Understanding the ULS-Based Model Fit Indices

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01. Introduction

In structural equation modeling (SEM) applications, model fit indices are often used to provide information about whether the proposed model is acceptable or a better model needs to be considered (Shi et al., 2019; Ximénez et al., 2022). **These fit indices are often affected by the estimation method** (Shi & Maydeu-Olivares, 2020). Although the maximum likelihood (ML) estimation is the most popular method when the outcome variable is continuous, the **unweighted least squares (ULS)** is though to be an alternative to address the categorical nature of Likert-type data (Forero et al., 2009).

This study aimed to understand the behavior of ULS-based fit indices (e.g., RMSEA, CFI, and TLI) **at the population level**.

02. Monte Carlo Simulation

	Types of Misspecifications		
Incidental Parameters	Misspecified dimensionality	Omitted cross-loadings	Omitted residual correlations
Model size	10, 30, 60, 90, 120	10, 30, 60, 90, 120	10, 30, 60, 90, 120
Factor loadings	.40, .60, .80	.40, .60, .80	.40, .60, .80
Magnitude of mis	Interfactor correlations = 60, .70, .80, .90.	Omitted cross-loadings = .10, .20, .30, .40	Omitted residual correlations = .10, .20, .30, .40
Omitted parameters	-	1, 2, 3, 4	1, 2, 3, 4

03. Population model

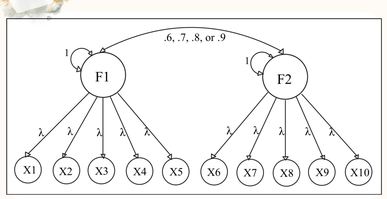


Figure 1. Population Model Type One Misspecification.

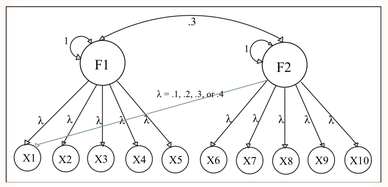


Figure 2. Population Model Type Two Misspecification.

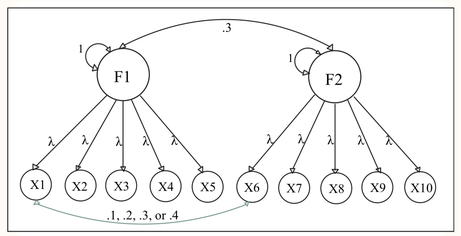
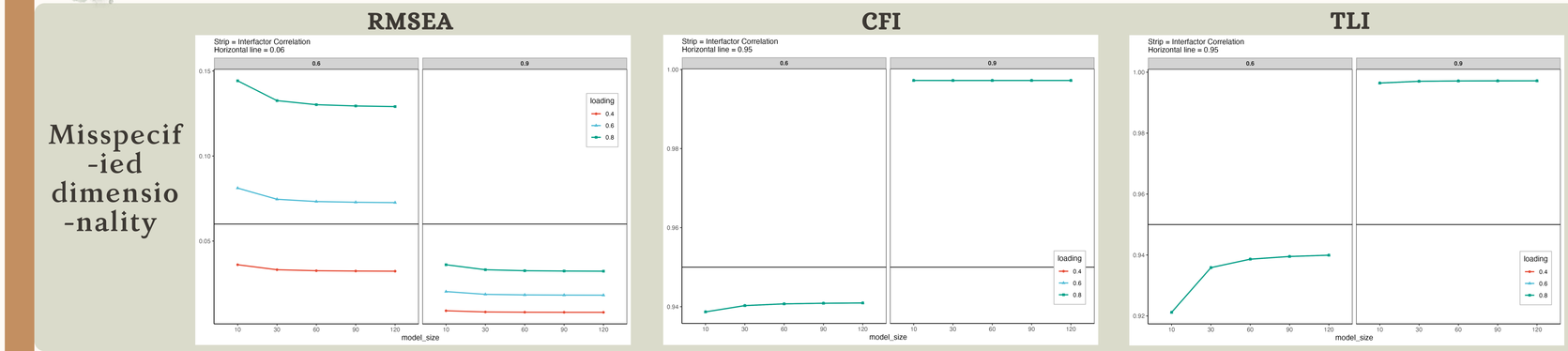


Figure 3. Population Model Type Three Misspecification.

04. Results/Findings



05. Conclusion

- Under type 1 mis: all indices are insensitive to large model size (> 30); CFI & TLI are insensitive to factor loadings.
- Under type 2 mis: as factor loadings increase, RMSEA suggests worse model fit, while CFI & TLI suggest better fit.
- Under type 3 mis: in case of high factor loadings, neither CFI and TLI is sensitive to model size, magnitude of omitted parameters, and number of omitted parameters.

06. Related literature

Forero, C. G., Maydeu-Olivares, A., & Gallardo-Pujol, D. (2009). Factor analysis with ordinal indicators: A Monte Carlo study comparing DWLS and ULS estimation. Structural Equation Modeling, 16(4), 625-641. https://doi.org/10.1080/10705510903203573

Shi, D., Lee, T., & Maydeu-Olivares, A. (2019). Understanding the model size effect on SEM fit indices. Educational and Psychological Measurement, 79(2), 310-334. https://doi.org/10.1177/0013164418783530

Ximénez, C., Maydeu-Olivares, A., Shi, D., & Revuelta, J. (2022). Assessing cutoff values of SEM fit indices: Advantages of the unbiased SRMR index and its cutoff criterion based on communality. Structural Equation Modeling: A Multidisciplinary Journal, 29(3), 368-380. https://doi.org/10.1080/10705511.2021.1992596