Measuring Well-Being
Psychometric Perspectives

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Overview

1. Background

2. Problems with single items and sum scores

3. Generalised latent variable modelling
   - Positive and negative aspects of subjective well-being

4. Hierarchical models
   - Using bifactor models to parse common and specific variance

5. Conclusion
What is well-being?

- Broad construct incorporating psychological, physical, social and material/economic components
- Poorly defined and typically operationalised in a variety of ways
- Focus on subjective and psychological well-being
Public policy

- GDP and life satisfaction
Subjective and psychological well-being

- **Subjective well-being**
  - Hedonic well-being – focussed on pleasure and affect
  - Ed Diener – Incorporates positive and negative affect, and life satisfaction

- **Psychological well-being**
  - Based on Aristotelian concept of eudaimonic well-being – ‘the good life’
  - Carol Ryff – self-acceptance, personal growth, purpose in life, positive relations with others, environmental mastery and autonomy
  - Martin Seligman – Authentic happiness model emphasising finding meaning in life

- Most health research focuses on the negative end of subjective well-being ➔ negative affect
Issues with measuring subjective well-being

- Not directly observable
- Positive or negative emphasis
- Scope → very general / very specific
- State vs trait
- Evaluative or affective
- Cultural differences
Issues to focus on today

- Problems with single items and sum scores
- Generalised latent variable modelling
- Hierarchical models
Latent variables

- Observed variables used to measure something not directly observable
- Recovered from the common variance (co-variance) between items
- Ubiquitous in statistics, not just psychometrics
Problems with single items

- Perceived issues, compared to multi-item scales
  - Poor reliability
  - Less validity

- More important issues
  - Problems with scaling \(\rightarrow\) restricted response categories, skewed response distribution
  - Can’t partition response variance into common variance, unique variance and measurement error

- Single items fine in many circumstances where a general e.g. life satisfaction
Problems with sum scores

- Still common practice to sum (or average) responses on multi-item scales
- Increased reliability and validity compared to single items
- Reliability is an issue for short scales, leads to redundant or similar items being included
- Restrictive assumptions needed to allow comparison across samples (classical test theory)
- Appropriate to sum scores of items with binary/ordinal response formats and treat this total score as continuous?
Issues to focus on today

- Problems with single items and sum scores
- Generalised latent variable modelling
- Hierarchical models
Two alternative methods

- Factor analysis
  - Items measured on a continuous scale (multivariate normal)
  - Factor loadings
  - Allows for a more precise estimate of reliability than Chronbach’s $\alpha$

- Item response theory
  - Binary or ordinal response scale
  - Item difficult and discrimination parameters
  - Information function provides a more sophisticated insight into reliability than Factor analysis

- Not quite so different!
Measurement models

Confirmatory factor analysis
= linear regression

Item response theory
= logistic regression
Generalised latent variable modelling

- Standard CFA and IRT models subsumed within a family of generalised latent variable models
- Increasing number of stats packages available to fit these kinds of models
  - Mplus, GLLAMM, R, Mx, Factor ... Stata v13
Positive and negative aspects of subjective well-being

- Most health research focuses on the negative end of subjective well-being → negative affect
- Evidence of independence of positive and negative affect
- Comparison of two scales, assuming unidimensionality
  - Hospital Anxiety and Depression Scale – 7-item depression subscale with 4-point ordinal response format
    - Cardiovascular disease, $N = 893$
    - Chronbach’s $\alpha = .83$
  - Short Depression Happiness Questionnaire – 6-item scale with 4-point ordinal response format
    - General population, $N = 1262$
    - Chronbach’s $\alpha = .88$
The problem with focussing on the negative

Two parameter logistic model fitted for each scale using Mplus

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<th>Item</th>
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<td>HADS12</td>
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<td>HADS14</td>
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<table>
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<td>SDHS1</td>
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<td>SDHS6</td>
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Item characteristic curves

