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Reinvestigation of the factor structure of the MHC-SF in the Netherlands: Contributions of exploratory structural equation modeling

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ABSTRACT

The present study used the methods of Confirmatory Factor Analysis (CFA) and Exploratory Structural Equation Modeling (ESEM) to reinvestigate the factor structure of the Mental Health Continuum-Short Form (MHC-SF) in a nationally representative sample from the Netherlands ($N = 1662$). The results showed that ESEM yielded better fit and considerably smaller factor correlations than did CFA. These findings suggest that ESEM is a more appropriate method than traditional CFA for examining the factor structure of mental well-being. The contributions of ESEM to current debates concerning the distinction between hedonic and eudaimonic well-being are discussed.

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1. Introduction

For a comprehensive assessment of mental well-being, researchers need to take into account both hedonic and eudaimonic aspects of well-being (Keyes, 2002). Hedonic (also called emotional or subjective) well-being involves the presence of positive feelings and life satisfaction, and the absence of negative feelings (Diener, 1984). Eudaimonic well-being involves the presence of certain skills and abilities that are required for optimal functioning (Keyes & Annas, 2009). The eudaimonic aspect of well-being is measured across two dimensions of psychological and social well-being. Psychological well-being primarily consists of key psychological skills required for functioning well in one's personal life (e.g., self-acceptance and personal growth, Ryff, 2014). Social well-being, on the other hand, captures how well an individual functions in social life as a member of a larger society (social integration and contribution, Keyes, 1998).

The emotional, social, and psychological aspects of well-being have been mostly studied separately. However, in Keyes' tripartite model of mental well-being (Keyes, 2002), mental well-being is considered to encompass all the three components. The briefest scale to assess the model is the 14-item Mental Health Continuum-Short Form (MHC-SF, Keyes et al., 2008). A considerable number of previous studies have investigated the factor structure of this scale in various cultural contexts. Many of these studies have used Confirmatory Factor Analysis (CFA). CFA has provided a fairly good level of support for the tripartite structure of the MHC-SF (e.g. Joshanloo, Wissing, Khumalo, & Lamers, 2013, Karaś, Cieciuch, & Keyes, 2014, Lamers, Westerhof, Bohlmeijer, ten Klooster, & Keyes, 2011). A recent study used the new method of Exploratory Structural Equation Modeling (ESEM) to examine the factor structure of the MHC-SF in Iran and the USA (Joshanloo, in press a). This study showed that ESEM outperformed CFA in capturing the factor structure of the MHC-SF, as indicated by better fit indices. Below, this relatively new method and its advantages over the traditional CFA approach are discussed.

1.1. ESEM versus CFA

The structure of many psychological instruments cannot be represented adequately within a simple CFA approach (Marsh et al., 2009; Morin, Marsh, & Nagengast, 2013). Specifically, the factor structures of these instruments are not consistent with the highly restrictive CFA assumption that each item loads on only one factor, whereas its loadings on all other factors are constrained to be zero. Constraining a majority of the factor loadings to zero may result in bad fit and the overestimation of factor correlations, when the non-target loadings are not near zero (Marsh et al., 2014). As Asparouhov and Muthen (2009) explain, "when non-zero cross-loadings are specified as zero, the correlation between factor indicators representing different factors is forced to go

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through their main factors only, leading to over-estimated factor correlations and subsequent distorted structural relations" (p. 398). Misspecification of cross-loadings results in factors with inflated intercorrelations, which may cast doubt on the distinguishability of the factors under study, even when the correlations are in fact small enough to be indicative of factor distinctiveness.

Because of the overly restrictive constraints of the CFA approach, some researchers have recently recommended the use of ESEM to represent the factor structure of multi-dimensional constructs (Marsh et al., 2011; Morin et al., 2013). This statistical procedure, developed by Asparouhov and Muthen (2009), is an integration of Exploratory Factor Analysis and CFA. It is argued that ESEM adequately addresses the limitations of CFA in representing the measurement model of multidimensional constructs, by imposing less restrictive constraints. This advantage stems from the fact that in ESEM, nontarget factor loadings are not constrained to zero (i.e., all items have loadings on all factors). When ESEM does not fit the data better than does the corresponding CFA model, and does not result in smaller factor correlations, the CFA solution would be preferable, because it is more parsimonious (Marsh et al., 2009). However, in practice, ESEM usually produces better fit and less elevated factor correlations than CFA (Marsh et al., 2014).

