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Is Less More? Reevaluating the Psychometric Properties of the Sense of Coherence-13 and a Revised Seven-Item Version in South Africa Using Classical Theory and Item Response Theory

Tyrone B. Pretorius * and Anita Padmanabhanunni

Department of Psychology, University of the Western Cape, Cape Town 7535, South Africa; apadmana@uwc.ac.za
* Correspondence: tpretorius@uwc.ac.za

Abstract: Studies on the dimensionality and factor structure of the Sense of Coherence-13 (SOC-13) scale have produced inconsistent results, and there is a need for comprehensive psychometric testing of the scale in different populations and using diverse methodologies. SOC refers to the individual's ability to perceive life as comprehensible, manageable, and meaningful. The current study investigated the dimensionality of the SOC-13 through the use of confirmatory factor analysis (CFA), ancillary bifactor indices and item response theory in a sample of young adults in South Africa. Participants were students (n = 322) who completed the SOC-13, the Connor–Davidson Resilience Scale, the PTSD Checklist for DSM-5 and short forms of the Center for Epidemiological Studies Depression Scale, and the trait scale of the Spielberger State-Trait Anxiety Inventory. CFA indicated the best fit for a one-factor model, but the problematic parameter estimates raise concerns about the construct validity of the scale. Non-parametric item response theory (Mokken scale analysis [MSA]) identified limitations in the original 13-item version, suggesting a more dependable seven-item version (SOC-7). This revised scale exhibited strong psychometric characteristics and was consistent with the theoretical foundations that underpin the construct. We verified the unidimensional structure of the SOC with the more stringent parametric item-response theory (Rasch analysis) which confirmed that the seven-item SOC is unidimensional. Rasch analysis confirmed the measurement invariance of the SOC-13 in terms of gender and area of residence. The study suggests that a shorter seven-item version consisting of items from the three components of sense of coherence has comparative properties to the 13-item version but the evidence does not provide support for the use of the SOC-13 as a multidimensional measure. Research in the area of sense of coherence would benefit from further validation studies of both the original SOC-13 and the revised SOC-7, especially across populations and settings.

Keywords: dimensionality; sense of coherence (SOC-13) scale; Mokken scale analysis

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1. Introduction

The construct of sense of coherence (SOC) was introduced by Antonovsky [1] as a central part of his salutogenic model, which emphasizes factors that support health and wellbeing. SOC represents a global orientation and comprises three underlying constructs: comprehensibility, manageability and meaningfulness [1]. Comprehensibility is the cognitive component of SOC and refers to the extent to which the individual perceives internal and external stimuli as understandable, coherent and clear. Manageability is SOC's instrumental or behavioral dimension and refers to individuals' subjective sense that they either possess or lack sufficient internal and external resources to effectively manage different situations in life. Meaningfulness is SOC's motivational aspect and is more of an emotional component. It entails a felt sense that one's life is purposeful and that the problems associated with daily living are worthy of investment and commitment [2].

SOC develops early in life through formative experiences and is relatively stable throughout the life course. Although SOC is not conceptualized as a personality trait, it does bear similarities to the construct of cognitive schema [3] in that it is an enduring view of life and of the world and colors appraisals of events. According to Antonovsky, SOC influences how individuals perceive and utilize generalized resistance resources [2]. These are internal (e.g., intelligence, resilience or self-esteem) and external (e.g., social support) resources that individuals can leverage to manage stressors and challenges in life. A distinctive feature of the SOC construct is that it combines cognitive, instrumental and motivation resistance resources. Individuals with a strong SOC perceive life as more comprehensible, manageable and meaningful, thus making them more resilient to stress and enhancing their overall wellbeing.

Based on the SOC construct, Antonovsky developed the SOC-29 and the condensed SOC-13 version of the scale; he intended that the scales be scored with a single total score and not component scores [1]. Existing research [4–6] has reported that low scores on the SOC scale are reflective of psychopathology (e.g., anxiety, post-traumatic stress disorder [PTSD] and depression), while high scores are indicative of lower levels of distress or the absence of psychiatric conditions. For example, a study investigating the association between SOC and anxiety among Japanese adults [4] reported that even after adjustment for potential confounding variables, anxiety was substantially higher among those with low SOC. A meta-analytic study on the association between SOC and PTSD [5] found that reduced levels of SOC were related to lower symptom severity. Higher levels of SOC were presumed to confer resilience by enhancing individuals' appraisals of their ability to cope with adversity. A South African study [7] reported that higher levels of SOC were associated with lower levels of anxiety, depression and hopelessness. The researchers presumed that SOC influenced appraisals of stressors and belief in the capacity to cope with difficult events.

Antonovsky conceptualized the SOC-13 as unidimensional, featuring three conceptual sub-components corresponding to each of the subscales and interacting to form an overarching factor (i.e., SOC). However, subsequent studies predominantly using parametric approaches (confirmatory factor analysis [CFA] and exploratory factor analysis [EFA]) [8,9] have produced disparate results, with some studies supporting the one-factor structure and others demonstrating the theoretically derived three-factor structure of the scale, albeit with some difficulty. For example, Stern and colleagues [10] confirmed a three-factor structure among a Slovenian sample but reported that the correlations between the factors were very high. The confirmation of three-factor structure also required correlation of the residuals of two-item pairs (Item 2 and Item 4). A validation study of an Arabic adaptation of the SOC-13 [11] stated that removal of the three reversely phrased items in the scale significantly enhanced its three-factor structure. Saravia and colleagues [12] found that the three-factor solution was a better fit than the one-factor solution in a Peruvian sample. Getnet and colleagues [13] discovered that a one-factor model of the SOC with 12 items had the best fit in a sample of Eritrean refugees in Ethiopia, while Roger and colleagues [14] reported that a one-factor model with nine items had a better statistical fit. Bonachi and colleagues [15] examined the factor structure of the SOC-13 in an Italian sample and found that the one-factor model best fit the data.

