M.Sc. Proposal: A data smoothing approach to improve reliability and validity of personality questionnaire responses

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BACKGROUND

- Substantial true-score variance at item-level underlines necessity for a more nuanced approach to personality[1,2]

- Traditional smoothing approaches (scale average, factor analysis) ignore unique item-level variance leading to information loss

- A new item-level smoothing approach is needed that reduces measurement error at the level of single items
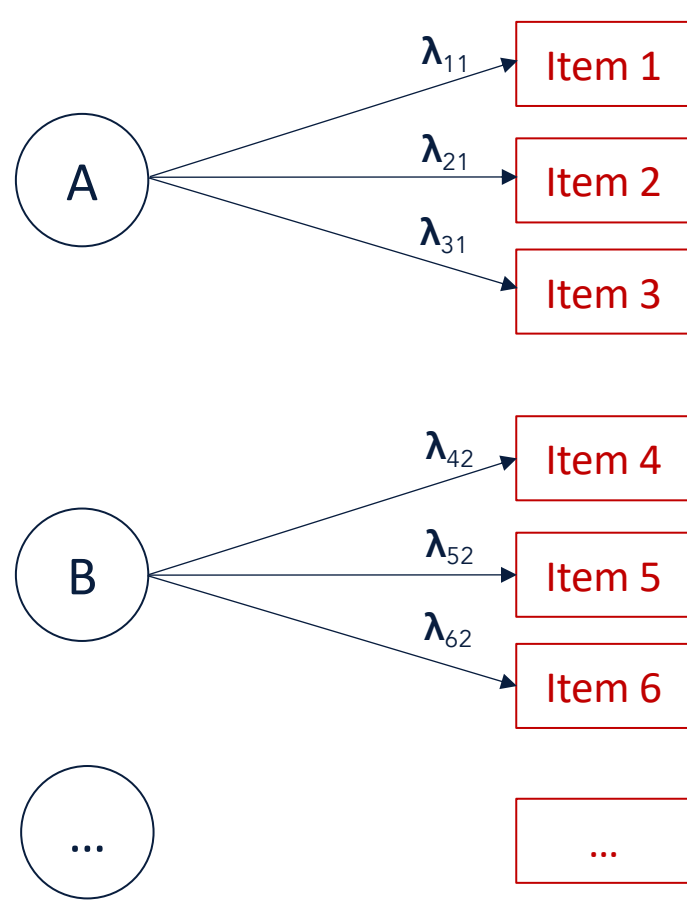
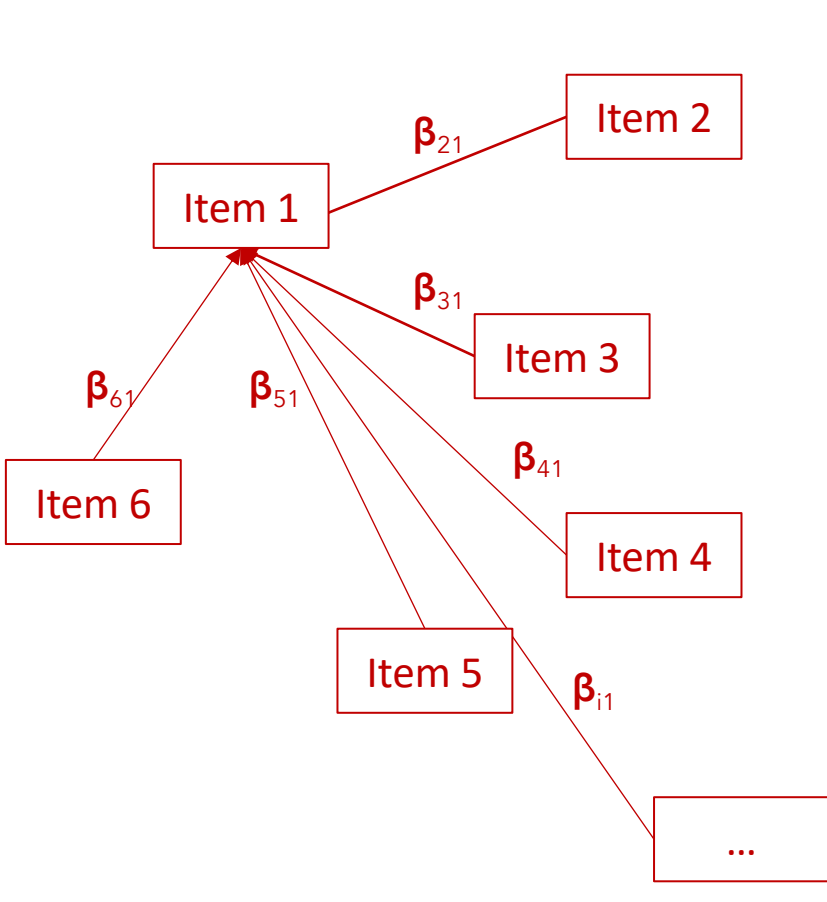## SMOOTHING APPROACHES