1.2. The present study

Given the close link between functioning and feeling (Keyes & Annas, 2009), and between the social and private aspects of human experience (Lieberman, 2013), the three well-being aspects are expected to be closely related. For example, optimal psychological functioning usually produces positive feelings (Huta & Waterman, 2014), positive emotions can build psychosocial skills in the long run (Fredrickson, 2001), and psychological skills are required for smooth functioning at the societal level. Hence, some of the items of the MHC-SF are expected to have significant associations with multiple constructs. Therefore, it would be necessary to use ESEM to reveal these cross-loadings. Moreover, ESEM is likely to produce better fit and more accurate factor correlations, which may turn out to be smaller than the ones produced by CFA. As stated earlier, prior comparisons of ESEM and CFA have supported this prediction (Joshanloo, in press a). A recent study in a nationally representative American sample using longer versions of the three well-being scales also revealed that ESEM yielded better fit and smaller factor correlations than did CFA (Joshanloo, in press b).

ESEM has never been used in the Netherlands to examine the factor structure of mental well-being. To fill this gap, in the present study, we examined the factor structure of the MHC-SF in this culture using ESEM in addition to CFA. We were also interested in examining measurement invariance and gender differences in the MHC-SF. Previous studies in various cultures indicate that gender differences in the three dimensions of the MHC-SF are usually small and nonsignificant (e.g., Karaś et al., 2014). However, Graham and Chattopadhyay's (2013) recent worldwide study shows that women tend to score higher than men in adult samples (e.g., older than 25 years). Thus, we expected women to report higher levels of emotional well-being in the present adult sample. Prior findings in adult Dutch samples support this prediction (Arrindell, Heesink, & Feij, 1999).

2. Method

2.1. Participants

We used the same data set collected by CentERdata and analyzed by Lamers et al. (2011). This nationally representative sample consists of 1662 Dutch respondents between the ages of 18 and 87 years. Males consist 49.8% of the sample. Of the participants, 22.9% age 18 to 29 years, 28.4% are 30 to 49 years, 26.5% are 50 to 64 years, and 22.2% age 65 years and over. The mean age is 47.6 ($SD = 17.7$). The response rate was 69% (for more detailed information about the sample see Lamers et al., 2011).

2.2. Measure

The MHC-SF (Keyes, 2002) consists of 14 items measuring emotional (3 items; e.g. 'How often did you feel happy?'), social (5 items; e.g., 'How often did you feel that you belonged to a community?'), and psychological well-being (6 items; e.g., 'How often did you feel good at managing the responsibilities of your daily life?'). Each item assesses the self-reported frequency of a feeling of well-being in the last month (0 = *never* to 5 = *every day*). Cronbach's alpha of the entire scale was .88. Alphas for emotional, social, and psychological subscales were .82, .73, and .82, respectively. There was no missing value in the data file used in the analyses. The MHC-SF has demonstrated a high level of convergent validity in the Netherlands (e.g., Lamers et al., 2011). Moreover, Item Response Theory analyses on the MHC-SF have shown that the items are reliable over time and across demographic characteristics (Lamers, Glas, Westerhof, & Bohlmeijer, 2012).

2.3. Statistical analysis

Model fit was assessed using CFA and ESEM in Mplus 7.4. We used maximum likelihood and an oblique geomin rotation with an ε value of .5, which is generally recommended in ESEM research (e.g. Marsh et al., 2009; Marsh et al., 2010; Morin et al., 2013). A minimum cutoff of .90 for the comparative fit index (CFI) and Tucker–Lewis index (TLI) and a maximum cutoff of .08 for the standard root mean square residual (SRMR) and root mean square error of approximation (RMSEA) were considered as indicative of acceptable fit (Bentler, 1990; Browne & Cudeck, 1993; MacCallum, Browne, & Sugawara, 1996). Models with smaller values of the Akaike information criterion (AIC) and Bayesian information criterion (BIC) are preferred to those with higher AIC and BIC values. To investigate measurement invariance across gender, each gender group was individually tested for goodness of fit, and then a series of increasingly restrictive measurement invariance tests was performed to establish configural, metric, and scalar invariance. The models were compared with cutoffs of .01 for ΔCFI and .015 for ΔRMSEA (Chen, 2007; Cheung & Rensvold, 2002).