Lerdal and colleagues [16] used item response theory (IRT: Rasch analysis) and reported that the goodness-of-fit analysis for the SOC-13 showed fit for 12 of the 13 items, with a minor misfit for Item 1, in a sample of adults with morbid obesity. The misfitting of Item 1 was attributed to the design of the rating scale; the SOC is scored on a seven-point rating scale where only the scale anchors of 1 and 7 are labelled (e.g., very seldom or never and very often) and hence respondents could have found it difficult to differentiate among all seven scale steps, as the scale lacks descriptive adjectives and only provides anchors for the items. Descriptive adjectives assist in clarifying the meaning of each item and without these, respondents may find it difficult to accurately differentiate between the various points on the scale. A study of healthy adults reported similar results [17]. Supporting Lerdal and colleagues' [16] conclusion, a Chinese study [18] indicated that Item 1 had the lowest factor loadings, but this was ascribed to potential cultural variations in the interpretation of items. In the Lerdal and colleagues study [16], the subscales Comprehensibility and Manageability were also reported to have low person-separation indices [16]. In a subsequent investigation, Lerdal and colleagues [19] evaluated the SOC-13 in a sample of patients with irritable bowel syndrome and found that an 11-item version of the scale had a better fit with the data. Some studies [20,21] have proposed a more parsimonious two-factor model, with one factor comprising the Comprehensibility and Manageability subscales and a second consisting of the Meaningfulness items.

In light of the varying findings on the dimensionality and factor structure of the SOC-13 across studies, populations and cultural contexts [22,23], further psychometric evaluation of the scale is essential. Studies have produced inconsistent results regardless of whether they have utilized CFA or IRT, and there is a clear need for comprehensive psychometric testing of the SOC-13 examining different populations and using diverse methodologies. The current study aims to extend research in this area by investigating the dimensionality and psychometric properties of the SOC-13 through the use of CFA, ancillary bifactor indices and non-parametric IRT (Mokken scale analysis [MSA]) as well as parametric IRT (Rasch) in a sample of young adults in South Africa.

MSA provides a non-parametric approach to evaluating the quality of a scale, allowing for the assessment of both item and scale homogeneity [24]. This technique complements parametric approaches such as CFA by offering a different lens through which to examine the data. While CFA focuses on the fit between a predetermined model and observed data, MSA focuses on the ordering or scaling of items [24]. It thereby offers insight into how well the items capture incremental levels of the underlying construct (SOC). Moreover, MSA is advantageous in that it makes fewer statistical assumptions, providing a more flexible framework for evaluating the scale in different population groups and cultural settings [25]. This feature is particularly crucial given the inconsistent findings on the SOC-13′s dimensionality across studies. To have more confidence about our findings with regard to the dimensionality of the SOC, we used the more stringent parametric item response theory, Rasch analysis, which has more restrictive assumptions than MSA.

2. Materials and Methods

2.1. Participants and Procedures

The literature suggests, as a rule of thumb, a minimum of 10 cases per indicator for CFA. For the SOC-13 with three subscales, the number of indicators is 26; thus, a minimum of 260 cases would be needed [26]. For MSA, a minimum sample of 250 participants is required to evaluate the scalability of an instrument [27]. In the case of Rasch analysis, it is suggested that a sample size between 108–243 would provide 99% confidence that the analysis would yield useful and stable estimates within 0.5 logits. An electronic version of the instruments described in the Section 2.2 was developed using Google Forms. The electronic link was emailed to 1700 randomly selected students together with a description of the study and an invitation to participate. We received 322 completed questionnaires, representing a response rate of 18.9%. Most participants were women (77%) and resided in an urban area (87.3%). The mean age of the sample was 26.01 years (SD = 10.19).

2.2. Instruments

Participants completed the following questionnaires: a brief demographic survey, the SOC-13, the Connor–Davidson Resilience Scale (CD-RISC10) [28], the PTSD Checklist for DSM-5 (PCL-5) [29], and short forms of the Center for Epidemiological Studies Depression Scale (CES-D10) [30] and the trait scale of the Spielberger State-Trait Anxiety Inventory (STAI-T5) [31].

The SOC-13 is a 13-item measure of the extent to which respondents view the world as manageable, understandable and meaningful. It has a seven-point Likert scale response format. An example item from the SOC-13 is "Do you have the feeling that you are being treated unfairly?" A 1993 review conducted by the author of the SOC-13 found estimates of internal consistency between 0.74 and 0.91 in 16 studies [1]. A more recent review (2017) found Cronbach's alphas that ranged between 0.70 and 0.92 in 127 studies [22]. The SOC-13 has been used with a sample of schoolteachers [32] and a sample of students in South Africa [33], and reliability coefficients of 0.81 were reported for both samples.

The CD-RISC10 is a 10-item version of the original 25-item measure of resilience [34]. The items of the CD-RISC10 are rated on a five-point scale with scale anchors not true at all (0) and true nearly all the time (4). An example item is "I tend to bounce back after illness, injury or other hardships." In the original study that developed the short version of the scale, the authors reported a reliability coefficient of 0.85, and the ability of CD-RISC10 scores to moderate the relationship between childhood maltreatment and current psychiatric symptoms served as evidence of construct validity [28]. In a South African study with schoolteachers, the authors used classical test theory and IRT to investigate the psychometric properties of the CD-RISC10; they reported that the instrument was unidimensional and displayed satisfactory reliability (alpha = 0.95, Mokken scale reliability = 0.95), and there was sufficient evidence of construct, convergent and criterion-related validity [32].

