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KUANT Guides

Guide No.
KUANT 005.2

What to Report:

Information to report for a Confirmatory Factor Analysis based on Brown (2006).

Geldhof, G.J., McConnell, E.K. & Selig, J.P. (2008)

Model Specification

- Conceptual / empirical justification for the hypothesized model
- Complete description of the parameter specification of the model
  - List the indicators for each factor
  - Indicate how the metric of the factors was defined (specify which observed variables were used as marker indicators)
  - Describe all freely estimated, fixed, and constrained parameters (factor loadings and cross-loadings, random and correlated indicator errors, factor correlations, intercepts and factor means)
- Demonstrate that the model is identified (*df*, scaling of latent variables, absence of empirical underidentification)

Input Data

- Description of sample characteristics, sample size, and sampling method
- Description of the type of data used (nominal, interval; scale range of indicators)
- Tests of estimator assumptions (multivariate normality of input indicators)
- Extent and nature of missing data, and the method of missing data management (direct ML, multiple imputation)
- Provide sample correlation matrix and indicator SDs (with means, if applicable), or make such data available on request

Model Estimation

- Indicate the software and version used (ex.: LISREL 8.72)
- Indicate the type of data/matrices analyzed (variance-covariance, tetrachoric correlations/asymptotic covariances)
- Indicate the estimator used (e.g., ML, weighted lease squares; as justified by the properties of the input data)

Model Evaluation

- Overall goodness-of-fit
  - Report model χ^2 along with its *df* and *p* value
  - Report multiple fit indices (e.g., SRMR, RMSEA, CFI) and indicate cutoffs used; provide confidence intervals, if applicable
- Localized areas of ill fit
  - Report strategies used to assess focal strains in the solution (modification indices/standardized residuals, Wald tests, EPC values)
  - Report absence of areas of ill fit (e.g., largest modification index) or indicate the areas of strain in the model (e.g., modification index, EPC value)

Model Eval. (cont.)

- If your model was respecified, provide a compelling substantive rationale for the added or removed parameters and clearly document (improvement in) fit of the modified models
- Parameter estimates
  - Provide all parameter estimates (factor loadings, error variances, factor variances), including any nonsignificant estimates

Reporting Data in Tables

Presenting data for a multiple-group or longitudinal model can be a daunting task. The tables and figures included in this section attempt to alleviate some of this burden by providing a clear and concise template for presenting data in a longitudinal study.

Table 1: Goodness of Fit

Table 1 provides an example of how to report a model's goodness of fit. From this table we can easily see that the initial CFA had acceptable model fit (RMSEA = .11, CFI = .96, NNFI = .94), and that weak (loading) and strong (intercept) invariance could be established. Invariance was established using the RMSEA reasonableness test and 90% confidence intervals for the three invariance tests are presented. The reasonableness tests are not applicable beyond establishing factorial invariance, and we can see that the researcher used the delta method (χ^2 difference) for all other tests.

The addition of the "Constraint Tenable" column also eases interpretation of this table. Simply looking down this column allows the reader to see that both weak and strong invariance were established, that the variance/covariance matrix significantly differed across time points, and that this difference is due to a significant change in the construct variances over time. The standardized covariances (i.e., correlations) were equitable across time points. We additionally see that there was a significant change in the latent mean of at least one construct over time.

Table 2: Indicators and Relationships

Table 2 provides information about individual indicators and the relationship of each to its respective construct. This table presents the equated and standardized estimates for each indicator's factor loading and intercept. The equated estimates allow readers to calculate Wald statistics, while the standardized estimates present factor loadings in a more easily interpretable format. Each indicator's error variance (theta) and R^2 are also provided.

Table 3: Correlation Matrix

Table 3 is a standard correlation matrix for the latent variables. This table also provides standard errors and Wald statistics for each parameter, making it easy to see which estimates are significant.

Figures 1 & 2: Path Diagrams

The complex structure of most SEMs often necessitates that authors provide a path diagram of their final structural model. Figures 1 and 2 provide two ways that this can be done. The model represented in Figure 1 is relatively simple and can be presented with data from all matrices present.

Figure 2 represents a model that is only slightly more complex, but is one in which there are several directional paths. To make reading these paths easier, only significant latent regressions (standardized) and correlations are presented within the diagram. When models are presented in this way, it is still necessary to provide the omitted information in tables.

Table 1

Fit Indices for the Nested Sequence in the Multiple Group Confirmatory Factor Analysis

Model	χ^2	*df*	*p*	$\Delta\chi^2$	Δ *df*	*p*	RMSEA	RMSEA 90% CI	NNFI	CFI	Constraint Tenable
Null Model	3961.98	258	<.001	---	---	---	---	--- ---	---	---	---
Configural Invariance	298.64	126	<.001	---	---	---	.105	.087-.124	0.935	0.959	---
Loading Invariance[1]	354.82	146	<.001	---	---	---	.110	.093-.127	0.933	0.950	Yes
Intercept Invariance[1]	394.95	166	<.001	---	---	---	.108	.096-.123	0.935	0.946	Yes
Homogeneity of Variances/ Covariances[2]	471.88	189	<.001	76.93	23	<.001	---	--- ---	---	---	No
Homogenity of Variances[2]	438.47	176	<.001	43.52	10	<.001	---	--- ---	---	---	No
Equality of Correlations[2]	408.76	171	<.001	13.81	5	.0169	---	--- ---	---	---	Yes
Stabilities	422.30	173	<.001	27.35	7	<.001	---	--- ---	---	---	No
Latent Mean Invariance[2]	457.44	176	<.001	62.49	10	<.001	---	--- ---	---	---	No

