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Considering a Bifactor Model of Children's Subjective Well-Being Using a Multinational Sample

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Abstract

In the current study, we consider the viability of a bifactor model of children's subjective well-being (SWB) by contributing to the discussion on the dimensionality of children's SWB. We specify a general factor of SWB and four group factors (context-free cognitive life satisfaction, domain-based cognitive life satisfaction, positive affect, and negative affect) using structural equation modelling and parceling. We used data from the Children's Worlds International Survey of Children's Well-Being (N=92 782). Our analysis strategy included confirmatory factor analysis and bifactor analysis. We found a good fit for the specified bifactor model, with all items loading onto a general factor and group factors. For the bifactor analysis, after controlling for the general factor, the loadings on the group factors were substantially lower, and did not meet the criteria of acceptability for bifactor indices thresholds. The common variance of the items is largely explained by the general factor; thus, the specification of the group factors cannot be justified. Further, we found an excellent fit for a model using the parceling approach. From a measurement perspective, the construct of children's SWB can potentially be measured as a unidimensional construct. Thus, it may be feasible to report a total score for children's SWB, as opposed to scores on the individual subscales (group factors). Applied researchers can thus confidently use SWB as a unidimensional construct or follow the parceling approach in the structural equation model context.

Keywords Children · Subjective well-being · Bi-factor model · Parceling approach

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1 Introduction

The concept of subjective well-being (SWB) has its genesis in the Greek philosophical concept of 'hedonism', representing the pursuit of pleasure in life and the reduction of pain. Hedonic well-being is generally characterised as having a positive outlook in life, and is concerned with achieving an enjoyable life. It is often concretised as life-satisfaction, happiness and SWB (Adler & Seligman, 2016). In modern times, SWB is evident in Jahoda's (1958) landmark paper that ignited the paradigmatic shift in how mental health is conceptualised and understood – from merely an absence of mental illness to positive mental states, such as happiness. SWB was also profoundly influenced by and embedded in the Social Indicators Movement of the 1960's, encapsulated in Bauer's (1966) edited volume on *Social Indicators* and Wilson's (1967), *Correlates of avowed happiness*. Bradburn's (1969) *The structure of psychological well-being*, wherein he propounded the independence of positive affect and negative affect, represents a watershed moment in the field of SWB as it suggested the multidimensional nature of SWB. This momentum carried over into the 1970's, and was evident in the work of Andrews and Withey (1976), which focused on the cognitive component of life-satisfaction, and Campbell et al.'s (1976) work that foregrounded the importance of satisfaction in various domains.

Since the late 1960's, there has been a substantial increase in research on SWB, driven largely by the Social Indicators Movement (Diener, 2006 ;Diener et al., 2013). This focus has intensified over the past few years and is indicative of the shift towards valuing the individual's position in society, the critical nature of the 'subjective' in evaluating life, and the acknowledgement that well-being should include a consideration of positive ideals that are beyond the bounds of economic prosperity (Diener, 2001; Diener et al., 1999). Research on SWB is premised on the idea that the exclusive reliance on traditional objective measures and indicators only provide a limited understanding of people's lives, and how people make sense of their lives, and requires a more comprehensive understanding of overall quality of life (Casas, 2011; Savahl et al., 2019).

SWB is a complex multifaceted concept comprising individuals' perceptions, experiences, and evaluations about their overall life and certain aspects of their lives (Diener, 1984). The 'subjective' aspect reflects the self-report character, which is the essence of SWB. It is often referred to as self-reported well-being, and includes both cognitive and affective components. The cognitive component consists of overall or general life satisfaction and satisfaction with specific aspects of life (e.g. social relationships, school, living conditions). The affective component is theorised to comprise both positive and negative affect (Diener et al., 1999).

Diener (2009) conceptualised the components of SWB as fitting on a conceptually aligned 'tripartite' hierarchical structural configuration. In the explication of a theoretical model of SWB, Diener (1984) distinguished between bottom-up and top-down theories. Bottom-up theories are premised on the notion that life satisfaction evaluations are based on, and determined by, our assessment of satisfaction in a select number of life domains, which individuals deem important in their lives. There is an assumption of causal influence of these domains on global life satisfaction. Top-down theories propound a reverse-direction of causality - those who present with higher levels of general life satisfaction evaluate specific life domains more favourably. These satisfaction judgements are largely influenced by readily accessible information, and found to be stable over periods of time ranging from weeks to months (Schimmack, 2008).

The importance of the affective component of SWB is largely grounded on Bradburn's (1969) research, which made sense of SWB as an outcome of an individual's position on two independent dimensions, described as positive affect and negative affect. Bradburn and Caplovitz (1965) conceptualised these two dimensions as independent, with overall well-being dependent on the relative balance or tension between positive and negative affect (Bradburn, 1969).

Negative affect is related to variables associated with traditional 'mental-illness' approaches (Bradburn, 1969), while positive affect is related to completely different *positive* variables, ostensibly unrelated to negative affect. Barrett and Russell (1998) and Russell (2003) expanded the traditional positive–negative dichotomy with the formulation of the Core Affect Theory. Core affect is defined as neurophysiological states accessible at a higher level of consciousness that manifest in moods and emotions. Yik et al. (2011) suggest that core affect is the essence of mood and emotion, and not synonymous with them. Russell's (2003) circumplex model theorises the affect self-ratings allocation to different octants formed by the confluence of two-dimensional axes with an opposite affect at each extreme. Positive–negative affect conforms to one of those axes, and activation-deactivation to another.

While the empirical literature on SWB, as it relates to adults, has a history that extends to the 1960's, it has only been considered in children in the last two decades. This is largely as a result of epistemological shifts encapsulated in developments in sociological theories of childhood, theories of child development, international children's rights treaties, and the post-structural turn in the social sciences. These developments have a conceptual home in what Ben-Arieh (2008) referred to as the *Child Indicator Movement*. The 'movement', along with large-scale research studies such as the: Health Behaviour in School Children (HBSC); the Program for International Student Assessment (PISA); UNICEF Report Cards 7 (2007), 11 (2014), and 16 (2020); the Children's Worlds Survey, and the Children's Understanding of Well-Being (CUWB), have further aggrandised research on children's well-being. While the HBSC, PISA, and UNICEF Report Cards have broader objectives, the Children's Worlds and CUWB have a specific focus on child well-being, generating substantial data that can be used for cross-cultural and comparative studies. These research studies have functioned as the empirical platform that enhanced epistemological, theoretical, and conceptual understandings of children's well-being. It further advanced innovations in measurement theory as it relates to measuring the construct of child well-being. Further to that, it helped place children on the political agenda of governments across the world, prioritising children as an important population cohort, childhood as a valid structural feature of society, and children's SWB as a critical social policy consideration. With children's well-being now a focus within the policy space, issues concerning its conceptualisation and measurement are a priority.

Interestingly, the conceptualisation of children's SWB appears to be intricately related to the measurement thereof. In this way, advances in measurement and statistical data modelling software have allowed researchers to hypothesise and test different conceptual and theoretical models, and various structural configurations. While earlier research on children's SWB used instruments based on measures used for adults, there has been substantial growth in the field. Recent research studies (e.g. Casas & González-Carrasco, 2021) have demonstrated consistent evidence of sound psychometric properties on a number of child-specific SWB measures. The field has further progressed from the use of single-item scales, to more sophisticated multiple-item scales assessing different theoretical components of children's SWB and various aspects of children's lives. In-depth qualitative research (e.g. Casas et al., 2013a, b; Montserrat et al., 2021) has also provided key insights into how children from different contexts consider the items on various SWB scales, and their process of selecting various response options. These advancements confirm children's evolving capacity to meaningfully consider questions relating to their overall well-being, and specific domains of their SWB, and to provide a considered endorsement of response options (Savahl et al., 2021).

