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The factorial structure of the Suicide Intent Scale: a comparative study in clinical samples from 11 European regions

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Abstract

Although the Suicide Intent Scale (SIS) is a widely used instrument in research on suicidal behavior, comparative research on the latent structure of the SIS has been neglected. To determine whether a general factor model of the SIS is supported, alternative factor models of the SIS were evaluated comparatively in 11 clinical samples. The SIS was applied as part of a structured clinical interview to patients after an episode of non-fatal suicidal behavior. The samples were drawn from 11 study centers within the frame of the WHO/EURO multicenter study on suicidal behavior. Three different two-factor and two three-factor models of the SIS were examined in each sample using principal component analysis with orthogonal Procrustes rotation. The factorial structure of the 'subjective part' of the SIS (items 9–14) was strongly supported, whereas an acceptable model fit for the 'objective part' was not found. Possible future revisions of 'objective' SIS items may be worth consideration. As a limitation, the results of the study might not generalize to other samples that use different definitions of non-fatal suicidal behavior. Copyright © 2008 John Wiley & Sons, Ltd.

Key words: Suicide Intent Scale (SIS), factor analysis, Procrustes rotation, non-fatal suicidal behavior, WHO/EURO multicenter study on suicidal behavior

Introduction

Suicide intent represents an established theoretical concept in suicide research. In general, suicide intent refers to the conscious purpose of a person to utilize the (suicidal) act as a means to end the own life (Maris et al., 2000). More specifically, suicide intent plays an important role in the assessment of patients being referred to medical or psychiatric treatment after an act of non-fatal suicidal behavior. Suicide intent is defined as 'the seriousness or the intensity of the wish of a patient to terminate his life' (Beck et al., 1974, p. 45) or as the 'extent to which the patient wished to die at the time of the attempt' (Hawton, 2000, p. 522). Hence, determining suicide intent accurately in patients with a non-fatal suicidal episode, promises to be of great importance for the clinical treatment of suicidal patients and the prevention of future non-fatal and fatal suicidal acts.

The most often used and recommended instrument to assess suicide intent (Hawton, 2000; Maris et al., 2000) is the Beck Suicide Intent Scale (SIS) (Beck et al., 1974). The SIS, as conceived by the original authors, should assess two facets or domains of suicide intent: 'objective' or factual aspects of the act prior to, during, and after the suicidal act has been conducted. This first facet was labeled 'circumstances'. The second facet refers to thoughts and feelings of the suicidal patient at the time of the suicidal act. The label 'self report' was used to underline the 'subjective' dimension of the assessment of suicide intent (Beck et al., 1974; Beck et al., 1975; Beck et al., 1976).

Suicide research has investigated three broad subject areas related to the SIS. First, the SIS was investigated as a predictor for future fatal and non-fatal suicidal behavior (Beck et al., 1989; Hjelmeland et al., 1998; Tejedor et al., 1999; Brown et al., 2004; Kerkhof and Arensman, 2004; Suominen et al., 2004; Baca-Garcia et al., 2005; Harriss and Hawton, 2005; Harriss et al., 2005). Second, other studies examined the relationships between the SIS and several variables associated with non-fatal suicidal behavior (e.g. clinical and sociodemographic characteristics) (Casey, 1989; Nielsen et al., 1993; Suominen et al., 1997; Hjelmeland et al., 2000; Blenkiron et al., 2000; Hjelmeland et al., 2002a; Hjelmeland et al., 2002b; Milnes et al., 2002; Haw et al., 2003; Astruc et al., 2004; Chopin et al., 2004; Hawton et al., 2004; Sudhir Kumar et al., 2006; Conner et al., 2007). Third, topics related to the clinical usefulness of the SIS for the treatment of patients with non-fatal suicidal behavior were discussed (Keeley et al., 2002; Baca-Garcia et al., 2004; Bergen and Hawton, 2007). However, comparative research on the latent structure of the SIS has been neglected. Although Beck et al. (1974) proposed a clear hypothetical structure of the SIS, no study yet examined the latent structure of the SIS with theory testing methods. The eight existing factor analytic studies of the SIS solely applied exploratory techniques to investigate the latent structure of the SIS (Beck et al., 1976; Wetzel, 1977; Mieczkowski et al., 1993; Kingsbury, 1993; Spirito et al., 1996; Hjelmeland et al., 1998; Niméus et al., 2002; Diaz et al., 2003). Table 1 summarizes the major characteristics and the results of the previous factor analytic studies of the SIS.

As Table 1 indicates, previous factor analytic studies differ considerably in terms of clinical samples investigated, samples sizes, and the numbers of factors extracted. The majority of the studies used the eigenvalue > 1 criterion to determine the number of components to be retained. The number of factors extracted varied between two and four. In five studies one or more items were excluded from the final factor solution. In one study (Wetzel, 1977), a one item factor was extracted and retained in the rotated SIS solution. Sample sizes ranged from $N = 48$ (person item ratio = 3.2) (Wetzel, 1977) to $N = 776$ (person item ratio = 51.7) (Hjelmeland et al., 1998). Threshold item loadings were regarded as salient for values as low as $a = 0.40$ to $a = 0.55$, even though none of the studies reported criteria for acceptable or non-acceptable item cross-loadings on more than one factor (e.g. simple structure; McDonald, 2005). Explained total variance by the respective factor solutions varied between 44% (Spirito et al., 1996) and 68% (Kingsbury, 1993). In three studies, the explained total variance was not reported (Wetzel, 1977; Mieczkowski et al., 1993; Diaz et al., 2003). Internal consistency estimates (Cronbach's α) of the extracted factors, if mentioned, ranged between $\alpha = 0.64$ (Spirito et al., 1996) and $\alpha = 0.90$ (Mieczkowski et al., 1993; Hjelmeland et al., 1998).

The majority of the studies did not indicate whether missing item responses occurred and how cases with missing item responses were treated in subsequent statistical analysis. Only one study reported that patients were excluded from analysis if complete information on all SIS items was not available (Niméus et al., 2002). Most samples consisted of adult patients with episodes of non-fatal suicidal behavior (two consist of adolescent patients; Kingsbury, 1993; Spirito et al., 1996). Two studies used additional diagnostic criteria for including patients (Wetzel, 1977; Mieczkowski et al., 1993). In only three of the eight publications the definition of non-fatal suicidal behavior that was applied in the respective investigation was reported (Hjelmeland

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Table 1. Summary of previous factor analytic studies of the Suicide Intent Scale (SIS; Beck et al., 1974)

Reference	Sample description			Factor analytic characteristics and results					
	Sample size	Sample description	Definition suicidal behavior	Factor extraction criterion	Threshold for factor loading	Eigenvalues and/or variances reported	Nr. factors		Factor composition (SIS items)
Beck et al. (1976)[1]	$N = 188$	Adult inpatients with suicide attempts (18–63 years, mean = 30.00 years)	No definition	Eigenvalue criterion	≥0.40	Yes	4	F1 F2 F3 F4	1–3 5–7, 15 10–14 4, 8 9 (insufficient factor loading)
Wetzel (1977)[2]	$N = 48$	Suicide attempters	No definition	Eigenvalue criterion	–	–	4	F1 F2 F3 F4	1–3 10, 11, 14 6, 8, 9, 12, 13, 15 4
Kingsbury (1993)	$N = 50$	Inpatients and outpatients with an overdose (13–18 years, mean = 15.8 years)	No definition	Eigenvalue criterion	≥0.55	Yes	4	F1 F2 F3 F4	1–3 5, 6, 8, 15 9–13 4, 7 14 (insufficient factor loading)
Nimeus et al. (2002)	$N = 555$	Inpatients with suicide attempts (15–92 years, mean = 38.8, SD = 16.1 years)	According to Beck et al. (1972)	Eigenvalue criterion	≥0.45	Yes	4	F1 F2 F3 F4	1–3 4–7 6, 8, 15 9–15

Table 1. *Continued*

Reference	Sample description			Factor analytic characteristics and results					
	Sample size	Sample description	Definition suicidal behavior	Factor extraction criterion	Threshold for factor loading	Eigenvalues and/or variances reported	Nr. factors		Factor composition (SIS items)
Spirito et al. (1996)	*N* = 190	Inpatients with suicide attempts (predominantly by overdose) (12–17 years, mean = 15.3, SD = 1.3 years)	No definition	Eigenvalue criterion	≥0.40	Yes	3	F1 F2 F3	1–4 5, 6, 15 9–14 7, 8 (insufficient factor loading)
Hjelmeland et al. (1998)	*N* = 776[3]	Patients with parasuicides (15 years and above)	According to Platt et al. (1992)	Eigenvalue criterion	–	–	3	F1 F2 F3	1–4 5–7, 15 9–14 8 (insufficient factor loading)
Mieczkowski et al. (1993)	*N* = 98	Inpatients with a history of suicide attempts (M = 28, SD = 10 years)	No definition	Eigenvalue criterion	≥0.50	Yes	2	F1 F2	1–7, 15 9–14 8 (insufficient factor loading)
Diaz et al. (2003)	*N* = 689[3]	Inpatients with suicide attempts	According to O´Carroll et al. (1996)	Scree test	≥0.40	–	2	F1 F2	1–3, 5–8, 15 4, 9–14

[1] Three additional items referring to previous attempts, reactions to the attempt, and visualization of death were used in the factor analysis.
[2] One additional item was used in the factor analysis ('Alcohol did not contribute to attempt').
[3] The sample represented a pooled data set.

et al., 1998; Niméus et al., 2002; Diaz et al., 2003). The summary of previous studies on the factorial structure of the SIS reveals some important methodological limitations which will be briefly discussed.