3. Results

3.1. ESEM vs CFA

The fit indices for CFA and ESEM are presented in Table 1. As shown in Table 1, the ESEM model fitted the data noticeably better than did the corresponding CFA model, as indicated by larger CFI and TLI values and smaller AIC, BIC, RMSEA, and SRMR values. In fact, the fit of the CFA model was not acceptable based on the standards commonly used in psychological research. Factor loadings are presented in Table 2. We used the commonly used cutoff of .30 for size of loading to be considered salient in defining constructs (e.g. Fabrigar, Wegener, MacCallum, & Strahan, 1999; Rosellini & Brown, 2011). In CFA, all of the items loaded highly and significantly on their target factor. Similarly, in ESEM, all of the items loaded significantly on their target factors. In ESEM, all of the items had significant secondary loadings, but the secondary loadings were considerably weaker than the primary ones. Items 11 and 12 had cross-loadings that reached the cutoff of .30. The three ESEM factors clearly correspond to the three intended dimensions of the MHC-SF.

[1] In addition to the three-factor model, we also tested a one-factor model and a two-factor model (where all of the social and psychological items were specified to load on a single eudaimonic well-being factor). These two models did not provide an adequate fit and thus, are not considered in this article.

Table 1
Confirmatory and Exploratory Factor Analyses.

Model	χ^2	*df*	CFI	TLI	SRMR	AIC	BIC	RMSEA	90% CI for RMSEA	
									LL	UL
ESEM	565.567	52	0.945	0.903	0.031	69,929.533	70,079.541	0.077	0.071	0.083
CFA	1144.373	74	0.885	0.858	0.057	70,464.338	70,565.090	0.093	0.089	0.098

Note. LL = lower limit; UL = upper limit. The BIC value is sample-size adjusted. All χ^2 values are significant at $p < .001$.

With regard to factor correlations, as can be seen in Table 3, the estimates were considerably smaller in the ESEM model ($M = 0.38$) than they were in the CFA model ($M = 0.70$), indicating greater factor distinctiveness in the ESEM model. Given a better fit obtained with the ESEM model, the existence of significant cross-loadings, and diminished factor correlations in the ESEM model, we considered the ESEM solution to be superior to the CFA solution, and used it in the subsequent invariance testing.

3.2. Analyses across gender

The ESEM model fitted the data reasonably well in females ($\chi^2 = 285.965$, $p < 0.001$, RMSEA = 0.073, CFI = 0.950; SRMR = 0.030) and males ($\chi^2 = 351.226$, $p < 0.001$, RMSEA = 0.083, CFI = 0.936, SRMR = 0.035). To examine measurement invariance, the baseline model was tested simultaneously in both gender groups. As can be seen in Table 4, this model (M1) fitted the data very well, indicating that configural invariance was supported. Equality constraints were then imposed on all factor loadings across the groups. As shown in Table 4 (M2), both the ΔCFI and ΔRMSEA indicated full metric invariance. Finally, equality constraints were imposed on all item intercepts (M3), and both the ΔCFI and ΔRMSEA were small enough to indicate full scalar invariance. We proceeded with comparing latent means across gender groups, using the parameters of the last model (M3). No significant gender differences were found in psychological (unstandardized fitted $\text{mean}_{(\text{female})} = 0.027$, $SE = 0.056$, $p = 0.631$) and social (unstandardized fitted $\text{mean}_{(\text{female})} = -0.023$, $SE = 0.060$, $p = 0.703$) well-being. Yet, as expected, females scored significantly higher than males on emotional well-being (unstandardized fitted $\text{mean}_{(\text{female})} = 0.124$, $SE = 0.053$, $p = 0.019$).

Table 2
Standardized factor loadings for the three-factor ESEM and three-factor CFA models.

	ESEM			CFA
	Emotional	Social	Psychological	
Emotional				
Item 1	**0.792*****	0.076***	0.022	**0.815*****
Item 2	**0.582*****	0.091***	0.215***	**0.755*****
Item 3	**0.806*****	0.042*	0.002	**0.795*****
Social				
Item 4	0.246***	**0.376*****	0.201***	**0.686*****
Item 5	0.195***	**0.314*****	0.197***	**0.599*****
Item 6	0.047**	**0.814*****	−0.150***	**0.574*****
Item 7	0.090***	**0.556*****	0.099**	**0.609*****
Item 8	−0.120***	**0.471*****	0.285***	**0.544*****
Psychological				
Item 9	0.091***	0.276***	**0.514*****	**0.714*****
Item 10	0.230***	0.042	**0.518*****	**0.669*****
Item 11	**0.334*****	0.028	**0.460*****	**0.677*****
Item 12	−0.072**	**0.300*****	**0.426*****	**0.526*****
Item 13	0.048*	0.094***	**0.665*****	**0.695*****
Item 14	0.299***	0.066**	**0.546*****	**0.757*****

Note. Loadings ≥.30 are in boldface.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

4. Discussion

The present study used a nationally representative Dutch sample to examine the factor structure of the MHC-SF. Both CFA and ESEM clearly identified the three a priori well-being factors, supporting the efficacy of the MHC-SF in measuring the tripartite model of mental well-being in this culture. However, ESEM performed better than CFA, as reflected in better fit indices and lower factor correlations produced in ESEM. Furthermore, ESEM provided more accurate information on the relationship between individual items and factors, as discussed below.

