

Psychology 454: Latent Variable Modeling

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Outline

- 1 Problems with SEM
 - Specification
 - Data Errors
 - Errors of analysis and respecification
 - Errors of interpretation

- 2 Final comments

44 ways to fool yourself with SEM

Adapted from Rex Kline; Principals and Practice of Structural Equation Modeling, 2005

- ① Specification
- ② Data
- ③ Analysis and Respecication
- ④ Interpretation

Specification errors

- ❶ Specifying the model after the data are collected.
 - Particularly a problem when using archival data.
- ❷ Are key variables omitted?
- ❸ Is the model identifiable?
- ❹ Omitting causes that are correlated with other variables in the structural model.
- ❺ Failure to have sufficient number of indicators of latent variables.
 - “Two might be fine, three is better, four is best, anything more is gravy” (Kenny, 1979)
- ❻ Failure to give careful consideration to directionality.
 - Path techniques are good for estimating strengths if we know the underlying model, but are not good for determining the model (Meehl and Walker, 2002)

Specification errors (continued)

- 7 Specifying feedback loops (“non recursive models”) as a way to mask uncertainty
- 8 Overfit the model, ignoring parsimony
- 9 Add disturbances (“measurement error correlations” aka “correlated residuals”) with substantive reason
- 10 Specifying indicators that are multivocal without substantive reason

Data Errors

- ❶ Failure to check the accuracy of data input or coding
 - Missing data codes (use a clear missing value)
 - Misytyped, mis-scanned data matrices
 - Improperly reversed items
 - Let the computer do it for you
 - Why reverse an item when a negative sign will do it for you?
- ❷ Ignoring the pattern of missing data, is it random or systematic.
- ❸ Failure to examine distributional characteristics
 - Weird data -> weird results
- ❹ Failure to screen for outliers
 - Outliers due to mistakes
 - Outliers due to systematic differences

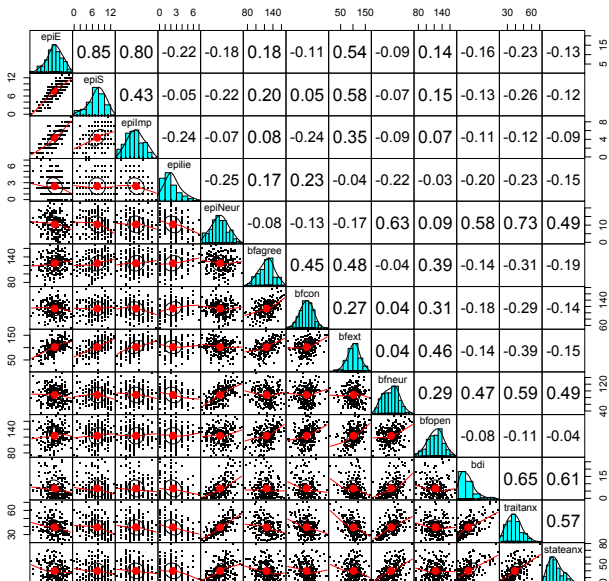
Describe the data

```
> describe(epi.bfi)
```

```
pairs.panels(epi.bfi,pch=".",gap=0) #mind the gap
```

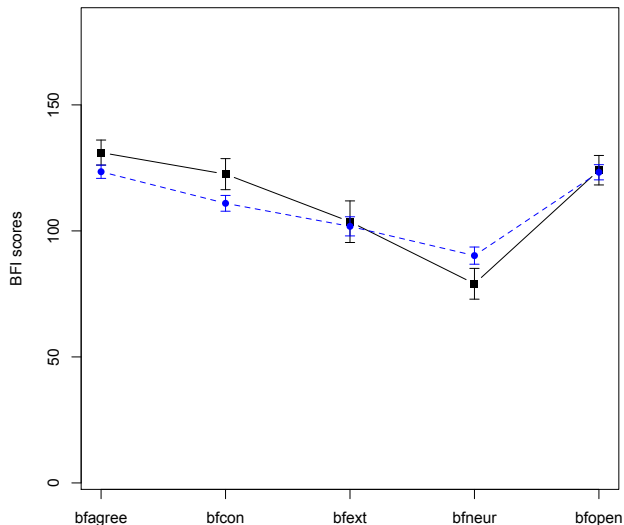
	var	n	mean	sd	median	trimmed	mad	min	max	range	skew	kurtosis	se
epiE	1	231	13.33	4.14	14	13.49	4.45	1	22	21	-0.33	-0.06	0.27
epiS	2	231	7.58	2.69	8	7.77	2.97	0	13	13	-0.57	-0.02	0.18
epiImp	3	231	4.37	1.88	4	4.36	1.48	0	9	9	0.06	-0.62	0.12
epilie	4	231	2.38	1.50	2	2.27	1.48	0	7	7	0.66	0.24	0.10
epiNeur	5	231	10.41	4.90	10	10.39	4.45	0	23	23	0.06	-0.50	0.32
bfagree	6	231	125.00	18.14	126	125.26	17.79	74	167	93	-0.21	-0.27	1.19
bfcon	7	231	113.25	21.88	114	113.42	22.24	53	178	125	-0.02	0.23	1.44
bfext	8	231	102.18	26.45	104	102.99	22.24	8	168	160	-0.41	0.51	1.74
bfneur	9	231	87.97	23.34	90	87.70	23.72	34	152	118	0.07	-0.55	1.54
bfopen	10	231	123.43	20.51	125	123.78	20.76	73	173	100	-0.16	-0.16	1.35
bdi	11	231	6.78	5.78	6	5.97	4.45	0	27	27	1.29	1.50	0.38
traitanx	12	231	39.01	9.52	38	38.36	8.90	22	71	49	0.67	0.47	0.63
stateanx	13	231	39.85	11.48	38	38.92	10.38	21	79	58	0.72	-0.01	0.76