However, regardless of the advancements made in the field, the theoretical and conceptual status of the concept of SWB, as reflected in the extant literature on adult and children SWB, remain contested. One point of contestation is that research on children's SWB has largely used cognitive life satisfaction as the sole indicator of SWB (Rees et al., 2020). A common practice among applied researchers is their claim to be investigating children's SWB, but not appropriately including affect as part of the conceptual model (Savahl et al., 2021). Studies that have included affect tend to focus on positive affect, with substantially fewer studies considering both positive and negative affect.

Another related point of contestation relates to the structural configuration, which refers to the alignment of the various components of the conceptual model. In the adult literature on SWB, Busseri and Sadava's (2011) seminal review identified five structural configurations:

- separate components model (conceptualised as separate constructs that require independent analysis);
- hierarchical structure (conceptualised as a higher-order SWB construct and three lower-order components of cognitive life satisfaction, positive affect and negative affect);
- causal system (conceptualised as a causal model where positive affect and negative affect cause cognitive life satisfaction);
- composite model (conceptualised as a composite of cognitive life satisfaction, positive affect and negative affect, wherein the three constructs are treated as joint contributors to overall well-being; and
- configuration of components (conceptualised as an integrative system of psychological processes that manifest as distinct configurations)

Savahl et al. (2021) impress the importance of these differential conceptual configurations of SWB. These configurations engender critical theoretical and methodological implications in applied studies, given that it can be suggestive of different outcomes concerning the interrelation of the components of SWB, the correlates of SWB, its stability over time, and applicability in diverse contexts.

Recent evidence from cross-sectional and longitudinal studies (see Busseri, 2015; Galinha & Pais-Ribeiro, 2009; Metler & Busseri, 2017) confirmed the viability of a hierarchical structural configuration of SWB. Busseri's (2018) meta-analysis provides further evidence for the generalisability of a hierarchical structural conceptualisation. In the literature on children's SWB, Savahl et al. (2021) confirmed the tenability of a hierarchical factor structure using a large multi-country sample of 10- to 12-year-old children. These authors put forward a quadripartite model comprising a second-order factor of SWB, and four first-order latent factors consisting of: context-free cognitive life satisfaction, domain-based cognitive life satisfaction, positive affect, and negative affect latent factors. While their model has the advantage of presenting a full theoretical model of children's SWB, the hierarchical second-order model presents with some shortcomings. First, the second-order model does not allow for the simultaneous assessment of the domain-specific factors as independent from the general factor. In the second-order model, the domain-specific factors are modelled as 'disturbances'. In an applied sense, considering the current study, there is a possibility that one of the factors in the SWB second-order model configuration may only reflect the general factor of SWB. In other words, the common variance of this domain is entirely explained by the general factor of SWB. The second-order model in this instance would not be able to account for this 'non-existence' of a domain as it would legitimately exist as a lower-order factor (see Chen et al., 2006 for further concrete examples and a more detailed discussion). Second, the second-order model does not allow for the testing of predictive relationships with external variables. Third, the second-order model does not allow for the testing of measurement invariance at the general and domain-specific level. This leaves researchers with a conundrum – how to model hierarchical structural configurations in applied settings.

A resolution is available through the use of a bifactor model, which addresses the shortcomings of the second-order model (Torres-Vallejos et al., 2021). A bifactor measurement model specifies that for multidimensional data, there is a general factor that explains the common item variance for items, but that there are also group factors (domain-specific) or sub-traits accounting for additional common variance for item subsets (Chen, et al., 2006; Reise, 2012; Rodriguez et al., 2016). In a restricted bifactor model, each factor loads on a single general factor, and on one of the group factors. The general factor represents the overarching construct, while the group factors represent the more conceptually specific latent constructs. The general and group factors are assumed to be orthogonal. While bifactor models typically help answer the question of whether scales have a strong enough general factor to justify a unidimensional model, it can also provide direction on the appropriateness of using a total score, or whether presenting the scores of the domain-specific latent factors would provide a meaningful interpretation (Chen, et al., 2006; Reise, 2012; Rodriguez et al., 2016). Importantly, it allows for the determination of the unique contribution of the general factor and group factors in the prediction of external variables (Reise et al., 2010).

1.1 The Current Study

In the current study, we consider the viability of a bifactor model of children's SWB – this will facilitate the inclusion of the full conceptual model in the measurement of children's SWB in the structural equation modelling (SEM) context. To this end, we follow the process and guidelines as recommended by Rodriguez et al. (2016). We specify a general factor of SWB and four group (latent) factors of context-free cognitive life satisfaction, domain-based cognitive life-satisfaction, positive affect, and negative affect. Our hypothesis is as follows: the common variance of the items can be explained by the general factor *and* the four group factors, over and above the general factor. Figure 1 presents a diagrammatic representation of the bifactor conceptual model, while Figure 2 presents the aforementioned second-order hierarchical conceptual model. We specify a restricted bifactor model with the general and group factors assumed to be orthogonal. Based on the outcomes of the bifactor analysis, we followed recommendations by Rodriguez et al. (2016) and tested a model consisting of parcels. Parceling refers to the process of aggregating individual items into 'parcels' and using those parcels, in lieu of items, as the indicators of the target latent construct (Kishton & Widaman, 1994, see also Matsunaga, 2008 for a detailed discussion, and Little et al., 2002 for a review). Parceling presents with a number of key advantages. First, it provides a more parsimonious model as opposed to a unidimensional model with a high number of individual indicators, and thus increases the given model's efficiency to define the latent construct. Second, it enhances scale communality and reduces random error (Matsunaga, 2008). Third, given the aggregation of scores it tends to approximate the distribution of the target construct more efficiently than individual items (Bagozzi & Heatherton, 1994; Boyle, 1991; Matsunaga, 2008). Fourth, the use of parcels increases the likelihood that the scores are more continuous and normally distributed (Rodriguez et al., 2016). Parceling, does however, present with some risks. First, parceling runs the risk of generating biased parameter estimates. However, this is only applicable when well-conditioned data are used (Little et al., 2002). Second, in the context of scale multidimensionality, parceling may result in model misspecification (Little et al., 2002). While this risk is of substantial concern, it can be mitigated if well-established measures are used with unidimensionality confirmed empirically and theoretically. Following Matsunaga (2008), if this condition is met, then the parceling approach is appropriate. In the current study, the individual scales unidimensionality have been confirmed a priori in a range of studies using confirmatory factor analysis (see Casas & Rees, 2015, Casas, 2017, Casas & González-Carrasco, 2021; Savahl et al., 2021).

