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Psychometric properties of the German version of the suicide cognitions scale in two clinical samples

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ABSTRACT

The present study aimed at evaluating the psychometric properties of German Suicide Cognitions Scale (SCS-18/SCS-9) in two clinical samples. Validity and reliability were established in an outpatient- (n = 277) and in an inpatient sample (n = 75). Statistical analyses included confirmatory factor analyses, correlation analyses, between-group comparison by history of lifetime suicide attempts, and regression analyses. The three-factor model showed good model fit for the long version of the SCS (SCS-18). For the short version of the SCS (SCS-9), a bifactor model yielded the best fit. Overall, the total scale of the SCS-18 and the SCS-9 and the subscales of the SCS-18 showed satisfactory internal consistency, as well as good convergent validity. The SCS-18 subscales and the SCS-9 demonstrated clinical utility by differentiating between participants with prior and without prior suicide attempts. The SCS (subscale unsolvability and SCS-9 score) predicted current suicide ideation as well as suicide ideation 7–10 days later – even after controlling for established risk-factors (e.g., depression, hopelessness, interpersonal variables). Results suggest that the SCS-18 and the SCS-9 are reliable and valid measures to assess suicidal cognitions that can be used in clinical as well as in research settings.

1. Introduction

Various theoretical accounts on the development of suicide ideation stress the importance of dysfunctional and/or distorted beliefs: The perception that one is a burden to others as well as the need to belong is not met is central to the Interpersonal Psychological Theory of Suicide (IPTS; Joiner, 2005), whereas perceptions of defeat and entrapment are essential components of the Integrated Motivational-Volitional Model of Suicide (IMV; O`Connor, 2011). In their Cognitive Model of Suicidal Behavior (CMSB) Wenzel and Beck (2008) emphasize the importance of hopelessness and perceptions of unbearability, i.e., the appraisal that stressors are no longer tolerable. The Fluid Vulnerability Theory (FVT; Rudd, 2006) is also specific to suicide and overlaps considerably with the IPTS, IMV, and CMSB, especially with respect to the hypothesized role of suicidogenic thoughts and beliefs. Yet, the FVT "considers a broader spectrum of suicidogenic beliefs referred to as the *suicidal belief system,* and does not designate any particular thoughts and beliefs as being more or less important than any others" (Klonsky et al., 2017, p. 10). Nonetheless, the FVT specifies unlovability, helplessness and poor distress tolerance as core belief categories, within the suicidal belief system (Rudd, 2006). These belief categories are thought to be more persistent and enduring than cognitive-affective states such as hopelessness or burdensomeness and to contribute to a fluid vulnerability, which fluctuates over time and is essential to the ebb and flow of suicidal ideation. The Suicide Cognitions Scale (SCS)[1] was developed to measure the suicidal belief system (Gibbs, 2010; Bryan et al., 2014).

The SCS is an 18-item self-report instrument, designed to assess central aspects of the suicidal belief system. Regarding its dimensionality, previous studies have yielded different results: The two original proposed subscales *unlovability* (i.e., perceptions that one is a burden to others, is unworthy of love and respect, and deserves to be punished) and *unbearability* (i.e., perceptions that one is incapable of tolerating one`s emotional pain) have been identified in a validation study in two military samples (Bryan et al., 2014). Other studies suggested that the

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[1] The Suicide Cognitions Scale was initially developed by Rudd and colleagues (The Suicide Cognitions Scale: a suicide-specific measure of hopelessness; unpublished manuscript).

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SCS may actually have three latent factors as opposed to two using an exploratory approach in adolescent inpatients (Gibbs, 2010) and a confirmatory approach in psychiatric inpatients (Ellis and Rufino, 2015): unlovability, unbearability and *unsolvability* (i.e., perceptions that one is hopelessly incapable of solving one`s problems and that suicide is the only solution). Most recently, Bryan and Harris (2018) have provided support for a bifactor model (including one general factor and four to five specific factors) in two military samples. In bifactor models, multidimensionality is modeled differently: All items load to a differing degree onto the general factor reflecting the broad construct (such as the suicidal belief system) and onto one specific factors representing subdomains that are conceptually relevant (Reise, 2012). Yet, a 3-factor structure also yielded good model fit in one of their examined samples (outpatients with active suicidal ideation). Moreover, a 9-item short form (SCS-9) – assessing unbearability, unlovability and unsolvability with three items each – has been developed using a sample of military outpatients with chronic pain (Bryan et al., 2017). Again, a 3-factor structure exhibited the best model fit in a series of confirmatory factor analysis. However, a solution with 1 or 2 latent factors also yielded an adequate fit.

The SCS-18 and the SCS-9 as well as their subscales showed very good internal consistencies throughout psychometric studies in different clinical samples (all $\alpha \geq 0.88$; Bryan et al., 2014; Ellis and Rufino, 2015, 2017 and medium test-retest reliability ($r_{tt} = 0.46$) that reflects the fluctuating nature of suicidal cognitions (Ellis and Rufino, 2015). In clinical and military samples, the SCS-18 have demonstrated convergent validity, correlating positively with self-report measures of suicide ideation, depression, perceived burdensomeness and hopelessness demonstrating moderate to large effects (Bryan et al., 2014; Ellis and Rufino, 2015). The SCS-9 has exhibited a similar correlational pattern supporting its convergence with the SCS-18 (Bryan et al., 2017). The SCS-18 and its subscales have been shown to distinguish between (multiple) suicide attempters and suicide ideators (Bryan et al., 2014; Ellis and Rufino, 2015). Furthermore, SCS total and subscale scores (i.e., unlovability and especially unsolvability) have been shown to predict concurrent suicide ideation – controlling for hopelessness and depression (Ellis and Rufino, 2015). Finally, a high score on the SCS unlovability as well as SCS unbearability-subscale predicted suicide attempts within a 2-year period in military personnel – over and above lifetime suicide attempts and current suicide ideation (Bryan et al., 2014).

