Clarifying the Factor Structure of the Self-Compassion Scale: Nested Comparisons of Six Confirmatory Factor Analysis Models

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Abstract

Self-compassion is associated with greater well-being and lower psychopathology. There are mixed findings regarding the factor structure and scoring of the Self-Compassion Scale (SCS). Using confirmatory factor analysis, we tested and conducted nested comparisons of six previously posited factor structures of the SCS. Participants were *N*=1158 Canadian undergraduates (72.8% women, 26.6% men, 0.6% non-binary; M_{age}=19.0 [*SD*=2.3]). Results best supported a two-factor hierarchical model with six lower-order factors. A general self-compassion factor was not supported at the higher- or lower-order levels; thus, a single total score is not recommended. Given the hierarchical structure, researchers are encouraged to use structural equation models of the SCS with two latent variables: self-caring and self-coldness. A strength of this study is the large sample, while the undergraduate sample may limit generalizability.

Keywords: self-compassion, confirmatory factor analysis, Self-Compassion Scale, nested comparison, hierarchical factor structure.

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Self-compassion – treating oneself with the same kindness as one would others – is a protective factor following trauma and a promising target in psychological therapy (Zeller et al., 2015). However, disagreement about the factor structure and validity of total self-compassion scores of the Self-Compassion Scale (SCS; Neff, 2003b), a popular self-compassion measure, warrants clarification, the objective of the current study.

Neff (2003a) posits a nested structure with six subdimensions (self-kindness, mindfulness, common humanity, self-judgement, overidentification, and isolation), three subdimensions, each with two corresponding positive and negative components (self-kindness/self-judgement, mindfulness/overidentification, common humanity/isolation), and one over-arching self-compassion factor, suggesting a one-, three-, or six-factor lower-order model may represent the construct. Gilbert (2010) argues self-compassion is comprised of factors aligned with the safeness processing system (self-caring; positive items) and the threat/defense processing system (self-coldness; negative items), suggesting a two-factor lower-order model.

In studies examining theoretically plausible factor structures of the SCS at the lower-order level, neither one- nor three-factor models were supported (e.g., Brenner et al., 2017; Coroiu et al., 2018; Petrocchi et al., 2014). A six-factor structure was supported in several studies (*N*=424, Williams et al., 2014; *N*=1554, Kotsou & Leys, 2016), but others report substantial model misfit (Coroiu et al., 2018; Costa et al., 2016; Zeng et al., 2016). After modifications, Costa et al. (2016; *N*=1263) supported two factors (self-caring and self-coldness), as did Lopez et al. (2015; *N*=1643) using exploratory factor analysis.

Supporting hierarchical models, Neff (2003b; N_1=391, N_2=232) reported six lower-order factors loading on a single higher-order self-compassion factor, though subsequent studies failed to replicate this structure (Castilho et al., 2015; Williams et al., 2014). Conversely, others found that two higher-order factors (self-caring, self-coldness) with six lower-order factors showed marginal (*N*=2448, Coroiu et al., 2018) to good fit (*N*=1115, Brenner et al., 2017; N_1=406, N_2=416, Montero-Marín et al., 2016).

Recently, the SCS factor structure has been examined using bifactor models, where all factors are estimated as direct pathways to items (Markon, 2019). Bifactor models with two general factors (self-caring, self-coldness) and six specific factors (Brenner et al., 2017; Coroiu et al., 2018) and with only one general factor and six specific factors were supported (Cleare et al., 2018; *N*=526; Neff et al., 2017; four samples; Tóth-Király et al., 2017; *N*=505). There are numerous reasons why we do not use bifactor models in the present study. In simulations, Murray and Johnson (2013) found that the bifactor model has more favorable fit indices than any other model, even when the true model is hierarchical. Bonifay and Cai (2017) found that bifactor models typically overfit the data and tend to have favorable fit indices when modelling random data. Reise et al. (2016) similarly caution readers that bifactor models can accommodate implausible and invalid data patterns (see also Markon, 2019). Moreover, Neff (2003b) conceptualized the higher-order SCS factors are explained by, or meaningful in the context of their association with, the lower-order factors. Given bifactor general and specific factors are orthogonal, clinically relevant factor interpretation is difficult (e.g., the meaning of self-caring exclusive of self-kindness; Bonifay et al., 2016). Therefore, bifactor analyses should be cautiously interpreted, avoided in nested comparisons, and were not tested in the current study (Markon, 2019).

