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Assessing the cognitive component of subjective well-being: Revisiting the satisfaction with life scale with classical test theory and item response theory

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Life satisfaction is generally regarded as the cognitive component of subjective well-being, as opposed to positive and negative affect, which are regarded as the affective components. This topic has been extensively studied worldwide and has been linked to a variety of outcomes related to the work context as well as psychological well-being. In this study, we examine the psychometric properties of the Satisfaction with Life Scale (SWLS), one of the most widely used measures of life satisfaction, using three different approaches: classical test theory, Rasch analysis and Mokken analysis. Combining these three approaches provides a more comprehensive validation of an instrument. In this study, schoolteachers (*n* = 355) completed the SWLS, the trait scale of the State-Trait Anxiety Inventory, the Center for Epidemiological Studies Depression Scale, the Beck Hopelessness Scale and the University of California, Los Angeles Loneliness Scale. The three approaches confirmed the reliability, validity and unidimensional nature of the SWLS, thus supporting its continued use as a measure of life satisfaction in the South African context.

Keywords: Mokken analysis; Rasch analysis; classical test theory; satisfaction with life scale; reliability; validity.

Introduction

Positive psychology is a movement based on the seminal work of Seligman and others (e.g. Seligman, 2002; Seligman & Csikszentmihalyi, 2014), which sparked renewed interest in focusing on what can go right rather than what can go wrong, also known as psychological strength. During the Tanner Lecture Series at the University of Michigan, Seligman (2010) bemoaned psychology's obsession with 'what is wrong with life: suicide, depression, schizophrenia, and all the brick walls that can fall on you' (p. 232) and '[we] tried to create a field in which we asked the question, "what makes life worth living, and how can we build it?"' (p. 232) This sparked interest in research on positive psychological variables such as happiness, life satisfaction and subjective well-being. These terms are often used interchangeably. For example, in a multination study of subjective well-being worldwide, life satisfaction and happiness were used as variables with which to compare different types of economic systems in terms of subjective well-being (Tsai, 2009).

Whilst life satisfaction and happiness are often used as equivalents to subjective well-being, the latter concept is generally regarded as a multidimensional concept that consists of both affective and cognitive dimensions (Pavot & Diener, 2008). In this context, positive and negative affect are typically regarded as the affective components, whereas life satisfaction is regarded as the cognitive dimension (Prasoon & Chaturvedi, 2016). In this regard, Diener, Emmons, Larsen and Griffin (1985) described life satisfaction as a cognitive judgement of people's level of satisfaction based on a comparison with a standard. Moreover, a meta-analytic review provided some evidence for the hierarchical conceptualisation of subjective well-being and showed that positive affect, negative affect and life satisfaction load on a latent subjective well-being construct (Busseri, 2018). Busseri (2018) used meta-analytic correlations to estimate a latent subjective well-being factor, which had moderate to strong loadings on positive and negative affect as well as life satisfaction.

Life satisfaction is linked to a wide variety of outcomes related to the work context and psychological well-being. It has also been found to be negatively associated with depression, anxiety and stress in migrant and nonmigrant samples in the United States of America and Russia (Brailovskaia, Schönfeld, Kochetkov, & Margraf, 2019), as well as in university students in Brazil (Lopes & Nihei, 2021) and school students in China (Tang, Xiang, Cheung, & Xiang, 2021). In a study on work–

family conflict and its correlates, it was found that respondents with high levels of work–family conflict have decreased levels of life satisfaction (Cazan, Truţă, & Pavalache-Ilie, 2019). The same study also revealed positive correlations between life satisfaction and psychological well-being and positive affectivity, as well as a negative correlation with negative affectivity. Amongst the work-related variables that have been found to be associated with life satisfaction are job satisfaction and workplace attachment (Cazan et al., 2019), turnover intentions (Lin, Hu, Danaee, Alias, & Wong, 2021; Ohunakin, Adeniji, Oludayo, Osibanjo, & Oduyoye, 2019) and innovative work behaviour and job performance (Chughtai, 2021). Overall, life satisfaction has been found to be related to a vast range of organisational and health-related variables.

