CFI	SRMR	χ^2	RMSEA	CFI	SRMR
Unidimensional	135	360.23	0.13	0.75	0.09	302.75	0.08	0.92	0.04
CFA 2 factor	134	258.64	0.10	0.86	0.07	260.49	0.07	0.94	0.04
CFA 3 factor	132	231.47	0.09	0.89	0.08	255.33	0.07	0.94	0.04
Bifactor with 1 specific factor	118	251.42	0.11	0.96	0.07	232.66	0.07	0.99	0.03
Bifactor with 2 specific factors	102	162.68	0.08	0.98	0.05	171.60	0.06	1.00	0.02
Bifactor with 3 specific factors	87	123.58	0.07	0.99	0.04	117.65	0.04	1.00	0.02
Bifactor with 4 specific factors	73	91.68	0.05	0.99	0.03	88.31	0.03	1.00	0.01
Bifactor with 5 specific factors	60	68.47	0.04	1.00	0.02	67.23	0.03	1.00	0.01

df degrees of freedom, *RMSEA* root mean square error approximation, *CFI* comparative fit index, *SRMR* standardized root mean residual

model with four specific factors ($\Delta\chi^2(13) = 32.0$, $p = .031$), but the bifactor model with six specific factors was not significantly better than the bifactor model with five specific factors ($\Delta\chi^2(12) = 16.7$, $p = .162$). In sample 2, the bifactor model with four specific factors yielded significantly better fit than the bifactor model with three specific factors ($\Delta\chi^2(14) = 30.4$, $p = .007$), but the bifactor model with five specific factors was not significantly better than the bifactor model with four specific factors ($\Delta\chi^2(13) = 20.7$, $p = .078$). Item-factor loadings for the bifactor models are displayed in Table 1. In both samples, all 18 items significantly loaded onto the general factor with values greater than 0.48. In Sample 1, 14 of the 18 items also significantly loaded onto a specific factor above 0.30. In Sample 2, only four of the 18 items also significantly loaded onto a specific factor above 0.30. Based on item content, the five specific factors identified in Sample 1 most closely aligned with the following constructs: unbearability (four items), perceived burdensomeness (three items), hopelessness (two items), entrapment (three items), and alexithymia (two items). In Sample 2, the three of the four specific factors most closely aligned with the following constructs: unbearability (three items), hopelessness (two items), and entrapment (one item). The fourth specific factor did not have any items with loadings above 0.30. The internal consistency estimates for the general factor and each specific factor were very high (see Table 3).

IECV values are reported in Table 1. In Sample 1, items 9, 14, 16, and 18 had values greater than 0.80, whereas in Sample 2, all but two items (items 3 and 7) had values greater than 0.80, suggesting they were influenced predominantly by the general factor. The remaining items had lower IECV values, suggesting they were influenced by both the general factor and a specific factor. ECV values indicated the majority of the variance (64% in Sample 1, 88% in Sample 2) in SCS items was explained by the general factor whereas each of the specific factors accounted for only 2–11% of the common variance (see Table 3). In Sample 1, the PUC coefficient was 0.85 and the omega hierarchical value was 0.92, whereas in Sample 2, the PUC coefficient was 0.82 and the omega hierarchical value was 0.98, which suggests the SCS was primarily unidimensional (Reise et al. 2013), although some multidimensionality was also present. Construct replicability estimates indicated that only the general factor was especially well-defined in both samples. Factor determinacy estimates indicated that, in Sample 1, the general factor and three specific factors (i.e., unbearability, entrapment, and alexithymia) could be used meaningfully as scales or subscales, but in Sample 2, only the general factor could be used meaningfully as a scale (see Table 3). Finally, the overall relative parameter bias value was 0.07 in Sample 1 and 0.05 in Sample 2, which suggests item loadings on the general factor using the bifactor model were similar to item loadings using a unidimensional factor structure.

