

Testing Differential Item Functioning in Graded Response Polytomous IRT Models in Mplus version 5.2

Example data: 635 older adults (age 80-100) self-reporting on 7 items assessing the Instrumental Activities of Daily Living (IADL) as follows. We are examining differences between men ($N=214$) and women ($N=420$).

1. Housework (cleaning and laundry),
2. Bedmaking,
3. Cooking,
4. Everyday shopping,
5. Getting to places outside of walking distance,
6. Handling banking and other business,
7. Using the telephone

Multiple Group Graded Response Model Syntax and Truncated Output:

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TITLE: Assess polytomous IADL items
DATA: FILE IS ADL2.dat;
VARIABLE: NAMES ARE case female cial-cia7;
              USEVARIABLES ARE cial-cia7;
              CATEGORICAL ARE cial-cia7;
              GROUPING IS female (0=Men 1=Women);
              MISSING ARE .;

ANALYSIS: ESTIMATOR IS WLSMV; PARAMETERIZATION=THETA;

SAVEDATA: DIFFTEST=Configural.dat; ! Save configural info

OUTPUT: MODINDICES (6); !Constraints to drop p<.01

!!! CONFIGURAL MODEL FOR MEN REFERENCE GROUP
MODEL:
! Factor loadings all estimated
  IADL BY cial-cia7*;
! Item thresholds all free
  [cial$1-cia7$1];
  [cial$2-cia7$2];
  [cial$3-cia7$3];
! Item residual variances all fixed=1
  cial-cia7@1;
! Factor mean=0 and variance=1 for identification
  [IADL@0]; IADL@1;

!!! CONFIGURAL MODEL FOR WOMEN ALTERNATIVE GROUP
MODEL WOMEN:
! Factor loadings all estimated
  IADL BY cial-cia7*;
! Item thresholds all free
  [cial$1-cia7$1];
  [cial$2-cia7$2];
  [cial$3-cia7$3];
! Item residual variances all fixed=1
  cial-cia7@1;
! Factor mean=0 and variance=1 for identification
  [IADL@0]; IADL@1;

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TESTS OF MODEL FIT

Chi-Square Test of Model Fit	
Value	56.332*
Degrees of Freedom	19**
P-Value	0.0000

Chi-Square Contributions From Each Group	
MEN	19.295
WOMEN	37.036

* The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used for chi-square difference tests. MLM, MLR and WLSM chi-square difference testing is described in the Mplus Technical Appendices at www.statmodel.com. See chi-square difference testing in the index of the Mplus User's Guide.

** The degrees of freedom for MLMV, ULSMV and WLSMV are estimated according to a formula given in the Mplus Technical Appendices at www.statmodel.com. See degrees of freedom in the index of the Mplus User's Guide.

Chi-Square Test of Model Fit for the Baseline Model	
Value	19336.354
Degrees of Freedom	12
P-Value	0.0000

CFI/TLI	
CFI	0.998
TLI	0.999

Number of Free Parameters	56
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RMSEA (Root Mean Square Error Of Approximation)	
Estimate	0.079

This will serve as our baseline configural model.

Model 1. Configural Invariance Model
(Everything separate across groups *except* for parameters needed to be constrained for identification)