The Satisfaction with Life Scale (SWLS) is arguably the most extensively used measure of life satisfaction and has, in fact, been described as the gold standard for measuring life satisfaction (Kaczmarek, Bujacz, & Eid, 2015). This scale has been used in various countries and is available in several languages (e.g. Dutch: Van Loon, Tijhuis, Surtees, & Ormel, 2001; Spanish: Extremera & Fernandez-Berrocal, 2005; Japanese: Oishi & Sullivan, 2005; Korean: Cha, 2003; and Chinese: Liang & Zhu, 2015). Notably, the psychometric properties of the SWLS are largely based on classical test theory (CTT). For example, in the original study of the scale development, the authors reported a test–retest reliability and an alpha coefficient of 0.82 and 0.87, respectively. Exploratory factor analysis (EFA) resulted in a single factor extracted that explained 66% of the variance, and validity was established through positive correlations between the SWLS and a range of other measures of subjective well-being (Diener et al., 1985). Similarly, other studies have reported satisfactory reliability, validity and evidence for the unidimensionality of the SWLS based on the CTT in other cultures (e.g. Mexico: López-Ortega, Torres-Castro, & Rosas-Carrasco, 2016; Iran: Maroufizadeh, Ghaheri, Samani, & Ezabadi, 2016; and Pakistan: Barki, Choudhry, & Munawar, 2020).

Relatively few studies have employed item response theory (IRT), either parametric or nonparametric. Oishi (2006) examined the cross-cultural equivalence of the SWLS between American and Chinese samples, using the two-parameter logistic model of the IRT. They found that the item difficulty estimates of two of the items of the SWLS were different between the two groups. They also found that the mean satisfaction score of the American sample was substantially higher than that of the Chinese sample. Several studies have also examined the psychometric properties of the SWLS using Rasch analysis (e.g. Akif, 2021; Løvereide & Hagell, 2016; Schutte, Negri, Delle Fave, & Wissing, 2021) but with mixed results. Schutte et al. (2021) found that the results supported the unidimensional structure of the SWLS, that one item did not fit the model and that there was no differential item functioning (DIF) between South African and Italian samples. However, Akif (2021) and Løvereide and Hagell (2016) found that the IRT supported the reliability of the scale and that all items fitted the model well. Both Schutte

et al. (2021) and Løvereide and Hagell (2016) suggested the use of fewer response categories, rather than the seven-point Likert scale, which is the current format of the SWLS. To a certain extent, Oishi (2006) and Akif (2021) used a combination of both CTT and parametric IRT to examine the psychometric properties of the SWLS. In both studies, the authors used EFA and confirmatory factor analysis (CFA) to confirm the unidimensionality of the scale, in addition to an IRT analysis. Only one study was found that used a combination of CTT, parametric IRT and nonparametric IRT to examine the SWLS (Avşar, 2021). However, this was not, strictly speaking, an examination of the psychometric properties of the SWLS but rather an examination of the impact of excluding participants who provided aberrant responses to items of the SWLS. The results demonstrated that after the aberrant individuals were excluded, a better fit was obtained for the CFA, Mokken model and graded response model.

In this study, the reliability, validity and dimensionality of the SWLS are examined from three perspectives: CTT, parametric IRT (Rasch analysis) and nonparametric IRT (Mokken analysis). Generally, combining the IRT and CTT provides a comprehensive picture of the psychometric properties of an instrument (Akif, 2021; Oishi, 2006). For example, Oishi (2006) found that if only structural equation modelling was used in the analysis of the SWLS, they would have erroneously concluded that only one item of the SWLS had DIF, whereas IRT revealed that four items had DIF. In CTT, the instrument is the unit of analysis, whereas in IRT, the item is the unit of analysis. In this regard, CTT focuses more on instrument-level indices such as reliability or standard error of a scale, whilst IRT, as its name indicates, focuses more on item-level indices such as item difficulty and DIF (Abedalaziz & Leng, 2018). Moreover, IRT indices are less sample dependent than CTT indices. In this regard, Magno (2009) empirically demonstrated that unlike CTT, item difficulty indices and estimates of reliability in IRT were more stable across different samples. In addition, IRT provides information regarding person–item interactions which is not provided by CTT (Akif, 2021; Oishi, 2006). Mokken analysis is a non-parametric alternative to Rasch analysis; thus, it has fewer assumptions than Rasch analysis. In addition, the Rasch model assumes that all items have the same response function. Item response function refers to the probability that respondents with a high level of the latent trait will endorse an item whilst respondents with a lower level of the latent trait will not endorse the item. In Mokken analysis, no such assumption is made, and the item response function could differ for different items. Hence, using more than one approach provides a comprehensive picture of the instrument under investigation.