The PCL-5 is a 20-item measure of the presence and severity of PTSD symptoms. Responses to the 20 items are made on a five-point scale ranging from not at all (0) to extremely (4). An example PCL-5 item is "How much have you been bothered by irritable behavior, angry outbursts, or acting aggressively?" In the original validation study of the PCL-5, Blevins and colleagues reported a reliability coefficient of 0.94 and provided evidence of convergent and discriminant validity [29]. A South African study reported a reliability coefficient of 0.93 for the PCL-5 for a sample of university students [35].

The CES-D10 is a short form of the original 20-item CES-D and is a measure of symptoms of depression [36]. It consists of 10 items that are scored on a four-point scale ranging from rarely or none of the time (0) to most or all of the time (3). An example of items in the scale include "I felt that everything I did was an effort" and "I felt hopeful about the future". The authors of the short form of the CES-D reported a reliability coefficient of 0.88 and found that the short form was highly correlated with the original 20-item version (r = 0.97). In addition, they reported that the short form was as accurate as the original version in classifying respondents with depressive symptoms. In South Africa, Baron and colleagues reported reliability coefficients for the CES-D10 ranging from 0.69 to 0.89 for different language groups [37].

The STAI-T5 is a five-item version of the original 20-item trait scale of the STAI [38]. Responses to the STAI-T5 are made on a four-point scale ranging from not at all (1) to very much so (4). Examples of scale items are "I cannot get disappointments out of my mind" and "I worry about things that doesn't matter". The authors of the short form used IRT to derive a five-item unidimensional scale and reported a reliability coefficient of 0.86 for the short form. In addition, the relationship between STAI-T5 scores and measures of depression, life satisfaction and self-esteem provided evidence of external validity [31].

2.3. Ethics

The study was approved by the Humanities and Social Sciences Ethics Committee of the University of the Western Cape (ethics reference number: HS22/2/9, February 2022), and it was conducted in accordance with the guidelines of the Declaration of Helsinki. Participants provided informed consent, participation was voluntary and no identifying particulars of participants were collected.

2.4. Analysis

Responding to all items was mandatory, as participants could not proceed with the link if they had not responded to all items on a particular page. Thus, there were no missing data. All classical test theory analyses were conducted with IBM SPSS for Windows Version 28 (IBM Corp., Armonk, NY, USA). These analyses included checks of whether the data were normally distributed (indices of skewness and kurtosis), EFA, descriptive statistics (means and standard deviations) and assessments of reliability (alpha and omega) and intercorrelation between study variables (Pearson r). With respect to the distribution of data, indices of skewness between −2 and +2, and kurtosis values between −7 and +7, would indicate that the data are approximately normally distributed [39]. Factor loadings in EFA > 0.40 [40] and item-total correlations between 0.30 and 0.70 [41] would indicate substantial correlation between the items and the latent construct, which would provide evidence for construct validity.

We used CFA to test three models of the factor structure of the SOC-13: a one-factor model, a bifactor model with one general factor and three specific factors, and a correlated three-factor model. For this purpose, we used IBM SPSS AMOS for Windows Version 28 (IBM Corp., Armonk, NY, USA). The fit indices that were used to assess model fit were χ^2; the goodness-of-fit index (GFI); the comparative fit index (CFI); the Tucker–Lewis index (TLI); the root mean square error of approximation (RMSEA); and a model comparison index, Akaike's information criterion (AIC). Good fit indicators would be a non-significant χ^2 (which would, however, indicate a perfect fit [42]), GFI $\geq$ 0.95, CFI and TLI $\geq$ 0.90 and RMSEA $\leq$ 0.08. In terms of model comparison, the model with the lowest AIC value is considered to be the best model.

Since CFA only confirms the structure of an instrument and not whether the identified subscales explain a sufficient amount of variance in the items beyond that which is explained by the total scale, we used a freely available online Excel calculator to calculate ancillary bifactor indices [43]. These included explained common variance (*ECV*: the amount of variance explained by the general and specific factors, respectively) [44], omega (ω: a model-based estimate of reliability), omegaH (ωH: the amount of variance in total scores explained by the general factor) [45], the percentage of uncontaminated correlations (*PUC*: percentage of correlations between item pairs that are influenced by the general factor) and the construct replicability coefficient (H: "the correlation between a factor and an optimally weighted item-composite" p. 230) [46]. For specific factors, ωH is the amount of variance explained by the specific factor after the variance attributable to the general factor has been removed. While there are general guidelines for evaluating each of these indices individually, Reise and colleagues suggested that *PUC*, *ECV* and ωH should be considered together [47]. In this regard, Reise and colleagues have suggested that when *PUC* < 0.80, *ECV* > 0.60 and ωH > 0.70, the instrument under consideration should be regarded as essentially unidimensional, despite the presence of some dimensionality [47]. In addition, a construct replicability coefficient >0.80 reflects a latent variable that is well defined [46].

We used the monotone homogeneity model (MHM) in MSA to examine the dimensionality of the SOC-13 from an IRT perspective. MSA was conducted using the package "Mokken" [48] in R [49]. The MHM model has three assumptions: unidimensionality (the items are indicators of a single latent construct), local independence (conditional on the latent trait value of a person, the responses to different items are assumed to be independent, meaning that the latent trait value is the only source of relationship between the responses) and monotonicity (the likelihood of endorsing an item increases as the latent variable increases).