1.2 Aims of the Study

The current study has two broad aims. First, the study aims to determine the viability of a bifactor model of children's SWB in a multinational sample. Within this process, we broadly contribute to the discussion on the dimensionality

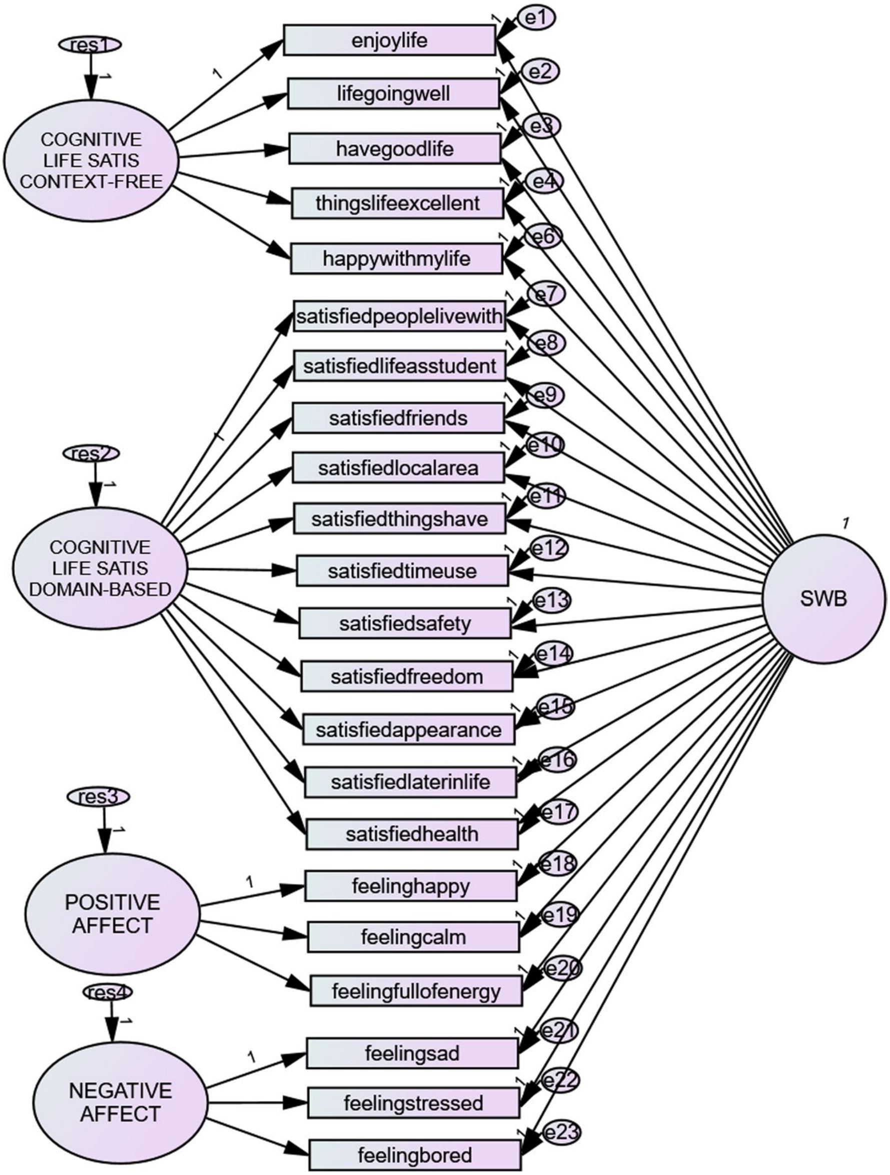


Fig. 1 Bifactor conceptual model

of children's SWB. Here, we explore the extent to which the multidimensional model of children's SWB has a strong enough general factor to justify a unidimensional measurement model. Second, the study aims to offer recommendations for the measurement of children's SWB using structural equation modelling in applied contexts – this includes a consideration of the item parceling approach.

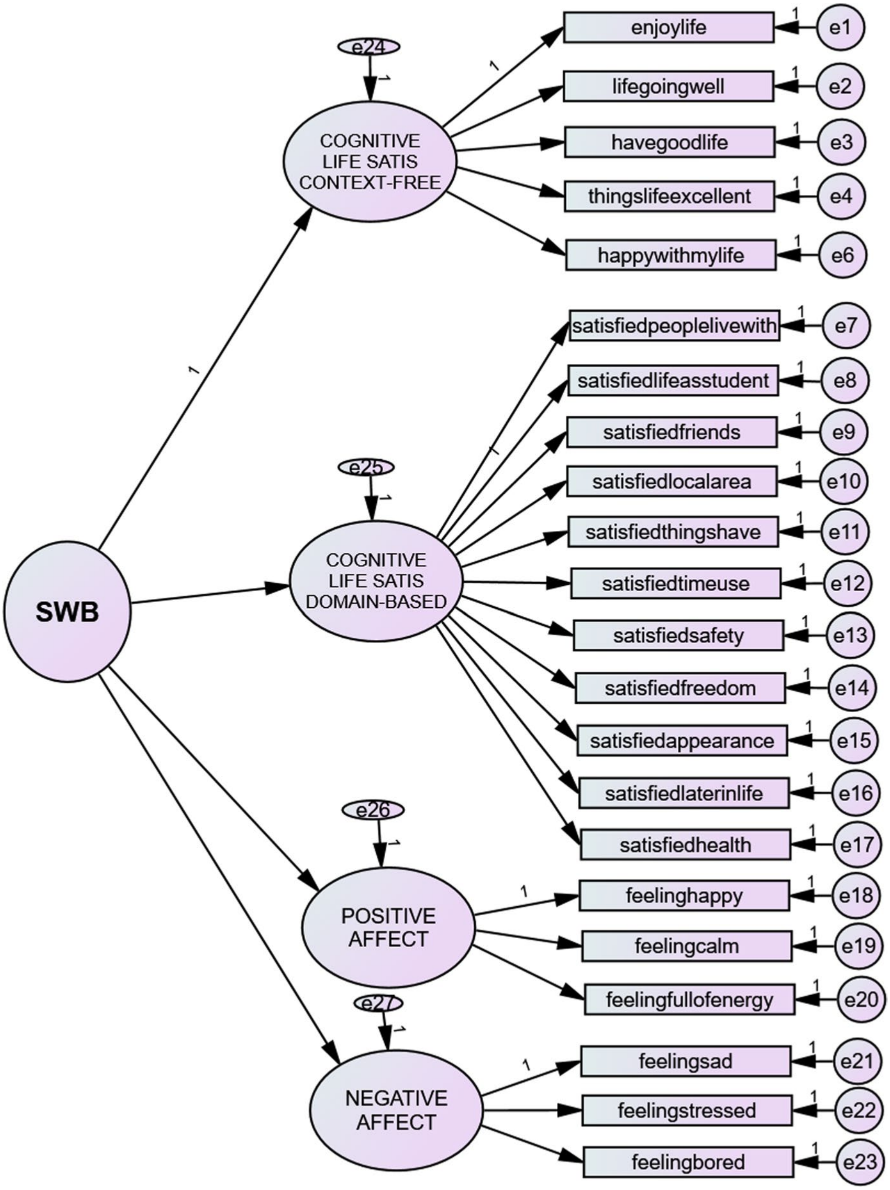


Fig. 2 Second-order hierarchical conceptual model

2 Method

We used data from the Children's Worlds global study on children's SWB. The study was conducted across 35 countries with children in three age groups (8, 10, and 12-years-old) selected from mainstream schools. In the current study, our analysis only included children in the 10- and 12-year-old age cohorts.