Method
Participants

Both primary and secondary schoolteachers (*n* = 355) from across South Africa participated in this study. Most of them

were based in the province of the Western Cape (82.3%) and taught primary school students (61.1%). The sample was largely urban in nature (61.7%) and women (76.6%), and the mean age of the sample was 41.9 years (± 12.4). The mean number of years that the participants have worked in the field of teaching was 15.7 years (± 11.8).

Instruments

All participants completed the following instruments: a brief demographic survey, the SWLS (Diener et al., 1985), the trait scale of the State-Trait Anxiety Inventory (STAI-T; Spielberger, 1988), the Center for Epidemiological Studies Depression Scale (CES-D; Radloff, 1977), the Beck Hopelessness Scale (BHS; Beck, Weissman, Lester, &Trexler, 1974) and the University of California, Los Angeles Loneliness Scale (UCLA-LS; Russell, 1996). As indicated, the SWLS measures the cognitive component of subjective well-being and consists of five items scored on a 7-point Likert scale, ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). The SWLS has generally demonstrated satisfactory psychometric properties, as previously indicated. Pavot and Diener (2008) provided an extensive review of the psychometric properties of the SWLS up until 2008. They also confirmed that factor analytic studies have replicated the one-factor structure of the scale. However, they highlighted that Item 5 ('If I could live my life over, I would change almost nothing') typically has lower factor loadings and item-total correlations than those of the rest of the items. However, they argue for the retention of Item 5 based on its high correlation with the other items. More recent studies have also confirmed the satisfactory psychometric properties of the SWLS. For example, López-Ortega et al. (2016) reported a reliability coefficient of 0.74. Moreover, in terms of validity, they found that the SWLS significantly correlates with depression and perceived health, amongst other factors. They also confirmed the single-factor structure through an EFA. Similarly, Barki et al. (2020) reported a reliability estimate of 0.89 and found that the SWLS significantly correlates with anxiety and depression. They also confirmed the unidimensional structure with a CFA. Other researchers have also used the SWLS in South Africa and reported satisfactory internal consistency reliability (Padmanabhanunni & Pretorius, 2021a).

The STAI-T is a measure of trait anxiety that consists of 20 items scored on a 4-point Likert scale, ranging from 1(*almost never*) to 4 (*almost always*). A favourable estimate of reliability has been reported both in the original study ($\alpha = 0.86$–0.92; Spielberger, 1988) and in more recent studies (e.g. Bee Seok, Abd Hamid, Mutang, & Ismail, 2018; Hallit et al., 2020; Stojanović et al., 2020). In South Africa, the STAI-T has also demonstrated satisfactory reliability when used with students (Pretorius & Padmanabhanunni, 2021) as well as with a manganese-exposed community when translated into several South African languages (Racette et al., 2021).

The CES-D is a widely used 20-item measure of depressive symptomology relying on a 4-point scale with response options ranging from zero (*rarely or none of the time*) to three (*most of or all the time*). This measure has generally demonstrated satisfactory internal consistency (e.g. Ilic, Babic, Dimitrijevic, Ilic, & Grujicic, 2019; Nia et al., 2019; Singh, Zaki, Farid, & Kaur, 2021). In South Africa, Hassem (2021) developed a 19-item adapted version of the CES-D to be used as an online screening tool for depression. The CES-D has also been used to assess depression in students (Padmanabhanunni & Pretorius, 2020; Pretorius, 1991) and teachers (Padmanabhanunni, Pretorius, Stiegler, & Bouchard, 2022), and it has generally demonstrated satisfactory internal consistency.

The BHS is a 20-item self-report measure of hopelessness scored on a dichotomous true-or-false response format. Satisfactory reliability estimates have been reported for the BHS both in the original study (Kuder-Richardson -20 = 0.93; Beck et al., 1974) and in several different contexts (e.g. Colombia: Kocalevent et al., 2017; Nigeria: Aloba, Olabisi, Ajao, & Aloba, 2017; and Japan: Sueki, 2020). Similar satisfactory estimates of reliability have also been reported for student samples in South Africa (Heppner, Pretorius, Wei, Lee, & Wang, 2002; Padmanabhanunni & Pretorius, 2021b).