UNSTANDARDIZED MODEL RESULTS (IFA MODEL SOLUTION)					UNSTANDARDIZED MODEL RESULTS (IFA MODEL SOLUTION)						
	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value		Estimate	S.E.	Est./S.E.	Two-Tailed P-Value		
Group MEN					Group WOMEN						
FACTOR LOADINGS: CHANGE IN PROBIT FOR 1-UNIT CHANGE IN THETA					FACTOR LOADINGS: CHANGE IN PROBIT FOR 1-UNIT CHANGE IN THETA						
IADL	BY				IADL	BY					
CIA1		5.877	1.475	3.986	0.000	CIA1		3.084	0.305	10.124	0.000
CIA2		3.185	0.549	5.803	0.000	CIA2		3.415	0.464	7.368	0.000
CIA3		3.089	0.445	6.947	0.000	CIA3		4.884	0.919	5.312	0.000
CIA4		4.136	0.829	4.988	0.000	CIA4		3.284	0.330	9.945	0.000
CIA5		2.578	0.374	6.888	0.000	CIA5		2.202	0.196	11.258	0.000
CIA6		2.663	0.495	5.381	0.000	CIA6		1.741	0.172	10.101	0.000
CIA7		1.115	0.218	5.119	0.000	CIA7		1.056	0.156	6.786	0.000
Means: MEAN OF THETA					Means: MEAN OF THETA						
IADL		0.000	0.000	999.000	999.000	IADL		0.000	0.000	999.000	999.000
Thresholds: NEGATIVE OF EXPECTED PROBIT WHEN THETA=0					Thresholds: NEGATIVE OF EXPECTED PROBIT WHEN THETA=0						
CIA1\$1		-7.445	1.856	-4.011	0.000	CIA1\$1		-4.581	0.400	-11.451	0.000
CIA1\$2		-5.134	1.374	-3.736	0.000	CIA1\$2		-3.289	0.336	-9.796	0.000
CIA1\$3		-0.831	0.662	-1.256	0.209	CIA1\$3		-0.706	0.221	-3.188	0.001
CIA2\$1		-4.484	0.639	-7.017	0.000	CIA2\$1		-5.426	0.623	-8.713	0.000
CIA2\$2		-3.851	0.588	-6.550	0.000	CIA2\$2		-4.453	0.546	-8.159	0.000
CIA2\$3		-2.265	0.489	-4.634	0.000	CIA2\$3		-2.800	0.442	-6.338	0.000
CIA3\$1		-3.879	0.483	-8.026	0.000	CIA3\$1		-7.202	1.188	-6.063	0.000
CIA3\$2		-2.810	0.451	-6.227	0.000	CIA3\$2		-6.137	1.067	-5.752	0.000
CIA3\$3		-0.565	0.325	-1.737	0.082	CIA3\$3		-3.878	0.831	-4.666	0.000
CIA4\$1		-5.180	0.924	-5.606	0.000	CIA4\$1		-4.479	0.377	-11.865	0.000
CIA4\$2		-4.190	0.756	-5.539	0.000	CIA4\$2		-2.803	0.306	-9.165	0.000
CIA4\$3		-2.173	0.567	-3.835	0.000	CIA4\$3		-0.679	0.238	-2.859	0.004
CIA5\$1		-4.614	0.574	-8.045	0.000	CIA5\$1		-3.745	0.281	-13.344	0.000
CIA5\$2		-2.622	0.374	-7.003	0.000	CIA5\$2		-1.687	0.190	-8.882	0.000
CIA5\$3		-1.191	0.300	-3.974	0.000	CIA5\$3		-0.118	0.151	-0.779	0.436
CIA6\$1		-4.603	0.709	-6.493	0.000	CIA6\$1		-3.201	0.243	-13.152	0.000
CIA6\$2		-3.340	0.570	-5.864	0.000	CIA6\$2		-2.115	0.190	-11.136	0.000
CIA6\$3		-2.233	0.474	-4.714	0.000	CIA6\$3		-1.173	0.162	-7.254	0.000
CIA7\$1		-3.115	0.383	-8.124	0.000	CIA7\$1		-3.407	0.325	-10.498	0.000
CIA7\$2		-2.376	0.279	-8.517	0.000	CIA7\$2		-2.712	0.233	-11.637	0.000
CIA7\$3		-1.779	0.234	-7.592	0.000	CIA7\$3		-1.747	0.165	-10.580	0.000
Variances: VARIANCE OF THETA					Variances: VARIANCE OF THETA						
IADL		1.000	0.000	999.000	999.000	IADL		1.000	0.000	999.000	999.000
Residual Variances (ALL FIXED=1)					Residual Variances (ALL FIXED=1)						

Model 2. Metric Invariance Model (loadings held equal across groups – discriminations can still vary via factor variances)