First, it is well known that the applied eigenvalue >1 rule to determine the number of components to be retained is the least preferable criterion in exploratory factor analysis (EFA). It is highly probable that the use of this criterion leads to an overextraction of factors (Costello and Osborne, 2005). Hence, it is very likely that particularly those studies on the factorial structure of the SIS which reported four factors, have extracted too many components (we use the terms factor and component interchangeably, although, from a methodological point of view, principal axis factoring and principal component analysis (PCA) are not the same, but usually yield very similar results; Thompson, 2004).

Second, principal components and factor analysis are applied to correlation matrices. Routinely, the Pearson coefficient r is used to calculate item correlations. Calculating correlations with r assumes interval scale measurement, a condition usually violated by the scaling of questionnaires items. Although we do not want to engage in the discussion of the pros and cons of treating ordinal scales as interval scales, it can be demonstrated that the range restriction of ordinal scales (particularly with items of less than five answering categories; West et al., 1995) may lead to attenuated correlations between items and lower reliability estimates of the composite scales (Cox, 1980; Ray, 1980; Bollen and Barb, 1981; Preston and Colman, 2000; Lubke and Muthén, 2004). This is especially critical for the SIS items which are measured on a three-point ordinal scale (Beck et al., 1976). One recommended remedy is the use of the polychoric correlation coefficient (Homer and O'Brian, 1988). Even though one study on the factorial structure of the SIS used this coefficient (Mieczkowski et al., 1993), the use of polychoric correlations is also associated with certain problems. The application of the polychoric coefficient assumes a specific measurement model: it is assumed that each observed ordinal attribute is derived from an underlying continuous variable with a normal distribution. Thus, the polychoric correlation assumes a bivariate normal distribution of both underlying continuous attributes (Jöreskog and Moustaki, 2001). Violation of this assumption may lead to biased estimates (Homer and O'Brian, 1988; Coenders and Saris, 1995).

Third, it has to be pointed out that reporting Cronbach's α for short scales (single factors of the three-factor and four-factor models of the SIS consist of only two to four items) with items measured on a three-point ordinal scale may result in lowered reliability (internal consistency) estimates. It should also be taken into consideration that Cronbach's α is influenced by test length, average correlation among items (Cortina, 1993; Streiner, 2003), and the number of rating categories (Cox, 1980; Ray, 1980; Preston and Colman, 2000; Weng, 2004). Because Cronbach's α is not an optimal estimate of factor reliability, the subsidiary use of alternative reliability estimates that avoid some of the limitations is recommended (Barclay et al., 1995).

Empirical evidence concerning the factor structure of the SIS is conflicting. The previous exploratory studies on the factorial structure of the SIS yielded different factorial solutions with regard to the number of factors extracted and the item composition of the factors. The present study aims to contribute to the question whether a common model of the factorial structure of the SIS can be supported cross-culturally. For this purpose, five alternative factor models of the SIS derived from published studies were examined with Procrustes rotation to maximum target factor fit. Examination of different models (model variation) was introduced due to the fact that multiple models will usually 'fit' to a given data matrix (Thompson, 2004). In order to account for sampling variation, 11 distinct patient samples obtained within a multicenter study on non-fatal suicidal behavior were used to comparatively examine the factor models of the SIS. A common definition of non-fatal suicidal behavior was utilized to guarantee a minimum comparability of responders across all samples. In the first step, socio-demographic and clinical sample attributes were examined. The second step of analysis was devoted to the non-parametric 'test' of alternative models of the factorial structure of the SIS.

Materials and methods

The present study includes 11 data sets from patients (aged 15 years and older) admitted to health care facilities all over Europe after an episode of non-fatal suicidal behavior. The data samples were collected within the WHO/EURO multicenter study on suicidal behavior (for further details see Bille-Brahe et al., 1995; Bille-Brahe et al., 1996a; Bille-Brahe et al., 1996b). Data sets from the following study centers were used: Cork

(Republic of Ireland), Gent (Belgium), Hall/Innsbruck (Austria), Helsinki (Finland), Leiden (the Netherlands), Oxford (UK), Padova (Italy), Pecs (Hungary), Stockholm (Sweden), Umea (Sweden), and Wuerzburg (Germany) (Kerkhof et al., 1994; Schmidtke et al., 2004). Non-fatal suicidal behavior was defined as 'an act with nonfatal outcome, in which an individual deliberately initiates a non-habitual behavior, that, without intervention from others, will cause self-harm, or deliberately ingests a substance in excess of the prescribed or generally recognized therapeutic dosage, and which is aimed at realizing changes which the subject desired via the actual or expected physical consequences' (Platt et al., 1992, p. 99; De Leo et al., 2006). The SIS was applied as part of a fully-structured clinical interview which was conducted approximately one week after the patient's hospital admission (Kerkhof et al., 1989). Informed consent was obtained from each study participant. The interviewers attended a three-days intensive training course before the study started (Bille-Brahe et al., 1996a).

Instrument

The SIS (Beck et al., 1974) comprises 15 questions concerning the circumstances of the non-fatal suicidal act (e.g. planning, preparation) and the patient's thoughts, feelings, and expectations associated with the non-fatal suicidal episode. Questions are asked and rated by an interviewer. Each question is rated on an ordinal scale with the optional values 0, 1, and 2, indicating an increasing degree of intent. The SIS total score ranges from 0 to 30. Even though the original theoretical framework of the SIS (Beck et al., 1974) proposed a slightly different factor composition, the commonly applied and established version of the SIS consists of two parts: the 'circumstances' subscale (items 1–8) and the 'self-report' subscale (items 9–15) (Beck et al., 1975; Beck and Lester, 1976; Beck et al., 1976; Beck et al., 1989).

Statistical analysis

Sample size

The likelihood of identifying the 'true' factorial structure of a set of items is a function of at least four factors: sample size, number of indicators per factor, magnitude of item factor loadings, and interactions among these variables (Gagné and Hancock, 2006). Often cited rules of thumb, referring to a necessary minimum number of subjects or a minimum subject to item or parameter ratio, are questioned by recent simulation studies (MacCallum et al., 2001; Costello and Osborne, 2005; Hogarty et al., 2005; Gagné and Hancock, 2006). Unfortunately, up to our knowledge, a commonly accepted and applicable formula or procedure to estimate a minimum sample size that accounts for the complexity of a factorial model as a function of the earlier mentioned four variables does not exist. Therefore, we decided to consult recent simulation results (Gagné and Hancock, 2006, tables 2 and 3) as a rough guidance to determine a minimum sample size. Under the assumption of homogeneous item loadings of at least $a = 0.4$, a minimum of four indicators per factor, and a minimum construct reliability (ρ_η, see section 'Factor analytic procedure') of $\rho_\eta = 0.80$, a sample size between $N = 100$ and $N = 200$ per study sample appears to be sufficient. Based on these criteria for minimum sample size, four samples from centers that participated in the WHO study were excluded from the present analyses (Bern, Switzerland, $N = 66$; Emilia-Romagna, Italy, $N = 56$; Ljubljana, Slovenia, $N = 62$; Sor-Trondelag, Norway, $N = 89$).

Missing data analysis

In most of the 11 study samples, missing values on the SIS items were observed. The following two-step procedure was applied: in the first step, cases showing more than one-third of missing item values (six or more missing values on the SIS items) were excluded from further analyses. In consequence, 10 cases from the Helsinki sample and one case from the Umea sample were excluded. In the remaining samples the number/proportion of subjects with missing SIS item values (one to five missing item values) was as follows: Cork: $n = 27$ (18.49%), Gent: $n = 21$ (18.75%), Helsinki: $n = 85$ (37.95%), Leiden: $n = 6$ (4.26%), Padova: $n = 4$ (3.77%), Pecs: $n = 10$ (9.90%), Stockholm: $n = 11$ (5.47%), Umea: $n = 48$ (39.34%), Wuerzburg: $n = 32$ (25.81%). In the Hall/Innsbruck and the Oxford samples, the SIS items were found to be complete. In the second step, missing values were imputed with a hot-deck nearest neighbor technique (random method) (Huisman, 2000).