MSA uses an automated item selection procedure (*AISP*) to indicate whether an item is unscalable (0), loads on a single scale (1) or loads on multiple scales (as many values as there are scales). MSA also provides a scalability coefficient, Mokken *H*, indicating the strength of the scale: *H* below 0.40 indicates a weak scale, *H* between 0.40 and 0.50 a medium scale and *H* above 0.50 a strong scale [50]. In addition, a scalability coefficient H_i is provided for each individual item, reflecting the extent to which the individual item contributes to the measurement of the latent construct. It is suggested that H_i lower than 0.30 indicates items that do not usefully contribute to the measurement of the latent construct [24]. If a scale is unidimensional, that also implies local independence [25]. Violations of the assumption of monotonicity are evaluated in MSA using a *Crit* value. Sijtsma and van der Ark have indicated that *Crit* values above 80 represent serious violations of monotonicity, while values below 80 indicate minor and acceptable violations [51]. Lastly, MSA also provides an estimate of internal consistency, MS_{rho}.

To confirm the unidimensionality of the SOC-7, we used the more stringent Rasch analysis. In Rasch analysis, the dimensionality of an instrument is assessed with a principal component analysis (PCA) of the residuals after the presumed latent trait has been removed. If the eigenvalue associated with a presumed second dimension is greater than 2, the instrument is likely dimensional. Rasch analysis also provides an extent to which items fit the Rasch model, infit and outfit mean square (MnSq). In general, MnSq values below 0.5 and above 1.5 are indicative of misfitting items [52]. We also used the differential item functioning (DIF) measure in Rasch to assess measurement invariance in terms of gender and area of residence (rural/urban). A DIF less than 0.50 would indicate measurement invariance [52]. The Rasch analysis were conducted with Winsteps version 5.6.0 [53].

To examine the criterion-related validity of the SOC, we obtained the zero-order correlations between SOC, resilience, depression, anxiety and PTSD. We predicted that SOC would be positively related to resilience, which the literature has also identified as playing a health-protective role, and negatively related to the indices of psychological wellbeing.

3. Results

We first tested three models of the factor structure of the SOC-13: a one-factor model, a bifactor model with one general factor and three specific factors, and a correlated three-factor model. These three models are presented in Figure 1.

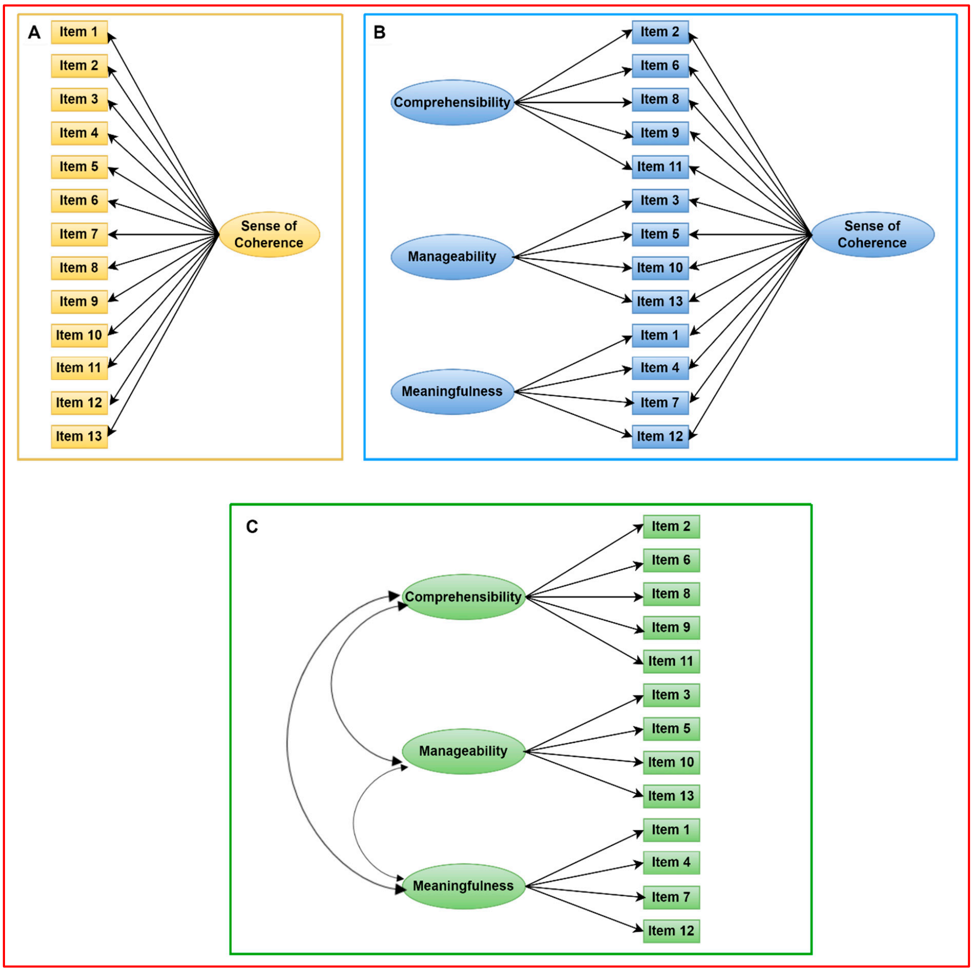

Figure 1. Three models of the factor structure of the SOC-13. Note. See Appendix A for a description of items. (**A**) = one-factor model, (**B**) = bifactor model, (**C**) = correlated three-factor model. Rectangles are observed measurements; ellipses are latent constructs.

The fit indices for the three models are in Table 1.

Table 1. Fit indices for three models of the factor structure of the SOC-13.