Clarifying whether a single factor (and hence single total score) reflects the factor structure of the SCS is important for more accurate and valid measure scoring. Unclear also is which model is superior *relative* to other posited models. We compared nested models of six different factor structures of the SCS, avoiding bifactor models. We predicted a six-factor (Petrocchi et al., 2014) or a hierarchical model with six lower-order factors loading on to two higher-order factors (Montero-Marín et al., 2016) would fit best.

Method

Participants

We report how we determined our sample size, all data exclusions (if any), all data inclusion/exclusion criteria, whether inclusion/exclusion criteria were established prior to data analysis, all measures in the study, and all analyses. We report absolute and comparative model fit indices and exact p-values (see Data Analyses section). A power analysis showed a sample of N=818 is required to detect a small effect (.15; α=.05; 80% power), estimating the most complex model in the current study (Soper, 2021). With the only eligibility criteria being participants were in their first- or second-year, Canadian undergraduates (N=1158, 72.8% women, 26.6% men, .6% non-binary; *M[SD]* age=19.0[*2.3*], n=157 excluded for missing data) completed a survey in fall 2016 and winter 2017 as part of a larger study (Strickland et al., 2019).

Procedure

All first-and second-year students were emailed invitations to complete a 30-minute online survey (compensated with gift cards or course credits), with three weekly reminders (response rate: 30.4%).

Measures

Participants completed the 26-item SCS (Neff, 2003b), using a 5-point frequency scale (1=never to 5=almost always), including three positively oriented and three negatively oriented facets.

Data analyses

Lower-order one, two (self-caring, self-coldness), three (corresponding to the three positive/negative self-compassion components; Neff 2003a), and six-factor models were tested. Hierarchical models tested included one higher-order global self-compassion factor with six lower-order factors, and two higher-order factors (self-caring, self-coldness) with six lower-order factors.

Models were tested using the lavaan package in R using the diagonally weighted least squares (DWLS) estimator for ordinal items. Fit indices and standard errors used the robust variation. The following absolute fit indices suggest adequate fit: Standardized Root Mean Square Residual (SRMR)<.08, Comparative Fit Index (CFI) and Tucker Lewis Index (TLI)>.90, and Root Mean Square Error of Approximation (RMSEA)<.06 (Hu & Bentler, 1999). Nested models were compared with likelihood ratio tests. While the code and full output from all models are accessible (see Strickland, 2021), the raw data needed to reproduce all of the reported results are not due to ethical constraints.

Results

The lower-order one-factor model fit indices were poor: $X^2(299, N=1129)=12966$, $p<.001$, SRMR=.14, RMSEA=.19, CFI=.78, TLI=.76. Standardized factor loadings ranged from .43-.74. The lower-order two-factor model showed acceptable fit on absolute fit indices and poor fit on relative fit indices: $X^2(298, N=1129)=2245$, $p<.001$, SRMR=.06, RMSEA=.08, CFI=.90,

TLI=.89. Standardized factor loadings ranged from .54-.77 for self-caring and .62-.82 for self-coldness. The factors were significantly intercorrelated (r=-.46, p<.001; SE=0.02). The three-factor model fit poorly: X^2(296, N=1129)=12669, p<.001, SRMR=.14, RMSEA=.13, CFI=.79, TLI=.77. Standardized factor loadings ranged from .61-.77 for self-kindness vs. self-judgement, .45-.76 for mindfulness vs. overidentification, and .45-.75 for common humanity vs. isolation. Latent variables were strongly related, ranging from r=.86, p<.001; SE=0.02 (self-kindness, common humanity) to r=.93, p<.001; SE=0.02 (mindfulness, common humanity). The correlated six-factor structure produced a non-positive definite covariance matrix. Inspection of the eigenvalues suggested that the overidentification factor had a negative eigenvalue and large latent correlations with other factors (i.e.,>.90) suggesting it is non-unique/inseparable from the other factors.