The UCLA-LS is a 20-item self-report measure of loneliness scored on a 4-point Likert scale ranging from 1 (*I never feel this way*) to 4 (*I often feel this way*). The author of the UCLA-LS reported alpha coefficients ranging between 0.89 and 0.94 for different samples of students, nurses, teachers and older individuals. In more recent studies, the UCLA-LS has consistently demonstrated satisfactory reliability (e.g. Arimoto & Tadaka, 2019; Zeas-Sigüenza, Oliveira, Ferreira, Ganho, & Ruisoto, 2021). The UCLA-LS has also demonstrated acceptable reliability in South Africa (Padmanabhanunni & Pretorius, 2021c; Pretorius, 1993). In a study in South Africa, Pretorius (2022) examined the dimensionality of the UCLA-LS using CFA and bifactor indices and concluded that it is best used as a total scale with three subscales.

Procedure

An electronic version of the above-mentioned instruments was first constructed using Google Forms. Then, a Google link was posted on teacher Facebook groups after permission was obtained from the administrators of these sites. The school liaison officers of the university also sent the link to schools with which they had a working relationship.

Data analysis

IBM SPSS Statistics version 27 for Windows (IBM Corp., Armonk, NY, USA) was used to perform the CTT analyses, and IBM SPSS Amos version 27 (IBM Corp.) was used to conduct CFA. In addition, Winsteps version 5.1.4 (Linacre, 2021a) was used to perform the Rasch analysis, and

R (R Core Team, 2017) was used to conduct the Mokken analysis with the 'Mokken' package (Van Der Ark, 2012).

The reliability of the SWLS was assessed in terms of Cronbach's alpha (α), composite reliability (CR) and Mokken scale reliability (MS_{rho}). Conventionally, a reliability coefficient greater than 0.70 is considered evidence of satisfactory reliability (Taber, 2018).

To determine the construct validity of the SWLS, the item-total correlations (CTT), item and person separation indices (Rasch analysis) and scalability coefficients for each item (H_i, Mokken analysis) were evaluated. In general, item-total correlations greater than 0.50 (DeVon et al., 2007, Hajjar, 2018) indicate that all items contribute to the measurement of the latent construct (i.e. life satisfaction). The H_i coefficient serves the same function as the item-total correlations in the sense that it indicates the extent to which each item contributes to the total scale. According to Mokken (1971), H_i coefficients greater than 0.30 indicate well-fitting items that contribute to the measurement of the latent construct. With regard to person and item separation indices, Linacre (2021b) recommends that a person separation index of > 2 together with person reliability of > 0.80 and an item separation index of > 3 together with item separation reliability of > 0.80 are acceptable. If these criteria are met, this would indicate that the scale can distinguish between different levels of 'performers' (i.e. those with high and low scores on the latent construct–person separation) and that an item difficulty hierarchy exists (item separation). For each item, the Rasch analysis also provides fit statistics called the infit and outfit mean square (*MnSq*), which is used to determine the extent to which each item fits the Rasch model. Linacre (2021b) suggested that mean square values below 0.50 and above 1.5 are indicative of misfitting items. Mokken analysis also provides an indication of whether items discriminate between participants who have high or low levels of life satisfaction (monotonicity) and whether there are items that respondents with the same level of life satisfaction may have endorsed in significantly different ways (invariant item ordering [IIO]; Sijtsma & Van Der Ark, 2017). For these two assumptions, monotonicity and IIO, Mokken analysis provides a *Crit* value, which is used to assess potential violations. According to Sijtsma and Van Der Ark (2017), a *Crit* value greater than 80 indicates serious violations, whereas a *Crit* value between 40 and 80 indicates minor but acceptable violations. To assess the measurement invariance between men and women, DIF was calculated using Rasch analysis. In this context, a DIF value smaller than 0.50 would indicate that the items measure the same construct across different groups (Linacre, 2021b). Given reported findings that women generally reported higher levels of life satisfaction (e.g. Joshanloo & Jovanović, 2020), it is important to demonstrate that the SWLS measures the same construct in the two groups.

Other types of construct validity include convergent, discriminant and concurrent validity. Firstly, to demonstrate convergent validity, the average variance extracted (AVE), CR and factor loadings were used. In general, significant factor loadings (Posch et al., 2019), an AVE value greater than 0.50 and an AVE value smaller than the CR value are evidence of convergent validity. Secondly, with regard to discriminant validity, an AVE value greater than the maximum shared variance (MSV) and average shared variance (ASV) is indicative of discriminant validity. This is because it indicates that the latent construct explains a greater proportion of the variance in the items that contribute to its measurement compared with the proportion of variance shared with other related constructs (Almén, Lundberg, Sundin, & Jansson, 2018). Finally, concurrent validity was established through the associations between life satisfaction and the indices of psychological distress which have been consistently linked to life satisfaction in the literature, namely anxiety, hopelessness, loneliness and depression (e.g. Brailovskaia et al., 2019; Tang et al., 2021).