Table 3 Explained common variance (ECV), internal consistency (ω), construct replicability (H), and factor determinacy (FD) estimates for the Suicide Cognitions Scale

Suicide cognitions scale factor	Sample 1				Sample 2			
	ECV	ω	H	FD	ECV	ω	H	FD
General	0.64	0.97	0.95	0.98	0.88	0.99	0.98	0.99
Specific factor 1	0.11	0.97	0.71	0.93	0.04	0.99	0.41	0.87
Specific factor 2	0.03	0.97	0.34	0.82	0.03	0.99	0.40	0.89
Specific factor 3	0.06	0.97	0.57	0.88	0.02	0.99	0.25	0.80
Specific factor 4	0.09	0.97	0.64	0.92	0.02	0.99	0.25	0.86
Specific factor 5	0.07	0.97	0.57	0.92	–	–	–	–

Discussion

Results of the present study supported both hypotheses. First, a bifactor structure provided the best model fit for SCS items. Second, ECV estimates and other statistics suggested that although the SCS possesses some multidimensionality, the SCS should primarily be viewed as a unidimensional scale. All 18 SCS items showed statistically significant and large loadings onto the general factor, which accounted for 64–88% of explained common variance. The general factor also yielded very high construct replicability and factor determinacy estimates, which suggests the general factor was very well-defined (Mueller and Hancock 2001) and that computing an overall SCS total score is meaningful (Gorsuch 1990). The omega hierarchical value was also very high in both samples ($\omega H = 0.92$ in Sample 1, $\omega H = 0.98$ in Sample 2), which suggests that SCS items were primarily influenced by the general factor and could therefore be considered unidimensional (Reise et al. 2013). Finally, the low relative parameter bias values (0.05–0.07) indicated that SCS item loadings on the bifactor model's general factor were similar to the item loadings on a unidimensional factor structure. Taken together, these patterns suggest that although some SCS items are influenced by narrower constructs, they are predominantly influenced by a general latent construct.

These results provide a possible explanation for seemingly mixed findings from earlier factor analyses of the SCS, which supported a multidimensional interpretation of the SCS but also suggested a unidimensional interpretation was acceptable (Bryan et al. 2014, 2017; Ellis and Rufino 2015; Gupta and Pandy 2015). In contrast to those earlier analyses that used a correlated factors approach that did not take into account the possible influence of a general factor (i.e., CFA), the bifactor modeling approach employed here examined such a possibility. Similar to previous research, results of both multidimensional CFA models tested in the present study were better than the unidimensional model in Sample 1, which included acutely suicidal psychiatric outpatients, with the relative best fit for the three-factor model. In contrast, the unidimensional and multidimensional models yielded comparable fit in Sample 2, which included a nonclinical sample with previous (though not necessarily recent) suicidal thoughts and behaviors. Across both samples, significant improvement in model fit was achieved, however, by taking into account the possible influence of an underlying general factor via bifactor modeling. Ultimately, the best-fitting model implicated the existence of a general factor as well as multiple specific factors. This general factor was more prominent in Sample 2 than Sample 1, which suggests the possibility that specific suicidogenic cognitions like perceived burdensomeness, entrapment, hopelessness, and alexithymia become more distinguishable as suicide risk intensifies. Nonetheless, these specific thought processes continue to be largely influenced by the underlying general factor of suicidal beliefs.

Of the various specific factors identified in each sample, the unbearability and hopelessness specific factors showed the greatest degree of similarity across both samples. In both samples, the unbearability factor included three common items (items 3, 5, and 8) and the hopelessness factor included two common items (items 7 and 10). The other specific factors identified in each sample had much less in common. One possible explanation for this finding is that unbearability and hopelessness are somewhat more differentiable as suicidogenic cognitions than other constructs. Given the relative difference in risk levels across samples, an alternative possibility is that constructs like perceived burdensomeness and entrapment emerge as discrete thought processes among individuals with acutely elevated suicide risk. This latter perspective would seem to converge with the core assumptions of the interpersonal-psychological and the integrated motivational-volitional theories of suicide, which hypothesize perceived burdensomeness and entrapment, respectively, as mechanisms underlying the emergence of elevated suicide risk states (Joiner 2007; O'Connor 2011).