A central co-ordinating committee managed and oversaw the design and implementation of the study, sampling protocol, and management of the data. Principal investigators led the implementation of the survey at the country level. This included developing the country sampling strategy, adapting the instrument, and obtaining ethics clearance. A tailored sampling strategy was developed by the co-ordinating committee and the country principal investigators for each country, following a set of agreed principles. These included the following criteria:

- A probability sample selected from a defined geographical unit. Some countries included a national sample, while others used a target geographical region.
- A minimum target sample size of 1000 children in each age group, and a minimum number of participating schools to control for the effect of clustering. While we used stratification in all countries, the nature of the stratification varied between countries. Where information about the number of children in all schools were available, we used random selection with probabilities proportional to the size of the schools. When this information was unavailable, we selected schools with uniform probability. In larger schools, we selected more than one class so as to reduce the need for high weighting coefficients in the final sample (Rees, 2017).

2.1 Ethics Statement

Each participating research team obtained ethics clearance as per their institutional and country-specific requirements. Each of the 35 participating countries obtained ethics approval from the Institutional Review Boards of the universities at which the researchers were based. Researchers obtained informed consent from the child participants; while parental informed consent was dependent on the prevailing practices and legal requirements in each country. In most countries, active consent was required from parents/guardians.

2.2 Measures

The Children's Worlds Survey used a questionnaire that consisted of over 180 items, developed by a group of child research experts in 2009 and revised through three iterations of the survey. The questionnaire also included a number of standardised scales, initially developed to assess adolescents' SWB. Through the three iterations, the items and scales were subjected to range of psychometric scrutiny across the three waves (see Casas, 2017; Casas & Rees, 2015; Casas & González-Carrasco, 2021). Research teams in participating countries also engaged with children from various contexts to develop and refine the item content and format, including the declarative statement, and question stem and response options (Rees et al., 2020). In the current study, we used the following scales, which have been confirmed by Casas and González-Carrasco (2021) and others to have appropriate reliability, and structural and construct validity:

2.2.1 The Children's Worlds Subjective Well-Being Scale (CW-SWBS)

The CW-SWBS was developed through a process of consultation with researchers and children globally (Rees et al., 2020). It was derived from the Students' Life Satisfaction Scale (SLSS; Huebner, 1991), which is the most widely used scale to measure global (context-free cognitive) life satisfaction. While the scale has been validated across many contexts, an in-depth cross-cultural psychometric analysis conducted by Casas (2017) found that the latent construct did not manifest appropriately in some of the items and required revision. Based on his findings, the scale was then subjected to a large-scale qualitative review that included substantial consultations with children. The outcome of this process was an instrument consisting of six items—three taken from the original scale and three new items generated by children who participated in the qualitative research. The scale response options are on a 0–10 end-labelled agreement scale with verbal anchors of "not all agree" (0) to "Totally agree" (10). The CW-SWBS has shown acceptable internal consistency (0.92 and 0.94) and an appropriate fit structure (Casas & González-Carrasco, 2021; Rees et al., 2020, Savahl et al., 2021).

2.2.2 The Children's Worlds Domain-Based Subjective Well-Being Scale

The importance of including domain-based items in measuring the SWB is well-established in the literature (Davern et al., 2007; Diener et al., 1999). Given the appropriateness of combining items of different levels of abstraction, the Children's Worlds: Domain-Based Subjective Well-Being Scale (CW-DBSWBS) was developed from the Personal Well-Being Index – School-Children (Cummins & Lau, 2005) and the Brief Multidimensional Students' Life Satisfaction Scale (Seligson et al., 2003). The scale comprises 11-items that assess children's domain-based cognitive life satisfaction, with each item representing a particular life domain. Five items were concretely-worded items from the BMSLSS (Seligson et al., 2003), namely: family (people children live with), friends, school (life as a student), area/environment (the place where children live), and self (the way you look); and four items from the abstractly-worded PWI-SC (Cummins & Lau, 2005), namely: standard of living (things you have), personal health, personal safety, and future security. Response options were on an 11-point unipolar satisfaction scale ranging from "Not at all" (0) to "Totally/Completely satisfied" (10). The CW-DBSWBS has shown acceptable internal consistency (0.87) and an appropriate fit structure (Casas & González-Carrasco, 2021; Rees et al., 2020; Savahl et al., 2021).

2.2.3 Children's Worlds Positive and Negative Affect Scale (CW-PNAS)

Positive affect and negative affect are critical components of the SWB hierarchical structure (Bradburn, 1969 in Savahl et al., 2021). Russell and Barrett (1999) developed the concept of core affect, which conceptualises 'affect' on a circumflex, orthogonal two-dimensional model denoted by pleasure – displeasure (pleasure or valence) and activation – deactivation (arousal or energy) (Rees et al., 2020). The Children's Worlds Study includes six items drawn from Russel's Core Affect Scale, which was based on the core affect theory of Russell and Barrett (1999). The scale specifies a concrete time-period of two weeks wherein participants are requested to endorse the extent to which they experienced three positive (happy, calm, and full of energy) and three negative (sad, stressed, and bored) affective states. For both positive affect and negative affect, these items reflect an activated, deactivated, and neutral affect (see Rees, 2019). The response options are scored on a 0–10 point scale. Both the positive affect and negative affect presented with an appropriate fit structure, with internal consistency of 0.69 and 0.68 respectively (Casas & González-Carrasco, 2021; Rees et al., 2020).

2.3 Data Analytic Strategy

The final Children's Worlds database consisted of 95 576 participants aged 10-and 12-years old. However, cleaning and depuration reduced the sample by 2794 cases, resulting in a final sample of 92 782 participants (girls = 49.7%; *M*age = 11.03, *SD* = 1.27). We applied full information maximum likelihood to address missing data. We were sensitized to the clustered nature of the Children's Worlds survey data – clustered data can occur when survey respondents are grouped by geographic region, country, and school. In the Children's Worlds survey, schools were identified as the main cluster variable. We attended to this by the use of post-stratification sample weighting and the subsequent use of the sample weighting analysis option in Stata. Specifically, weighting coefficients and robust standard errors were calculated to account for varying levels of participation within schools, and differences between planned and target numbers within schools and strata. Final weightings were discussed and agreed between the project director and each participating country research team (see Rees, 2017).

We are also mindful that country clustering could affect the analysis, as the correlation (similarity) between observations within each cluster (countries), could result in biased estimates and incorrect inferences. In the current analysis using SEM, we explored the option of using a multilevel model, which is often used to account for clustered data in SEM. However, we were cognisant of McCaffrey et al.'s (2001) suggestion that estimating standard errors in multilevel models often underestimate the true standard errors, particularly when the clustering structure is potentially influential (as in the case of Children's Worlds data). We, therefore, opted for the weighting option along with applying the bootstrap method (95% CI), which can account for clustering by resampling at the cluster level; ultimately this provides a more accurate estimate of the sampling distribution. Our analysis strategy followed a three-step process.

In the first step, we used confirmatory factor analysis in AMOS 27 to assess the fit structure of the overall model. Based on recommendations by Kline (2011), we used the Comparative Fit Index (CFI), the Standardised Root Mean Residual (SRMR), and the Root Mean Squared Error of Approximation (RMSEA) as fit indices to determine model fit. As indicators of good fit, we used the following cut-off thresholds as recommended by Casas (2017): CFI > .950; SRMR, RMSEA <.05.

