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Alignment optimization and the sequential testing approach for data harmonization

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Alignment optimization and the sequential testing approach for harmonizing multiple datasets

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Abstract

Technological advances and open science initiatives have made large-scale datasets more readily available than ever before. By combining data from different studies, researchers can attain larger and more diverse samples, increase statistical power, explore novel and broader research questions, study rare outcomes, and identify variations across populations and settings. However, cross-study discrepancies, such as non-standard or partial item administration, missing items, or other operational, contextual, or methodological differences, pose significant challenges to the comparability of datasets, and may undermine the validity of pooled analyses. Traditional approaches such as the sequential testing approach, which involves iteratively constraining and freeing measurement parameters to find a model that produces unbiased estimates and places factor scores on a common metric, enable the simultaneous and flexible management of measurement error and cross-group differences by statistically linking observed test items to a latent construct. While the sequential testing approach is widely used, it is often time-consuming, error-prone, and not scalable to many groups, limiting its practicality in harmonization efforts. Alignment optimization (AO; Asparouhov & Muthén, 2014), a recently developed method which reframes the model specification process as an optimization problem, is an efficient alternative to the traditional method. In this talk, we introduce the sequential testing approach and AO methods and demonstrate their application, relative strengths and limitations, and effectiveness in producing comparable factor scores through an empirical illustration harmonizing large-scale national datasets. Our findings highlight key trade-offs between precision, scalability, and efficiency, positioning AO as a practical and robust alternative to the traditional sequential testing approach.

Keywords

data harmonization, alignment optimization, measurement

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