The dimensionality of the SWLS was evaluated using all three approaches. To perform a factor analysis, both EFA (principal axis) and CFA were conducted. However, before the EFA was conducted, the suitability of the data for factor analysis was examined using the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity. In general, a KMO value above 0.5, both at scale level and individual item level, and a significance level for Bartlett's test below 0.05 suggests a substantial correlation in the data. Thus, it would be appropriate to proceed with factor analysis (Hadi, Abdullah, & Sentosa, 2016). The following fit indices were used in the CFA to measure the model fit (Kline, 2005): chi-square (χ^2, best if $p > 0.05$), comparative fit index (CFI, best if above 0.90), root-mean-square error of approximation (RMSEA, best if below 0.08), the Tucker–Lewis index (TLI, best if above 0.90) and the goodness-of-fit index (GFI, best if above 0.95). Mokken analysis provides an algorithm, an automated item selection procedure (AISP) that partitions items into scales. Items that are not selected through the AISP are regarded as unscalable (Sijtsma & Van Der Ark, 2017). In addition to providing an *H*-coefficient for each item (H_i), Mokken analysis also provides a scalability coefficient (*H*) for the entire scale to reflect the strength of the scale. The following rule of thumb is typically used to evaluate *H*: $H \geq 50$ reflects a strong scale, $0.40 \leq H < 0.50$ reflects an intermediate scale and $H < 0.40$ reflects a weak scale (Wind, 2017). After the presumed latent trait is removed, a principal component analysis (PCA) of the residuals is used in the Rasch analysis to detect multidimensionality. If a possible additional dimension, as indicated by the PCA (called the 'first contrast'), has an eigenvalue of > 2, then this suggests two or more items loading on a possible second factor, thus indicating multidimensionality (Linacre, 2021b).

Ethical considerations

Ethical approval for this study was obtained from the Humanities and Social Sciences Ethics Committee of the University of the Western Cape (reference number: HS21/3/8).

Participation was voluntary, and all participants provided informed consent before they were allowed to proceed with the electronic survey.

Results

Table 1 shows the reliabilities, descriptive statistics and intercorrelations between the study variables. Overall, the reliabilities of all scales can be considered to be satisfactory (α > 0.70). Notably, the mean life satisfaction score in the current study was 21.9 (± 7.3). This is significantly lower than the value reported by Diener et al. in the original research of the scale (M = 23.5, standard deviation [SD] = 6.43, t = −4.15, p < 0.001). It is also significantly lower than the value reported more recently by Jovanović and Brdar (2018)[1] for three different countries: Austria (M = 25.6, SD = 5.95, t = −9.58, p < 0.001), Croatia (M = 24.1, SD = 5.1, t = −5.71, p < 0.001) and Serbia (M = 23.3, SD = 5.7, t = −3.64, p < 0.001). However, it is comparable to the mean life satisfaction score reported in the same study for two countries: Bosnia and Herzegovina (M = 21.6, SD = 6.7, t = 0.76, p = 0.449) and Montenegro (M = 22.4, SD = 6.5, t = −1.31, p = 0.191).

Table 1 also indicates a significant negative relationship between life satisfaction and the indices of psychological distress: anxiety (r = −0.52, p < 0.001, 95% confidence interval [CI] [−0.59, −0.44]), depression (r = −0.55, p < 0.001, 95% CI [−0.62, − 0.47]), hopelessness (r = −0.62, p < 0.001, 95% CI [−0.68, −0.55]) and loneliness (r = −0.53, p < 0.001, 95% CI [−0.61, −0.45]). This indicates that high levels of life satisfaction are associated with low levels of anxiety, depression, hopelessness and loneliness, thus providing evidence of concurrent validity.