In the second step, we assessed the bifactor model, using AMOS 27 to assess the fit structure of the model. Within this process, we also considered a range of bifactor indices as recommended by Rodriguez et al., (2016) using the Bifactor Indices Calculator (Dueber, 2017) to calculate the following indices:

2.4 Omega

2.4.1 Coefficient Omega

The Coefficient Omega is a model-based reliability index that estimates the proportion of variance in the observed total score that can be accounted for by the modeled sources of common variance (Reise et al., 2013a). Given that it is essentially a reliability index, we regard scores >.70 as acceptable.

2.4.2 Omega Hierarchical

The coefficient Omega Hierarchical estimates the proportion of variance in total scores accounted for by a single general factor. In this way the variance in the scores of the group factors are regarded as measurement error (Reise et al., 2013b).

2.4.3 Omega Hierarchical Subscale

The Omega Hierarchical Subscale presents an index that calculates the unique variance of each group factor once the variance of the general factor has been partitioned out. In this way, it reflects the reliability of the sub-scale score, whilst controlling the variance of the general factor (Reise et al., 2013a).

2.4.4 Relative Omega

The Relative Omega represents the percent of reliable variance of the overall multidimensional composite model attributed to the general factor. It is calculated by dividing the Omega Hierarchical by Omega.

2.4.5 Explained Common Variance and Percent of Uncontaminated Correlations

The Explained Common Variance (ECV) represents the proportion of all common variance that can be explained by the general factor. The ECV can, therefore, be seen as an index of unidimensionality, in as much as it measures the variance specific to a general factor by calculating the variance explained by a general factor and dividing it by the variance explained by the general and groups factors. ECV can also be calculated for the sub-factors, subscale (ECV_S), and at the item level (I-ECV) (Rodriguez et al., 2016; Stucky et al., 2013; Stucky & Edelen, 2015).

The Percent of Uncontaminated Correlations (PUC) represents the number of unique correlations derived from the general factor divided by the total number of unique correlations. The PUC is used in conjunction with the ECV as it moderates potential parameter bias (Rodriguez et al., 2016). Taken together, the ECV and PUC helps to resolve questions on dimensionality. The following permutations for interpreting ECV and PUC values are evident in the literature:

- When ECV is > 0.70 relative bias is below the 10% benchmark; when ECV is > 0.80 then relative bias is less than 5% (Bonifay et al., 2015).
- When both ECV and PUC are > 0.70 relative bias will be negligible, and the common variance can be regarded as unidimensional (Rodriguez et al., 2016).
- When OmegaH is > . 70, ECV > 0.60, and PUC > 0.80, there is some evidence of multidimensionality; however, this is not strong enough to override an interpretation of unidimensionality (Reise et al., 2013a, b).

2.4.6 Factor Determinacy and Factor Replicability (H score)

Factor Determinacy (FD) represents the correlations between factor scores and the factors. When factor scores are determinate, then individual differences on the factor scores are reasonable representations of the true individual differences on the factor (Rodriguez et al., 2016). Gorsuch (1983) recommends a threshold score of FD >.90.

The *H* score is a reliability index that provides a measure of construct replicability; it is calculated as the correlation between a factor and an optimally weighted item composite (Hancock & Mueller, 2001). *H* is especially useful for assessing the extent to which the latent construct is defined by the indicators. High *H* scores are indicative of a well-defined latent construct. It, therefore, allows researchers to meaningfully assess the feasibility of a measurement model in the SEM framework (Rodriguez et al., 2016). Hancock and Mueller (2001) have recommended a standard threshold criteria of $H = .70$, with higher values ($H > .80$) representing a well-defined construct.

In the third step, we used the aggregated all-item-parcel approach, or latent-composite method (Holbert & Stephenson, 2002). This process entailed aggregating all items within the specific scales and using this scale-composite score as the sole indicator of the target construct (Matsunaga, 2008). In this way, we reduced the 22 items of the overall model into four parcels aligned to the theoretical dimensions of SWB. We tested this model using confirmatory factor analysis, where the latent construct of SWB was modelled to manifest the four parceled factors – we report on the *H* score as a measure of scale replicability.

3 Results

Table 1 presents the scale means and standard deviations, and the tests for normality (univariate and multivariate kurtosis and skewness). As the items exceeded the acceptable thresholds of deviation (critical ratio = 1.96), we used the bootstrap method (with maximum likelihood and 500 re-samples) as a resolution (Blunch, 2008; Finney & DiStefano, 2006)). The bootstrap procedure reduces potential bias of factor loadings and facilitates the management of standard errors in the context of non-normal data (Enders, 2010).

Table 1 Mean scores, standard deviations, skewness and kurtosis of items

	Item mean	Standard deviation	Skewness	CR	Kurtosis	CR
CW-SWBS						
EnjoyLife	8.757	2.050	–2.096	–260.037	4.424	274.400
LifeGoingWell	8.629	2.150	–1.941	–240.761	3.655	226.716
HaveGoodLife	8.798	2.044	–2.180	–270.408	4.749	294.553
LifeExcellent	8.159	2.404	–1.153	–143.002	15.273	947.378
HappyLife	8.837	2.094	–1.963	–243.565	3.887	241.136
CW-DBSWBS						
Satisfaction: people live with	8.941	1.889	–2.289	–283.934	5.466	339.078
Satisfaction: Life as student	8.440	2.131	–1.755	–217.757	3.107	192.702
Satisfaction: Friends	8.563	2.066	–1.865	–231.315	3.483	216.028
Satisfaction: Neighbourhood	8.416	2.264	–1.835	–227.639	3.167	196.476
Satisfaction: Things you have	8.906	1.877	–2.328	–288.871	5.934	368.110
Satisfaction: Time-use	8.426	2.085	–1.712	–212.345	3.020	187.345
Satisfaction: Safety	8.816	1.912	–2.157	–267.576	5.067	314.294
Satisfaction: Freedom	8.496	2.198	–1.857	–230.363	3.293	204.239
Satisfaction: Self (appearance)	8.299	2.414	–1.689	–209.493	2.379	147.565
Satisfaction: Future	8.390	2.272	–1.833	–227.403	3.203	198.666
Satisfaction: Health	8.928	1.904	–2.354	–292.019	5.888	365.235
CW-Positive Affect						
FeelingHappy	8.628	2.078	–1.963	–243.565	3.887	241.136
FeelingCalm	7.362	2.859	–1.035	–128.427	.190	11.795
FeelingFullEnergy	8.145	2.684	–1.605	–199.169	1.765	109.482
CW-Negative Affect						
FeelingSad	3.620	3.280	.566	70.278	–.928	–57.569
FeelingStressed	4.139	3.603	.292	36.239	–1.350	–83.761
FeelingBored	4.341	3.534	.255	31.642	–1.299	–80.602
Multivariate					590.086	2759.038

3.1 Confirmatory Factor Analysis

We used Confirmatory Factor Analysis (CFA) in AMOS 27 (Maximum Likelihood Estimation). Given that we previously tested the individual latent constructs (see Savahl et al., 2021), we commenced directly with conducting the CFA using the four-factor model (for ease of reference we present the fit statistics in Table 2, Models 1 to 3, for the individual scales, and Model 4 for the four-factor Model). The results show acceptable fit statistics with all scores meeting the acceptable thresholds. Table 3 presents the standardised regression weights.