<pre> ANALYSIS: ESTIMATOR IS WLSMV; PARAMETERIZATION=THETA; DIFFTEST=Configural.dat; ! Compare against configural SAVEDATA: DIFFTEST=Metric.dat; ! Save metric info !!! METRIC MODEL FOR MEN REFERENCE GROUP MODEL: ! Factor loadings all estimated IADL BY cia1* (L1) cia2* (L2) cia3* (L3) cia4* (L4) cia5* (L5) cia6* (L6) cia7* (L7); ! Item thresholds all free [cial\$1-cia7\$1]; [cial\$2-cia7\$2]; [cial\$3-cia7\$3]; ! Item residual variances all fixed=1 cial-cia7@1; ! Factor mean=0 and variance=1 for identification [IADL@0]; IADL@1; !!! METRIC MODEL FOR WOMEN ALTERNATIVE GROUP MODEL WOMEN: ! Factor loadings all NOW HELD EQUAL IADL BY cia1* (L1) cia2* (L2) cia3* (L3) cia4* (L4) cia5* (L5) cia6* (L6) cia7* (L7); ! Item thresholds all free [cial\$1-cia7\$1]; [cial\$2-cia7\$2]; [cial\$3-cia7\$3]; ! Item residual variances all fixed=1 cial-cia7@1; ! Factor mean=0 and variance=FREE for identification [IADL@0]; IADL*; </pre> <p>The DIFFTEST chi-square is nonsignificant, and no modification indices for freeing loadings were indicated, so it looks like metric invariance holds between men and women.</p>	<pre> Chi-Square Test of Model Fit Value 35.651* Degrees of Freedom 15** P-Value 0.0020 THIS IS THE TEST OF CONFIGURAL VS. METRIC INVARIANCE Chi-Square Test for Difference Testing Value 6.699 Degrees of Freedom 4** P-Value 0.1527 CFI/TLI CFI 0.999 TLI 0.999 Number of Free Parameters 50 RMSEA (Root Mean Square Error Of Approximation) Estimate 0.066 Estimate S.E. Est./S.E. Two-Tailed Estimate S.E. Est./S.E. P-Value Group MEN FACTOR LOADINGS: CHANGE IN PROBIT FOR 1-UNIT CHANGE IN THETA IADL BY CIA1 3.915 0.397 9.868 0.000 CIA2 4.019 0.566 7.096 0.000 CIA3 4.771 0.697 6.847 0.000 CIA4 4.055 0.489 8.289 0.000 CIA5 2.601 0.283 9.192 0.000 CIA6 2.269 0.250 9.063 0.000 CIA7 1.210 0.166 7.292 0.000 Variances: VARIANCE OF THETA IADL 1.000 0.000 999.000 999.000 Group WOMEN FACTOR LOADINGS: CHANGE IN PROBIT FOR 1-UNIT CHANGE IN THETA IADL BY CIA1 3.915 0.397 9.868 0.000 CIA2 4.019 0.566 7.096 0.000 CIA3 4.771 0.697 6.847 0.000 CIA4 4.055 0.489 8.289 0.000 CIA5 2.601 0.283 9.192 0.000 CIA6 2.269 0.250 9.063 0.000 CIA7 1.210 0.166 7.292 0.000 Variances: VARIANCE OF THETA IADL 0.693 0.154 4.492 0.000 </pre>
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Model 3a. Full Threshold Invariance Model (thresholds held equal across groups – difficulties can still vary via factor means)