The hierarchical model involving one higher-order factor and six lower-order factors showed poor fit: X (293, N=1129)=9303, p<.001, SRMR=.12, RMSEA=.12, CFI=.82, TLI=.80. At the lower-order level, standardized factor loadings ranged from .71-.79 for self-kindness, .55-.79 for mindfulness, .60-.78 for common humanity, .66-.83 for self-judgement, .63-.87 for overidentification, and .66-.83 for isolation. The lower-order factors showed standardized factor loadings from .64-.88 on the self-compassion factor. The hierarchical model with two higher-order factors (self-caring, self-coldness) and six lower-order factors (three facets/higher-order factor) showed adequate fit across indices: X^2(292, N=1129)=1728, p<.001, SRMR=.05, RMSEA=.07, CFI=.92, TLI=.91 (Figure 1).

The following models were compared to the hierarchical two-factor model using likelihood ratio tests: one-factor (X^2(7)=176.5, p<.001), two-factor (X^2(6)=239.7, p<.001), three-

factor ($X^2(4)=99.3$, $p<.001$), and one higher-order and six lower-order factors $X^2(7)=22.1$, $p<.001$). In all cases, the hierarchical two-factor model fit best.

Discussion

Several models of the SCS were compared using nested model comparisons. Contrary to Neff (2003b), a one-factor structure of the SCS was not supported. Few have replicated Neff's (2003b) findings and recent studies did not test the two-factor hierarchical model (Neff et al., 2019). A general factor may therefore be an inappropriate and invalid representation of the SCS (e.g., Brenner et al., 2017, Cleare et al., 2018; Williams et al., 2014), and use of a single SCS total score is not recommended. Rather, nested model comparisons suggest a plausible two-factor structure, with the more complex hierarchical two-factor model showing slight improvement over the lower order two-factor model, potentially because it better captured measure flaws (e.g., cross-or low-loading items). The two higher-order factors appear to represent self-coldness and self-caring, each explained by their corresponding three subfactors (e.g., self-coldness: self-judgement, isolation, and overidentification). The SCS should be analyzed with structural equation modelling using the higher- and lower-order factors rather than summed scores as predictors/outcomes.

The finding that the SCS is better reflected by two related factors than one general factor matches Gilbert's (2010) conceptualization of self-compassion as a two-process construct, supported by the moderate correlation between the higher-order self-caring and self-coldness factors. Moreover, the hierarchical two-factor structure advances findings supporting a two-factor lower-order structure: Costa et al. (2016) and Lopez et al. (2015) undertook modifications before finding good fit indices, suggesting higher-order domains with lower-order facets. Brenner's (2017) results also suggest the hierarchical two-factor model is a better alternative

than a one factor higher-or lower-order model, accounting for the difficulty interpreting nested bifactor model comparison (Markon, 2019).

Our difficulty estimating the six-factor model has been reported in previous studies (e.g., Lopez et al., 2015). Notably, Coroiu et al. (2018) found a six-factor structure showed good fit indices when items were randomly assigned to each factor, suggesting six factors may be an unreliable representation of the SCS. Moreover, Williams et al. (2014) supported a six-factor structure but did not compare the relative fit of a hierarchical two-factor structure.

The large sample and ordinal scoring are strengths, but our undergraduate sample may restrict generalizability of our study. The non-unique factor in the six-factor model and the high lower-order factor loadings in the hierarchical model (e.g.,>.95) suggests redundant items. Additionally, there is room for improvement on the fit of the two-factor hierarchical model, a result potentially driven by poorly specified items. The differences favoring the hierarchical model were also relatively slight and the lower-order two factor model is an alternative generally well-fitting structure. Future research might explore the factor structure of the 12-item short-form SCS (Raes et al., 2011). Altogether, nested comparisons informed the selection of the two-factor hierarchical model as the better-fitting relative factor structure of the SCS.