Socio-demographic and clinical sample characteristics

For each study sample, descriptive statistics for socio-demographic variables (age, gender, marital status,

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living situation, employment status) and clinical sample attributes (previous non-fatal suicidal episodes, previous psychiatric treatment) are reported.

Factor analysis

Three different two-factor and two three-factor models of the SIS (Beck et al., 1974; Mieczkowski et al., 1993; Spirito et al., 1996; Hjelmeland et al., 1998, Diaz et al., 2003) were tested in each of the 11 study samples separately. Previously published four-factor models were not examined (Beck et al., 1976; Wetzel, 1977; Kingsbury, 1993; Niméus et al., 2002) due to the fact that the published results suggested over-factorized solutions (Zwick and Velicer, 1986; McCrae et al., 1996).

Determination of the number of factors to be extracted

In the EFA literature, the debate on the best procedure to determine the correct number of factors is still unresolved. However, the use of the parallel analysis criterion is widely accepted and recommended (Thompson, 2004). Parallel analysis (Horn, 1965) compares a factor's eigenvalue obtained from a random matrix with the eigenvalue obtained from the empirical sample matrix. Samples of random normal numbers were repeatedly drawn (1000 replications) that mimic the number of items and the number of subjects in the study samples. The software used is described in Watkins (2000). From these random data, correlation matrices were calculated and (random) eigenvalues were extracted which served as reference for the empirical eigenvalues. To obtain variance estimates, standard deviations (SD) were calculated for the random eigenvalues. If the empirical eigenvalue of a factor was lower than the random eigenvalue (+ 2 SD), we concluded that the empirical factor has been extracted by chance. Although parallel analysis is mostly used in the context of EFA, we decided to apply it in the present 'confirmatory' analysis context in order to examine whether the five factor models to be tested are likely to comprise random factors (Hendriks et al., 2003).

Factor analytic procedure

To account for the ordinal level of data measurement, an optimal scaling procedure was applied to quantify the ordinal item scores. Optimal scaling extracts principal components from variables that were measured on a categorical or ordinal level and rescales the item scores optimally in a least squares sense with regard to a given data set. After optimal scaling, the rescaled item scores can be treated as if they were measured on an interval scale (Perrault and Young, 1980; Didow et al., 1985; Candel, 2001). For each of the five theoretical factor models separate optimally scaled item scores were calculated with the SPSS categorical PCA procedure (CATPCA; Meulman and Heiser, 2004). The component loadings from the CATPCA procedure served as input for the subsequent Procrustes rotation procedure. For 'confirmatory' analysis, PCA with orthogonal Procrustes rotation to maximum target factor fit was used (Levine, 1977; Caprara et al., 2000; Dunkel et al., 2002; Thompson, 2004; Hendriks et al, 2003). The 'confirmatory' Procrustes rotation procedure rotates orthogonal principal axis or principal components loadings to a theoretically specified target matrix of factor loadings with maximum congruence according to the least squares loss criterion (the terms 'confirmatory' and 'test' are used in quotation marks to indicate that we did not use a parametric confirmatory factor testing procedure). The theoretical or target factor-loading matrix specifies the number of components to be fitted and the factor-loading pattern of the test items. The theoretical or model matrices were derived and reconstructed from the relevant publications (Beck et al., 1974; Mieczkowski et al., 1993; Spirito et al., 1996; Hjelmeland et al., 1998; Diaz et al., 2003). An SPSS macro for Procrustes rotation described in McCrae et al. (1996) was applied.

Model fit was evaluated by the coefficient of congruence (CC; Wrigley and Neuhaus, 1955). The CC evaluates the degree of congruence between the theoretical and Procrustes rotated empirical matrix of factor loadings and is normed between −1 and +1 (Guadagnoli and Velicer, 1991). Recently published studies suggest that values of the CC ≥ 0.95 indicate sufficient similarity between the empirically Procrustes rotated and the theoretically postulated factors that comes close to factor equality. Values ranging from CC ≥ 0.85 to CC < 0.95 indicate only a fair factorial similarity (Chan et al., 1999; Lorenzo-Seva and Ten Berge, 2006). Reliability of the derived or extracted factors of the SIS was assessed by the reliability formula presented in Fornell and Larcker (1981; Segars, 1997). According to this formula, the reliability of a factor (ρ_η) is determined by the loadings of the keyed items on the target factor and the respective item error variation. Reliability estimates of $\rho_\eta \geq 0.80$, analogous to Cronbach's α, can be evaluated as acceptable (Robinson et al., 1991; Clark and

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Watson, 1995). Scale reliability was assessed with Cronbach's α. As a measure of construct validity, $\rho_{vc(\eta)}$ will be reported (Fornell and Larcker, 1981; Segars, 1997). The value of $\rho_{vc(\eta)}$ indicates the average item variance explained by the target factor. Factors that show average explained item variances of $\rho_{vc(\eta)} \geq 0.50$ can be regarded as construct valid factors or components. On the item level, salient item factor loadings (pattern indices) were evaluated by the application of the 'Fuerntratt criterion' (Fuerntratt, 1969; Shelby et al., 2005). The 'Fuerntratt criterion' suggests to consider both the loading of an item on the target factor and the item communality: a factor loading is regarded as sufficiently large (or salient) if the amount of explained item variance by a target factor reaches or exceeds 50% of the total explained item variance (item communality). Thus, the 'Fuerntratt criterion' can be formalized as: $a^2/h^2 \geq 0.50$. The 'Fuerntratt criterion' was used to identify salient and non-salient SIS item loadings in the several investigated factor analytic models.

Results

Table 2 summarizes details of the 11 study samples and presents the socio-demographic and clinical sample characteristics. The sample sizes varied between $N = 101$ (Pecs) and $N = 214$ (Helsinki). The mean age of the study participants ranged from $M = 30.84$ (SD = 12.59) (Padova) to $M = 41.63$ (SD = 17.03) (Stockholm). The proportion of males interviewed in the different study centers varied between 29% (Padova) and 54% (Gent). Other socio-demographic and clinical sample attributes are reported in Table 2.

Parallel analysis results confirm for each of the 11 samples that the extraction of two factors is justified (Beck et al., 1974; Mieczkowski et al., 1993; Diaz et al., 2003). In contrast to the two-factor models, the support for the extraction of three factors is only 'fair'. With regard to the factor model described by Spirito et al. (1996), the empirical eigenvalue of the third extracted component did not exceed the random eigenvalue (+2 SD) in eight of the 11 study samples (Cork, Gent, Helsinki, Oxford, Padova, Pecs, Umea, Wuerzburg). Similarly, the extraction of a third component in accordance with the factor model suggested by Hjelmeland et al. (1998) was not supported by parallel analysis in six samples (Gent, Oxford, Padova, Pecs, Umea, Wuerzburg).

The factor analytic results of the SIS are presented in Table 3. Evaluation of the five different factor models of the SIS with the Procrustes rotation procedure supported the extraction of the 'self-report' or 'subjective' SIS factor (F2 in the two-factor models, F3 in the three-factor models). In three models (Mieczkowski et al., 1993; Spirito et al., 1996; Hjelmeland et al., 1998) the 'subjective' factor comprised the SIS items 9–14. This factor model fitted the data very well (CC ≥ 0.95; $\rho_{vc(\eta)} \geq 0.50$; $\rho_\eta \geq 0.80$; $\alpha \geq 0.80$) in five (Mieczkowski et al., 1993) to eight (Spirito et al., 1996) of the 11 samples. With the exception of two samples (Helsinki, Umea), an acceptable model fit (0.85 < CC ≤ 0.94; $\rho_{vc(\eta)} \geq 0.50$; $\rho_\eta \geq 0.80$; $\alpha \geq 0.80$) was obtained for each of the remaining samples. However, model fit decreased considerably in more than half of the samples if the SIS items 4 or 15 were added to the 'subjective factor' as outlined in two other models of the SIS factor structure (Beck et al., 1974; Diaz et al., 2003).

The five different factor models of the SIS are primarily distinguished by the modeling of the 'objective' factor ('circumstances'). Overall, the factor 'circumstances' was not supported in any of the two-factor models. Factor congruence was mostly 'fair' (CC < 0.95). Factor reliability, scale reliability, and factor validity were not found to be acceptable ($\rho_\eta < 0.80$; $\alpha < 0.80$; $\rho_{vc(\eta)} < 0.50$) in the majority of the study samples. Although the split of the 'circumstances' factor in the three factor models increased the model fit with regard to factor congruence and factor validity in some of the samples, factor reliability and scale reliability remained unacceptably low ($\rho_\eta < 0.80$; $\alpha < 0.80$). As an exception, the three factor models fitted the data very well in the Stockholm sample (CC ≥ 0.95; $\rho_{vc(\eta)} \geq 0.50$; $\rho_\eta \geq 0.80$), although the scale reliability of one factor (factor 1, $\alpha = 0.74$) was below the threshold ($\alpha \geq 0.80$) for an acceptable reliability estimate.