Taken together, the SCS has demonstrated sound psychometric properties as well as clinical utility beyond other constructs considered to be risk factors for suicidal behavior. Against this background the aim of the current study was to introduce two German versions of the SCS (SCS-18 and SCS-9) and to examine their factor structure, reliability and construct validity within two independent clinical samples. Besides, further investigating the dimensionality of the SCS, we specifically focused on extending and replicating evidence on the construct validity of the instrument. To this end we investigated a mixed adult sample receiving outpatient psychotherapeutic care and a sample of psychiatric inpatients experiencing suicidal ideation in two separate studies.

2. Study 1

2.1. Methods

2.1.1. Procedures and participants

Outpatient sample: Between April 2017 and October 2017 a sample of $N = 277$ patients being treated at an outpatient psychotherapeutic clinic in Bochum/Germany were included in the study. If patients had agreed to participate, they were asked to fill out various questionnaires on a computer. The questionnaires were part of the initial assessment before treatment. One hundred seventy-six participants (62.8%) were female. The mean age was 37.2 years ($SD = 12.7$, range = 19–78 years). The most common diagnoses according to the International Classification of Diseases (ICD-10; WHO, 1992) were affective disorders (45.7%), as well as neurotic, stress-related, and somatoform disorders (39.1%), followed by personality disorders (5.4%), behavioral syndromes associated with physiological disturbances and physical factors (5.1%), psychotic disorders (2.5%) and other mental disorders (2.2%). Thirty-one patients (11.2%) had attempted suicide in their lifetime.

2.1.2. Measures

Suicide cognitions scale (SCS; Bryan et al., 2014)**.** The SCS consists of 18 items (SCS-18) or 9 items (SCS-9), that are rated on a 5-point Likert-scale ranging from 1 (strongly disagree) to 5 (strongly agree). Besides a total score subscale scores are computed by summing up responses. In the 3-factor model, each subscale of the SCS-18 contains 6 items, whereas each subscale of the SCS-9 contains 3 items. In this study, the SCS-9 was extracted out the SCS-18.

The translation procedure followed common guidelines regarding the cross-cultural validation of questionnaires (Wild et al., 2005; Hambleton et al., 2001). First, the SCS was translated independently from English to German by four different researchers. All of them are psychologists (experienced researchers with clinical experience). After comparing the different translations, the next step was to consent to a final German version. This German version was then translated back by a native speaker (who is familiar with mental health terms and self-report questionnaires). Finally, the back-translated scale was compared to the original scale and divergence was resolved using a consensus procedure. The final German SCS can be found in the appendix.

Suicide ideation and behavior scale – suicide ideation subscale (Skala Suizidales Erleben und Verhalten, SSEV-SI; Teismann et al., 2017). The SSEV-SI assesses the frequency of suicide ideation in the past four weeks (e.g., “During the past four weeks, I seriously considered killing myself”) with four items. All items are to be answered on a six-point Likert scale ranging from 0 (*never)* to 6 (*many times every day)*, with higher scores indicating greater severity of suicide ideation. Internal consistency was good in the current sample ($\alpha = 0.88$).

Interpersonal needs questionnaire (INQ, Van Orden et al., 2012; Hallensleben et al., 2016). The INQ assesses the amount of perceived burdensomeness with six items (e.g., “These days I feel like a burden on the people in my life”) and with nine items the amount of thwarted belongingness (e.g., “These days other people care about me”). All items are to be answered on a seven-point Likert scale ranging from 1 (*not at all true for me)* to 7 (*very true for me)*. The 15-item-version of the INQ showed excellent internal consistencies in the present sample (perceived burdensomeness: $\alpha = 0.92$; thwarted belongingness: $\alpha = 0.89$).

Short defeat and entrapment scale (SDES; Griffiths et al., 2015). The SDES comprises four items to assess perceptions of defeat (e.g., “I feel defeated by life”) and four items to assess perceptions of entrapment (e.g., “I would like to get away from who I am and start again”). All items are to be answered on a 5-point-Likert scale ranging from 0 (*not at all like me)* to 4 (*extremely like me*). Internal consistency was very good in the present sample $\alpha = 0.89$.

Depression-Anxiety-Stress scales 42 – depression subscale (DASS-D; Lovibond and Lovibond, 1995). Participants are asked to indicate to what extent fourteen statements on depressive symptoms applied to them over the past week from 0 (*did not apply to me at all*) to 3 (*applied to me very much or most of the time*). Internal consistency was excellent ($\alpha = 0.96$).

2.1.3. Statistical analyses

Dimensionality: With a series of confirmatory factor analyses it was tested, if the previously reported two- or three factor structures of the SCS-18 and SCS-9 could be replicated in this outpatient sample. Because the SCS scales are highly correlated and a 1-factor model also yielded adequate fit in some studies (Bryan et al., 2017, 2014), we additionally evaluated the fit of a unidimensional model. Since the SCS items are heavily skewed (see Table 1), all models were estimated using robust

Table 1
Item statistics and factor loadings of the 3-factor model (modified) in study 1 (N = 277) and in study 2 (N = 75).