Overall, the common variance explained by each specific factor was relatively small, which suggests the specific factors influenced items to a much smaller degree than the influence of the general factor. Factor determinacy values were good for the unbearability, entrapment, and alexithymia specific factors in Sample 1 but not Sample 2, indicating that the items comprising these specific factors may be meaningfully calculated and used as subscale scores with acutely suicidal individuals, but these subscales may not be as meaningful in lower risk groups. Despite the acceptable factor determinacy scores for several specific factors, construct replicability estimates were low for all specific factors, which suggests the underlying latent constructs were not well-defined independent of the general factor (Mueller and Hancock 2001). Taken together, these patterns indicate that although several specific factors are detectable, SCS items are influenced to a much larger degree by the general factor than each specific factor, and should therefore be interpreted as a unidimensional construct.

The bifactor analysis also resulted in four SCS items in Sample 1 that were influenced almost exclusively by the general factor, meaning they did not significantly load on any specific factor. All four of these items described perceptions that one is loathsome and unworthy of love, possesses no redeeming qualities, and deserves to die. This finding may suggest that perceived unworthiness and self-deprecation reflect suicidogenic cognitions that are more central to the mindset of suicidal individuals. This possibility may explain

previous research findings suggesting a stronger correlation of the unlovability factor with suicide ideation as compared to other SCS factors (Bryan et al. 2014, 2017).

Conceptually, this study lends some support to the notion of a suicidal belief system comprised of a network of interrelated maladaptive cognitions and beliefs (e.g., hopelessness, entrapment, perceived burdensomeness, unbearability, alexithymia). This network is influenced by an underlying belief system that is characterized in part by each of these constructs as well as perceptions of defectiveness, unworthiness, and self-deprecation. Although specific subdomains of suicidogenic cognitions can be distinguished from this general belief system, these more specific suicidogenic constructs are not fully independent of the general belief system. In other words, specific suicidogenic cognitions like hopelessness, entrapment, perceived burdensomeness, unbearability, alexithymia, and others may have more in common and be less distinct from each other than is often assumed. Clinically, the present results suggest that assessing the suicidal belief system in general may be just as meaningful and useful as assessing specific suicidogenic constructs. Likewise, suicide-focused treatments that target the suicidal belief system more broadly may yield better outcomes than treatments focusing on only one or a handful of specific constructs. Additional research is needed to test this assumption and to further investigate the structure of the suicidal belief system.

Conclusions based on the present findings should be made cautiously in light of several limitations. First, the present study enrolled only military personnel and veterans. Results therefore may not generalize to non-veteran samples or populations. Second, as would be expected in military and veteran populations, both samples were predominantly male, which precluded the examination of potential gender differences. Future studies with larger female samples are needed to determine if men and women endorse SCS items in similar (or different) ways. Third, although the SCS includes items that are consistent with items used in other measures of suicidogenic cognitions, item content nonetheless differs across various measures. It is possible that the items used on other measures of suicidogenic cognitions could be differentially influenced by a general latent variable relative to a construct-specific latent variable. Similar analyses should therefore be performed with other measures of suicidogenic cognitions to more clearly understand how alternative methods for assessing related constructs operate. Despite these limitations, the present study provides novel and practical information regarding the structure and optimal use of the SCS, and also provides new insight regarding the associations among multiple thought processes associated with high risk suicidal states.

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Compliance with Ethical Standards

Conflict of Interest Dr. Bryan reports grant funding from the Department of Defense and Bob Woodruff Foundation, and consultation salary from Neurostat Analytical Solutions. Ms. Harris reports no financial conflicts of interest.

Informed Consent Informed consent was obtained from all individual participants included in the study.

Animal Rights No animal studies were carried out by the authors for this article.

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