4.1. Factor structure of the MHC-SF

The fit of the three-factor ESEM model was acceptable, which suggests that mental well-being as measured by the MHC-SF consists of three correlated yet distinct factors in this sample. This is in keeping with a relatively large number of previous studies that have supported Keyes' tripartite model of well-being across various cultures using various scales (for reviews see Joshanloo, in press a, b). In prior research and the present study, separate psychological and social well-being factors emerged as distinct factors from each other, and from emotional well-being. Thus, this body of research has shown that it is possible to measure the three dimensions of mental well-being simultaneously.

Some researchers have recently indicated that the concept of mental well-being can be reduced to its emotional aspect, and that the eudaimonic aspect can be left out (Kashdan, Biswas-Diener, & King, 2008; Sheldon, 2013). One of the main arguments made in support of this suggestion is that eudaimonic well-being cannot be measured effectively using the existing eudaimonic well-being scales. Granted, eudaimonic well-being scales would benefit from constant revision and improvement. Yet, the findings of the present study and those of the previous research do not support the dismissal of eudaimonia on the grounds that it cannot be adequately measured in tandem with hedonic well-being.

4.2. ESEM versus CFA models

Consistent with the previous ESEM studies, we found a large number of significant secondary loadings in the measurement model of mental well-being. Not surprisingly, the ESEM model provided better fit, due to the relaxation of the constraints on nontarget factor loadings. Considering the available empirical evidence, it can be concluded that the ESEM studies on the factor structure of mental well-being, including the present study, have provided a larger degree of support for the tripartite model of mental well-being than the previous CFA studies. On this basis, well-being researchers are encouraged to consider using ESEM together with CFA when investigating the factor structure of

Table 3
Factor correlations.

	Emotional	Psychological	Social
Emotional	–	0.730	0.607
Psychological	0.433	–	0.791
Social	0.284	0.437	–

Note. CFA and ESEM correlations are presented above and below the diagonal, respectively. All correlations are significant at $p < .001$.

Table 4
Testing for measurement invariance.

	χ^2	*df*	CFI	RMSEA	Model comparison	ΔCFI	ΔRMSEA
M1. Configural invariance	637.191	104	0.943	0.079	–	–	–
M2. Full metric invariance	671.635	137	0.943	0.069	M2–M1	.000	−.010
M3. Full scalar invariance	772.223	148	0.933	0.071	M3–M2	−.010	.002

Note. All χ^2 values are significant at $p < .001$.

well-being constructs. The fact that hedonic, social, and psychological dimensions are linked at the theoretical level necessitates the application of ESEM, because cross-loadings are expected for the items of closely related concepts (Marsh et al., 2009). Failure to use more realistic statistical methods such as ESEM may lead to a premature dismissal of some central aspects of mental well-being and other unwarranted speculations.

4.3. Factor correlations

Overall, the factor correlations were found to be considerably smaller in ESEM than in CFA in our Dutch sample (see Table 3). Findings from Iran and the USA also indicate that ESEM yields smaller factor correlations in the MHC-SF than does CFA (Joshanloo, in press b). These results have been supported in studies using lengthier well-being measures (Joshanloo, in press b). These findings speak to current debates in the field of mental well-being. Some researchers have interpreted large factor correlations produced in CFA studies as a sign that hedonic and eudaimonic well-being are not empirically distinguishable (e.g., Kashdan et al., 2008). In fact, correlations found in some of the previous CFA studies are indicative of a large degree of overlap between hedonic and eudaimonic well-being (for a review see Joshanloo, in press b). In particular, the correlations between emotional and psychological well-being have been found to be as high as .96 (Disabato, Goodman, Kashdan, Short & Jarden, in press). However, ESEM has produced considerably lower correlations between the three dimensions of well-being. Considering that usually only correlations higher than .80 or .85 are taken as a potential indicator of poor discriminant validity or the presence of multicollinearity (Brown, 2015; Kline, 2011; Tabachnick & Fidell, 2007), it can be concluded that the ESEM studies (as well as many past CFA studies) have supported the empirical distinction of hedonic and eudaimonic well-being. Thus, using traditional CFA has partly caused the inflation of factor correlations, leading some researchers to conclude that the factors of well-being are not empirically distinguishable.

