

Mplus-Syntax zu Kapitel 25:  
Multitrait-Multimethod-Analysen (MTMM-Analysen)

Karin Schermelleh-Engel

10.06.2020

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Zu Kap. 25 – Multitrait-Multimethod-Analysen: Mplus-Syntax

## CTCM-Modell

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Title:   CTCM: 3 Traits, 3 Methoden
         Traits: UN=Unaufmerksamkeit, HA=Hyperaktivitaet, TV=Trotzverhalten
         Methoden: Mu=Mutter, Va=Vater, Le=Lehrer
         ohne fehlende Werte, deshalb Abweichungen zu den Ergebnissen im Buch

Data:    !Statt Rohdaten wird die modellimplizierte Korrelationsmatrix verwendet
         File = MTMM_CORR.dat;
         Type = CORRELATION;
         NOBSERVATIONS = 600;

Variable: ! Variablen im Datensatz
          Names are
          UN_M HA_M TV_M ! Mutter
          UN_V HA_V TV_V ! Vater
          UN_L HA_L TV_L ;! Lehrer

Analysis: !Schaeztmethode: ML
          Estimator = ML;

Model:   !Definition des CTCM-Modells
          ! Latente Varienzen werden auf eins fixiert
          ! Faktorladung der ersten Variable soll frei geschaezt werden
          UN by UN_M* UN_V UN_L ;
          HA by HA_M* HA_V HA_L ;
          TV by TV_M* TV_V TV_L ;

          Mu by UN_M* HA_M TV_M;
          Va by UN_V* HA_V TV_V;
          Le by UN_L* HA_L TV_L;

          !Latente Varienzen der Traits
          UN@1;
          HA@1;
          TV@1;

          !Latente Varienzen der Methoden
          Mu@1;
          Va@1;
          Le@1;

          !Keine Korrelationen zwischen Traits und Methoden
          UN with Mu@0 Va@0 Le@0 ;
          HA with Mu@0 Va@0 Le@0 ;
          TV with Mu@0 Va@0 Le@0 ;

Output:  SAMPSTAT STDYX;

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**Ergebnisse des CTCM-Modells:**

INPUT READING TERMINATED NORMALLY

SAMPLE STATISTICS

SAMPLE STATISTICS

	Covariances/Correlations/Residual Correlations				
	UN_M	HA_M	TV_M	UN_V	HA_V
UN_M	1.000				
HA_M	0.630	1.000			
TV_M	0.580	0.610	1.000		
UN_V	0.820	0.550	0.500	1.000	
HA_V	0.560	0.790	0.530	0.650	1.000
TV_V	0.450	0.520	0.720	0.600	0.660
UN_L	0.440	0.350	0.250	0.420	0.370
HA_L	0.280	0.470	0.280	0.290	0.440
TV_L	0.250	0.380	0.320	0.260	0.330

	Covariances/Correlations/Residual Correlations			
	TV_V	UN_L	HA_L	TV_L
TV_V	1.000			
UN_L	0.200	1.000		
HA_L	0.250	0.600	1.000	
TV_L	0.290	0.510	0.690	1.000

THE MODEL ESTIMATION TERMINATED NORMALLY

!Das folgende Ergebnis tritt häufig auf, wenn alle Traits und alle Methoden  
!im Modell enthalten sind  
!Das CTC(M-1)-Modell hat diese Schätz- und Identifikationsprobleme nicht

**WARNING:** THE RESIDUAL COVARIANCE MATRIX (THETA) IS NOT POSITIVE DEFINITE.  
THIS COULD INDICATE A NEGATIVE VARIANCE/RESIDUAL VARIANCE FOR AN OBSERVED  
VARIABLE, A CORRELATION GREATER OR EQUAL TO ONE BETWEEN TWO OBSERVED  
VARIABLES, OR A LINEAR DEPENDENCY AMONG MORE THAN TWO OBSERVED VARIABLES.  
CHECK THE RESULTS SECTION FOR MORE INFORMATION.  
PROBLEM INVOLVING VARIABLE TV\_M.

