

### Online Supplement. Model fit and convergent validity are separate issues

#### Covariance matrix of simulated data with near-zero MTHM correlations (n=1,000)

	T1M1	T1M2	T1M3	T2M1	T2M2	T2M3	T3M1	T3M2	T3M3
T1M1	1.79	-0.09	0.52	0.76	-0.15	0.38	0.68	-0.16	0.44
T1M2	-0.09	1.87	0.44	-0.16	0.62	0.34	-0.19	0.73	0.34
T1M3	0.52	0.44	1.77	0.43	0.38	0.65	0.49	0.38	0.68
T2M1	0.76	-0.16	0.43	1.95	0.01	0.63	0.70	-0.18	0.38
T2M2	-0.15	0.62	0.38	0.01	1.75	0.55	-0.20	0.59	0.28
T2M3	0.38	0.34	0.65	0.63	0.55	2.03	0.36	0.35	0.70
T3M1	0.68	-0.19	0.49	0.70	-0.20	0.36	1.97	-0.02	0.65
T3M2	-0.16	0.73	0.38	-0.18	0.59	0.35	-0.02	1.78	0.51
T3M3	0.44	0.34	0.68	0.38	0.28	0.70	0.65	0.51	1.81

#### Results of applying the CTCM model

Test statistic	19.230
Degrees of freedom	12
P-value (Chi-square)	0.083
Comparative Fit Index (CFI)	0.996
Tucker-Lewis Index (TLI)	0.987

From these results, the goodness-of-fit index of this measurement model is excellent. The chi-square value (19.23) is low at an impressive level and is not significant at a significance level of .05. CFI and TLI values are above .98.

#### Latent Variables:

	Estimate	Std.Err	z-value	P(> z )
T1 =~ T1M1	-0.519	0.115	-4.522	0.000

T1M2	-0.452	0.126	-3.595	0.000
T1M3	-0.467	0.139	-3.366	0.001
T2 =~				
T2M1	-0.514	0.110	-4.673	0.000
T2M2	-0.438	0.117	-3.749	0.000
T2M3	-0.547	0.125	-4.373	0.000
T3 =~				
T3M1	0.363	0.114	3.187	0.001
T3M2	0.629	0.137	4.608	0.000
T3M3	0.464	0.147	3.151	0.002
M1 =~				
T1M1	0.712	0.066	10.848	0.000
T2M1	0.754	0.063	12.063	0.000
T3M1	0.752	0.067	11.262	0.000
M2 =~				
T1M2	0.801	0.071	11.320	0.000
T2M2	0.816	0.066	12.429	0.000
T3M2	0.676	0.069	9.769	0.000
M3 =~				
T1M3	0.838	0.078	10.713	0.000
T2M3	0.783	0.079	9.949	0.000
T3M3	0.830	0.078	10.649	0.000
Covariances:				
	Estimate	Std.Err	z-value	P(> z )
T1 ~~				
M1	0.000			
M2	0.000			
M3	0.000			
T2 ~~				
M1	0.000			
M2	0.000			
M3	0.000			
T3 ~~				
M1	0.000			
M2	0.000			
M3	0.000			
T1 ~~				
T2	0.282	0.215	1.312	0.190
T3	-0.254	0.217	-1.169	0.243
T2 ~~				
T3	-0.170	0.225	-0.754	0.451
M1 ~~				
M2	-0.403	0.159	-2.543	0.011
M3	0.548	0.065	8.373	0.000
M2 ~~				
M3	0.526	0.069	7.642	0.000

However, the MTHM correlation between T1M1 and T1M2 is almost zero.  $(-.519) * (-.452) + .712 * .801 * (-.403) = .00$ . In this way, model-based correlations between T2M1-T2M2 and T3M1-T3M2 can also be obtained. The observed MTHM correlations and model-based correlations are as follows.