- Hospital Anxiety and Depression Scale - Depression subscale
Item characteristic curves

- Short Depression Happiness Questionnaire
Test information function

- Hospital Anxiety and Depression Scale - Depression subscale
Test information function

- Short Depression Happiness Questionnaire
Independent constructs

- So far have assumed positive and negative affect two ends of a continuum
- Evidence of independence of positive and negative affect
- Analysis of the SDHS reveals two factor positive–negative structure provides ‘better fit’, however correlation between factor is .86
- CFA useful for testing latent structure against theory
Issues to focus on today

- Problems with single items and sum scores
- Generalised latent variable modelling
- **Hierarchical models**
Hierarchical models

- Most CFA studies focus on separate correlated factors
- Often theoretically salient higher-order constructs, or high inter-factor correlations indicating factors are not entirely independent
- Two approaches to modelling hierarchical structure
  - Higher-order
  - Bifactor
Higher-order vs bifactor models

\[ F_2 \] \quad G \quad \begin{array}{c} \text{F1} \end{array} \\
\[ F_1 \] \quad G \quad \begin{array}{c} \text{F2} \end{array} \\
\boxed{} \quad \boxed{} \quad \boxed{} \\
\boxed{} \quad \boxed{} \quad \boxed{} \\
\boxed{} \quad \boxed{} \quad \boxed{} \\
\boxed{} \quad \boxed{} \quad \boxed{} \\
\boxed{} \quad \boxed{} \quad \boxed{F1} \\
\boxed{} \quad \boxed{} \quad \boxed{F2}

- Hospital Anxiety & Depression Scale, 14-items split across two subscales
- Twenty-one studies, provided data from 28 unique samples ($N = 21,820$)
- Compared ‘best fit’ latent structures previously identified plus bifactor
- Re-analysis and multivariate meta-analysis
## HADS Meta CFA model fit

<table>
<thead>
<tr>
<th>Model</th>
<th>RMSEA</th>
<th>CFI</th>
<th>TLI</th>
<th>BIC</th>
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<tbody>
<tr>
<td>1. Unidimensional</td>
<td>0.089</td>
<td>0.863</td>
<td>0.838</td>
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<td>2. Zigmond &amp; Snaith</td>
<td>0.058</td>
<td>0.943</td>
<td>0.932</td>
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<td>8. Higher-order</td>
<td>0.053</td>
<td>0.953</td>
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<td>9. Bifactor</td>
<td>0.043</td>
<td>0.974</td>
<td>0.963</td>
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Implications for mood disorders

DSM-V Reliability

- Major Depressive Disorder: 0.28
- Antisocial Personality Disorder: 0.21
- Generalized Anxiety Disorder: 0.20
- Mixed Anxiety-Depressive Disorder: -0.004

Legend:
- Very good agreement
- Questionable agreement
- Good agreement
- Unacceptable agreement
DSM-V Reliability

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Well-being in general

- So far have shown bifactor model useful applied to symptoms of anxiety and depression
- Also evidence of its applicability more widely to well-being
  - 795 university students
  - Examined bifactor models for subjective well-being, psychological well-being and a combined well-being model
Chen et al (2012) subjective well-being

RMSEA = .054 (CI: .047 to .062), SRMR = .026, CFI = .974
Chen et al (2012) psychological well-being

RMSEA = 0.075 (CI: 0.071 to 0.079), SRMR = 0.045, CFI = 0.908
Chen et al (2012) combined well-being

RMSEA = .061 (CI: .058 to .063), SRMR = .051, CFI = .900
Conclusions

- Well-being a broad concept incorporating psychological, physical, social and material
- Single items are fine in some circumstances
- Avoid use of sum scores where possible, instead use factor scores
- Tests do not have to be long → Computer adaptive testing
- Generalised latent variable modelling offers advantages over traditional CFA → best of both worlds
- Think carefully about what you want to measure (and how to measure it)!
Thank you, any questions?