MODEL FIT INFORMATION

Number of Free Parameters 33

Loglikelihood

H0 Value	-5778.404
H1 Value	-5761.889

Information Criteria

Akaike (AIC)	11622.808
Bayesian (BIC)	11767.907
Sample-Size Adjusted BIC	11663.141
(n* = (n + 2) / 24)	

!Der Modellfit ist noch zufriedenstellend, da eine große Stichprobe  
!analysiert wurde

Chi-Square Test of Model Fit

Value	33.030
Degrees of Freedom	12
P-Value	0.0010

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## RMSEA (Root Mean Square Error Of Approximation)

Estimate	0.054	
90 Percent C.I.	0.033	0.076
Probability RMSEA <= .05	0.347	

## CFI/TLI

CFI	0.994
TLI	0.983

## Chi-Square Test of Model Fit for the Baseline Model

Value	3791.751
Degrees of Freedom	36
P-Value	0.0000

## SRMR (Standardized Root Mean Square Residual)

Value	0.023
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## MODEL RESULTS

		Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
UN	BY				
	UN_M	0.815	0.057	14.223	0.000
	UN_V	0.722	0.054	13.479	0.000
	UN_L	0.415	0.042	9.982	0.000
HA	BY				
	HA_M	0.816	0.075	10.827	0.000
	HA_V	0.698	0.068	10.208	0.000
	HA_L	0.397	0.051	7.823	0.000
TV	BY				
	TV_M	0.185	0.142	1.299	0.194
	TV_V	0.339	0.140	2.426	0.015
	TV_L	0.398	0.065	6.168	0.000
MU	BY				
	UN_M	0.523	0.086	6.056	0.000
	HA_M	0.521	0.102	5.110	0.000
	TV_M	<b>1.011</b>	0.083	12.236	0.000
VA	BY				
	UN_V	0.594	0.063	9.442	0.000
	HA_V	0.605	0.075	8.114	0.000
	TV_V	0.848	0.070	12.133	0.000
LE	BY				
	UN_L	0.617	0.040	15.590	0.000
	HA_L	0.789	0.038	20.866	0.000
	TV_L	0.721	0.045	15.996	0.000
UN	WITH				
	MU	0.000	0.000	999.000	999.000
	VA	0.000	0.000	999.000	999.000
	LE	0.000	0.000	999.000	999.000
HA	WITH				
	MU	0.000	0.000	999.000	999.000
	VA	0.000	0.000	999.000	999.000
	LE	0.000	0.000	999.000	999.000
	UN	0.568	0.070	8.070	0.000

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TV	WITH				
MU		0.000	0.000	999.000	999.000
VA		0.000	0.000	999.000	999.000
LE		0.000	0.000	999.000	999.000
UN		0.409	0.149	2.750	0.006
HA		0.677	0.111	6.102	0.000
VA	WITH				
MU		0.762	0.053	14.381	0.000
LE	WITH				
MU		0.324	0.071	4.577	0.000
VA		0.288	0.074	3.915	0.000
Variances					
UN		1.000	0.000	999.000	999.000
HA		1.000	0.000	999.000	999.000
TV		1.000	0.000	999.000	999.000
MU		1.000	0.000	999.000	999.000
VA		1.000	0.000	999.000	999.000
LE		1.000	0.000	999.000	999.000

!Es gibt hier eine negative Schätzung der Fehlervarianz von TV\_M

Residual Variances					
UN_M		0.072	0.025	2.884	0.004
HA_M		0.084	0.030	2.815	0.005
TV_M		-0.057	0.160	-0.357	0.721
UN_V		0.124	0.021	5.980	0.000
HA_V		0.160	0.021	7.522	0.000
TV_V		0.170	0.035	4.922	0.000
UN_L		0.452	0.033	13.684	0.000
HA_L		0.195	0.033	5.886	0.000
TV_L		0.318	0.046	6.983	0.000