On the item level, it was evident that mainly items from the 'objective' factor most often did not meet the salience criterion of $a^2/h^2 \geq 0.50$. In the three two-factor models, particularly the SIS items 4 and 15 were found to show poor target factor loadings. In the factor model from Beck et al. (1974) the salience criterion for both items was not met in more than half of the samples. In the factor model from Mieczkowski et al. (1993) the SIS items 4 and 15 did not indicate sufficient salience in six and three samples, respectively. Regarding the factor model from Diaz et al. (2003) the salience criterion for the SIS items 4 and 15 was not supported in at least three samples, respectively. In the three-factor models, non-salient loadings were mainly observed for the SIS

Table 2. Description of the study samples (sample size, sampling period, sociodemographic, and clinical variables)

Study center	Sample size	Sampling period	Age	Gender	Marital status				Living situation			
	N[1]	Years	M (sd)	% (*N*) Male	% (*N*) Single	% (*N*) Married	% (*N*) Widowed	% (*N*) Divorced Separated	% (*N*) Alone	% (*N*) Partner	% (*N*) Parents Relative Friend	% (*N*) Institution Other
Cork (Ireland)	146	1995–97	32.54 (12.22)	46.58 (68)	64.38 (94)	21.23 (31)	0.68 (1)	13.70 (20)	25.34 (37)	26.71 (39)	41.10 (60)	6.85 (10)
Gent (Belgium)	112	1996–98	33.06 (12.78)	53.57 (60)	53.57 (60)	25.89 (29)	2.68 (3)	17.86 (20)	31.25 (35)	33.93 (38)	29.46 (33)	5.36 (6)
Hall/Innsbruck (Austria)	137	1997–99	35.10 (12.61)	43.80 (60)	57.66 (79)	22.63 (31)	2.92 (4)	16.79 (23)	32.85 (45)	35.04 (48)	24.09 (33)	8.03 (11)
Helsinki (Finland)	214	1990	36.01 (12.07)	42.52 (91)	48.13 (103)	25.70 (55)	3.74 (8)	22.43 (48)	34.11 (73)	44.39 (95)	17.29 (37)	4.21 (9)
Leiden (Netherlands)	141	1990–92	35.33 (13.12)	32.62 (46)	43.26 (61)	35.46 (50)	1.42 (2)	19.86 (28)	39.72 (56)	38.30 (54)	15.60 (22)	6.38 (9)
Oxford (U.K.)	150	1997	32.07 (13.67)	38.67 (58)	51.33 (77)	19.33 (29)	2.00 (3)	27.33 (41)	23.33 (35)	23.33 (35)	32.67 (49)	20.67 (31)
Padova (Italy)	106	1990–93	30.84 (12.59)	29.25 (31)	63.21 (67)	26.42 (28)	4.72 (5)	5.66 (6)	8.49 (9)	31.13 (33)	58.49 (62)	1.89 (2)
Pecs (Hungary)	101	1997–99	35.13 (13.42)	37.62 (38)	31.68 (32)	36.63 (37)	4.95 (5)	26.73 (27)	22.77 (23)	40.59 (41)	27.72 (28)	8.91 (9)
Stockholm (Sweden)[4]	201	1990–92	41.63 (17.03)	36.82 (74)	45.77 (92)	22.39 (45)	4.98 (10)	26.87 (54)	47.26 (95)	37.81 (76)	12.44 (25)	2.49 (5)
Umea (Sweden)	121	1990–92	36.01 (14.04)	33.88 (41)	49.59 (60)	23.97 (29)	2.48 (3)	23.97 (29)	44.63 (54)	40.50 (49)	8.26 (10)	6.61 (8)
Wuerzburg (Germany)	124	1990–93	37.58 (13.90)	41.13 (51)	43.55 (54)	37.90 (47)	6.45 (8)	12.10 (15)	32.26 (40)	45.16 (56)	16.13 (20)	6.45 (8)

Table 2. *Continued*

Study center	Employment status					Previous non-fatal suicidal episodes[3]				Previous psychiatric treatment[3]			
	% (*N*) Employed	% (*N*) Un-employed	% (*N*) Not employed[2]	% (*N*) Retired/ disabled	% (*N*) Temporary sick/other	% (*N*) No episode	% (*N*) 1 episode	% (*N*) 2–3 episodes	% (*N*) 4 or more episodes	% (*N*) Never	% (*N*) 1 time	% (*N*) 2–3 times	% (*N*) 4 times or more
Cork (Ireland)	34.25	26.71	18.49	11.64	8.90	37.78	26.67	14.07	21.48	51.91	15.27	12.21	20.61
	(50)	(39)	(27)	(17)	(13)	(51)	(36)	(19)	(29)	(68)	(20)	(16)	(27)
Gent (Belgium)	33.93	20.54	19.64	18.75	7.14	49.06	19.81	24.53	6.60	54.90	23.53	12.75	8.82
	(38)	(23)	(22)	(21)	(8)	(52)	(21)	(26)	(7)	(56)	(24)	(13)	(9)
Hall/Innsbruck	35.77	24.09	10.95	15.33	13.87	45.26	26.28	11.68	16.79	50.36	13.14	13.14	23.36
(Austria)	(49)	(33)	(15)	(21)	(19)	(62)	(36)	(16)	(23)	(69)	(18)	(18)	(32)
Helsinki	43.46	11.68	10.28	27.10	7.48	46.83	19.02	14.63	19.51	49.51	18.93	11.17	20.39
(Finland)	(93)	(25)	(22)	(58)	(16)	(96)	(39)	(30)	(40)	(102)	(39)	(23)	(42)
Leiden	24.11	6.38	29.08	15.60	24.82	33.81	23.02	21.58	21.58	60.63	13.39	13.39	12.60
(Netherlands)	(34)	(9)	(41)	(22)	(35)	(47)	(32)	(30)	(30)	(77)	(17)	(17)	(16)
Oxford (U.K.)	37.33	18.00	14.67	22.00	8.00	33.78	21.62	16.89	27.70	68.24	11.49	4.05	16.22
	(56)	(27)	(22)	(33)	(12)	(50)	(32)	(25)	(41)	(101)	(17)	(6)	(24)
Padova (Italy)	50.00	15.09	24.53	5.66	4.72	62.14	18.45	16.50	2.91	78.57	7.14	8.16	6.12
	(53)	(16)	(26)	(6)	(5)	(64)	(19)	(17)	(3)	(77)	(7)	(8)	(6)
Pecs (Hungary)	43.56	19.80	10.89	19.80	5.94	37.62	24.75	24.75	12.87	57.43	17.82	16.83	7.92
	(44)	(20)	(11)	(20)	(6)	(38)	(25)	(25)	(13)	(58)	(18)	(17)	(8)
Stockholm	36.32	9.45	3.98	22.39	27.86	47.72	26.40	14.21	11.68	50.25	15.23	14.72	19.80
(Sweden)[3]	(73)	(19)	(8)	(45)	(56)	(94)	(52)	(28)	(23)	(99)	(30)	(29)	(39)
Umea (Sweden)	30.58	9.92	16.53	18.18	24.79	36.67	21.67	22.50	19.17	42.02	10.08	22.69	25.21
	(37)	(12)	(20)	(22)	(30)	(44)	(26)	(27)	(23)	(50)	(12)	(27)	(30)
Wuerzburg	41.13	8.87	25.81	11.29	12.90	57.85	25.62	12.40	4.13	56.67	14.17	17.50	11.67
(Germany)	(51)	(11)	(32)	(14)	(16)	(70)	(31)	(15)	(5)	(68)	(17)	(21)	(14)

[1] The sample size refers to the total number of cases with valid or imputed data on the SIS.
[2] The category 'not employed' comprises the subgroups 'housewife/houseman', 'assisting partner', 'full-time student', and 'armed services'.
[3] Only valid cases are presented in the table.
[4] In the study center Stockholm one person was coded as "transsexual". This case was excluded from analysis.

item 3. Item component loadings for each sample separately are available upon request from the first author (E.A.).

Discussion

Previous exploratory studies on the factorial structure of the SIS (Beck et al., 1974) yielded heterogeneous factorial solutions. Thus, in a strong sense, no general evidence-based criteria were available concerning the scaling of the SIS items. The aim of the present study was to comparatively evaluate the factorial structure of the SIS in 11 different European samples of patients admitted to health care facilities after an episode of non-fatal suicidal behavior. The study samples were comparable with regard to the applied definition of non-fatal suicidal behavior and the data sampling procedure (Platt et al., 1992; Bille-Brahe et al., 1995; Bille-Brahe et al., 1996a; Hjelmeland and Hawton, 2004).