Table 2 Fit indexes for the CFA and SEM

Model Bootstrap, ML, 95% CI, Resamples = 500	X^2	*df*	P	CFI	RMSEA	SRMR
1. CW-SWBS	7571.125	9	.000	.982	.052 (.049-.055)	.017
2. CW-DBSWBS	9619.482	44	.000	.969	.049 (.048-.049)	.027
3. Positive/Negative Affect	2080.564	8	.000	.974	.034 (.031-.35)	.028
4. Initial CFA 4-Factor model	19636.630	203	.000	.977	.032 (.032—.033)	.021
5. Bi-factor model	15749.316	187	.000	.981	.030 (.029—.030)	.018
6. Second-order model	20036.426	205	.000	.979	.032 (.032–0.33)	.021
7. Parceled model	423.423	2	.000	.997	.048 (.044—.052)	.013

3.2 Bifactor Analysis

Thereafter, we tested the full bifactor model – the specification of which included all items loading onto both a general factor along with one of the four group factors (Model 5 in Table 2; Figure 3). We found an acceptable fit for the bifactor model, with the general factor accounting for the common variance among the items; and additional variance accounted for by four domain specific factors, beyond that of the general factor. This is in contrast to the second-order model (Model 6 in Table 2), which presents a hierarchical configuration with the latent construct of SWB manifesting in four lower-order domain specific factors. Using the specified fit statistics thresholds, we note that both the bifactor and second-order model present with a good fit. The results of the bifactor analysis (specific indices) are presented in Table 4.

We followed the guidelines as recommended by Rodriguez et al. (2016) who categorise the indices into two broad types: those that index the properties of total and subscale scores and those that inform the appropriateness of the measure or model in a SEM context. We followed three steps, as described below.

First, we used model-based reliability estimates to assess the interpretability of the total and sub-scale (group factor) scores in the context of assumed multidimensionality. Here we considered the various indices of Omega. The Omega/OmegaS index, the general factor, Context-Free SWB, and Domain-Based SWB met the threshold for acceptable fit (.70), while positive affect and negative affect fell slightly short. For OmegaH/OmegaHS, only the general factor (.87) met the criteria, while the context-free, domain-based and positive affect factors were substantially lower. With an index of .61, negative affect was approaching the acceptable threshold. The results suggest that 87% of the variance of the unit-weighted total score

Table 3 Standardised regression weights for the bifactor model

Parameter			Estimate	Lower	Upper	P
enjoylife	←	CWSWBS	.405	.394	.418	.002
lifegoingwell	←	CWSWBS	.478	.468	.487	.002
havegoodlife	←	CWSWBS	.498	.488	.507	.003
thingslifeexcellent	←	CWSWBS	.373	.362	.385	.002
happywithmylife	←	CWSWBS	.438	.428	.450	.002
satisfiedlifeasstudent	←	DOMAINSWB	.084	.061	.107	.004
satisfiedfriends	←	DOMAINSWB	.174	.151	.197	.003
satisfiedlocalarea	←	DOMAINSWB	.154	.107	.194	.005
satisfiedthingshave	←	DOMAINSWB	.108	.039	.167	.008
satisfiedtimeuse	←	DOMAINSWB	.063	.010	.111	.022
satisfiedsafety	←	DOMAINSWB	–.038	–.094	.008	*.152^{ns}*
satisfiedfreedom	←	DOMAINSWB	–.083	–.141	–.030	.007
satisfiedappearance	←	DOMAINSWB	–.283	–.305	–.255	.004
satisfiedlaterinlife	←	DOMAINSWB	–.211	–.242	–.177	.004
satisfiedhealth	←	DOMAINSWB	–.180	–.218	–.139	.006
satisfiedpeoplelivewith	←	DOMAINSWB	.181	.155	.207	.002
feelinghappy	←	Positive_Affect	.332	.317	.348	.003
feelingcalm	←	Positive_Affect	.295	.282	.309	.003
feelingfullofenergy	←	Positive_Affect	.389	.372	.405	.005
feelingsad	←	Negative_Affect	.642	.635	.650	.003
feelingstressed	←	Negative_Affect	.595	.587	.604	.004
feelingbored	←	Negative_Affect	.586	.579	.595	.003
enjoylife	←	SWB	.703	.695	.710	.005
havegoodlife	←	SWB	.713	.707	.720	.002
satisfiedpeoplelivewith	←	SWB	.582	.572	.592	.003
satisfiedlifeasstudent	←	SWB	.562	.554	.572	.006
satisfiedfriends	←	SWB	.493	.483	.505	.002
satisfiedlocalarea	←	SWB	.540	.531	.548	.002
satisfiedthingshave	←	SWB	.630	.624	.638	.002
satisfiedtimeuse	←	SWB	.658	.653	.666	.001
satisfiedsafety	←	SWB	.705	.698	.712	.002
satisfiedfreedom	←	SWB	.670	.664	.678	.001
satisfiedappearance	←	SWB	.639	.627	.654	.002
satisfiedlaterinlife	←	SWB	.622	.612	.633	.002
satisfiedhealth	←	SWB	.617	.607	.629	.001
feelingbored	←	SWB	–.191	–.198	–.183	.005
feelingstressed	←	SWB	–.212	–.219	–.205	.006
feelingfullofenergy	←	SWB	.408	.400	.417	.002
feelingsad	←	SWB	–.246	–.253	–.239	.007
lifegoingwell	←	SWB	.719	.713	.727	.005
thingslifeexcellent	←	SWB	.658	.644	.666	.010
happywithmylife	←	SWB	.712	.706	.720	.004
feelinghappy	←	SWB	.656	.649	.664	.004
feelingcalm	←	SWB	.383	.376	.390	.004