<pre> ANALYSIS: ESTIMATOR IS WLSMV; PARAMETERIZATION=THETA; DIFFTEST=Metric.dat; SAVEDATA: DIFFTEST=Scalar.dat; ! Save full scalar info !!! FULL SCALAR MODEL FOR MEN REFERENCE GROUP MODEL: ! Factor loadings all estimated IADL BY cia1* (L1) cia2* (L2) cia3* (L3) cia4* (L4) cia5* (L5) cia6* (L6) cia7* (L7); ! Item thresholds all free [cia1\$1-cia7\$1]; [cia1\$2-cia7\$2]; [cia1\$3-cia7\$3]; ! Item residual variances all fixed=1 cial-cia7@1; ! Factor mean=0 and variance=1 for identification [IADL@0]; IADL@1; !!! FULL SCALAR MODEL FOR WOMEN ALTERNATIVE GROUP MODEL WOMEN: ! Factor loadings all STILL HELD EQUAL IADL BY cia1* (L1) cia2* (L2) cia3* (L3) cia4* (L4) cia5* (L5) cia6* (L6) cia7* (L7); ! Item thresholds NOW HELD EQUAL IF LEFT OFF (LESS TYPING) ! Item residual variances all fixed=1 cial-cia7@1; ! Factor mean=FREE and variance=FREE for identification [IADL*]; IADL*; </pre>	<pre> Chi-Square Test of Model Fit Value 85.129* Degrees of Freedom 22** P-Value 0.0000 THIS IS THE TEST OF METRIC VS. THRESHOLD INVARIANCE Chi-Square Test for Difference Testing Value 93.962 Degrees of Freedom 13** P-Value 0.0000 CFI/TLI CFI 0.997 TLI 0.998 Number of Free Parameters 30 RMSEA (Root Mean Square Error Of Approximation) Estimate 0.095 MODEL MODIFICATION INDICES M.I. E.P.C. Std E.P.C. StdYX E.P.C. Group MEN Means/Intercepts/Thresholds [CIA3] 29.398 -2.718 -2.718 -0.540 [CIA4] 6.092 1.037 1.037 0.244 [CIA5] 15.588 1.118 1.118 0.396 [CIA3\$3] 29.138 2.136 2.136 0.424 [CIA5\$3] 7.443 -0.561 -0.561 -0.199 Group WOMEN Means/Intercepts/Thresholds [CIA3] 29.412 2.719 2.719 0.657 [CIA4] 6.126 -1.040 -1.040 -0.297 [CIA5] 15.599 -1.118 -1.118 -0.472 [CIA3\$3] 29.136 -1.796 -1.796 -0.434 [CIA5\$3] 7.442 0.532 0.532 0.224 </pre> <p>The DIFFTEST chi-square is significant, and the modification indices suggest that item 3 is a problem (especially the last threshold). Let's see what happens when we free the item 3 thresholds between groups.</p>
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Model 3b. Partial Threshold Invariance Model (freeing item3 between groups)

<pre> ANALYSIS: ESTIMATOR IS WLSMV; PARAMETERIZATION=THETA; DIFFTEST=Metric.dat; ! Compare against metric SAVEDATA: DIFFTEST=ScalarB.dat; ! Save partial scalar info !!! PARTIAL SCALAR MODEL FOR MEN REFERENCE GROUP MODEL: ! Factor loadings all estimated IADL BY cia1* (L1) cia2* (L2) cia3* (L3) cia4* (L4) cia5* (L5) cia6* (L6) cia7* (L7); ! Item thresholds all free [cia1\$1-cia7\$1]; [cia1\$2-cia7\$2]; [cia1\$3-cia7\$3]; ! Item residual variances all fixed=1 cial-cia7@1; ! Factor mean=0 and variance=1 for identification [IADL@0]; IADL@1; !!! PARTIAL SCALAR MODEL FOR WOMEN ALTERNATIVE GROUP MODEL WOMEN: ! Factor loadings all STILL HELD EQUAL IADL BY cia1* (L1) cia2* (L2) cia3* (L3) cia4* (L4) cia5* (L5) cia6* (L6) cia7* (L7); ! Item thresholds NOW HELD EQUAL EXCEPT CIA3 [cia3\$1 cia3\$2 cia3\$3]; ! Item residual variances all fixed=1 cial-cia7@1; ! Factor mean=FREE and variance=FREE for identification [IADL*]; IADL*; </pre>	<pre> Chi-Square Test of Model Fit Value 54.741* Degrees of Freedom 21** P-Value 0.0001 THIS IS THE TEST OF METRIC VS. PARTIAL SCALAR INVARIANCE Chi-Square Test for Difference Testing Value 35.275 Degrees of Freedom 11** P-Value 0.0002 CFI/TLI CFI 0.998 TLI 0.999 Number of Free Parameters 33 RMSEA (Root Mean Square Error Of Approximation) Estimate 0.071 Thresholds for Men... CIA3\$1 -5.990 0.784 -7.643 0.000 CIA3\$2 -4.338 0.720 -6.028 0.000 CIA3\$3 -0.872 0.502 -1.737 0.082 Thresholds for Women... CIA3\$1 -6.935 0.802 -8.649 0.000 CIA3\$2 -6.064 0.756 -8.027 0.000 CIA3\$3 -4.202 0.674 -6.234 0.000 MODEL MODIFICATION INDICES M.I. E.P.C. Std E.P.C. StdYX E.P.C. Group MEN Means/Intercepts/Thresholds [CIA1] 8.379 -1.211 -1.211 -0.296 [CIA5] 8.422 0.841 0.841 0.297 Group WOMEN Means/Intercepts/Thresholds [CIA1] 8.389 1.212 1.212 0.360 [CIA5] 8.410 -0.841 -0.841 -0.354 </pre> <p>The DIFFTEST chi-square is still significant, and the modification indices suggest that item 5 is a problem (and item 1 too). Let's see what happens when we free the item 5 thresholds between groups.</p>
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Model 3c. Partial Threshold Invariance Model (freeing item3 and item5 between groups)