Fit Index	Good Fit Indicator	One Factor	Bifactor	Three Correlated Factors
χ^2 (*df*)		101.90 (57)	114.43	123.74 (61)
p-value	>0.05	<0.001	<0.001	<0.001
GFI	≥0.95	0.95	0.95	0.95
TLI	≥0.90	0.95	0.91	0.93
CFI	≥0.90	0.96	0.94	0.94
RMSEA [90% CI]	≤0.08	0.05 [0.03, 0.07]	0.06 [0.05, 0.08]	0.06 [0.04, 0.07]
AIC	lower values	169,895	194,426	183,735

Note. GFI = goodness-of-fit index, TLI = Tucker–Lewis index, CFI = comparative fit index, RMSEA = root mean square error of approximation.

Table 1 indicates that all three models fit the data to an acceptable degree (GFI ≥ 0.95, CFI and TLI ≥ 0.90, RMSEA ≤ 0.08). The model comparison index indicated that the one-factor model demonstrated the best fit (AIC = 169.90) compared to the bifactor model (AIC = 194.43) and the correlated three-factor model.

The factor loadings for the three models are presented in Table 2.

Table 2. CFA parameter estimates of three models of the factor structure of the SOC-13.

Item [1]	One Factor	Bifactor				Correlated Three Factors		
	SOC	SOC	S1	S2	S3	S1	S2	S3
1	0.40 *	0.27 *			0.40 **			0.48 **
2	0.18 *	0.37 *	0.14			0.22 *		
3	0.29 *	0.36 *		0.44 **			0.31 *	
4	0.40 *	0.25 *			0.42 **			0.49 **
5	0.46 **	0.40 **		0.31 *			0.48 **	
6	0.63 **	0.66 **	−0.26			0.63 **		
7	0.54 **	0.43 **			0.50 **			0.64
8	0.58 **	0.79 **	−0.55			0.73 **		
9	0.62 **	0.81 **	−0.55			0.76 **		
10	0.59 **	0.53 **		0.29 *			0.60	
11	0.48 **	0.50 **	−0.10			0.45 **		
12	0.67 **	0.31 *			0.48 **			0.74
13	0.77 **	0.65		0.26 *			0.78 **	

Note. [1] See Appendix A for description of items. SOC = sense of coherence total scale, S1 = Subscale 1: comprehensibility, S2 = Subscale 2: manageability, S3 = Subscale 3: meaningfulness. * $p < 0.05$, ** $p < 0.01$.

Table 2 indicates that the first four items of the total scale, in both the one-factor and the bifactor models, had parameter estimates ≤0.40 (0.18 to 0.40). In addition, Items 1 and 2 had loadings ≤0.40 on the specific factors. In the correlated three-factor model, Items 2 and 3 had factor loadings ≤0.40. In the bifactor model, four items had negative loadings on comprehensibility.

Fit indices in CFA merely indicate whether a particular factor structure fit the data to an acceptable degree and do not indicate whether the factors identified explain a meaningful amount of variance in the items. We therefore calculated ancillary bifactor indices to ascertain whether the total scale and the subscales explain a meaningful amount of variance in the items. The ancillary bifactor indices are reported in Table 3.

Table 3. Bifactor indices for the general and specific factors of the SOC-13 (*PUC* = 0.72).

Factor	*ECV*	Omega	Omega *H*	Bifactor *H*
General factor–total scale	0.643	0.86	0.739	0.87
Specific factor–comprehensibility	0.127	0.84	0.125	0.49
Specific factor–manageability	0.080	0.68	0.308	0.34
Specific factor–meaningfulness	0.150	0.64	0.672	0.51

Note. *ECV* = explained common variance. *H* = construct replicability coefficient.

The ancillary bifactor indices in Table 3 indicate that the general factor explains 64.3% of the variance in all the items and that three specific factors account for 35.7% of the variance in all the items. The *PUC* < 0.80 (0.72), *ECV* > 0.60 (0.64) and ωH of the general factor > 0.70 (0.74) indicate some dimensionality but not enough to rule out the interpretation that the scale is essentially unidimensional. In addition, the construct replicability coefficient > 0.80 (0.87) indicates the presence of a well-defined latent variable. The model-based estimates of internal consistency (omega) for two subscales were below the acceptable standard for reliability (0.70).

We used MSA to confirm the unidimensionality of the SOC-13 and the contribution of each item to the measurement of the latent construct. From the perspective of classical test theory, we also obtained the factor loadings (λ) in EFA as well as item-total correlations (*ITC*), only for those items identified by MSA as well-functioning items. The results are presented in Table 4.

Table 4. Mokken scale analysis and classical test theory indices for the SOC-13 and the SOC-7.

Item [1]	*AISP*	Mokken H_i	*SE*	*Crit*	λ	*ITC*
1	0	0.24	0.04	42		
2	2	0.15	0.04	72		
3	2	0.21	0.04	37		
4	0	0.24	0.03	0		
5	1	0.27	0.03	0		
6	1	0.33	0.03	0	0.65 **	0.59 **
7	1	0.31	0.03	0	0.50 **	0.46 **
8	1	0.34	0.03	10	0.67 **	0.59 **
9	1	0.36	0.03	8	0.69 **	0.61 **
10	1	0.34	0.03	0	0.57 **	0.52 **
11	1	0.26	0.04	17		
12	1	0.36	0.03	0	0.63 **	0.57 **
13	1	0.40	0.03	0	0.76 **	0.68 **

Note. [1] See Appendix A for description of items. ** $p < 0.01$. *AISP* = automated item selection procedure, H_i = Mokken *H* coefficient for individual items, *SE* = standard error of H_i, *Crit* = crit value for monotonicity, λ = factor loadings, *ITC* = item-total correlations.