[1] Evaluated with the RMSEA Model Test
[2] Evaluated with the χ^2 Difference Test
Note. Each nested model contains its constraints, plus the constraints of all previous, tenable models

Table 2

Loading and Intercept Values, Residuals, and R^2 Values for Each Indicator, and the Estimated Latent Variance from the Strong Metric Invariance Model

	Equated Estimates		Standardized		
Indicator	*Loading (SE)*	*Intercept (SE)*	*Loading*[a]	*Theta*	R^2
Positive Affect (time 1): Estimated Latent Variance = .71					
Parcel 1	1.01 (0.05)	0.05 (0.05)	0.94	0.180	.82
Parcel 2	.995 (0.02)	-0.12 (0.05)	0.93	0.160	.84
Parcel 3	1.00 (0.02)	0.07 (0.05)	0.94	0.100	.90
Positive Affect (time 2): Estimated Latent Variance = .64					
Parcel 1	1.01 (0.05)	0.05 (0.05)	0.84	0.13	0.84
Parcel 2	.995 (0.02)	-0.12 (0.05)	0.83	0.13	0.89
Parcel 3	1.00 (0.02)	0.07 (0.05)	0.83	0.18	0.83
Negative Affect (time 1): Estimated Latent Variance = .93					
Parcel 1	0.98 (0.02)	0.25 (0.04)	0.93	0.22	0.77
Parcel 2	1.03 (0.02)	-0.12 (0.04)	0.97	0.08	0.93
Parcel 3	0.99 (0.02)	-0.14 (0.04)	0.94	0.16	0.84
Negative Affect (time 2): Estimated Latent Variance = .68					
Parcel 1	0.98 (0.02)	0.25 (0.04)	0.88	0.18	0.85
Parcel 2	1.03 (0.02)	-0.12 (0.04)	0.92	0.18	0.81
Parcel 3	0.99 (0.02)	-0.14 (0.04)	0.89	0.18	0.87

[a]Common Metric Completely Standardized Solution

Table 3

Correlations between Latent Constructs for Online Condition

	POSA_T1	NEGA_T1	POSA_T2	NEGA_T2
POSA_T1	1.00			
NEGA_T1	-0.029 (0.108) -0.265	1.00		
POSA_T2	0.772 (0.046) 16.635	-0.042 (0.108) -0.380	1.00	
NEGA_T2	-0.070 (0.108) -0.645	0.771 (0.048) 16.116	0.042 (0.109) 0.383	1.00

Note: POSA_T1 = Positive Affect Time 1; NEGA_T1 = Negative Affect Time 1; POSA_T2 = Positive Affect Time 2; NEGA_T2 = Negative Affect Time 2.

Figure 1

Path Diagram – Carpenter Thesis.

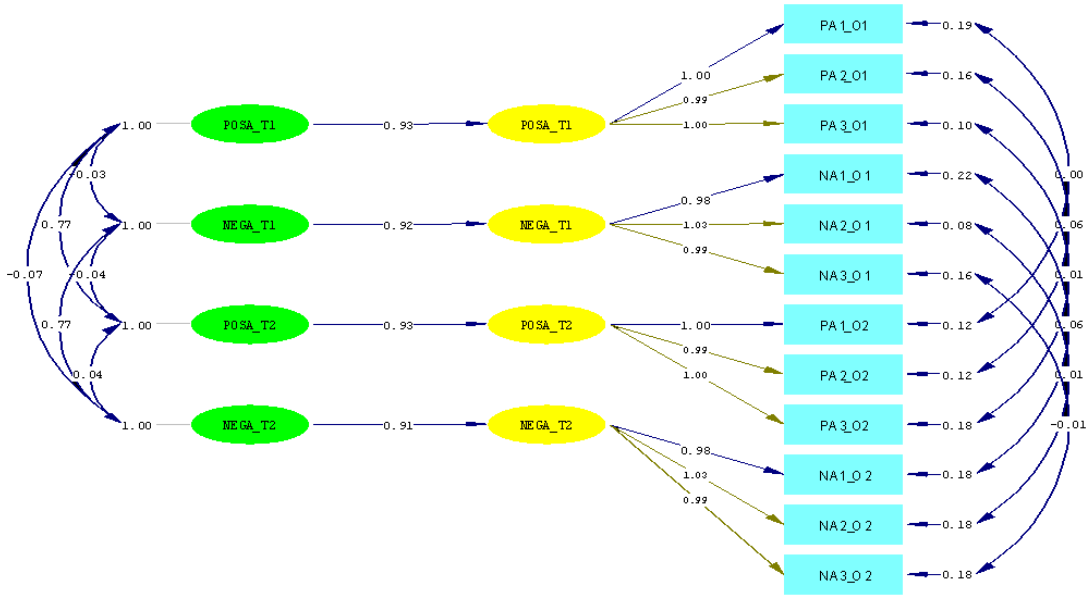

Figure 2

Path Diagram – No Indicators