Scale aggregate
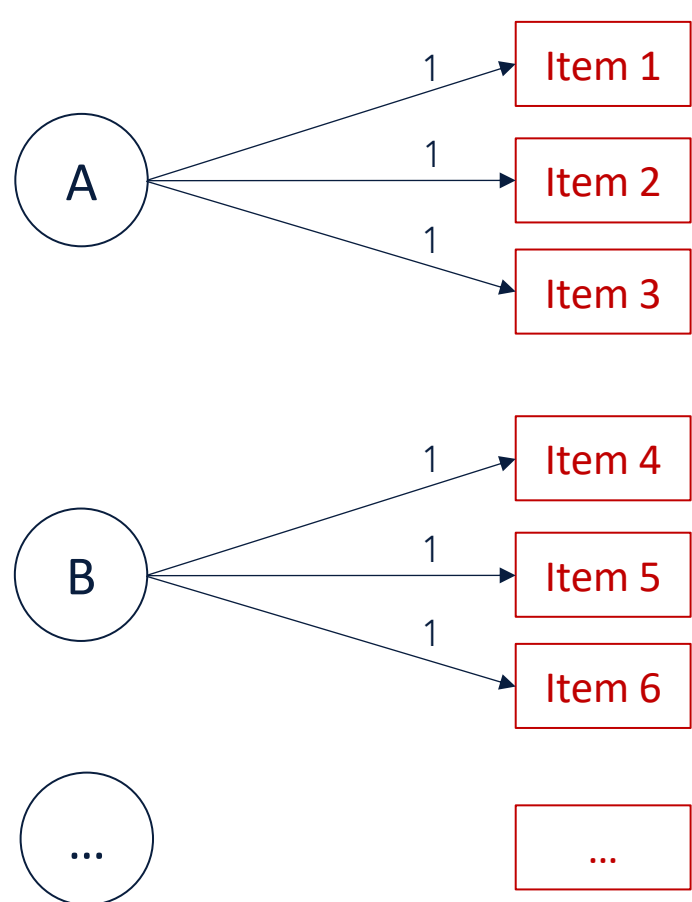
- Items are pulled to the simple, unit-weighted mean/sum score of their a priori defined scale

- Theory-driven smoothing

Factor analysis

- Items are pulled to their non-unit-weighted factor score of their a priori defined scale

- Theory- and data-driven smoothing

Item-level data smoothing

- Items are pulled by all other items independent of a priori defined scales and item assignments

- Data-driven smoothing

PROPOSED METHOD

1 **Simulation**

- Comparison of the three smoothing approaches in estimating the true score variance-covariance matrix Σ_T

- Simulation Design: $y \sim MVN(0, \Sigma = \Lambda\Phi\Lambda' + \Psi)$

  Λ = matrix of factor loadings

  Φ = variance-covariance matrix of latent factors`

  Ψ = variance-covariance matrix of manifest residuals

  1000 replications, number of variables $p = 12$

  Manipulations: number of factors ($q = 2, 6, 12$), factor loadings (correctly vs mis-specified), factor intercorrelations (orthogonal vs oblique), hierarchical structure ($L = 1, 2, 3$), measurement error ($\sigma_\varepsilon = 0.5$ vs 1), sample size ($N = 100, 250, 500$)

- Dependent variables: Bias(θ) where $\theta \in \Sigma_T = \Lambda\Phi\Lambda'$

2 **Empirical validation**

- Comparison of the three smoothing approaches in influencing item- and facet-level reliability, stability, and validity

- Empirical validation based on two data sets; HEXACO data ($N = 2868$) and data collected during May 2020

EXPECTED RESULTS

The new item-level data smoothing approach is expected to

- reduce bias in true score variance-covariance estimates

- improve distributional properties

- increase inter-rater and re-test reliability

- increase stability estimates

- increase predictive validity for life outcomes

- improve facet-level analysis

IMPLICATIONS

Step towards narrow scale or item-level analyses that

- overcomes issues of interpretability and ambiguousness aligned with theory-driven scale measures

- acknowledges unique true-score variance of personality nuances

- opens up new possibilities in personality research

References

[1] McCrae, R. R. (2015). A more nuanced view of reliability: Specificity in the trait hierarchy. *Personality and Social Psychology Review, 19*, 97–112.
[2] McCrae, R. R., & Mõttus, R. (2019). What personality scales measure: A new psychometrics and its implications for theory and assessment. *Current Directions in Psychological Science.*