Table 2 shows the CTT, Rasch and Mokken indices for the items of the SWLS. It can be observed that the inter-item correlations were all significant and above 0.50. Moreover, the item-total correlations ranged between 0.63 and 0.84. Item 5 ('If I could live my life over, I would change almost nothing') exhibited the lowest correlation with the latent variable, but it was higher than 0.50. The H_i coefficients ranged between 0.58 and 0.73, thus exceeding the suggested cut-off of > 0.30. The factor loadings were all above 0.70 (Hair, Ringle, & Sarstedt, 2011), ranged between 0.74 and 0.91 and

were all significant. In addition, there were no significant violations of monotonicity and only one minor violation of IIO (Item 5, $Crit$ = 61). The infit and outfit $MnSq$ values were all within the range of > 0.50 – < 1.5, indicating the absence of misfitting items. The DIF value for all items across gender was < 0.50, indicating measurement invariance across men and women.

The results of the KMO and Bartlett's tests indicated that the data set was adequately sampled and that there was substantial correlation in the data set (KMO = 0.863, KMO for individual items = 0.82–0.91, Bartlett's test = 1125.88, p < 0.001). They therefore indicated that factor analysis of the data is appropriate. The EFA extracted one factor, which accounted for 71.15% of the variance, hence demonstrating a dominant factor underlying the SWLS. As shown in Figure 1, a one-factor model of the SWLS was examined using CFA.

The results of CFA are reported in Table 3. The fit indices were all above the suggested best-fit indicator (χ^2 = ns, GFI = 0.99, TLI = 0.99, CFI = 0.99 and RMSEA = 0.05), indicating that a one-factor representation of the SWLS is a favourable fit for the data.

Table 4 shows the CTT, Rasch and Mokken indices for the SWLS at the scale level, together with the suggested cut-off values. With regard to reliability, the Cronbach alpha (0.90), CR (0.93) and MS_{rho} (0.90) values were all above 0.70, and the AVE value (0.73) was larger than 0.50 and also larger than the MSV value (0.38) and the ASV (0.31). In this regard, the highest correlation coefficient between life satisfaction and the indices of psychological well-being was with hopelessness (r = −0.62). Thus, the squared correlation (MSV) was 0.38. Average shared variance is the mean of the squared correlations between life satisfaction, anxiety, depression, hopelessness and loneliness. The separation

TABLE 1: Intercorrelations, reliabilities and descriptive statistics for variables.

Variable	1	2	3	4	5
1. Life satisfaction	-	(-0.59, -0.44)	(-0.62, -0.47)	(-0.68, -0.55)	(-0.60, -0.45)
2. Anxiety	-0.52***	-	(0.69, 0.79)	(0.55, 0.68)	(0.58, 0.71)
3. Depression	-0.55***	0.74***	-	(0.54, 0.67)	(0.59, 0.71)
4. Hopelessness	-0.62***	0.62***	0.61***	-	(0.48, 0.62)
5. Loneliness	-0.53***	0.65***	0.65***	0.55***	-
Mean	21.8	44.9	22.0	5.7	47.2
Standard deviation	7.3	10.3	12.2	4.9	11.3
Alpha	0.90	0.91	0.92	0.91	0.92

The correlation coefficients are below the diagonal, and the 95% confidence intervals are above the diagonal.
***, p < 0.001.

1. The Jovanović and Brdar (2018) study reported scaled mean scores.

TABLE 2: Classical test theory and item response theory indices for the Satisfaction with Life Scale at the item level.
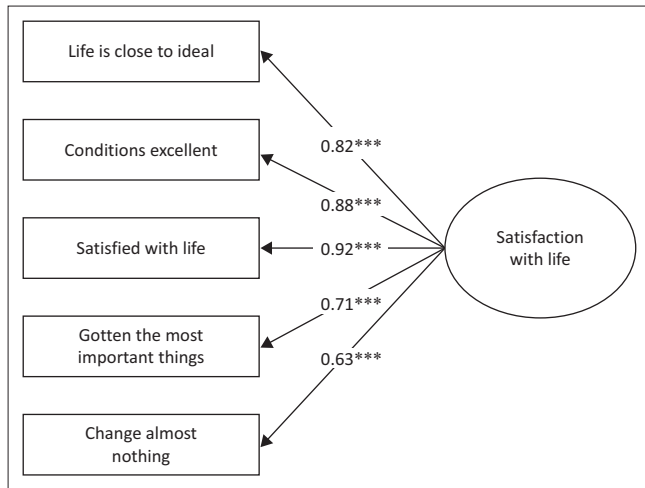
Item	1	2	3	4	5
1. Life is close to ideal	-	-	-	-	-
2. Conditions excellent	0.74***	-	-	-	-
3. Satisfied with life	0.74***	0.83***	-	-	-
4. Gotten the most important things	0.59***	0.60***	0.66***	-	-
5. Change almost nothing	0.53***	0.53***	0.57***	0.57***	-
Mean	4.2	4.3	4.6	4.9	3.9
Standard deviation	1.8	1.7	1.7	1.7	1.9
Factor loadings	0.86	0.89	0.91	0.81	0.74
Item-total correlations	0.77	0.80	0.84	0.70	0.63
Infit $MnSq$ (Rasch)	0.92	0.74	0.65	1.20	1.48
Outfit $MnSq$ (Rasch)	0.89	0.78	0.63	1.24	1.44
H_i (Mokken)†	0.67	0.70	0.73	0.64	0.58
SE of H (Mokken)	0.03	0.03	0.02	0.03	0.04
$Crit$ value for monotonicity (Mokken)	0	0	0	0	0
$Crit$ value for IIO (Mokken)	0	0	0	0	61
DIF across gender (Rasch)	0.30	0.11	0.23	-0.29	-0.35