<pre> ANALYSIS: ESTIMATOR IS WLSMV; PARAMETERIZATION=THETA; DIFFTEST=Metric.dat; ! Compare against metric SAVEDATA: DIFFTEST=ScalarC.dat; ! Save partial scalar info !!! PARTIAL SCALAR MODEL FOR MEN REFERENCE GROUP MODEL: ! Factor loadings all estimated IADL BY cia1* (L1) cia2* (L2) cia3* (L3) cia4* (L4) cia5* (L5) cia6* (L6) cia7* (L7); ! Item thresholds all free [cia1\$1-cia7\$1]; [cia1\$2-cia7\$2]; [cia1\$3-cia7\$3]; ! Item residual variances all fixed=1 cial-cia7@1; ! Factor mean=0 and variance=1 for identification [IADL@0]; IADL@1; !!! PARTIAL SCALAR MODEL FOR WOMEN ALTERNATIVE GROUP MODEL WOMEN: ! Factor loadings all STILL HELD EQUAL IADL BY cia1* (L1) cia2* (L2) cia3* (L3) cia4* (L4) cia5* (L5) cia6* (L6) cia7* (L7); ! Item thresholds NOW HELD EQUAL EXCEPT CIA3 AND CIA5 [cia3\$1 cia3\$2 cia3\$3]; [cia5\$1 cia5\$2 cia5\$3]; ! Item residual variances all fixed=1 cial-cia7@1; ! Factor mean=FREE and variance=FREE for identification [IADL*]; IADL*; </pre>	<pre> Chi-Square Test of Model Fit Value 48.203* Degrees of Freedom 20** P-Value 0.0004 THIS IS THE TEST OF METRIC VS. PARTIAL SCALAR INVARIANCE Chi-Square Test for Difference Testing Value 22.663 Degrees of Freedom 9** P-Value 0.0070 CFI/TLI CFI 0.999 TLI 0.999 Number of Free Parameters 36 RMSEA (Root Mean Square Error Of Approximation) Estimate 0.067 Thresholds for Men... CIA3\$1 -5.898 0.769 -7.668 0.000 CIA3\$2 -4.270 0.707 -6.041 0.000 CIA3\$3 -0.862 0.495 -1.742 0.081 CIA5\$1 -4.684 0.456 -10.264 0.000 CIA5\$2 -2.664 0.330 -8.070 0.000 CIA5\$3 -1.210 0.280 -4.323 0.000 Thresholds for Women... CIA3\$1 -6.640 0.769 -8.638 0.000 CIA3\$2 -5.767 0.723 -7.975 0.000 CIA3\$3 -3.909 0.645 -6.065 0.000 CIA5\$1 -4.078 0.335 -12.174 0.000 CIA5\$2 -2.051 0.280 -7.330 0.000 CIA5\$3 -0.507 0.264 -1.921 0.055 </pre> <p>The DIFFTEST chi-square is still significant, but no modification indices for freeing thresholds were indicated. We could still remove the constraints for the item 1 thresholds and see if that helps.</p>
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Model 3d. Partial Threshold Invariance Model (freeing item3 and item5 and item1 between groups)