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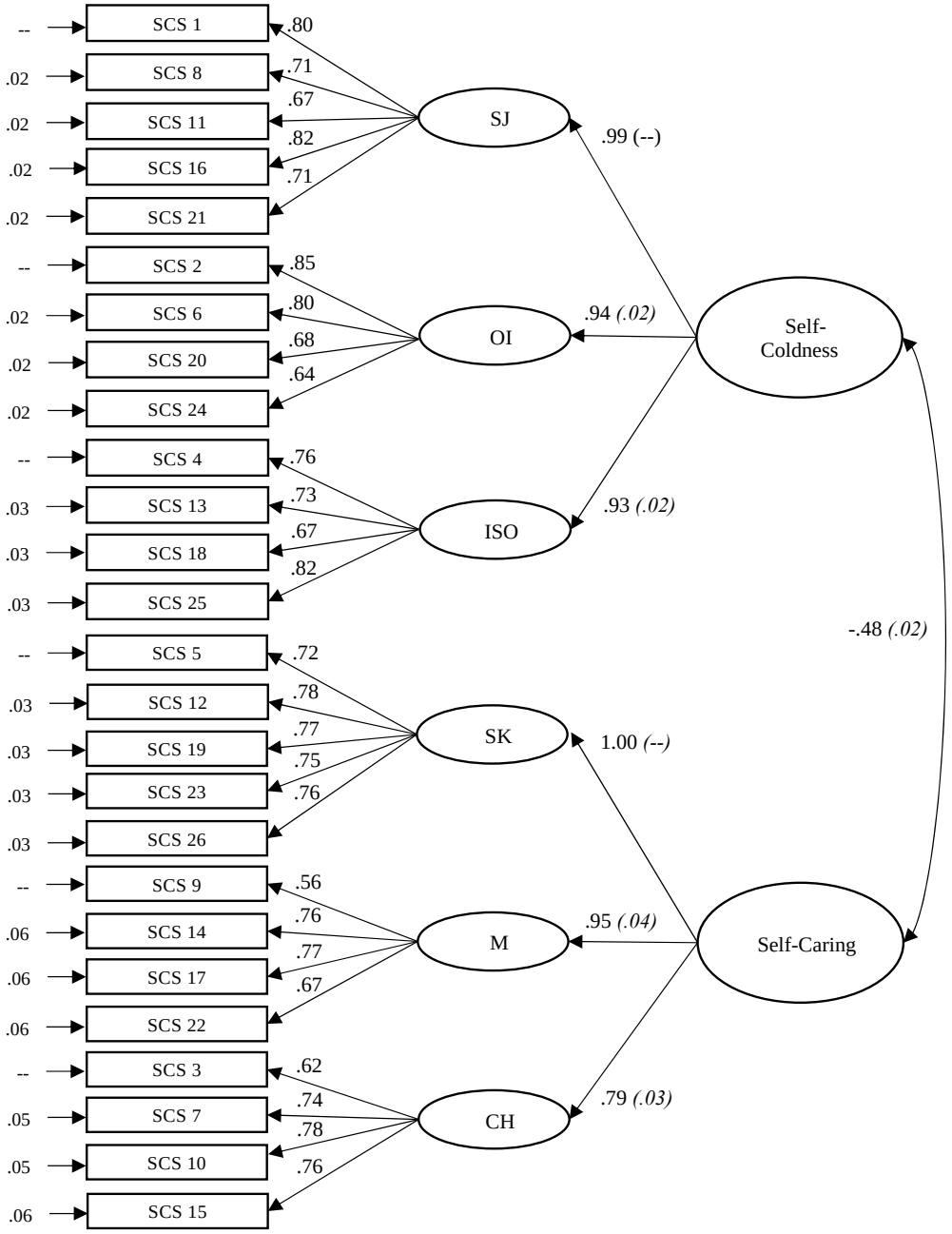
Figure 1. Two-factor hierarchical model of the Self-Compassion Scale with standardized factor loadings (*p<.001). Standardized coefficients are reported with standard errors *(SE)* and error terms are left of items. SJ=self-judgement, OI=overidentification, ISO=isolation, SK=self-kindness, M=mindfulness, and CH=common humanity. All factor loadings and correlations were significant (p<.001).



Open Science

Open Data: Raw data needed to reproduce all of the reported results are not openly accessible due to ethical constraints, however, the code and output are accessible (Strickland, 2021).

Open Materials: I confirm that there is sufficient information for an independent researcher to reproduce all of the reported methodology, including the code and results output (Strickland, 2021).

Preregistration of Studies and Analysis Plans: This study was not preregistered with an analysis plan.