^{ns} = Not significant

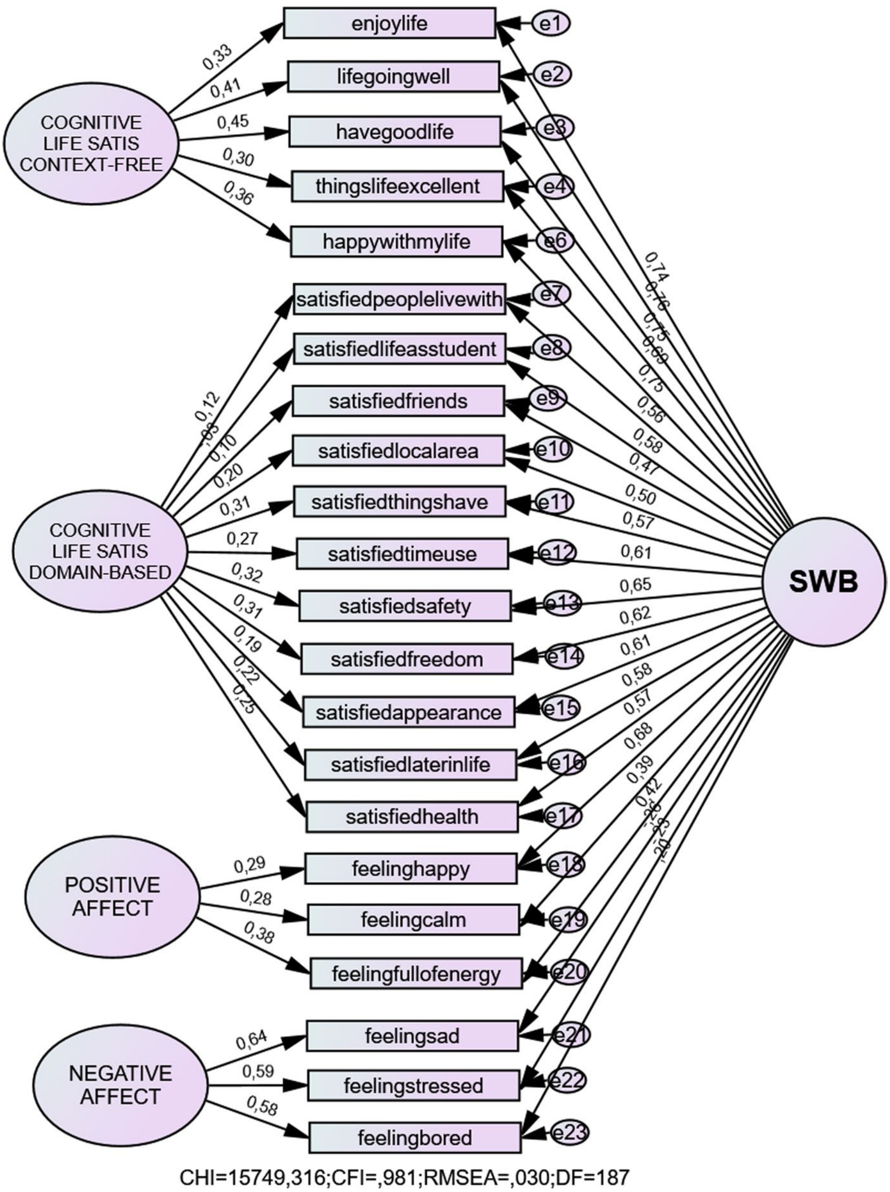


Fig. 3 Bifactor model

is attributable to the general factor, with only 6% (93-87) of the reliable variance attributable to the multidimensionality related to group factors.

Second, we assessed dimensionality, using the indices of ECV and PUC. The ECV for the general factor was .073, which means that 73% of the common variance is explained by the general factor, with 27% shared across the group factors.

Table 4 Bi-factor indices

	Omega/ OmegaS	OmegaH/ OmegaHS	Relative Omega	ECV ECV_S	PUC	FD	H
General Factor	0.93*	0.86*	0.92*	0.73*	0.70*	0.94*	0.93*
Context-Free Life Satisfaction	0.92*	0.19	0.20	0.21		0.70	0.45
Domain-Based Life Satisfaction	0.87*	0.10	0.12	0.14		0.59	0.39
Positive Affect	0.62	0.18	0.29	0.28		0.55	0.26
Negative Affect	0.68	0.60	0.88*	0.87*		0.81	0.63

* Meets threshold for acceptability

This, along with a PUC of .70 that moderates the effect of bias related to the ECV, indicates that the common variance is essentially unidimensional. We also note the I-ECV values (see Table 5), wherein the scores of nine of 11 items on the domain-based sub-factor fell above the threshold of >.80. All these items are thus pure markers of the general factor, with little contribution to the specified sub-factor. This suggests that the domain-based sub-factor may not be viable as a specific factor of the overall model, over and above the general factor – the variance associated with items on the domain-based sub-factor is nearly completely explained by the general factor. We further note the low factor loadings of these items on the sub-factor in the bifactor model (see Table 3 and Fig. 3). Related to this, we found one negative loadings on domain-based sub-factor, which is contrary to our theoretical specification and prediction. Similar results were obtained by Chen et al. (2006), and we surmise that this is an artefact of fitting the bifactor model. Negative factor loadings suggest anomalous results as either: the negative correlations among some set of items are strong enough to result in the formation of separate 'contrast' factor defined by items with negative loadings; or the item variance is being completely accounted for by the general factor (Eid et al., 2017; Scopel Hoffman et al., 2022).

Given these results, applied researchers may consider fitting an incomplete bifactor model by removing the domain-based sub-factor and allowing these items to only load onto the general factor (see Chen et al., 2006, for a more in-depth discussion). However, in our study, 10 of the 11 items on the sub-scale were significant, with only one item (satisfied with life as a student) failing to meet significance. Therefore, regardless of the low loadings, we tentatively accept the tenability of the full-bifactor model.

Third, we considered the quality of the measurement model by assessing the extent to which the latent constructs are defined by the particular items using Factor Determinacy (FD) and Construct Replicability (*H*). Low FD and *H* scores for the context-free, domain-based and positive affect group factors suggest that these latent constructs may not be reliably specified, casting doubt on the factor score estimates. For the general factor, both FD and *H* are similar, which provides further evidence of unidimensionality.

Taken together, the bifactor analysis is indicating that for the general factor all the indices met the criteria for acceptability, suggesting that the SWB model can be represented as unidimensional. The negative affect factor, while falling somewhat short, is approaching acceptability; while the variance of the items on the domain-based factor is likely completely explained by the general factor.

Table 5 Item Explained Common Variance (I-ECV)

Factor	Item Name	I-ECV
Context-Free	Item1	0.833*
Context-Free	Item2	0.772
Context-Free	Item3	0.735
Context-Free	Item4	0.840*
Context-Free	Item5	0.814*
Domain-Based	Item6	0.957*
Domain-Based	Item7	0.998*
Domain-Based	Item8	0.958*
Domain-Based	Item9	0.867*
Domain-Based	Item10	0.765
Domain-Based	Item11	0.837*
Domain-Based	Item12	0.810*
Domain-Based	Item13	0.797
Domain-Based	Item14	0.907*
Domain-Based	Item15	0.876*
Domain-Based	Item16	0.841*
Positive Affect	Item17	0.842*
Positive Affect	Item18	0.655
Positive Affect	Item19	0.552
Negative Affect	Item20	0.142
Negative Affect	Item21	0.127
Negative Affect	Item22	0.104

*I-ECV Threshold > .80. Nine of the 11 items on the Domain-Specific sub-factor are above the threshold, which means that the majority of the items on domain-specific factor are likely pure markers of the General Factor

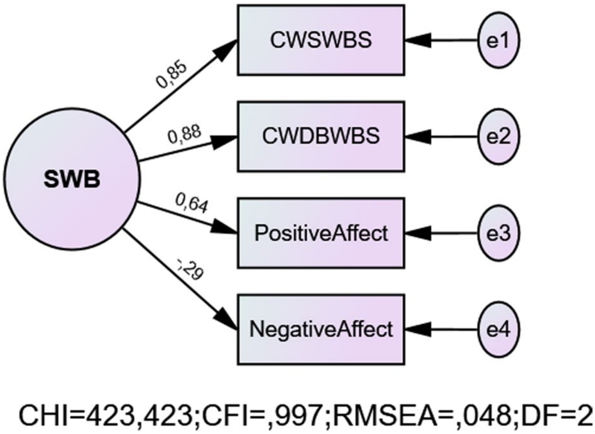
3.3 Parceling Analysis

Based on the outcomes of the bifactor analysis, we followed recommendations by Rodriguez et al. (2016) and tested a model consisting of parcels. Specifically, we followed an aggregated all-item-parcel approach wherein the 22 items of the overall model were reduced into four parcels aligned to the theoretical dimensions of SWB. We obtained an excellent fit for the model (see Model 7 in Table 2; Figure 4), which was further corroborated by a high H score (0.871) indicating a well-defined latent construct (SWB).

4 Discussion

The study aimed to establish the viability of a bifactor model of children's SWB, to resolve issues of dimensionality; i.e. to determine whether the strength of a general factor justifies a unidimensional measurement model, or whether group factors

Fig. 4 Parceled model



legitimately exist as lower-order factors; and to offer recommendations for the measurement of children's SWB in an applied SEM context.