	Observed correlations	Model-based correlations
T1M1-T1M2	-.09	.00
T2M1-T2M2	.01	-.02
T3M1-T3M2	-.02	.02

That is, the MTHM correlations are close to zero in any of the two methods. However, the fit index of the model was almost perfect. Therefore, the claim that the fit index of the model guarantees MTHM correlation is unfounded.

### Comparison of the CTCM and UTCM models

The results of applying the UTCM model to this data are as follows.

Test statistic	41.168
Degrees of freedom	15
P-value (Chi-square)	0.000
Comparative Fit Index (CFI)	0.984
Tucker-Lewis Index (TLI)	0.963

The chi-square difference between the two models is  $41.168 - 19.230 = 21.938$  ( $p < .001$ ). That is, according to the procedure proposed by Widaman (1985), this model is judged to have convergent validity. However, as discussed above, the MTHM correlations are close to zero in any of the two methods. Therefore, there is no basis for claiming that convergent validity can be evaluated through chi-square comparison with nested models.

### Covariance matrix of simulated data with near-zero trait variances (n=1,000)

	T1M1	T1M2	T1M3	T2M1	T2M2	T2M3	T3M1	T3M2	T3M3
T1M1	1.53	-0.38	0.22	0.60	-0.33	0.17	0.55	-0.36	0.25
T1M2	-0.38	1.45	0.17	-0.46	0.49	0.12	-0.37	0.43	0.17
T1M3	0.22	0.17	1.59	0.19	0.17	0.51	0.25	0.14	0.51
T2M1	0.60	-0.46	0.19	1.95	-0.09	0.47	0.78	-0.20	0.45
T2M2	-0.33	0.49	0.17	-0.09	1.79	0.47	-0.26	0.58	0.35
T2M3	0.17	0.12	0.51	0.47	0.47	1.76	0.45	0.35	0.74
T3M1	0.55	-0.37	0.25	0.78	-0.26	0.45	1.90	0.05	0.58
T3M2	-0.36	0.43	0.14	-0.20	0.58	0.35	0.05	1.78	0.50
T3M3	0.25	0.17	0.51	0.45	0.35	0.74	0.58	0.50	2.03

### Results of applying the CTCM model

Test statistic	15.788
Degrees of freedom	12
P-value (Chi-square)	0.201
Comparative Fit Index (CFI)	0.997
Tucker-Lewis Index (TLI)	0.992

From these results, the goodness-of-fit index of this measurement model is excellent. The chi-square value (15.78) is low at an impressive level and is not significant at a significance level of .05. CFI and TLI values are above .99.

### Latent Variables:

	Estimate	Std.Err	z-value	P(> z )
T1 =~				
T1M1	-0.005	1.565	-0.003	0.997
T1M2	0.012	3.594	0.003	0.997
T1M3	0.003	0.735	0.003	0.997
T2 =~				
T2M1	0.529	0.080	6.594	0.000
T2M2	0.520	0.088	5.888	0.000

T2M3	0.546	0.077	7.079	0.000
T3 =~				
T3M1	0.587	0.081	7.276	0.000
T3M2	0.637	0.083	7.641	0.000
T3M3	0.569	0.077	7.397	0.000
M1 =~				
T1M1	0.730	0.045	16.181	0.000
T2M1	0.785	0.054	14.449	0.000
T3M1	0.783	0.053	14.828	0.000
M2 =~				
T1M2	0.717	0.048	14.960	0.000
T2M2	0.707	0.057	12.352	0.000
T3M2	0.598	0.061	9.781	0.000
M3 =~				
T1M3	0.705	0.061	11.511	0.000
T2M3	0.712	0.065	11.020	0.000
T3M3	0.761	0.068	11.252	0.000

The trait variances of T1 are almost zero. T1 does not affect any of T1M1, T1M2 or T1M3. The fit index of the model was almost perfect. Therefore, the claim that the fit index of the model guarantees trait variances is unfounded.

### **Comparison of the CTCM and UTCM models**

Model comparisons are not presented because the analysis of the UTCM model for these data does not converge.