To evaluate five competing models of the factorial structure of the SIS, a principal components based Procrustes rotation to a hypothetical target matrix was undertaken. A 'purist' approach to psychometrics and factor analysis doubts that the chosen PCA followed by a Procrustes rotation procedure is a 'correct' 'confirmatory' analysis of a latent variable model. Principal component scores are weighted sumscores of the observed variables. Thus, in psychometric language, PCA is a variable reduction technique but not a latent variable model (Borsboom, 2006). The authors of this paper acknowledge these methodological and terminological differences. Furthermore, with regard to theoretical considerations, the original work on the SIS defines suicidal intent as 'cluster of factors but must take into account a variety of rather disparate elements' (Beck et al., 1974, p. 45). Hence, it can be argued that a strong theoretical rationale for the SIS is lacking. The items of the SIS appear to represent a bundle of empirical clinical observations which have been collected in a more or less systematic way. From this point of view, with regard to the lack of an elaborate theoretical model behind the SIS, the application of a data reduction technique appears to be more justified than an explicit latent variable model with its strong statistical model and measurement implications.

The main result of the present study is that the 'subjective' or 'self report' factor of the SIS, consisting of the items 9–14 as proposed in three different factor models (Mieczkowski et al., 1993; Spirito et al., 1996; Hjelmeland et al., 1998), was confirmed in the majority of the samples. Similar results were not found for other factor models of the 'self-report' factor (Beck et al., 1974; Diaz et al., 2003). The second main finding refers to the scalability of the 'objective' or 'circumstances' items of the SIS: examination of each of the five factor models found no convincing evidence (in terms of factor similarity, factor validity, and factor reliability) in the majority of the samples for one or two 'objective' or 'circumstances' factors of the SIS. Particularly, low item saliences and factor loadings of the SIS item 3 ('Precautions against discovery and/or intervention') in the three-factor models, and of the items 4 ('Action to gain help after attempt') and 15 ('Degree of premediation') in the two-factor models were observed. Based on these results it has to be concluded that the 'objective part' is associated with substantial conceptual flaws.

A close inspection of the SIS items of the 'objective part' suggests that the meaning of some of the items is somehow ambiguous if the heterogeneity of motives or intentions of the non-fatal suicidal act is accounted for (Hjelmeland et al., 2002a; Hjelmeland et al., 2002b; Chopin et al., 2004; Hjelmeland and Hawton, 2004; Antretter et al., 2006; Conner et al., 2007). For example, in SIS item 4 ('Action to gain help after the attempt') the most severe item score indicates that a patient did not contact or notify a helper after the non-fatal suicidal act. This score may be attributed to a patient with a serious wish to die who did not contact a helper in order to prevent rescue after a medically serious self-injury. However, an identical item value would be recorded for a patient without a wish to die who gave the same answer because the self-inflicted injury was regarded as non-serious. It is reasonable to assume that some of the meanings of the items of the 'objective part' may considerably differ in subgroups of patients with distinct patterns of motives (Chopin et al., 2004; Conner et al., 2007). A possible substantial change in the item pool of the 'objective part', particularly accounting for the distinctiveness of subgroups of patients with non-fatal suicidal acts, might be worth consideration for future revisions of the SIS. Our findings imply that the general factorial structure of the SIS probably consists of two dimensions as hypothesized by Beck et al. (1974). Results from the examination of the numbers of factors or components that should be reasonably extracted did not generally support the extraction of three SIS factors. Comparison of the empirical sample eigenvalues with randomly obtained eigenvalues indicated that three factor solutions of the SIS are

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Table 3. Results from Procrustes rotation to maximum target factor congruence

		Two-factor models									
Study sample	Factor	Beck et al. (1974) SIS factor model F1 (items 1–8) F2 (items 9–15)					Mieczkowski et al. (1993) SIS factor model F1 (items 1–7, 15) F2 (items 9–14)				
		CC	$\rho_{vc(\eta)}$	ρ_η	α	NSI	CC	$\rho_{vc(\eta)}$	ρ_η	α	NSI
Cork	F1	0.83	0.29	0.75	0.71	4	0.92	0.36	0.81	0.76	4
N = 146	F2	0.91	0.49	0.86	0.85	15	0.95	0.53	0.87	0.86	–
	F3	–	–	–	–	–	–	–	–	–	–
Gent	F1	0.88	0.30	0.76	0.69	1, 2	0.94	0.34	0.79	0.72	–
N = 112	F2	0.86	0.51	0.87	0.85	15	0.92	0.59	0.89	0.88	–
	F3	–	–	–	–	–	–	–	–	–	–
Hall/	F1	0.79	0.23	0.67	0.60	4	0.91	0.31	0.76	0.69	–
Innsbruck	F2	0.92	0.59	0.90	0.89	15	0.97	0.67	0.92	0.92	–
N = 137	F3	–	–	–	–	–	–	–	–	–	–
Helsinki	F1	0.87	0.28	0.74	0.68	4	0.89	0.31	0.77	0.73	4, 15
N = 214	F2	0.84	0.49	0.84	0.81	11	0.81	0.50	0.82	0.80	11
	F3	–	–	–	–	–	–	–	–	–	–
Leiden	F1	0.76	0.29	0.72	0.70	4, 7, 8	0.88	0.38	0.81	0.77	4
N = 141	F2	0.87	0.49	0.86	0.85	15	0.94	0.56	0.88	0.88	–
	F3	–	–	–	–	–	–	–	–	–	–
Oxford	F1	0.80	0.27	0.68	0.62	6, 8	0.87	0.29	0.74	0.69	6, 15
N = 150	F2	0.92	0.55	0.89	0.89	–	0.89	0.57	0.89	0.90	–
	F3	–	–	–	–	–	–	–	–	–	–
Padova	F1	0.91	0.29	0.74	0.65	4	0.91	0.28	0.74	0.64	4, 15
N = 106	F2	0.96	0.65	0.93	0.91	–	0.95	0.71	0.93	0.93	–
	F3	–	–	–	–	–	–	–	–	–	–
Pecs	F1	0.91	0.29	0.76	0.67	–	0.92	0.31	0.77	0.69	–
N = 101	F2	0.94	0.49	0.87	0.83	15	0.95	0.54	0.87	0.84	–
	F3	–	–	–	–	–	–	–	–	–	–
Stockholm	F1	0.89	0.34	0.79	0.74	–	0.96	0.40	0.84	0.80	–
N = 201	F2	0.94	0.68	0.93	0.93	15	0.95	0.74	0.94	0.95	–
	F3	–	–	–	–	–	–	–	–	–	–
Umea	F1	0.66	0.27	0.63	0.62	3, 4, 8	0.76	0.33	0.73	0.68	3, 4
N = 121	F2	0.86	0.41	0.82	0.82	15	0.91	0.46	0.83	0.83	–
	F3	–	–	–	–	–	–	–	–	–	–
Wuerzburg	F1	0.71	0.23	0.63	0.61	2, 4	0.85	0.31	0.75	0.71	2, 4
N = 124	F2	0.88	0.54	0.88	0.89	15	0.93	0.60	0.90	0.90	–
	F3	–	–	–	–	–	–	–	–	–	–

Note: CC = congruence coefficient; $\rho_{vc(\eta)}$ = average explained factor variance; ρ_η = reliability of the construct (factor reliability); α = Cronbach's alpha (scale reliability); NSI = non-salient items (SIS items which did not correspond to the Fuerntratt criterion).

[1] Small differences of the values for Cronbach's α between factor models with an identical item factor composition result from the optimally scaled item scores that were calculated for each factor model separately.