	Study 1: outpatient sample						Study 2: inpatient sample				
Item	Mean	Sd	Skew	Kurtosis	Factor loading	Factor loading*	Mean	Sd	Skew	Kurtosis	Factor loading
1	2.11	1.13	0.63	−0.54	0.88		2.69	1.00	0.07	0.17	0.50
2	1.54	0.85	1.39	0.86	0.85		2.20	0.99	0.7	−0.06	0.66
3	2.40	1.19	0.28	−1.14	0.85		3.19	1.05	−0.03	−0.41	0.82
4	1.95	1.07	0.98	0.12	0.66		2.36	1.06	0.7	−0.97	0.53
5	3.07	1.18	−0.34	−0.91	0.74		3.59	0.79	−0.46	0.72	0.58
6	2.10	1.15	0.83	−0.19	0.70		2.63	1.01	0.09	−0.83	0.51
7	2.26	1.01	0.45	−0.43	0.71		3.16	1.04	0.19	−0.72	0.48
8	3.08	1.24	−0.39	−0.95	0.72		3.71	0.87	−0.41	−−0.36	0.55
9*	2.32	1.25	0.55	−0.84	0.86	0.87*	2.88	0.10	−0.01	−0.53	0.78
10*	2.18	0.96	0.49	−0.22	0.71	0.72*	2.91	0.92	0.19	−0.33	0.57
11*	2.63	1.23	0.29	−0.98	0.84	0.87*	3.33	1.20	−0.10	−1.01	0.83
12*	2.68	1.15	0.04	−0.97	0.83	0.79*	3.37	0.91	−0.38	0.48	0.70
13*	2.13	1.10	0.71	−0.35	0.72	0.70*	2.75	1.04	0.38	−0.26	0.65
14*	2.38	1.25	0.56	−0.75	0.90	0.93*	2.84	1.03	−0.21	−0.63	0.77
15*	1.50	0.83	1.81	3.17	0.88	0.87*	2.15	1.07	0.91	0.36	0.70
16*	1.35	0.69	2.15	4.67	0.95	0.97*	1.84	0.97	0.96	0.31	0.85
17	1.52	0.87	1.71	2.34	0.90		2.53	1.27	0.37	−0.90	0.88
18*	1.56	0.93	1.75	2.45	0.89	0.90*	1.77	.97	1.12	0.66	0.87

Note: 3-factor model (modified): unlovability: item 1, 4, 6, 9, 14, 18; unsolvability: item 2, 7, 10, 15–17; unbearability: item 3, 5, 8, 11–13; residual correlation between item 2 and 15, 7 and 10, 5 and 8; items with asterisk (*) are included in the short version of the SCS (study 1).

Table 2
Study 1: Results of confirmatory factor analysis.

Model	Chi²	Df	RMSEA	SRMR	CFI	TLI	ECV	ωH
Outpatient sample (N = 277)								
1 factor	954.9	119	0.160	0.109	0.91	0.90		
1 factor (mod.)	*525.6*	*116*	*0.113*	*0.077*	*0.95*	*0.95*		
2 factor	710.7	118	0.135	0.092	0.94	0.93		
2 factor (mod.)	*394.2*	*115*	*0.094*	*0.064*	*0.97*	*0.97*		
Bifactor with 2 specific factors	*1430.5*	*118*	*0.200*	*0.133*	*0.87*	*0.083*	0.62	0.52
3 factor	629.3	132	0.117	0.085	0.95	0.94		
3 factor (mod.)	*359.3*	*129*	*0.08*	*0.061*	*0.98*	*0.97*		
Bifactor with 3 specific factors	*2297.9*	*118*	*0.258*	*0.172*	*0.78*	*0.72*	0.57	0.33
3 factor SCS-9	89.9	24	0.100	0.056	0.99	0.98		
Bifactor with 3 specific factors SCS-9	47.3	18	0.076	0.039	0.99	0.98	0.76	0.76

Note: Goodness of fit indices: Comparative Fit Index [CFI], Tucker-Lewis-index [TLI] with values >0.95 indicating good and >0.90 adequate fit; Badness of fit indices: root-mean-square-error-of-approximation [RMSEA] with <0.06 good and <0.08 adequate fit and standardized root-mean-square residual [SRMR] <0.05 good and <0.10 acceptable fit; Explained common variance [ECV]; Coefficient Omega hierarchical [ωH].

weighted least squares estimation which is suited for modest violation of non-normality in ordinal data, medium to large models and small to moderate sample sizes (Flora und Curran 2004; Li 2016). We further tested the fit of two bifactor models using confirmatory factor analysis (Reise et al., 2012). Besides loading onto the general factor, all items were allowed to load on one specific factor. Bifactor models containing either two (unlovability and unbearability) or three specific factors (unlovability, unbearability and unsolvability) were tested.

Because of the increased type-1 error for the Chi-square statistics (leading to the rejection of correctly identified models), we additionally provide fit indices indicating goodness of fit (Comparative Fit Index [CFI] and Tucker-Lewis-index [TLI] with values >0.95 indicating good and >0.90 adequate fit, both less affected by violations of normality) and badness of fit (root-mean-square-error-of-approximation [RMSEA] with <0.06 indicating good and <0.08 indicating adequate fit and standardized root-mean-square residual [SRMR] with <0.05 indicating good and <0.10 indicating acceptable fit). Both RMSEA and SRMR tend to be biased with smaller sample (i.e., N < 250; Schermelleh-Engel et al., 2003; Hu and Bentler, 1999). For the bifactor models, Omega hierarchial (ωH) and explained common variance (ECV) were additionally calculated. ωH indicates the proportion of variance that is attributable to a general factor with higher values indicating unidimensionality, while ECV values indicate the strength of a general factor by giving the proportion of all common variance explained by the factor with higher values indicating unidimensionality (Reise, 2012; Rodriguez et al., 2016). Analyses were carried out in R (package "lavaan"; Rosseel, 2012; R Core Team, 2015).

Reliability: To determine the internal consistencies of the SCS-18 and the SCS-9, Cronbach`s alphas were calculated.