! Schätzprobleme: Eine negative Fehlervarianz

## STANDARDIZED MODEL RESULTS

## STDYX Standardization

		Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
UN	BY				
UN_M		0.811	0.053	15.379	0.000
UN_V		0.723	0.050	14.413	0.000
UN_L		0.414	0.038	10.952	0.000
HA	BY				
HA_M		0.807	0.069	11.718	0.000
HA_V		0.693	0.062	11.151	0.000
HA_L		0.402	0.048	8.334	0.000
TV	BY				
TV_M		0.185	0.142	1.301	0.193
TV_V		0.339	0.139	2.441	0.015
TV_L		0.399	0.063	6.332	0.000
MU	BY				
UN_M		0.520	0.084	6.196	0.000
HA_M		0.516	0.101	5.122	0.000
TV_M		1.011	0.078	12.895	0.000
VA	BY				
UN_V		0.595	0.059	10.143	0.000
HA_V		0.601	0.073	8.232	0.000
TV_V		0.846	0.065	13.113	0.000

! Schätzprobleme: Eine standardisierte Faktorladung > 1.0

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LE	BY				
	UN_L	0.616	0.032	19.121	0.000
	HA_L	0.799	0.030	27.021	0.000
	TV_L	0.722	0.036	19.793	0.000
UN	WITH				
	MU	0.000	0.000	999.000	999.000
	VA	0.000	0.000	999.000	999.000
	LE	0.000	0.000	999.000	999.000
HA	WITH				
	MU	0.000	0.000	999.000	999.000
	VA	0.000	0.000	999.000	999.000
	LE	0.000	0.000	999.000	999.000
	UN	0.568	0.070	8.070	0.000
TV	WITH				
	MU	0.000	0.000	999.000	999.000
	VA	0.000	0.000	999.000	999.000
	LE	0.000	0.000	999.000	999.000
	UN	0.409	0.149	2.750	0.006
	HA	0.677	0.111	6.102	0.000
VA	WITH				
	MU	0.762	0.053	14.381	0.000
LE	WITH				
	MU	0.324	0.071	4.577	0.000
	VA	0.288	0.074	3.915	0.000
Variances					
	UN	1.000	0.000	999.000	999.000
	HA	1.000	0.000	999.000	999.000
	TV	1.000	0.000	999.000	999.000
	MU	1.000	0.000	999.000	999.000
	VA	1.000	0.000	999.000	999.000
	LE	1.000	0.000	999.000	999.000
Residual Variances					
	UN_M	0.071	0.025	2.848	0.004
	HA_M	0.082	0.029	2.781	0.005
	TV_M	<b>-0.057</b>	999.000	999.000	999.000
	UN_V	0.124	0.022	5.630	0.000
	HA_V	0.158	0.022	7.041	0.000
	TV_V	0.169	0.036	4.771	0.000
	UN_L	0.450	0.034	13.398	0.000
	HA_L	0.200	0.035	5.674	0.000
	TV_L	0.319	0.047	6.771	0.000

! Schätzprobleme: Eine standardisierte Faktorladung > 1.0

## R-SQUARE

Observed Variable	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
UN_M	0.929	0.025	37.067	0.000
HA_M	0.918	0.029	31.136	0.000
TV_M	<b>Undefined</b>	<b>0.10569E+01</b>		
UN_V	0.876	0.022	39.783	0.000
HA_V	0.842	0.022	37.614	0.000
TV_V	0.831	0.036	23.389	0.000
UN_L	0.550	0.034	16.384	0.000
HA_L	0.800	0.035	22.699	0.000
TV_L	0.681	0.047	14.456	0.000