4.4. Factors and factor loadings

In CFA studies, all nontarget factor loadings are constrained to zero. As a result of this style of specification, usually all items of the MHC-SF have been found to load strongly on their intended factors in prior CFA studies. In the present CFA analysis in the Netherlands, this finding was replicated (see Table 2). Yet, ESEM studies, including the present one, draw a different picture of some of the items of the MHC-SF. In our ESEM analysis, we found that all the items of the scale had significant (yet mostly nonsalient) secondary loadings on multiple factors.

Two secondary factor loadings reached the cutoff of .30 for inclusion in the interpretation of factors. Item 11 ("that you had warm and trusting relationships with others"), which is related to psychological well-being, had a relatively strong loading on emotional well-being. This indicates the importance of having good relationships for experiencing positive emotions in Dutch culture. Item 12 ("that you had experiences that challenged you to grow and become a better person"), which is related to psychological well-being, had a relatively strong secondary loading on social well-being. This may indicate that in Dutch culture, trying to "grow and become a better person" is not merely a personal undertaking. Instead, it also involves a healthy connection to broader society (e.g., contributing to society). This is consistent with the fact that the Netherlands is close to the top in world rankings of social capital (measuring social cohesion and engagement; Legatum Institute, 2012). An inspection of the size of factor loadings indicates that these two items contribute to the emotional and social well-being factors only slightly, and these factors are primarily defined by their intended items. The present pattern of loadings illustrates the possibility that a reliable item of a construct can have significant levels of associations with other constructs and we need a statistical method such as ESEM to reveal these associations (Asparouhov, Muthén, & Morin, 2015).

In ESEM, if many of the items do not have salient loadings on their intended factors, one could conclude that the a priori design of the scales is not replicated (Furnham, Guenole, Levine, & Chamorro-Premuzic, 2013). But, the three-dimensional factor structure of the MHC-SF was clearly replicated in the present sample. The number of salient secondary loadings was small, and the primary loadings were considerably stronger than the secondary ones. These suggest that the secondary loadings did little to the definition of the constructs. Thus, the present pattern of cross-loadings does not seem to signify poor-functioning items or constructs that must be revised or replaced. When the secondary loadings are moderate-sized and weaker than primary loadings, the item can be safely placed with its target factor (Pett, Lackey, & Sullivan, 2003).

Although the findings do not seem to indicate a need for revision of the items of the Dutch version of the MHC-SF used here, they highlight the need for using ESEM for a more accurate representation of the measurement model of the MHC-SF in this culture. Researchers are encouraged to study the three well-being factors in the context of ESEM rather than CFA or SEM. ESEM analysis seems also preferable to analyses based on linear combinations of the items (e.g., multiple regression).

4.5. Gender differences

The results of measurement invariance analyses across gender revealed full metric and scalar invariance, with no indication of differential item functioning for any of the items. These results indicate that the scale has the same basic factor structure across the two genders (configural invariance), the factor loadings are not significantly different across gender (full metric invariance), and there are no significant gender differences in the item intercepts (full scalar invariance). These results are congruent with previous findings supporting the measurement invariance of the MHC-SF across gender in several cultures (e.g. Joshanloo, in press a; Karaś et al., 2014; Lamers et al., 2011). Moreover, as expected, the results of latent mean analysis indicated no gender differences in social and psychological well-being, which is compatible with finding from the USA (Joshanloo, in press a). Nevertheless, in line with Arrindell et al.'s (1999) findings in a large Dutch sample, we found females to score higher than males on emotional well-being.

4.6. Concluding remarks

This study is not without limitations. For example, although the data were collected via a random selection in municipal registers, compared with national statistics, single and never married persons, the elderly, widowers, and immigrants are slightly underrepresented. In addition, although ESEM has proved to outperform CFA here and in many past

studies, it is a new statistical technique in which best practice remains to be established (Marsh et al., 2011). For example, currently researchers are largely relying on the general guidelines used in CFA for evaluating model fit (Marsh et al., 2010). Yet, given that in ESEM models, more parameters are estimated than in CFA models, additional research is required to provide specific guidelines for the evaluation of model fit in ESEM, which may turn out to be slightly different from those commonly used in CFA studies. Despite these limitations, the findings of the present study contribute to the current debates among well-being researchers by showing that the correlations between the three components of mental well-being are not strong enough to suggest redundancy or to introduce statistical difficulties. It is hoped that such studies will pave the way for a more informed and comprehensive conceptualization and assessment of mental well-being in the Netherlands and other European countries.

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