DIF, differential item functioning; IIO, invariant item ordering.
Item intercorrelations below the diagonal.
†, Scalability coefficient of individual items.
***, p < 0.001.

The rectangles show the measured variables, and the ellipse shows the latent variable. Regression weights are standardised.

***, $p < 0.001$.

FIGURE 1: One-factor model of the Satisfaction with Life Scale with the indices of psychological well-being as outcome variables.

TABLE 3: Confirmatory factor analysis fit indices for the Satisfaction with Life Scale: one-factor model.

Goodness-of-fit index	Best fit indicator	Fit indices
χ^2 (df)	-	7.27 (4)
p	Nonsignificant	$p = 0.12$
GFI	> 0.95	0.99
TLI	> 0.90	0.99
CFI	> 0.90	0.99
RMSEA	< 0.08	0.05

χ^2, chi-square statistic; GFI, goodness-of-fit index; TLI, Tucker–Lewis index; CFI, comparative fit index; RMSEA, root-mean-square error of approximation.

TABLE 4: Classical test theory and item response theory indices for the Satisfaction with Life Scale at the scale level.

Index	Value	Suggested cut-off
Cronbach's alpha (α)	0.895	> 0.7
Composite reliability (CR)	0.931	> 0.7
Average variance extracted (AVE)	0.731	> 0.5
Maximum shared variance (MSV)	0.384	< AVE
Average shared variance (ASV)	0.310	< AVE
Standard error of measurement	1.91	Small values
Item separation reliability (Rasch)	0.97	> 0.8
Item separation index (Rasch)	5.91	> 3
Person separation reliability (Rasch)	0.85	> 0.8
Person separation index (Rasch)	2.37	> 2
Unexplained variance in the first contrast (Rasch)	1.82†	< 2
Scale H (Mokken)	0.661	> 0.50
Mokken scale reliability (MS_{rho})	0.896	> 0.70

†, Eigenvalue.

CR, Composite reliability; AVE, Average variance extracted; MSV, Maximum shared variance; ASV, Average shared variance.

indices were at an acceptable level (item separation index = 5.91, person separation index = 2.37). Similarly, the separation reliabilities also exceeded the suggested cut-off values (item separation reliability = 0.97, person separation reliability = 0.85). The eigenvalue associated with a possible additional factor in the Rasch analysis was found to be 1.82, indicating that the scale is essentially unidimensional. However, at least two items (items four and five) were reflected on the first contrast. The disattenuated correlation

between the Rasch dimension and the first contrast was 0.73, indicating that the two clusters of items have more than half of their variance in common, which would support a possible interpretation that the two clusters of items measure the same latent variable (Linacre, 2021b). The scalability coefficient in the Mokken analysis also indicated the existence of a very strong scale ($H = 0.66$).

Discussion

In this study, we used CTT and IRT to examine the replicability of the psychometric properties of the SWLS in a sample of South African teachers. The results obtained support the findings in the literature regarding the psychometric properties of the SWLS as examined through CTT (e.g. Barki et al., 2020; Diener et al., 1985; Maroufizadeh et al., 2016) and IRT (e.g. Akif, 2021; Oishi, 2006).