We found an overall Mokken *H* coefficient of 0.30 for the SOC-13, reflecting a very weak scale. The *AISP* indicated that Items 1 and 4 were not Mokken-scalable with the MHM and that Items 2 and 3 loaded on a different MHM scale. Since a two-item scale is not a viable option, this would imply that the nine-item MHM scale is the major Mokken scale. While Items 5 and 11 loaded on the scale, the Mokken H_i values for these items were below the recommended 0.30 limit, indicating that these items do not make a significant contribution to the measurement of the latent construct. There were also violations of monotonicity for all items, but as the *Crit* values were all below 80, these may be considered minor violations of monotonicity. Six items that were unscalable, loaded on a different scale or had Mokken H_i coefficients below 0.30 were consequently excluded, and the resultant MSA of the remaining seven items produced an overall Mokken *H* of 0.43, indicating a medium scale. The Mokken H_i coefficients for the seven items ranged between 0.35 and 0.49, and there was only one minor violation of monotonicity with a *Crit* value of 5. The factor loadings and item-total correlations were determined for the remaining seven items. Table 4 indicates that all λ were ≥0.50 (0.50 to 0.76) and that all *ITC* were >0.40 (0.46 to 0.68), reflecting substantial correlations between the items and the latent construct. Despite the exclusion of the six items, the remaining seven items still contained indicators of comprehensibility (three items), manageability (two items) and meaningfulness (two items). A CFA of the seven-item SOC with standardized regression coefficients is presented in Figure 2.

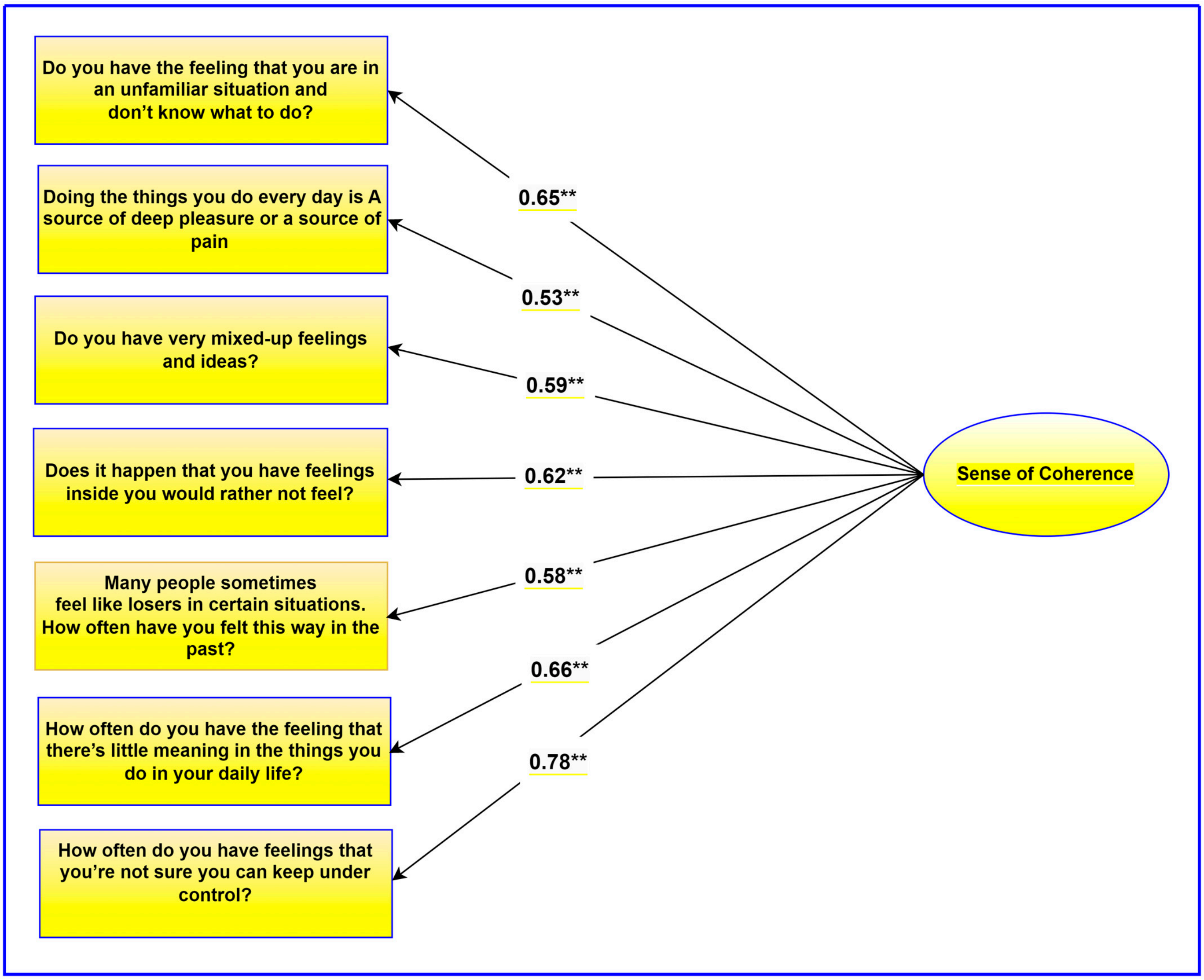

Figure 2. A one-factor model of the SOC-7. Note. Rectangles are observed variables; ellipses are latent variables. Regression coefficients are standardized. ** $p < 0.01$.

As can be seen in Figure 2, all regression coefficients were above 0.40 and ranged between 0.53 and 0.78, demonstrating strong factor loadings.