We found a good fit for the specified bifactor model with all items loading onto a general factor as well as four specific group factors (context-free cognitive life satisfaction, domain-based cognitive life satisfaction, positive affect, and negative affect) that were assumed orthogonal. This finding is significant as it represents the first study of its kind that models children's SWB using a bifactor structure. Kaufman et al. (2022) and Al Nima et al. (2020) found similar results using data from adult samples. Our study is premised on the notion that children's SWB is a multidimensional construct, and thus a meaningful interpretation of SWB should take into consideration the various dimensions that make up the construct. An important finding of our study is that the construct of children's SWB, conceptualised as a multidimensional construct, can potentially be measured as a unidimensional construct. Therefore, it may be feasible to report a total score for children's SWB, as opposed to scores on the individual subscales (group factors).

In previous analyses (Savahl et al., 2021), we found a good fit for the hierarchical structural model of children's SWB, wherein we propound a quadripartite hierarchical model consisting of a single higher-order factor of SWB manifesting in four lower-order factors (see Model 6 Table 2). However, the results of our analyses in the current study are indicating that after controlling for the general factor, the loadings on the group factors are substantially lower and do not meet the criteria of acceptability as per the bifactor indices thresholds. This means that the common variance of the items is largely explained by the general factor, and the specification of the group factors cannot be justified – it is, therefore, not possible to apportion meaningful variation for the group factors. In other words, their legitimacy as lower-order factors is called into question. However, given the results of the bifactor analysis, there is evidence that negative affect could potentially exist as a separate factor. This finding is not surprising given the correlation of negative affect with psychopathological constructs (Böhnke et al., 2014). Bradburn (1969) in fact, pointed out that negative affect is more related to constructs within the purview of traditional 'mental-illness' approaches.

All the other items in this model are self-reported positively-valenced variables. Cummins et al. (2018) states that all these variables are expected to be correlated, because the existence of a composite positive affect (the Homeostatically Protected Mood, HP-Mood), which has effects on all of them and potentially is a biasing factor in self-reported data. These authors state that HP-Mood comprises three specific positive affects, namely: content, happy, and alert. Our model includes three positive affects, although they are not exactly the same: full of energy, happy, and calm. In our model, positive affect does not does not present as an outstanding unique variance by itself on the latent SWB variable. At that point, we do not know whether that result is specific to child populations.

From a measurement perspective, the study findings provide empirical evidence that the construct of children's SWB can potentially be measured as a unidimensional construct, regardless of the heterogeneity of the item content. The consequence of this is that it may be feasible to report on a total score for SWB, as opposed to scores on the individual sub-scales (group factors) (Kaufman et al., 2022; Rodriguez et al., 2016). Applied researchers can, therefore, use SWB as a unidimensional construct in the SEM context. This is especially useful for researchers exploring predictors of SWB, with the additional benefit of allowing for the testing of measurement invariance using the full conceptual model of children's SWB; i.e. for conducting group comparisons, e.g. across different contexts, age, gender etc. In our study, a unidimensional model would consist of 22 items – while this may be acceptable, another approach, providing a more parsimonious model, would be to create parcels (Matsunaga, 2008; Rodriguez et al., 2016). These parcels would be based on the items of the group factors and then used as indicators to identify a single latent construct of SWB. The common variance of these factors would be explained by the single latent construct of SWB. In our study, we achieved this by using the aggregated all-item-parcel approach, wherein the 22 items were collapsed into content homogenous group factors of context-free cognitive life satisfaction, domain-based cognitive life satisfaction, positive affect, and negative affect. Using the parceling approach, our analysis demonstrated excellent fit statistics for the 'parcel model'; with an H score of 0.871 indicating a high level of factor replicability, which points to a well-defined latent construct of children's SWB.

For applied researchers who may want to use this approach in research on children's SWB, we recommend a careful consideration of the items of the various group factors. We also recommend the inclusion of a broader range of indicators for the positive affect and negative affect group factors, given that the positive affect and negative affect group factors only consisted of three items each. As the current study consists of a heterogenous multinational sample, we recommend that researchers assess both the bifactor and parceling approach in individual contexts using homogenous country samples. This is an important undertaking as both the factor loadings and the overall structure are likely context dependent (Casas, 2017; Rees et al., 2020). Finally, given that our study is demonstrating that the dimensions of context-free cognitive life satisfaction, domain-based cognitive life satisfaction, positive affect, and negative affect reflect the overall construct of SWB we recommend that researchers endevour to use the full conceptual model when reporting on SWB.

5 Conclusion

Bifactor models provide a useful framework to understand how theoretically informed multidimensional constructs, consisting of heterogenous items can be used in the SEM context (Reise et al., 2010). In our current study, we considered the viability of a bifactor model of children's SWB. We refrained from engaging in a discussion on the theoretical and conceptual make up of children's SWB and from testing or comparing different conceptual models of children's SWB. Our focus was geared towards providing information to applied researchers on issues relating to the measurement of children's SWB. Our analysis confirmed a good fit for the bifactor model, with the bifactor indices indicating a strong general factor, which ultimately suggests that the concept of children's SWB can be modelled as a unidimensional factor in the SEM context. We further put forward a consideration of the parceling approach, using parcelled data comprising context-free cognitive life-satisfaction, domain-based cognitive life-satisfaction, positive affect, and negative affect. Parceling, while relatively novel and somewhat controversial, is a promising method and a fruitful area for further research. Finally, while our study used a pooled sample of countries, we are mindful that across four waves of data collection, we consistently found that most of the variation in children's SWB is within rather than between countries (see Rees, 2017; Rees et al., 2020; Savahl et al., 2022). We, therefore, recommend that the analysis presented in the current study be replicated, and that the various models of SWB (second-order hierarchical, bifactor, and parceling) be tested at the individual country level. We are not advocating for one over the other; rather, we advise researchers to be guided by the aims and objectives of their studies. The second-order hierarchical model that includes various components of SWB, is essentially a theoretical model, and is useful for testing the context-specific applicability of the full conceptual model of SWB. For those who aspire to measure SWB as a unidimensional construct using a total score, envisage exploring predictive relationships with external variables, or to conduct group comparisons, the bifactor model offers an efficient approach. For those intending to build sophisticated and more complex models that include a range of predictors, correlates and determinants of SWB, the parceling approach offers the highest level of parsimony.

Author contributions SS was the lead author. SS conceptualised the study, wrote the background and rationale, wrote the literature review, wrote the method, conducted and led the analysis, wrote the discussion and conclusion. FC conceptualised the study with SS and SA, contributed to the literature review, conducted part of the analysis with SS and SA, wrote part of the discussion and conclusion. SA conceptualised the study with SS and FC, contributed to the literature review, wrote the method with SS, conducted part of the analysis with SS and FC, wrote part of the discussion and conclusion. All authors conducted editorial work and approved the final draft.

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Data Availability The data are available from the Children's Worlds core group, upon reasonable request.

Declarations

The authors have no competing interests to declare that are relevant to the content of this article. For the Children's Worlds Study, principal investigators led the implementation of the survey at the country level. This included developing the sampling strategy, adapting the instrument, and obtaining ethics clearance. The raw data supporting the conclusions of this article are available from the International Society for Child Indicators upon reasonable request at www.isciweb.org; conditions and restrictions are applicable.

Conflict of Interest We confirm no conflict of interest.

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