Validity: Convergent validity was established using correlation analyses. Group differences in SCS-18 and SCS-9 scores between participants without lifetime suicide attempts and participants with lifetime suicide attempts were tested using *t*-tests for independent groups to determine discriminant validity. Finally, a series of hierarchical regression analysis was conducted to examine whether suicidal cognitions as assessed with the SCS were predictive for concurrent suicide ideation controlling for various risk factors (i.e., depression, perceived burdensomeness, thwarted belongingness, defeat and entrapment) in order to test the incremental validity of the SCS with regards to suicidal ideation. Data analysis was conducted by using the statistic software program SPSS 24.0.

2.2. Results

2.2.1. Dimensionality of the SCS

In Table 2, results of the confirmatory factor analyses are reported. Initial model fit was unsatisfactory for all tested models. By allowing residual correlations between item 2 and 15, 7 and 10, as well as 5 and 8 (which deemed appropriate because of very similar item wordings and because modification indices suggested considerable improvement of fit), better model fit was achieved (modified models in Table 2).

The (modified) three-factor solution revealed adequate (RMSEA, SRMR) or good model fit (CFI, TLI) for the SCS-18. The same was true for the SCS-9, with the exception of an unsatisfactory RMSEA value (0.10). The two-factor solution showed good fit according to CFI and TLI. Yet, considering all fit indices, we decided to favor the modified three-factor model. Factor loadings for the modified three-factor model are reported in Table 2. All items showed excellent loadings on the respective factors.

The bifactor models with two and three specific factors showed

Table 3
Convergent validity of the SCS subscales in study 1 ($N = 277$).

	Unsolvability	*Unbearability*	*Unlovability*	*Perceived Burdensomeness (INQ)*	*Thwarted Belongingness (INQ)*	*Suicidal Ideation (SSEV-SI)*	*Depression (DASS-D)*	*Defeat and Entrapment (SDES)*
Mean (SD)	**10.3 (4.1)**	**15.9 (5.7)**	**12.4 (5.4)**	**2.2 (1.4)**	**3.5 (1.4)**	**1.9 (3.3)**	**19.4 (11.9)**	**14.0 (7.8)**
Unsolvability				0.59**	0.50**	0.73**	0.60**	0.65**
Unbearability	0.70**			0.56**	0.53**	0.49**	0.64**	0.75**
Unlovability	0.74**	0.67**		0.74**	0.56**	0.54**	0.63**	0.70**
SCS sum score (SCS-9)	0.88**	0.84**	0.87**	0.67**	0.58**	0.62**	0.68**	0.76**
SCS sum score (SCS-18)	0.89**	0.90**	0.90**	0.71**	0.60**	0.64**	0.70**	0.79**

*$p < 0.05$.
** $p < 0.01$.

worse model fit in comparison. Also ωH and ECV values did not indicate a strong general factor in the SCS-18. However, for the SCS-9 the bifactor model showed the best fit and also ωH and ECV values indicated a strong general factor (see Table 2). Consequently, only the total score of the SCS-9 was used for further analysis.

2.2.2. Reliability

Internal consistencies were excellent for the SCS-18 total score ($\alpha = 0.94$;) and all SCS-18 subscales (unsolvability $\alpha = 0.88$, unbearability $\alpha = 0.88$, unlovability $\alpha = 0.88$). For the SCS-9, only the internal consistency for the total score was calculated ($\alpha = 0.89$).

2.2.3. Construct validity

In Table 3, correlations between SCS total and subscale scores and other self-report measures are shown. The SCS total scale as well as all SCS-subscales were positively and significantly correlated with measures of depression, perceived burdensomeness, thwarted belongingness, defeat and entrapment as well as suicide ideation. The pattern of correlations with other measures for the SCS-18 and the SCS-9 was comparable.

Participants with lifetime suicide attempts reported significantly higher scores on all SCS-18 subscales than participants without lifetime suicide attempts: SCS-18 unsolvability, $t(274) = -4.486$, $p < 0.001$ (mean [sd] $_{\text{no-SA}} = 10.0$ [3.9] vs. mean [sd] $_{\text{SA}} = 13.4$ [4.4]), SCS-18 unbearability, $t(275) = -3.195$, $p < 0.001$ (mean [sd] $_{\text{no-SA}} = 15.6$ [5.6] vs. mean [sd] $_{\text{SA}} = 19.0$ [5.2]), SCS-18 unlovability, $t(275) = -4.370$, $p < 0.001$ (mean [sd] $_{\text{no-SA}} = 11.9$ [5.1] vs. mean [sd] $_{\text{SA}} = 16.3$ [6.0]). The same was true for the SCS-9 score $t(275) = -4.631$, $p < 0.001$ (mean [sd] $_{\text{no-SA}} = 18.0$ [6.7] vs. mean [sd] $_{\text{SA}} = 24.0$ [7.5]),

In hierarchical linear regression analyses concurrent suicide ideation was predicted by depression and perceived burdensomeness (see Table 4). Entering the SCS-18 subscales in the model led to a substantial improvement with respect to the variance explained (additional 21% explained). Of the subscales, unsolvability accounted for most of this effect and was the only subscale revealing a significant positive beta coefficient. Entering the SCS-9 sum score also improved the model with regards to variance explained (additional 7% explained) and significantly predicted suicidal ideation.