Graphic descriptions using SPLOMs



High lie score subjects seem different

High lie scorers are different



Data errors (continued)

- ⑤ Assuming all relationships are linear without checking
 - graphical techniques are helpful for non-linearities
 - Simple graphical techniques do not help for interactions
- ⑥ Ignoring lack of independence among observations
 - Nesting of subjects within pairs, within classrooms, with managers
 - Can we model the nesting?

Errors of analysis and respecification

- ❶ Failure to check the accuracy of computer syntax
 - Direction of effects
 - Error specifications
 - Omitted paths
- ❷ Respecifying the model based entirely on statistical criteria
 - Just because it does not fit does not mean it should be fixed
- ❸ Failure to check for admissible solutions
 - Are some of the paths impossible?
 - Do some of the variables have negative variances?
- ❹ Reporting only standardized estimates
 - These are sample based estimates and reflect variances (errorful) and covariances (supposedly error free)
- ❺ Analyzing a correlation matrix when the covariance matrix is more appropriate
 - Anything that has growth or change component must be done with covariances

Errors of Analysis and respecification (continued)

- ⑥ Analyzing a data set with extremely high correlations
 - solution will either be unstable or will not work if variables are too “colinear”
- ⑦ Not enough subjects for complexity of the data
 - This is ambiguous – what is enough?
 - Remember, the standard error of a correlation reflects sample size $se = \frac{r^2}{\sqrt{(1-r^2)(n-2)}}$

Errors of Analysis and respecification (continued)

- ⑧ Setting scales of latent variables inappropriately.
 - particularly a problem with multiple group comparisons
- ⑨ Ignoring the start values or giving bad ones.
 - Supplying reasonable start values helps a great deal
- ⑩ Do different start values lead to different solutions?
- ⑪ Failure to recognize empirical underidentification
 - for some data sets, the model is underidentified even though there are enough parameters
 - Failure to separate measurement from structural portion of model
 - Use the two or four step procedure

Errors of Analysis and respecification (continued)

- 12 Estimating means and intercepts without showing measurement invariance
- 13 Analyzing parcels without checking if parcels are in fact factorially homogeneous.
 - Factorial Homogeneous Item Domains (FHID)
 - Homogenous Item Composites (HIC)
 - (but consider contradictory advice on parcels)

Errors of Interpretation

- ❶ Looking only at indexes of overall fit
 - need to examine the residuals to see where there is misfit, even though overall model is fine
- ❷ Interpreting good fit as meaning model is improved.
 - consider alternative models
 - better able to reject alternatives
- ❸ Interpreting good fit as meaning that the endogenous variables are strongly predicted.
 - What is predicted is the covariance of the variables, not the variables
 - Are the residual covariances small, not whether the error variance is small
- ❹ Relying solely on statistical criterion in model evaluation
 - What can the model not explain
 - What are alternative models
 - What constraints does the model imply

Errors of interpretation (continued)

- 5 Relying too much on statistical tests
 - significance of particular path coefficients does not imply effect size or importance
 - Overall statistical fit (χ^2) is sensitive to model misfit as $f(N)$
- 6 Misinterpreting the standardized solution in multiple group problems
- 7 Failure to consider equivalent models
 - Why is this model better than equivalent models?
- 8 Failure to consider non-equivalent models
 - Why is this model better than other, non-equivalent models?
- 9 Reifying the latent variables
 - Latent variables are just models of observed data
 - “Factors are fictions”
- 10 Believing that naming a factor means it is understood

Errors of interpretation (continued)

- 11 Believing that a strong analytical method like SEM can overcome poor theory or poor design.
- 12 Failure to report enough so that you can be replicated
- 13 Interpreting estimates of large effects as evidence for “causality”

Final Comments

- ① Theory First
 - What are the alternative theories?
 - Are there specific differences in the theories that are testable?
- ② Measurement Model
 - Comparison of measurement models?
 - How many latent variables? How do you know?
 - Measurement Invariance?
- ③ Structural Model
 - Comparison of multiple models?
 - What happens if the arrows are reversed?
- ④ Theory Last
 - What do we know now that we did not know before?
 - What do we have shown is not correct?