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Reevaluating Factor Analysis: Violations of the Reflective Measurement Model and a Proposed Correction for Item Selection Bias.

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Poster

Reevaluating Factor Analysis: Violations of the Reflective Measurement Model and a Proposed Correction for Item Selection Bias.

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Abstract

Factor analysis is widely used in psychological measurement under the assumption that it adheres to a reflective measurement model, where observed variables are manifestations of an underlying latent construct. This approach aligns with a scientific realist perspective, where factors represent independent causal structures. However, we demonstrate that standard factor analytic procedures violate key assumptions of reflectivity, particularly due to item selection biases that impose a range restriction on factor loadings. This restriction inflates factor variance estimates, distorts latent correlations, and introduces systematic bias in fit indices.

Through theoretical derivation and extensive simulations, we show that selecting items based on their observed loadings alters the empirical distribution of factor loadings, leading to overestimation of factor strength and underestimation of error variance. Furthermore, this bias propagates into structural analyses, affecting the validity of latent correlations and goodness-of-fit statistics. Our work extends previous discussions on the impact of item selection, but crucially distinguishes range restriction at the variable level from traditional sample-level restrictions.

To address this issue, we propose a novel correction method that adjusts for the distributional distortion of factor loadings, preserving the intended properties of the reflective measurement model. We compare our approach with existing corrections, including SRMR-unbiased adjusted by communalities, and evaluate its effectiveness across various sample sizes and item selection criteria.

Beyond its technical implications, this study raises fundamental epistemological concerns about the alignment between latent variable modeling and the philosophical assumptions of psychological measurement. By refining factor analytic methods, we enhance both their theoretical coherence and practical utility.

Keywords

Factor-analysis, measurement-model, range-restriction, item-selection, scientific-realism

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