A PCA of the standardized residuals, after the Rasch dimension was removed, found that the eigenvalue of a presumed second dimension was 1.79 (<2), thus confirming that the SOC-7 is unidimensional. The infit MnSq values ranged between 0.79 and 1.17 while the outfit MnSq values ranged between 0.78 and 1.23; thus, there were no misfitting items in the Rasch dimension. Lastly, DIF values for gender ranged between −0.14 and 0.20, while for area of residence they ranged between − 0.05 and 0.06. These DIF values, which were all below 0.50, provide evidence of measurement invariance.

The indices of skewness and kurtosis, descriptive statistics, reliabilities and intercorrelations between variables are reported in Table 5.

Table 5. Intercorrelations, indices of skewness and kurtosis, descriptive statistics and reliabilities of study variables.

Variables	1	2	3	4	5	6
1. Sense of Coherence-13	—					
2. Sense of Coherence-7	0.96 **	—				
3. Resilience	0.48 **	0.46 **	—			
4. Depression	−0.69 **	−0.65 **	−0.51 **	—		
5. Anxiety	−0.63 **	−0.63 **	−0.50 **	0.66 **	—	
6. PTSD	−0.68 **	−0.63 **	−0.46	0.68 **	0.66 **	—
Skewness	0.23	0.23	−0.28	0.05	0.03	−0.02
Kurtosis	−0.16	−0.48	−0.49	−0.73	−0.88	−0.90
Mean	47.63	25.49	25.60	14.15	12.36	38.46
Standard deviation	12.92	8.85	8.12	6.77	4.13	18.98
α	0.83	0.83	0.90	0.84	0.88	0.94
ω	0.84	0.83	0.90	0.85	0.88	0.94
MS_{rho}	0.83	0.82				

** $p < 0.001$.

The indices of skewness and kurtosis fell within the recommended range (skewness: −2 to +2; kurtosis: −7 to +7), indicating that the data were approximately normally distributed. The reliabilities of all scales were satisfactory (α and ω = 0.83 to 0.94; MS_{rho} = 0.82 and 0.83).

Table 5 further indicates that both the SOC-13 and the SOC-7 were positively associated with resilience (r = 0.48 and 0.46, respectively, $p < 0.001$, medium effect size) and negatively associated with depression (−0.69 and −0.65, respectively, $p < 0.001$, large effect size), anxiety (−0.63 for both, $p < 0.001$, large effect size) and PTSD (−0.68 and −0.63, respectively, $p < 0.001$, large effect size). The correlations with these variables were very similar for the SOC-13 and the SOC-7, and in one instance the correlation was identical. Fisher's z-test indicated no statistical difference between the SOC-13 and the SOC-7 in terms of the correlation with resilience (z = 0.32, p = 0.749), depression (z = 0.92, p = 0.358) and PTSD (z = 1.11, p = 0.267). Lastly, there was a substantial correlation between the SOC-13 and the SOC-7 (r = 0.96, $p < 0.001$).

4. Discussion

Existing studies investigating the factor structure of the SOC-13 have produced conflicting results [13,19,23]. Hence, the current study aimed to extend research on the dimensionality of the scale using classical test theory, ancillary bifactor indices and a non-parametric IRT approach. There were several salient findings. CFA fit indices indicated that a one-factor structure, a bifactor structure and a correlated three-factor structure fit the data to an acceptable degree but that the one-factor model had the best fit. This aligns with Antonovsky's original conceptualization of SOC as a unidimensional construct [1] but contrasts with some prior studies that have supported a three-factor structure [10,11]. These disparate findings in the literature may be attributed to population differences or methodological variations, and the present study contributes additional insights into the factor structure of the scale. The parameter estimates for some of the items in all three CFA models, however, were problematic: Some were very low, and some were negative. This echoes concerns voiced in a study by Lerdal et al. [16], where the goodness-of-fit analysis showed fit for only 12 of the 13 items. Our results may indicate that different aspects of SOC are being amplified in the current context and among the population group. Low and negative parameter estimates are concerning, as they undermine the construct validity of the scale. Negative loadings can imply that some items of the scale are not measuring the intended construct effectively, and the very low loadings suggest that some items may not be contributing meaningful information.

Ancillary bifactor indices indicated that there the scale was not likely to be multidimensional and that the scale should essentially be regarded as unidimensional. In this regard, after accounting for the reliable systematic variance due to the general factor, the specific factors did not account for a meaningful amount of variance. The construct replicability coefficient for the general factor indicated a strong latent variable. These findings support Antonovsky's [1] argument that on theoretical grounds it is not advisable to isolate individual dimensions of the SOC scale for separate examination. Antonovsky also stressed that the three components of the scale should not be used as subscales because they are dynamically interrelated.

MSA identified that the 13 items of the SOC-13 constituted a weak scale, and there were six items that were either unscalable, loaded on separate scale or had Mokken H_i coefficients below the recommended 0.30. This partially aligns with findings by Lerdal and colleagues, who suggested an 11-item version for a more suitable fit [19]. These six items were consequently excluded, and the remaining seven items reflected a medium scale, with acceptable Mokken H_i coefficients. Factor loadings in CFA and item-total correlations indicated that all seven items were substantially correlated with the latent construct, thus supporting construct validity for the seven-item version. Rasch analysis provided further evidence for the unidimensionality and validity of the SOC-7. A PCA of the standardised residuals indicated only one meaningful dimension; there were no misfitting items and DIF supported measurement invariance. The SOC-7 still contained indicators of comprehensibility, manageability and meaningfulness. These findings indicate that the revised SOC-7 could be a more reliable and valid measure than the original SOC-13.