3. Study 2

3.1. Procedures and participants

Inpatient sample: Between September 2015 and August 2017 a sample of $N = 75$ psychiatric inpatients with a primary diagnosis of a unipolar depressive disorder (major depression, dysthymia) and current or lifetime suicide ideation as assessed with the Suicide Behaviors Questionnaire Revised (SBQ-R; Osman et al., 2001; Glaesmer et al., 2017) or the Structured Clinical Interview for DSM-IV (SCID-I; Wittchen et al., 1997) being treated in a psychiatric hospital in Leipzig/Germany were included in the study. Exclusion criteria were insufficient knowledge of German language, bipolar disorders, substance use disorders in the past year, current psychotic symptoms, primary diagnosis of personality disorder, and IQ < 85 in a language-based intelligence test (Lehrl, 2005). After an extensive baseline assessment including self-report instruments the participants underwent a 6-days ecological momentary assessment. At follow-up (7 to 10 days after baseline) participants answered several self-report questionnaires. The analyses presented here are based on the paper and pencil baseline and follow-up assessments. For more details about the study procedure see Forkmann et al., (2018). Fifty-one participants (68%) were female. The mean age was 37.9 years ($SD = 14.4$) ranging from 18 to 85. Twenty-five participants (33.3%) had attempted suicide in their lifetime.

3.2. Measures

Suicide cognitions scale (SCS, Bryan et al., 2014). The SCS is described in study 1. The German SCS was assessed at baseline and 7–10 days later at follow-up.

Beck scale for suicide ideation (BSS; Beck and Steer, 2016; Kliem and Brähler, 2016b). The BSS is a 21-item self-report measure that surveys suicidal symptoms during the past week on a 3-point severity scale and was applied at baseline and at follow-up. Internal consistency was very good (baseline: $\alpha = 0.94$).

Interpersonal needs questionnaire (INQ, Van Orden et al., 2012; Hallensleben et al., 2016).The INQ is described in study 1. It showed good internal consistencies in the present sample (perceived burdensomeness: $\alpha = 0.89$; thwarted belongingness: $\alpha = 0.82$)

Rasch-based depression screening (DESC; Forkmann et al., 2009). The DESC assesses depressive symptoms with 10 items. Items refer to the last two weeks, and participants are asked to mark how often they experienced each symptom on a 5-point Likert scale from 0 (never) to 4 (always). Total scores range from 0 to 40 with higher scores indicating greater depression. Internal consistency was good in the current study: $\alpha = 0.86$.

Beck hopelessness scale (BHS; Kliem and Brähler, 2016a). The BHS includes 20 true-false items that assess pessimistic and hopeless cognitions during the past week (e.g., "I look forward to the future with hope and enthusiasm"). Internal consistency in the current study was excellent ($\alpha = 0.94$).

3.3. Statistical analyses

Dimensionality: Similar to study 1, a series of confirmatory factor analyses using robust weighted least squares estimation was performed to examine if the two- or three factor structure of the SCS-18 and SCS-9 could be replicated or if an unidimensional model fit the data. To evaluate model fit, Chi-square statistics, CFI, TLI, RMSEA and SRMR are reported and interpreted analogously to study 1. Because of the small

Table 4
Hierarchical regression analysis predicting concurrent suicidal ideation (SSEV-SI) in study 1 (N = 277).

Model		Unstandard. β	CI		T	p	Adj. R^2
1	*Intercept*	*−0.930*	*(−1.59–*	*−0.27)*	*−2.762*	*0.006*	0.27
	Depression (DASS-D)	**0.148**	**(0.12–**	**0.18)**	**10.024**	**0.000**	
2	*Intercept*	−1.845	(−2.71 -	−0.98)	−4.219	0.000	
	Depression (DASS-D)	**0.068**	**(0.03–**	**0.11)**	**3.309**	**0.001**	0.35
	Perceived Burdensomeness (INQ)	**0.135**	**(0.07–**	**0.16)**	**5.313**	**0.000**	
	Thwarted Belongingness (INQ)	−0.005	(−0.04–	0.03)	−0.287	0.774	
	Defeat/Entrapment (SDES)	0.061	(−0.01–	0.13)	1.846	0.066	
3	*Intercept*	−3.612	(−4.54–	−2.69)	−7.667	0.000	
	Depression (DASS-D)	**0.040**	**(0.01–**	**0.07)**	**2.291**	**0.023**	0.56
	Perceived Burdensomeness (INQ)	**0.094**	**(0.05–**	**0.14)**	**3.858**	**0.000**	
	Thwarted Belongingness (INQ)	−0.012	(−0.04–	0.02)	−0.907	0.365	
	Defeat/Entrapment (SDES)	0.003	(−0.06–	0.06)	0.087	0.931	
	Unsolvability (SCS)	**0.584**	**(0.48–**	**0.69)**	**10.800**	**0.000**	
	Unbearability (SCS)	−0.063	(−0.14–	0.02)	−1.564	0.119	
	Unlovability (SCS)	−0.092	(−0.18–	0.00)	−1.957	0.051	
3s	*Intercept*	−3.257	(−4.22	-2.29)	−6.646	0.000	0.42
	Depression (DASS-D)	**0.045**	**(0.01**	**0.09)**	**2.267**	**0.024**	
	Perceived Burdensomeness (INQ)	**0.087**	**(0.04**	**0.14)**	**3.396**	**0.001**	
	Thwarted Belongingness (INQ)	−0.017	(−0.05	0.01)	−1.094	0.275	
	Defeat/Entrapment (SDES)	−0.017	(−0.09	0.05)	−0.504	0.614	
	Sum score (SCS-9)	**0.211**	**(0.13**	**0.29)**	**5.417**	**0.000**	

sample size, models with a bifactor structure could not be identified in the data and are thus not analyzed. Analyses were carried out in R (package "lavaan"; Rosseel, 2012; R Core Team, 2015).

Reliability: Besides Cronbach`s alphas, test-retest reliability (for an interval of 7–10 days) for the SCS-18 was calculated.