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					Three-factor models									
Diaz et al. (2003) SIS factor model F1 (items 1–3, 5–8, 15) F2 (items 9–14, 4)					Spirito et al. (1996) SIS factor model F1 (items 1–4) F2 (items 5, 6, 15) F3 (items 9–14)					Hjelmeland et al. (1998) SIS factor model F1 (items 1–4) F2 (items 5–7, 15) F3 (items 9–14)				
CC	$\rho_{vc(\eta)}$	ρ_{η}	α	NSI	CC	$\rho_{vc(\eta)}$	ρ_{η}	α	NSI	CC	$\rho_{vc(\eta)}$	ρ_{η}	α	NSI
0.94	0.36	0.81	0.76	–	0.94	0.47	0.78	0.68	–	0.95	0.47	0.78	0.68	–
0.95	0.49	0.87	0.84	–	0.94	0.56	0.79	0.71	–	0.94	0.52	0.81	0.76	–
–	–	–	–	–	0.95	0.56	0.88	0.86	–	0.95	0.55	0.88	0.86	–
0.92	0.33	0.78	0.73	1, 2	0.87	0.43	0.74	0.62	4	0.87	0.42	0.73	0.61[1]	4
0.80	0.50	0.84	0.80	4	0.86	0.49	0.74	0.66	–	0.92	0.46	0.77	0.69	–
–	–	–	–	–	0.93	0.60	0.90	0.88	–	0.93	0.60	0.90	0.88	–
0.91	0.31	0.76	0.68	–	0.93	0.43	0.75	0.62	–	0.91	0.42	0.74	0.62	–
0.93	0.58	0.90	0.87	–	0.92	0.54	0.77	0.66	–	0.95	0.49	0.80	0.71	–
–	–	–	–	–	0.97	0.68	0.93	0.92	–	0.97	0.68	0.93	0.92	–
0.90	0.30	0.76	0.72	15	0.82	0.43	0.69	0.57	3, 4	0.81	0.42	0.69	0.57	3, 4
0.81	0.46	0.82	0.79	11	0.85	0.40	0.67	0.64	–	0.88	0.43	0.74	0.71	15
–	–	–	–	–	0.81	0.52	0.84	0.80	11	0.81	0.52	0.83	0.80	11
0.88	0.37	0.80	0.76	8	0.89	0.40	0.71	0.57	3	0.89	0.40	0.71	0.57	3
0.91	0.49	0.86	0.85	–	0.86	0.59	0.81	0.82	–	0.87	0.54	0.82	0.83	–
–	–	–	–	–	0.95	0.59	0.90	0.88	–	0.93	0.57	0.89	0.88	–
0.76	0.26	0.67	0.66	6, 8, 15	0.90	0.43	0.73	0.59	3	0.86	0.42	0.71	0.59	3
0.84	0.49	0.86	0.87	4	0.87	0.47	0.72	0.70	–	0.87	0.39	0.71	0.65	–
–	–	–	–	–	0.94	0.63	0.91	0.90	–	0.92	0.61	0.90	0.90	–
0.96	0.30	0.77	0.68	15	0.95	0.42	0.73	0.54	–	0.95	0.42	0.73	0.54	–
0.93	0.63	0.92	0.90	–	0.82	0.41	0.65	0.53	15	0.85	0.41	0.71	0.61	15
–	–	–	–	–	0.95	0.72	0.94	0.93	–	0.95	0.71	0.94	0.93	–
0.88	0.27	0.74	0.67	–	0.93	0.46	0.77	0.65	–	0.88	0.44	0.75	0.64[1]	3
0.90	0.48	0.85	0.81	4	0.93	0.48	0.73	0.54	–	0.93	0.41	0.73	0.60	–
–	–	–	–	–	0.95	0.55	0.88	0.84	–	0.95	0.55	0.88	0.84	–
0.90	0.36	0.80	0.76	–	0.96	0.54	0.82	0.74	–	0.96	0.54	0.82	0.74	–
0.91	0.66	0.93	0.92	4	0.95	0.64	0.84	0.81	–	0.95	0.61	0.86	0.84	–
–	–	–	–	–	0.96	0.77	0.95	0.95	–	0.96	0.76	0.95	0.95	–
0.83	0.32	0.76	0.71	3, 8	0.67	0.37	0.57	0.50	3, 4	0.66	0.37	0.55	0.49[1]	3, 4
0.92	0.42	0.83	0.80	–	0.92	0.55	0.79	0.69	–	0.94	0.54	0.82	0.76	–
–	–	–	–	–	0.92	0.49	0.85	0.83	–	0.92	0.48	0.85	0.83	–
0.88	0.31	0.76	0.70	2	0.89	0.39	0.71	0.59	3	0.89	0.39	0.71	0.60[1]	3
0.91	0.52	0.88	0.86	–	0.90	0.49	0.75	0.65	–	0.90	0.43	0.75	0.67	–
–	–	–	–	–	0.95	0.64	0.91	0.90	–	0.94	0.64	0.91	0.90	–

not protected against the extraction of random factors.

The reported findings may help to interpret some conflicting results concerning the predictive validity of the SIS. Some study findings supported the predictive validity of the SIS total or subscale scores for future non-fatal repetition (Hjelmeland et al., 1998; Kerkhof and Arensman, 2004; Harriss et al., 2005), and for future suicide (Beck et al., 1989; Niméus et al., 2002; Suominen et al., 2004; Harriss and Hawton, 2005). Other prospective studies did not confirm the predictive validity of the SIS for non-fatal (Tejedor et al., 1999; Haw et al., 2003) or for fatal suicidal behavior (Hjelmeland et al., 1998; Tejedor et al., 1999). Not surprisingly, the studies used different SIS items to generate SIS subscales. In addition, different scoring methods (e.g. sum scores or median split) or cut-off values were used to obtain a total SIS score. Without evidence based models of the dimensional structure of the SIS, however, it is very likely that contradictory findings on the predictive validity of the SIS will emerge. In other words, the flawed operationalization of the 'Suicide Intent' construct, at least with regard to the 'objective' factor, prevents detection of possible benefits that might be associated with the adequate empirical application of the theoretical concept.

Conclusions

The results from the present study supported the construct validity of the 'self-report' or 'subjective part' (items 9–14) of the SIS. For the 'circumstances part', however, the construct validity was not confirmed. Based on this finding, a future change of the 'objective part' might be worth consideration.

As a limitation of the present study it should be noted that it is unresolved whether the results obtained from this study are applicable to patient samples characterized by other definitions of non-fatal suicidal behavior. The definition used in the present study does not distinguish between patients with or without a suicidal intention (Bille-Brahe et al., 1995; De Leo et al., 2006). In contrast, other definitions either distinguish suicidal behaviors according to the presence or absence of suicide intent (e. g. O'Carroll et al., 1996; Skegg, 2005) or only consider non-fatal suicidal acts that meet specified criteria of medical lethality (e.g. Beautrais, 2001). However, commonly accepted and internationally applicable definitions of different types of non-fatal suicidal behaviors have not yet emerged (O'Carroll et al., 1996; De Leo et al., 2006; Silverman, 2006). A further limitation is related to the translated SIS versions applied in the present multicenter study. Multilingual studies often assume that the careful translation of an instrument provides the full transfer of all measurement characteristics. However, Van de Vijver (1998) argues that the equivalence of the translations should be empirically scrutinized. A corresponding study (e. g. Bushnell et al., 2005; Corbiére et al., 2006) for the SIS is still lacking.

Declaration of Interests

The authors have no competing interests.

References

Antretter E, Dunkel D, Osvath P, Voros V, Fekete S, Haring C. Multilevel modeling was a convenient alternative to common regression designs in longitudinal suicide research. JCE 2006; 59(6): 576–86.

Astruc B, Torres S, Jollant F, Jean-Baptiste S, Castelnau D, Malafosse A, Courtet P. A history of major depressive disorder influences intent to die in violent suicide attempters. J Clin Psychiatry 2004; 65(5): 690–5.

Baca-Garcia E, Diaz-Sastre C, Garcia Resa E, Blasco H, Braquehais Conesa D, Saiz-Ruiz J, De Leon J. Variables associated with hospitalization decisions by emergency psychiatrists after a patient's suicide attempt. Psychiatr Serv 2004; 55(7): 792–7.

Baca-Garcia E, Diaz-Sastre C, Garcia Resa E, Blasco H, Braquehais Conesa D, Oquendo MA, Saiz-Ruiz J, De Leon J. Suicide attempts and impulsivity. Eur Arch Psychiatry Clin Neurosci 2005; 255: 152–6.

Barclay D, Thompson R, Higgins C. The partial least squares (PLS) approach to causal modeling, personal computer adoption and use as an illustration. Technology Studies 1995; 2(2): 285–309.

Beautrais AL. Suicides and serious suicide attempts: two populations or one? Psychol Med 2001; 31: 837–45.

Beck AT, Lester C. Components of suicidal intent in completed and attempted suicides. J Psychol 1976; 92: 35–8.

Beck AT, Beck R, Kovacs M. Classification of suicidal behaviors I: quantifying intent and medical lethality. Am J Psychiatry 1975; 132(3): 285–7.

Beck AT, Schuyler D, Herman I. Development of Suicidal Intent Scales. In Beck AT, Resnik HLP, Lettieri DJ (eds) The Prediction of Suicide. Bowie, MD: Charles Press, 1974, pp. 45–56.

Beck AT, Steer RA, Trexler LD. Alcohol abuse and eventual suicide: a 5- to 10-year prospective study of alcohol-abusing suicide attempters. J Stud Alcohol 1989; 50(3): 202–9.

Beck AT, Weissman A, Lester D, Trexler L. Classification of suicidal behaviors II: dimensions of suicidal intent. Arch Gen Psychiatry 1976; 33: 835–7.