Firstly, the mean life satisfaction score for the current sample of teachers in South Africa was found to be significantly lower than the values reported in other countries. Pavot and Diener (2009) asserted that it is typical for citizens in Western countries to score highly on a range of measures of well-being, including the SWLS. This assertion seems to be corroborated by South African studies that have also reported low life satisfaction scores prior to the pandemic (e.g. Westaway, Maritz, & Golele, 2003: $M = 21.7$, SD = 8.8; Field & Buitendach, 2011: $M = 17.47$, SD = 6.33). However, there have also been South African studies that reported very high life satisfaction scores amongst South African samples (Le Roux, Kagee, Van Der Merwe, & Parker, 2008: $M = 28.7$, SD = 7.8; Roothman, Kirsten, & Wissing, 2003: $M = 24.9$ and SD = 5.4 for men and $M = 24.8$ and SD = 6.0 for women). The available evidence therefore does not allow for a definitive statement of the impact of the pandemic on the life satisfaction of teachers. Rather, it merely reflects the fact that they have low levels of life satisfaction, which may have been the case even prior to the pandemic.

Secondly, all the indices of reliability (Cronbach's alpha, CR and MS_{rho}) exceeded the conventional cut-off (> 0.70), thus demonstrating that the SWLS has very satisfactory reliability that supports its continued use as a research instrument. Thirdly, both the CTT and the IRT confirmed that the SWLS demonstrates sufficient validity. With regard to construct validity, all items were found to highly correlate with the total scale. In addition, the scalability coefficient of the individual items (H_i) indicated that all items contributed to the measurement of life satisfaction. Moreover, the person and item separation indices confirmed that the SWLS can distinguish between respondents with low and high scores on life satisfaction (person separation – Rasch; monotonicity – Mokken) and that an item difficulty hierarchy exists (item separation). The Mokken analysis also confirmed that there was no violation of the assumption of IIO, and thus that there was consistency in the way respondents with the same level of satisfaction responded to items. Differential item functioning also demonstrated that there were no gender differences in the measurement of the construct.

Notably, the convergent, discriminant and concurrent validity of the SWLS were also confirmed. The significant factor loadings of the five items and the fact that the AVE value was above 0.50 and below the CR value confirmed the convergent validity of the scale. The total life satisfaction score accounted for a greater proportion of the variance in the five items (AVE) as opposed to the variance it shared with the indices of psychological well-being (MSV, ASV), thus demonstrating discriminant validity. Finally, the significant associations between life satisfaction and the indices of psychological distress provided evidence of concurrent validity. The CTT, Rasch and Mokken analyses provided complementary evidence of the unidimensional nature of the scale through EFA, CFA (CTT), the scalability coefficient (Mokken) and PCA of the residuals after the Rasch factor was extracted.

Some concerns have been expressed regarding Item 5 ('If I could live my life over, I would change almost nothing'; Oishi, 2006; Pavot & Diener, 2008; Schutte et al., 2021). This item seems to be conceptually different from the other four items in that it focuses on the past, whereas the other four focus on the present. As in these other studies, Item 5 has also been found to have the lowest item-total correlation and the lowest factor loading in the current study. However, both CTT and IRT seem to suggest that, whilst this item is conceptually different, its inclusion in the scale is probably warranted. In CFA, the factor loading of Item 5 was lower than the other four items but still significant, whilst in Rasch analysis the disattenuated correlation coefficient suggested that the two clusters of items measure the same underlying construct. This requires further and more detailed investigation in future studies.

In summary, the three approaches mentioned in this study provide complementary evidence of the reliability, validity and unidimensional nature of the SWLS. The SWLS has largely been used as a research rather than a diagnostic instrument, and the evidence from three different perspectives supports its continued use in research on subjective well-being.

Limitations

This study has some limitations. For example, as we have largely used self-report measures, it is important to acknowledge the potential self-report bias. The study results, however, are comparable to previously reported results. In addition, most of the teachers were from one province only, thereby limiting the generalisability of the study. Therefore, in future studies, researchers should attempt to select more representative samples.

Conclusion

The SWLS is a popular and widely used measure of life satisfaction that is extensively used in South Africa. To our knowledge, this is the first study in which CTT, Rasch and Mokken analyses are used in a complementary manner to evaluate the psychometric properties of the SWLS. The results indicate that the SWLS is a reliable, valid and unidimensional measure of the cognitive component of subjective well-being.

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Competing interests

Authors' contributions

Funding information

Data availability

The data sets generated and/or analysed during the current study are available from the corresponding author upon reasonable request.

Disclaimer

The views and opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of any affiliated agency of the authors.

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