Zu Kap. 25 – Multitrait-Multimethod-Analysen: Mplus-Syntax

## CTC(M-1)-Modell

```

Title: CTC(M-1): 3 Traits, 3 Methoden,
      Traits: UN=Unaufmerksamkeit, HA=Hyperaktivitaet, TV=Trotzverhalten
      Methoden: Mu=Mutter, Va=Vater, Le=Lehrer
      Methode Mutter wird auf null fixiert

Data: !Statt Rohdaten wird die Korrelationsmatrix verwendet
      File = MTMM_CORR.dat;
      Type = CORRELATION;
      NOBSERVATIONS = 600;

Variable: ! Variablen im Datensatz
      Names are
      UN_M HA_M TV_M ! Mutter
      UN_V HA_V TV_V ! Vater
      UN_L HA_L TV_L ;! Lehrer

Analysis: !Schaeztmethode: ML
      Estimator = ML;

Model: !Definition des CTC(M-1)-Modells
      ! Latente Varianzen werden auf eins fixiert
      ! Faktorladung der ersten Variable soll frei geschaezt werden
      UN by UN_M* UN_V UN_L ;
      HA by HA_M* HA_V HA_L ;
      TV by TV_M* TV_V TV_L ;

      ! Methode "Mutter" wird auf null fixiert
      !Mu by UN_M* HA_M TV_M;
      Va by UN_V* HA_V TV_V;
      Le by UN_L* HA_L TV_L;

      !Latente Varianzen der Traits
      UN@1;
      HA@1;
      TV@1;

      !Latente Varianzen der Methoden
      !Mu@1;
      Va@1;
      Le@1;

      !Keine Korrelationen zwischen Traits und Methoden
      UN with Va@0 Le@0 ; !Mu@0
      HA with Va@0 Le@0 ; !Mu@0
      TV with Va@0 Le@0 ; !Mu@0

```

## Zu Kap. 25 – Multitrait-Multimethod-Analysen: Mplus-Syntax

**Ergebnisse des CTC(M-1)-Modells:**

Output: SAMPSTAT STDYX;

INPUT READING TERMINATED NORMALLY

THE MODEL ESTIMATION TERMINATED NORMALLY

MODEL FIT INFORMATION

Number of Free Parameters 28

Loglikelihood

H0 Value	-5788.568
H1 Value	-5761.889

Information Criteria

Akaike (AIC)	11633.136
Bayesian (BIC)	11756.250
Sample-Size Adjusted BIC	11667.358
(n* = (n + 2) / 24)	

!Der Modellfit ist gerade noch akzeptabel wegen der großen Stichprobe  
 !Gebenueber dem Beispiel im Buch wurden hier die fehlenden Werte  
 !eliminiert, was zu geringfügigen Unterschieden in den Ergebnissen führt

Chi-Square Test of Model Fit

Value	53.358
Degrees of Freedom	17
P-Value	0.0000

RMSEA (Root Mean Square Error Of Approximation)

Estimate	0.060	
90 Percent C.I.	0.042	0.078
Probability RMSEA <= .05	0.172	

CFI/TLI

CFI	0.990
TLI	0.979

Chi-Square Test of Model Fit for the Baseline Model

Value	3791.751
Degrees of Freedom	36
P-Value	0.0000

SRMR (Standardized Root Mean Square Residual)

Value	0.041
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MODEL RESULTS

		Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
UN	BY				
	UN_M	0.976	0.031	31.095	0.000
	UN_V	0.852	0.034	25.044	0.000
	UN_L	0.441	0.035	12.523	0.000



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HA	BY				
HA_M		0.940	0.032	29.155	0.000
HA_V		0.838	0.034	24.703	0.000
HA_L		0.404	0.033	12.222	0.000
TV	BY				
TV_M		0.927	0.034	27.284	0.000
TV_V		0.782	0.036	21.781	0.000
TV_L		0.350	0.036	9.838	0.000
VA	BY				
UN_V		0.401	0.025	16.116	0.000
HA_V		0.404	0.026	15.492	0.000
TV_V		0.520	0.030	17.365	0.000
LE	BY				
UN_L		0.575	0.036	15.810	0.000
HA_L		0.768	0.036	21.484	0.000
TV_L		0.696	0.038	18.250	0.000
UN	WITH				
VA		0.000	0.000	999.000	999.000
LE		0.000	0.000	999.000	999.000
HA	WITH				
VA		0.000	0.000	999.000	999.000
LE		0.000	0.000	999.000	999.000
UN		0.691	0.025	28.154	0.000
TV	WITH				
VA		0.000	0.000	999.000	999.000
LE		0.000	0.000	999.000	999.000
UN		0.629	0.029	22.041	0.000
HA		0.704	0.025	28.009	0.000
LE	WITH				
VA		0.089	0.052	1.718	0.086
Variances					
UN		1.000	0.000	999.000	999.000
HA		1.000	0.000	999.000	999.000
TV		1.000	0.000	999.000	999.000
VA		1.000	0.000	999.000	999.000
LE		1.000	0.000	999.000	999.000
Residual Variances					
UN_M		0.046	0.021	2.207	0.027
HA_M		0.115	0.021	5.489	0.000
TV_M		0.139	0.028	5.020	0.000
UN_V		0.131	0.019	6.958	0.000
HA_V		0.135	0.019	7.223	0.000
TV_V		0.129	0.025	5.216	0.000
UN_L		0.461	0.033	14.052	0.000
HA_L		0.181	0.035	5.213	0.000
TV_L		0.388	0.035	10.940	0.000