DOI: 10.1002/mpr

Bergen H, Hawton K. Variations in time of hospital presentation for deliberate self-harm and their implications for clinical services. J Affect Disord 2007; 98: 227–37.
Bille-Brahe U, Schmidtke A, Kerkhof AJFM, De Leo D, Lönnqvist J, Platt S, Sampaio Faria J. Background and introduction to the WHO/EURO Multicentre Study on Parasuicide. Crisis 1995; 16(2): 72–8, 84.
Bille-Brahe U, Kerkhof A, De Leo D, Schmidtke A, Crepet B, Lönnqvist J, Michel K, Salander-Renberg E, Stiles TC, Wasserman H, Egebo H. A repetition-prediction study on European parasuicide populations. Part II of the WHO/Euro multicentre study on parasuicide in cooperation with the EC concerted action on attempted suicide. Crisis 1996a; 17(1): 22–31.
Bille-Brahe U, Andersen K, Wasserman D, Schmidtke A, Bjerke T, Crepet P, De Leo D, Haring C, Hawton K, Kerkhof A, Lönnqvist J, Michel K, Philippe A, Querejeta I, Salander-Renberg E, Temesvary B. The WHO-EURO Multicentre Study: Risk of parasuicide and the comparability of the areas under study. Crisis 1996b; 17(1): 32–42.
Blenkiron P, House A, Milnes D. The timing of acts of deliberate self-harm: is there any relation with suicidal intent, mental disorder or psychiatric management? J Psychosom Res 2000; 49: 3–6.
Bollen KA, Barb KH. Perason's R and coarsely categorized measures. Am Sociol Rev 1981; 46: 232–39.
Borsboom D. The Attack of the Psychometricians. Psychometrika 2006; 71(3): 425–40.
Brown GK, Henriques GR, Sosdjan D, Beck AT. Suicide intent and accurate expectations of lethality: predictors of medical lethality of suicide attempts. J Consult Clin Psychol 2004; 72(6): 1170–4.
Bushnell DM, Martin ML, Summers KH, Svihra J, Lionis C, Patrick DL. Quality of life of women with urinary incontinence: cross-cultural performance of 15 language versions of th I-QOL. Qual Life Res 2005; 14: 1901–13.
Candel MJJM. Recovering the metric structure in ordinal data: linear versus nonlinear principal components analysis. Quality & Quantity 2001; 35: 91–105.
Caprara GV, Bermúdez J, Maslach C, Ruch W. Multivariate methods for the comparison of factor structures in cross-cultural research. J Cross Cult Psychol 2000; 31(4): 437–64.
Casey PR. Personality disorder and suicide intent. Acta Psychiatr Scand 1989; 79: 290–5.
Chan W, Ho RM, Leung K, Chan DKS, Yung YF. An alternative method for evaluating congruence coefficients with Procrustes rotation: a bootstrap procedure. Psychological Methods 1999; 4(4): 378–402.
Chopin E, Kerkhof A, Arensman E. Psychological dimensions of attempted suicide: theories and data. In De Leo D, Bille-Brahe U, Kerkhof A, Schmidtke A (eds) Suicidal Behaviour. Theories and Research Findings. Göttingen: Hogrefe & Huber, 2004, pp. 41–60.
Clark LA, Watson D. Constructing validity: basic issues in scale development. Psychological Assessment 1995; 7: 309–19.
Coenders G, Saris WE. Categorization and measurement quality. The choice between Pearson and polychoric correlations. In Saris WE, Muennich A (eds) The Multitrait-Multimethod Approach to Evaluate Measurement Instruments. Budapest: Eoetvoes University Press, 1995, pp. 125–44.
Conner KR, Duberstein PR, Beckman A, Heisel MJ, Hirsch JK, Gamble S, Conwell Y. Planning of suicide attempts among depressed inpatients ages 50 and over. J Affect Disord 2007; 97: 123–8.
Corbiére M, Bisson J, Lauzon S, Ricard N. Factorial validation of a French short-form of the working alliance inventory. Int J Methods Psychiatr Res 2006; 15(1): 36–45.
Cortina JM. What is coefficient alpha? An examination of theory and applications. J Appl Psychol 1993; 78(1): 98–104.
Costello AB, Osborne JW. Best practices in exploratory factor analysis: four recommendations for getting the most from your analysis. Practical Assessment, Research & Evaluation 2005; 10(7): 1–9. Available: http://pareonline.net/pdf/v10n7.pdf [21 February 2007].
Cox III EP. The optimal number of response alternatives for a scale: a review. J Marketing Res 1980; 17: 407–22.
De Leo D, Burgis S, Bertolote JM, Kerkhof AJFM, Bille-Brahe U. Definitions of suicidal behavior. Lessons learned from the WHO/EURO multicentre study. Crisis 2006; 27(1): 4–15.
Diaz FJ, Baca-Garcia E, Diaz-Sastre C, Garcia Resa E, Blasco H, Braquehais Conesa D, Saiz-Ruiz J, De Leon J. Dimensions of suicidal behavior according to patient reports. Eur Arch Psychiatry Clin Neurosci 2003; 253: 197–202.
Didow NM, Keller KL, Barksdale HC, Franke GR. Improving measure quality by alternating least squares optimal scaling. J Marketing Res 1985; 22: 30–40.
Dunkel D, Froehlich S, Antretter E, Haring C. Replication of a two-factor model of the Beck Depression Inventory in alcohol dependents and suicide attempters. Psychopathology 2002; 35: 228–33.
Fornell C, Larcker DF. Evaluating structural equation models with unobservable variables and measurement error. J Marketing Res 1981; 18: 39–50.
Fuerntratt E. Zur Bestimmung der Anzahl interpretierbarer gemeinsamer Faktoren in Faktorenanalysen psychologischer Daten (The determination of the number of interpretable common factors in factor analysis of psychological data). Diagnostica 1969; 15: 62–75.
Gagné P, Hancock GR. Measurement model quality, sample size, and solution propriety in confirmatory factor models. Multivariate Behav Res 2006; 41(1): 65–83.
Guadagnoli E, Velicer W. A comparison of pattern matching indices. Multivariate Behav Res 1991; 26(2): 323–43.

DOI: 10.1002/mpr

Harriss L, Hawton K. Suicidal intent in deliberate self-harm and the risk of suicide: the predictive power of the Suicide Intent Scale. J Affect Disord 2005; 86: 225–33.

Harriss L, Hawton K, Zahl D. Value of measuring suicidal intent in the assessment of people attending hospital following self-poisoning or self-injury. Br J Psychiatry 2005; 186: 60–6.

Haw C, Hawton K, Houston K, Townsend E. Correlates of relative lethality and suicidal intent among deliberate self-harm patients. Suicide Life-Threat Behav 2003; 33(4): 353–64.

Hawton K. General hospital management of suicide attempters. In Hawton K, Van Heeringen K (eds) The International Handbook of Suicide and Attempted Suicide. Chichester: John Wiley & Sons, 2000, pp. 519–37.

Hawton K, Harriss L, Simkin S, Bale E, Bond A. Self-cutting: patient characteristics compared with self-poisoners. Suicide Life-Threat Behav 2004; 34(3): 199–208.

Hendriks AAJ, Perugini M, Angleitner A, Ostendorf F, Johnson JA, De Fruyt F, Hřebičková M, Kreitler S, Murakami T, Bratko D, Conner M, Nagy J, Rodriguez-Fornells A, Ruisel I. The Five-Factor Personality Inventory: cross-cultural generalizability across 13 countries. Eur J Personality 2003; 17: 347–73.

Hjelmeland H, Hawton K. Intentional aspects of non-fatal suicidal behaviour. In De Leo D, Bille-Brahe U, Kerkhof A, Schmidtke A (eds) Suicidal Behaviour. Theories and Research Findings. Göttingen: Hogrefe & Huber, 2004, pp. 67–78.

Hjelmeland H, Knizek BL, Nordvik, H. The communicative aspect of nonfatal suicidal behavior – are there gender differences? Crisis 2002a; 23(4): 144–55.

Hjelmeland H, Stiles TC, Bille-Brahe U, Ostamo A, Salander-Renberg E, Wasserman D. Parasuicide: the value of suicidal intent and various motives as predictors of future suicidal behavior. Arch Suicide Res 1998; 4: 209–25.

Hjelmeland H, Nordvik H, Bille-Brahe U, De Leo D, Kerkhof AD, Lönnqvist J, Michel K, Salander Renberg E, Schmidtke A, Wasserman D. A cross-cultural study of suicide intent in parasuicide patients. Suicide Life-Threat Behav 2000; 30(4): 295–303.

Hjelmeland H, Hawton K, Nordvik H, Bille-Brahe U, De Leo D, Fekete S, Grad O, Haring C, Kerkhof AJFM, Lönnqvist J, Michel K, Salander Renberg E, Schmidtke A, Van Heeringen K, Wasserman D. Why people engage in parasuicide: a cross-cultural study of intentions. Suicide Life-Threat Behav 2002b; 32(4): 380–93.