Validity: Convergent validity and discriminant validity were examined analogously to study 1. To evaluate incremental validity of the SCS a series of hierarchical regression analyses were conducted to examine whether suicidal cognitions as assessed with the SCS subscales were predictive for suicidal ideation at follow-up controlling for various risk factors (i.e. depression, perceived burdensomeness, thwarted belongingness, hopelessness). Data analysis was conducted by using the statistic software program SPSS 24.0.

3.4. Results

3.4.1. Dimensionality

Of all tested models (see Table 5), the (modified) three-factor solution of the SCS-18 showed the best fit according to the CFI and TLI indices while RMSEA and SRMR indicated unsatisfactory model fit. The 3-factor model of the SCS-9 indicated unsatisfactory fit according all reported indices and thus no subscale scores were calculated. Following the confirmatory approach we decided against the exploratory examination of other possible models and thus did not analyze SCS-9 scores further in study 2.

Table 5
Study 2 (N = 75): Results of confirmatory factor analysis.

Inpatient sample (N = 75) Model	Chi^2	Df	RMSEA	SRMR	CFI	TLI
1 factor	470.7	119	0.200	0.166	0.73	0.69
1 factor (mod.)	*335.2*	*116*	*0.159*	*0.144*	*0.83*	*0.80*
2 factor	385.4	118	0.175	0.148	0.79	0.76
2 factor (mod.)	*275.6*	*115*	*0.137*	*0.127*	*0.88*	*0.85*
3 factor	338.0	132	0.145	0.127	0.86	0.84
3 factor (mod.)	*235.3*	*129*	*0.106*	*0.107*	*0.93*	*0.92*
3 factor SCS-9	99.6	24	0.206	0.115	0.87	0.80

Note: Goodness of fit indices: Comparative Fit Index [CFI], Tucker–Lewis-index [TLI] with values > 0.95 indicating good and >0.90 adequate fit; Badness of fit indices: root-mean-square-error-of-approximation [RMSEA] with <0.06 good and <0.08 adequate fit and standardized root-mean-square residual [SRMR] <0.05 good and <0.10 acceptable fit.

3.4.2. Reliability

Internal consistencies were good for the SCS-18 total score (α = 0.83) and two SCS-18 subscales (unsolvability α = 0.84, unbearability α = 0.82) but unsatisfactorly for unlovability (α = 0.45). Test-retest coefficients were good for SCS-18 unsolvability (r = 0.75), SCS-18 unbearability (r = 0.70) and the SCS-18 total score (r = 0.69), but medium for SCS-18 unlovability (r = 0.50).

3.4.3. Construct validity

Correlations of the SCS-18 subscales and sum scores with measures of interpersonal variables, hopelessness, suicidal ideation and depression are shown in Table 6. All correlations were significant and positive exhibiting moderate to large effects with one exception: Thwarted belongingness was only significantly associated with unloveability and the sum score of the SCS-18. Unsolvability demonstrated the strongest relationships with the other measures under study.

Participants with and without lifetime suicide attempts did not differ regarding SCS-18 unsolvability, $t(63) = -0.582$, *n.s.* (mean [sd] $_{\text{no-SA}}$ = 14.6 [4.3] vs. mean [sd] $_{\text{SA}}$ = 15.2 [4.7]), and SCS-18 unbearability, $t(63) = 0.608$, *n.s.* (mean [sd] $_{\text{no-SA}}$ = 20.3 [4.1] vs. mean [sd] $_{\text{SA}}$ = 19.6 [4.0]). Yet, participants with lifetime suicide attempts reported significantly higher SCS-18 unlovability scores, $t(63) = -2.674$, p = 0.01 (mean [sd] $_{\text{no-SA}}$ = 14.3 [4.0] vs. mean [sd] $_{\text{SA}}$ = 18.2 [7.6]).

As shown in Table 7, unsolvability was a predictor of suicide ideation at follow-up (7 to 10 days later) after controlling for various established risk factors, (i.e.,. depression, hopelessness, perceived burdensomeness, thwarted belongingness) and accounted for an additional 11% of variance explained.

4. General discussion

In the present study, we provide a psychometric evaluation of the German SCS (SCS-18/SCS-9). In line with other psychometric studies on the original versions of the SCS-18 (Bryan et al., 2014; Rufino and Ellis, 2015) and the SCS-9 (Bryan et al., 2017), the German versions showed good internal consistency, as well as good construct validity.

Using a confirmatory approach, the 3-factor structure reported by Ellis and Rufino (2015) for the SCS-18 showed the best model fit for the German versions of SCS-18 in both studies. Yet, the original model was slightly adjusted following the highest modification indices and introducing correlated error terms for the SCS-18. In the inpatient sample the modified 3-factor structure showed a good model fit according CFI

Table 6
Convergent validity of the SCS subscale in study 2 ($N = 75$).

	Unsolvability	*Unbearability*	*Unlovability*	*Perceived Burdensomeness (INQ)*	*Thwarted Belongingness (INQ)*	*Hopelessness (BHS)*	*Suicidal Ideation (BSS)*	*Depression (DESC)*
Mean (SD)	**15.8 (4.3)**	**19.9 (4.3)**	**15.6 (5.7)**	**3.1 (1.3)**	**4.0 (1.1)**	**12.8 (4.8)**	**8.9 (8.9)**	**25.5 (6.2)**
Unsolvability				0.54**	0.19	0.58**	0.63**	0.53**
Unbearability	0.64**			0.32**	0.15	0.48**	0.31**	0.47**
Unlovability	0.45**	0.25*		0.46**	0.36**	0.39**	0.26*	0.24*
SCS sum score (SCS-18)	*0.86***	*0.75***	*0.76***	*0.56***	*0.31***	*0.60***	*0.50***	*0.50***

*p < 0.05, **p < 0.01

and TLI, while RMSEA and SRMR indicated unsatisfactory model fit. With respect to the small sample size ($N = 75$) this result should be considered to be rather preliminary and might be attributable to the sample size (Schermelleh-Engel et al., 2003; Hu and Bentler, 1999). One might speculate that the third factor, unsolvability, that has been found in different populations (Gibbs, 2010; Ellis and Rufino, 2015) is not specific for a population but might be evident in case of more severe suicidality (more frequent suicide ideation or suicidal behavior).