The correlation of the SOC-7 with resilience, depression, anxiety and PTSD provided evidence for the criterion-related validity of the scale. This means that the scale is measuring what it is intended to measure, and it can be considered a valid tool for assessing SOC. As expected, the SOC-7 was positively related to resilience and negatively related to depression, anxiety and PTSD. This pattern of correlations aligns closely with previous findings [4,5,54] for the SOC-13, which has also been observed to have a positive relationship with resilience and negative relationships with variables such as depression, PTSD and anxiety. For example, Ushida and colleagues [4] investigated the association between SOC and anxiety among adults in all prefectures of Japan and found that low SOC was associated with higher levels of anxiety. Pachi and colleagues [55] assessed the role of SOC in the relationship between burnout and depression among nurses during the pandemic and reported that it had a moderating effect (i.e., higher levels of SOC weakened the impact of burnout and the likelihood of developing depression). The fact that the SOC-7 retains its expected correlations with these other constructs, even after removal of problematic items, adds confidence that the shortened scale still captures the essence of the original SOC-13 scale.

These findings have potential implications. For practitioners, the problematic parameter estimates for some of the items of the SOC-13 mean that caution should be exercised when using the scale for assessment or intervention, particularly within the South African context. The scale may not be capturing the construct as intended, which could lead to incorrect conclusions or ineffective interventions. Given the disparity between the MSA and CFA results for the full SOC-13, additional validation studies are needed, especially to test the revised SOC-7 across populations and settings. The relationships between the SOC-7 and other constructs (i.e., resilience, depression, anxiety and PTSD) can have practical utility in both clinical and research settings. For example, the SOC-7 could be used as a predictor or outcome variable in studies or interventions aimed at improving resilience or reducing psychological distress.

The study had certain limitations. The low and negative CFA parameter estimates, which could be indicative of issues with the model, raise questions about the validity and reliability of the results and the need for more testing within the current context. Although the SOC-7 demonstrated good criterion-related validity with measures such as resilience and mental health outcomes, these are not exhaustive of all possible criterion variables. Future research evaluating the criterion validity of the scale using different constructs is recommended. While the SOC-7 scale seemed to have better psychometric properties than the SOC-13, it is unclear how well this revised version generalizes to other populations within South Africa or more broadly, and further investigation is needed. The sample was disproportionately female and most participants resided in an urban area. This may have implications for the generalizability of our findings.

5. Conclusions

The current study contributes to the ongoing debate surrounding the psychometric properties and dimensionality of the SOC-13. The CFA indicated the best fit for a one-factor model, but the problematic parameter estimates of some items—ranging from very low to negative values—raise concerns about the construct validity of the scale, particularly in the South African context. Ancillary bifactor indices underscore Antonovsky's assertion that the scale is essentially unidimensional and its components are dynamically interrelated, making it inappropriate to analyze individual dimensions separately. MSA revealed weaknesses in the original 13-item version, pointing to a need for the more dependable seven-item version (SOC-7), which not only demonstrated robust psychometric properties but also aligned with the theoretical foundations underlying the construct. Given these findings, practitioners may need to exercise caution when employing the SOC-13 in assessments or interventions in South Africa. The conflicting outcomes between the MSA and CFA call for further validation studies of both the original SOC-13 and the revised SOC-7, especially across populations and settings. This study marks a pivotal step toward refining the SOC scale for more reliable and valid applications in diverse contexts.

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Appendix A

Table A1. Items of the SOC-13.

Item	Dimension	Item Wording and Response Format	Decision
1	ME	Do you get the feeling that you don’t really care about what goes on around you? 1 Very seldom or never; 2; 3; 4; 5; 6; 7 Very often	Excluded–not scalable
2	CO	Has it happened in the past that you were surprised by the behavior of people you thought you knew? 1 Never happened; 2; 3; 4; 5; 6; 7 Always happened	Excluded–different scale
3	MA	Has it happened that people you counted on disappointed you? 1 Never happened; 2; 3; 4; 5; 6; 7 Always happened	Excluded–different scale
4	ME	Until now your life has had 1 No clear goals or purpose; 2; 3; 4; 5; 6; 7 Very clear goals and purpose	Excluded–not scalable
5	MA	Do you have the feeling that you have been treated unfairly? 1 Very often; 2; 3; 4; 5; 6; 7 Very seldom or never	Excluded–$H_i < 0.30$
6	CO	Do you have the feeling that you are in an unfamiliar situation and don’t know what to do? 1 Very often; 2; 3; 4; 5; 6; 7 Very seldom or never	Retained

Table A1. *Cont.*

Item	Dimension	Item Wording and Response Format							Decision
7	ME	Doing the things you do every day is							Retained
		1 A source of deep pleasure and satisfaction	2	3	4	5	6	7 A source of pain and boredom	
8	CO	Do you have very mixed-up feelings and ideas?							Retained
		1 Very often	2	3	4	5	6	7 Very seldom or never	
9	CO	Does it happen that you have feelings inside you would rather not feel?							Retained
		1 Very often	2	3	4	5	6	7 Very seldom or never	
Item	Dimension	Item wording and response format							Decision
10	MA	Many people—even those with a strong character—sometimes feel like losers in certain situations. How often have you felt this way in the past?							Retained
		1 Never	2	3	4	5	6	7 Very often	
11	CO	When something happened, have you generally found that							Excluded–$H_i < 0.30$
		1 You overestimated or underestimated its importance	2	3	4	5	6	7 You saw things in the right proportion	
12	ME	How often do you have the feeling that there's little meaning in the things you do in your daily life?							Retained
		1 Very often	2	3	4	5	6	7 Very seldom or never	
13	MA	How often do you have feelings that you're not sure you can keep under control?							Retained
		1 Very often	2	3	4	5	6	7 Very seldom or never	

Note. CO = comprehensibility, MA = manageability, ME = meaningfulness.

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