Hogarty KY, Hines CV, Kromrey JD, Ferron JM, Mumford KR. The quality of factor solutions in exploratory factor analysis: the influence of sample size, communality, and overdetermination. Educational and Psychological Measurement 2005; 65(2): 202–26.

Homer P, O'Brian RM. Using Lisrel models with crude rank category measures. Quality & Quantity 1988; 22: 191–201.

Horn JL. A rationale and test for the number of factors in factor analysis. Psychometrika 1965; 30: 179–85.

Huisman M. Imputation of missing item responses: some simple techniques. Quality & Quantity 2000; 34: 331–51.

Jöreskog KG, Moustaki I. Factor analysis of ordinal variables: a comparison of three approaches. Multivariate Behav Res 2001; 36(3): 347–87.

Keeley HS, McAucliffe C, Corcoran P, Perry IJ. Concordance of clinical estimation of suicidal intent. Ir J Psych Med 2002; 19(3): 84–5.

Kerkhof AJFM, Arensman E. Repetition of attempted suicide: frequent, but hard to predict. In De Leo D, Bille-Brahe U, Kerkhof A, Schmidtke A (eds) Suicidal Behaviour. Theories and Research Findings. Göttingen: Hogrefe & Huber, 2004, pp. 111–24.

Kerkhof A, Bernasco W, Bille-Brahe U, Schmidtke A, Platt S. The European Parasuicide Study. Interviewer Schedule (EPSIS Version 5.1.). University of Leiden, The Netherlands, Department of Clinical and Health Psychology, 1989.

Kerkhof AJFM, Schmidtke A, Bille-Brahe U, De Leo D, Lönnqvist J. Attempted Suicide in Europe. Findings from the Multicentre Study of Parasuicide by the WHO Regional Office for Europe. Leiden: DSWO Press, 1994.

Kingsbury SJ. Clinical components of suicidal intent in adolescent overdose. J Am Acad Child Adolesc Psychiatry 1993; 32(3): 518–20.

Levine MS. Canonical Analysis and Factor Comparison. London: Sage Publications, 1977.

Lorenzo-Seva U, Ten Berge JMF. Tucker's congruence coefficient as a meaningful index of factor similarity. Methodology 2006; 2: 57–64.

Lubke GH, Muthén BO. Applying multigroup confirmatory factor models for continuous outcomes to Likert scale data complicates meaningful group comparisons. Structural Equation Modeling 2004; 11(4): 514–34.

MacCallum RC, Widaman KF, Preacher KJ, Hong S. Sample size in factor analysis: the role of model error. Multivariate Behavioral Research 2001; 36(4): 611–37.

Maris RW, Berman AL, Silverman MM. The theoretical component in suicidology. In Maris RW, Berman AL, Silverman MM (eds) Comprehensive Textbook of Suicidology. London: The Guilford Press, 2000, pp. 26–61.

McCrae RR, Zonderman AB, Costa PT, Bond MH, Paunonen SV. Evaluating replicability of factors in the revised NEO personality inventory: confirmatory factor analysis versus Procrustes rotation. J Pers Soc Psychol 1996; 70(3): 552–66.

McDonald RP. Semiconfirmatory factor analysis: the example of anxiety and depression. Structural Equation Modeling 2005; 12(1): 163–72.

Meulman JJ, Heiser WJ. SPSS Categories 13.0. Chicago, IL: SPSS Inc., 2004.

DOI: 10.1002/mpr

Mieczkowski TA, Sweeney JA, Haas GL, Junker BW, Brown RP, Mann JJ. Factor composition of the Suicide Intent Scale. Suicide Life-Threat Behav 1993; 23(1): 37–45.

Milnes D, Owens D, Blenkiron P. Problems reported by self-harm patients. Perception, hopelessness, and suicidal intent. J Psychosom Res 2002; 53: 819–22.

Nielsen AS, Stenager E, Bille-Brahe U. Attempted suicide, suicidal intent, and alcohol. Crisis 1993; 14(1): 32–8.

Niméus A, Alsén M, Träskman-Bendz L. High suicidal intent scores indicate future suicide. Arch Suicide Res 2002; 6: 211–9.

O'Carroll PW, Berman AL, Maris RW, Mosciki EK, Tanney BL, Silverman M. Beyond the Tower of Babel: a nomenclature for suicidology. Suicide Life-Threat Behav 1996; 26: 227–35.

Perrault WD, Young FW. Alternating least squares optimal scaling: analysis of nonmetric data in marketing research. J Marketing Res 1980; 17: 1–13.

Platt S, Bille-Brahe U, Kerkhof A, Schmidtke A, Bjerke T, Crepet P, De Leo D, Haring C, Lönnqvist C, Michel J, Philippe L, Pommereau X, Querejeta I, Salander-Renberg E, Temesváry B, Wasserman D, Sampaio Faria J. Parasuicide in Europe: the WHO/EURO multicentre study on parasuicide. I. Introduction and preliminary analysis for 1989. Acta Psychiatr Scand 1992; 85: 97–104.

Preston CC, Colman AM. Optimal number of response categories in rating scales: reliability, validity, discriminative power, and respondent preferences. Acta Psychol 2000; 104: 1–15.

Ray JJ. How many answer categories should attitude and personality scales use? South African Journal of Psychology 1980; 10: 53–4.

Robinson JP, Shaker PR, Wrightsman LS. Criteria for scale selection and evaluation. In Robinson JP, Shaver PR, Wrightsman LS (eds) Measures of personality and social psychological attitudes. San Diego, CA: Academic Press, 1991, pp. 1–15.

Schmidtke A, Bille-Brahe U, De Leo D, Kerkhof A. Suicidal Behavior in Europe. Results from the WHO/EURO Multicentre Study on Suicidal Behaviour. Cambridge: Hogrefe & Huber, 2004.

Segars AH. Assessing the unidimensionality of measurement: a paradigm and illustration within the context of information systems research. Omega Int J Mgmt Sci 1997, 25(1): 107–21.

Shelby RA, Golden-Kreutz DM, Andersen BL. Mismatch of posttraumatic stress disorder (PTSD) symptoms and DSM-IV symptom clusters in a cancer sample: exploratory factor analysis of the PTSD Checklist-Civilian version. J Traum Stress 2005; 18(4): 347–57.

Silverman MM. The language of suicidology. Suicide Life-Threat Behav 2006; 36(5): 519–32.

Skegg K. Self-harm. Lancet 2005; 366: 1471–83.

Spirito A, Sterling CM, Donaldson DL. Factor analysis of the Suicide Intent Scale with adolescent suicide attempters. J Personality Assessment 1996; 67(1): 90–101.

Streiner DL. Starting at the beginning: an introduction to coefficient alpha and internal consistency. J Personality Assessment 2003; 80(1): 99–103.

Sudhir Kumar CT, Mohan R, Ranjith G, Chandrasekaran R. Characteristics of high intent suicide attempters admitted to a general hospital. J Affect Disord 2006; 91: 77–81.

Suominen K, Isometsä E, Ostamo A, Lönnqvist J. Level of suicidal intent predicts overall mortality and suicide after attempted suicide: a 12-year follow-up study. BMC Psychiatry 2004; 4(11): 1–7.

Suominen K, Isometsä E, Henriksson M, Ostamo A, Lönnqvist J. Hopelessness, impulsiveness and intent among suicide attempters with major depression, alcohol dependence, or both. Acta Psychiatr Scand 1997; 96: 142–9.

Tejedor MC, Diaz A, Castillon JJ, Pericay JM. Attempted suicide: repetition and survival – findings of a follow-up study. Acta Psychiatr Scand 1999; 100: 205–11.

Thompson B. Exploratory and Confirmatory factor analysis. Understanding Concepts and Applications. Washington, DC: American Psychological Association, 2004.

Van de Vijver FJR. Towards a theory of bias and equivalence. ZUMA-Nachrichten Spezial 1998; 41–65.

Watkins MW. Monte Carlo PCA for parallel analysis (computer software). State College, PA: Ed & Psych Associates, 2000.

Weng L-J. Impact of the number of response categories and anchor labels on coefficient alpha and test-retest reliability. Educational and Psychological Measurement 2004; 64(6): 956–72.

West SG, Finch JF, Curran PJ. Structural equation models with nonnormal variables. In Hoyle RH (ed.) Structural Equation Modeling. London: Sage Publications, 1995, pp. 56–75.

Wetzel RD. Factor structure of Beck's Suicide Intent Scales. Psychol Rep 1977; 40: 295–302.

Wrigley C, Neuhaus J. The matching of two sets of factors. Am Psychol 1955; 10: 418–9.

Zwick WR, Velicer WF. Factors influencing five rules for determining the number of components to retain. Psychol Bull 1986; 99: 432–42.

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