For the SCS-9, a bifactor structure with one general and three specific factors revealed the best fit. Interestingly, Bryan et al. (2017) have reported adequate fit for an unidimensional model in the SCS-9 as well. However, Bryan et al. (2017) favored a 3-factor model because of better model fit. While we find the idea of a bifactor structure compelling and encourage researchers to examine such models in future studies along multidimensional models, conceptual aspects should also be taken into account. While the three factors of the SCS are highly correlated and a total score is useful to evaluate the relative strength of the overall suicidal belief system, specifying core constructs such as unbearability, unlovability and unsolvability might be especially beneficial in clinical work, for example to choose specific beliefs as a target in psychotherapy.

Internal consistencies of the SCS-18 were good, in both studies although an astonishingly low internal consistency was found for the unlovability subscale in the inpatient sample (study 2) that might be a consequence of the small sample size. To further establish psychometric properties of the German version of SCS in psychiatric inpatients an investigation in a larger sample should be conducted. Compared to the SCS-18 the SCS-9 did show a comparable internal consistency supporting its use as a brief and reliable tool that has been initially demonstrated by Bryan et al. (2017). Test-retest reliability for the SCS-18 was in a medium range after a short follow-up of 7 to 10 days which is in line with assumptions of suicidal beliefs being of medium-term stability and somewhat higher than values reported by Rufino and Ellis (2015) obtained using a longer interval between assessments (admission and discharge). Further investigations should determine the stability of the measure in more detail (e.g., pre and post-treatment or by using longer follow-up intervals).

In terms of construct validity, moderate to large positive correlations of the SCS and its subscales with measures of depression, suicidal ideation, thwarted belongingness, perceived burdensomeness, hopelessness and defeat/entrapment were shown in both studies supporting the convergent validity of the SCS-18. Patterns of correlations for the SCS-18 and the SCS-9 were comparable, suggesting that the SCS-9 is associated with clinical variables to a similar degree as the SCS-18 which is in line with the study developing the SCS-9 (Bryan et al., 2017). In addition, both the subscales of the SCS-18 and the SCS-9 differentiate between persons with prior and persons without prior suicide attempts – at least within the outpatient sample in study 1. This suggests an increasing risk for the occurrence of suicidal behavior with increasing SCS-18 and SCS-9 scores and is line with previous studies (Ellis and Rufino, 2015; Bryan et al., 2014) as well as the FVT (Rudd, 2006).

This has to be noted with respect to the fact that no SCS-9 item contains the word *suicide*. The SCS-9 therefore seems to be suitable for the assessment of suicidal cognitions in persons who are not willing to communicate about suicidality openly. However, the SCS-18 incorporates only two items including the term suicide and a comparison between the SCS-18 scores with and without these items has not revealed any impact with regards to its validity (Bryan et al., 2014).

Of note, the SCS-18 subscales (especially unsolvability) and the SCS-9, predicted concurrent and prospective suicide ideation beyond the effect of other variables such as hopelessness, defeat/entrapment, perceived burdensomeness and thwarted belongingness supporting its incremental validity and clinical utility. All these are core constructs of different theories of suicidality (Joiner, 2005; O`Connor, 2011; Wenzel and Beck, 2008) and apparently play a different role in the emergence of suicidal ideation and behavior. This finding is in line with previous research showing a strong association between SCS-

Table 7
Hierarchical regression analysis predicting suicidal ideation (BSS) at follow up in the inpatient sample (study 2).

Model		Unstandard.β	CI		*T*	*p*	Adj. R^2
1	*Intercept*	*−9.405*	*(−16.57–*	*−2.23)*	*−2.618*	*0.011*	0.31
	Depression (DESC)	0.275	(−0.04–	0.59)	1.766	0.082	
	Hopelessness (BHS)	**0.751**	**(0.36–**	**1.14)**	**3.854**	**0.000**	
2	*Intercept*	*−9.777*	*(−17.48–*	*−2.07)*	*−2.534*	*0.014*	
	Depression (DESC)	0.283	(−0.03–	0.59)	1.788	0.078	0.35
	Hopelessness (BHS)	**0.462**	**(0.01–**	**0.92)**	**2.033**	**0.046**	
	Perceived Burdensomeness (INQ)	**2.054**	**(0.39–**	**3.72)**	**2.457**	**0.017**	
	Thwarted Belongingness (INQ)	−0.627	(−2.23–	0.97)	−0.782	0.437	
3	*Intercept*	*−11.565*	*(−20.26–*	*−2.87)*	*−2.658*	*0.010*	
	Depression (DESC)	0.058	(−0.26–	0.37)	0.368	0.714	0.46
	Hopelessness (BHS)	0.230	(−0.21–	0.67)	1.050	0.298	
	Perceived Burdensomeness (INQ)	1.377	(−0.21–	2.97)	1.730	0.089	
	Thwarted Belongingness (INQ)	−0.175	(−1.71–	1.36)	−0.228	0.820	
	Unsolvability (SCS)	**0.920**	**(0.41–**	**1.43)**	**3.627**	**0.001**	
	Unbearability (SCS)	−0.081	(−0.58–	0.42)	−0.324	0.747	
	Unlovability (SCS)	−0.078	(−0.39–	0.23)	−0.506	0.615	