## Zu Kap. 25 – Multitrait-Multimethod-Analysen: Mplus-Syntax

## STANDARDIZED MODEL RESULTS

STDYX Standardization

!Messmodelle der drei Traits

		Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
UN	BY				
	UN_M	0.977	0.011	89.986	0.000
	UN_V	0.844	0.015	55.172	0.000
	UN_L	0.444	0.031	14.508	0.000
HA	BY				
	HA_M	0.941	0.012	81.299	0.000
	HA_V	0.838	0.016	52.694	0.000
	HA_L	0.418	0.030	13.750	0.000
TV	BY				
	TV_M	0.928	0.015	60.058	0.000
	TV_V	0.778	0.021	37.354	0.000
	TV_L	0.351	0.033	10.650	0.000

!Messmodelle der Methoden

!Methode Mutter wurde auf null fixiert und fehlt deshalb hier

VA	BY				
	UN_V	0.397	0.025	16.159	0.000
	HA_V	0.404	0.026	15.580	0.000
	TV_V	0.517	0.028	18.162	0.000
LE	BY				
	UN_L	0.579	0.030	19.484	0.000
	HA_L	0.795	0.027	28.969	0.000
	TV_L	0.698	0.028	24.669	0.000

!Korrelationen zwischen Traits und Methoden auf null fixiert

!Korrelationen zwischen Traits HA, UN, TV geschätzt

UN	WITH				
	VA	0.000	0.000	999.000	999.000
	LE	0.000	0.000	999.000	999.000
HA	WITH				
	VA	0.000	0.000	999.000	999.000
	LE	0.000	0.000	999.000	999.000
	UN	0.691	0.025	28.154	0.000
TV	WITH				
	VA	0.000	0.000	999.000	999.000
	LE	0.000	0.000	999.000	999.000
	UN	0.629	0.029	22.041	0.000
	HA	0.704	0.025	28.009	0.000

!Kovarianz zwischen den Methoden Lehrer und Vater wurde geschätzt, ist aber nicht signifikant

LE	WITH				
	VA	0.089	0.052	1.718	0.086

## Variances

UN	1.000	0.000	999.000	999.000
HA	1.000	0.000	999.000	999.000
TV	1.000	0.000	999.000	999.000
VA	1.000	0.000	999.000	999.000
LE	1.000	0.000	999.000	999.000

## Zu Kap. 25 – Multitrait-Multimethod-Analysen: Mplus-Syntax

!Fehlervarianzen sind alle positiv

## Residual Variances

UN_M	0.046	0.021	2.191	0.028
HA_M	0.115	0.022	5.288	0.000
TV_M	0.140	0.029	4.875	0.000
UN_V	0.129	0.020	6.427	0.000
HA_V	0.135	0.020	6.710	0.000
TV_V	0.127	0.026	4.935	0.000
UN_L	0.468	0.033	14.022	0.000
HA_L	0.194	0.038	5.076	0.000
TV_L	0.390	0.037	10.555	0.000

## R-SQUARE

Observed Variable	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
UN_M	0.954	0.021	44.993	0.000
HA_M	0.885	0.022	40.649	0.000
TV_M	0.860	0.029	30.029	0.000
UN_V	0.871	0.020	43.427	0.000
HA_V	0.865	0.020	43.056	0.000
TV_V	0.873	0.026	33.830	0.000
UN_L	0.532	0.033	15.948	0.000
HA_L	0.806	0.038	21.085	0.000
TV_L	0.610	0.037	16.494	0.000