unsolvability and to a smaller extent unlovability with suicide ideation (Bryan et al., 2017; Ellis and Rufino, 2015). Therefore, perceptions such as "…suicide is the only way to solve my problems" or "…nothing can help solve my problems" seem to be of specific importance to increasing suicidal thoughts. One may speculate that corresponding cognitions are closely linked to suicide ideation as they may be the result of perceptions of perceived burdensomeness, thwarted belongingness, hopelessness and defeat/entrapment. In line with this assumption, Roeder and Cole (2018) recently proposed to conceptualize such specific cognitions "as reinforcing one another in ways that exacerbate or maintain a larger system of negative beliefs, and then to treat this negative belief system (not specific parts of it) as a higher-order construct that serves as a more optimal predictor of suicide ideation" (p. 11). Future studies should clarify how different types of negative cognitions interact and whether it is more beneficial to differentiate them or to consider them as part of a latent negative cognitive network. Most importantly it is necessary to prospectively evaluate the predictive ability of the SCS with regards to actual suicidal behavior or the transition from thoughts to action as this is one of the major challenges in suicidality research (Klonsky et al., 2017). Initial evidence that the SCS predicts future suicide attempts has been provided by Bryan et al. (2014).

Several limitations have to be considered when interpreting the results. First, since 100% of the sample was Caucasian it is unclear how the findings would generalize to other populations. Second, the size of the inpatient sample in study 2 was rather small. Future studies in larger samples should be conducted to establish psychometric properties in inpatient samples (in Germany). Third, an acceptable model fit was established after introducing correlated error terms which is a slight variation of the original models and replication in other samples would be desirable. Fourth, there were differences concerning the mode of administration. The inpatient sample was assessed using paper-and-pencil versions, while the outpatient sample was assessed on a computer-based assessment. Nevertheless, evidence suggests that mode of administration has very little impact on psychometric properties of measures (Gwaltney et al., 2008). Fifth, the current study investigates two versions of the SCS, but it has to be considered, that in both samples the two versions were not presented separately, but the SCS-9 was extracted out of the SCS-18. This might be a source of error or of overestimation of psychometric properties when comparing both versions.

Despite these limitations, the present study provides psychometrically sound German versions of the SCS. Our results suggest that both versions of SCS are reliable and valid measures of suicidal cognitions suggesting possible use for both suicide risk assessment and monitoring as well as planning of treatment for individuals experiencing suicide ideation and behavior.

Ethics approval and consent to participate

All participants provided written informed consent. Furthermore, all procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards and all study procedures where approved by the regional Ethics Committee of the Ruhr-Universität Bochum (No: 318/2016) and the University of Leipzig (No: 388-13-16122013).

Consent to publish

All participants provided consent to publish all anonymized data reported in this publication.

Availability of data and materials

All relevant data are reported within the paper. Analyzed data are available from the corresponding author on reasonable request.

Competing interests

All authors declare that they have no competing interests.

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Authors' contributions

LS, NH, TT, TF, and HG originated the idea. LS performed the statistical analyses. NH, AS, DR, TT, TF and HG contributed to data collection. LS, HG and TT wrote the manuscript draft. All authors contributed in the interpretation of the results and the writing and critical reviewing of the final manuscript. All authors read and approved the final manuscript. LS and HG share first authorship of the paper.

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Appendix. The German Suicide Cognitions Scale

Instruktion: Die folgenden 18 Aussagen messen Überzeugungen über Probleme, die Menschen manchmal haben. Bitte lesen Sie jede Aussage sorgfältig durch und umkreisen Sie die Zahl, die am besten beschreibt, wie Sie im Augenblick fühlen. Bitte denken Sie daran, jedes Item zu bewerten und nur eine Zahl pro Item einzukreisen.

	In diesem Augenblick fühle ich mich	Lehne stark ab	Lehne ab	Neutral	Stimme zu	Stimme stark zu
1	Die Welt wäre besser ohne mich.	1	2	3	4	5
2	Suizid ist der einzige Weg, um meine Probleme zu lösen	1	2	3	4	5
3	Ich kann diesen Schmerz nicht mehr aushalten.	1	2	3	4	5
4	Ich bin noch nie in etwas erfolgreich gewesen.	1	2	3	4	5
5	Ich kann es nicht ertragen, weiterhin so aufgewühlt zu sein.	1	2	3	4	5
6	Für die Fehler, die ich gemacht habe, kann mir niemals verziehen werden.	1	2	3	4	5
7	Niemand kann mir helfen, meine Probleme zu lösen.	1	2	3	4	5
8	Es ist unerträglich, wenn ich so aufgewühlt bin.	1	2	3	4	5
9	Ich bin es überhaupt nicht wert, geliebt zu werden.	1	2	3	4	5
10	Nichts kann mir dabei helfen, meine Probleme zu lösen.	1	2	3	4	5
11	Es ist unmöglich, zu beschreiben, wie schlecht ich mich fühle.	1	2	3	4	5
12	Ich bin meinen Problemen nicht länger gewachsen.	1	2	3	4	5
13	Ich kann mir nicht vorstellen, dass irgendjemand mit dieser Art von Schmerz fertigwerden könnte.	1	2	3	4	5
14	An mir ist nichts wertvoll.	1	2	3	4	5
15	Suizid ist der einzige Weg, um diesen Schmerz zu beenden.	1	2	3	4	5
16	Ich verdiene es nicht, noch einen weiteren Moment zu leben.	1	2	3	4	5
17	Ich würde lieber sterben, als diesen unerträglichen Schmerz zu ertragen.	1	2	3	4	5
18	Niemand ist so abscheulich wie ich.	1	2	3	4	5

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