<pre> ANALYSIS: ESTIMATOR IS WLSMV; PARAMETERIZATION=THETA; DIFFTEST=Metric.dat; ! Compare against metric SAVEDATA: DIFFTEST=ScalarD.dat; ! Save partial scalar info !!! PARTIAL SCALAR MODEL FOR MEN REFERENCE GROUP MODEL: ! Factor loadings all estimated IADL BY cia1* (L1) cia2* (L2) cia3* (L3) cia4* (L4) cia5* (L5) cia6* (L6) cia7* (L7); ! Item thresholds all free [cia1\$1-cia7\$1]; [cia1\$2-cia7\$2]; [cia1\$3-cia7\$3]; ! Item residual variances all fixed=1 cial-cia7@1; ! Factor mean=0 and variance=1 for identification [IADL@0]; IADL@1; !!! PARTIAL SCALAR MODEL FOR WOMEN ALTERNATIVE GROUP MODEL WOMEN: ! Factor loadings all STILL HELD EQUAL IADL BY cia1* (L1) cia2* (L2) cia3* (L3) cia4* (L4) cia5* (L5) cia6* (L6) cia7* (L7); ! Item thresholds NOW HELD EQUAL EXCEPT CIA3 AND CIA5 AND CIA1 [cia3\$1 cia3\$2 cia3\$3]; [cia5\$1 cia5\$2 cia5\$3]; [cia1\$1 cia1\$2 cia1\$3]; ! Item residual variances all fixed=1 cial-cia7@1; ! Factor mean=FREE and variance=FREE for identification [IADL*]; IADL*; Chi-Square Test of Model Fit Value 43.285* Degrees of Freedom 19** P-Value 0.0012 CFI/TLI CFI 0.999 TLI 0.999 Number of Free Parameters 39 RMSEA (Root Mean Square Error Of Approximation) Estimate 0.063 </pre>	<pre> THIS IS THE TEST OF METRIC VS. PARTIAL SCALAR INVARIANCE Chi-Square Test for Difference Testing Value 13.464 Degrees of Freedom 7** P-Value 0.0616 Thresholds for Men... CIA1\$1 -5.101 0.496 -10.289 0.000 CIA1\$2 -3.522 0.493 -7.150 0.000 CIA1\$3 -0.570 0.399 -1.427 0.154 CIA3\$1 -5.983 0.790 -7.576 0.000 CIA3\$2 -4.334 0.723 -5.994 0.000 CIA3\$3 -0.873 0.502 -1.740 0.082 CIA5\$1 -4.734 0.466 -10.167 0.000 CIA5\$2 -2.690 0.337 -7.982 0.000 CIA5\$3 -1.220 0.284 -4.302 0.000 Thresholds for Women... CIA1\$1 -5.570 0.510 -10.920 0.000 CIA1\$2 -4.232 0.457 -9.261 0.000 CIA1\$3 -1.553 0.404 -3.840 0.000 CIA3\$1 -6.941 0.809 -8.582 0.000 CIA3\$2 -6.069 0.763 -7.958 0.000 CIA3\$3 -4.212 0.682 -6.174 0.000 CIA5\$1 -4.228 0.345 -12.263 0.000 CIA5\$2 -2.206 0.291 -7.572 0.000 CIA5\$3 -0.666 0.275 -2.422 0.015 Since item 4 was suggested and the DIFFTEST is marginal, we try that: ANALYSIS: ESTIMATOR IS WLSMV; PARAMETERIZATION=THETA; DIFFTEST=Metric.dat; ! Compare against metric SAVEDATA: DIFFTEST=ScalarE.dat; ! Save partial scalar info MODEL WOMEN: ! Item thresholds NOW HELD EQUAL EXCEPT CIA3 AND CIA5 AND CIA1 AND CIA4 [cia3\$1 cia3\$2 cia3\$3]; [cia5\$1 cia5\$2 cia5\$3]; [cia1\$1 cia1\$2 cia1\$3]; [cia4\$1 cia4\$2 cia4\$3]; Chi-Square Test for Difference Testing Value 9.101 Degrees of Freedom 6** P-Value 0.1680 Ok, now we can call scalar done. </pre>
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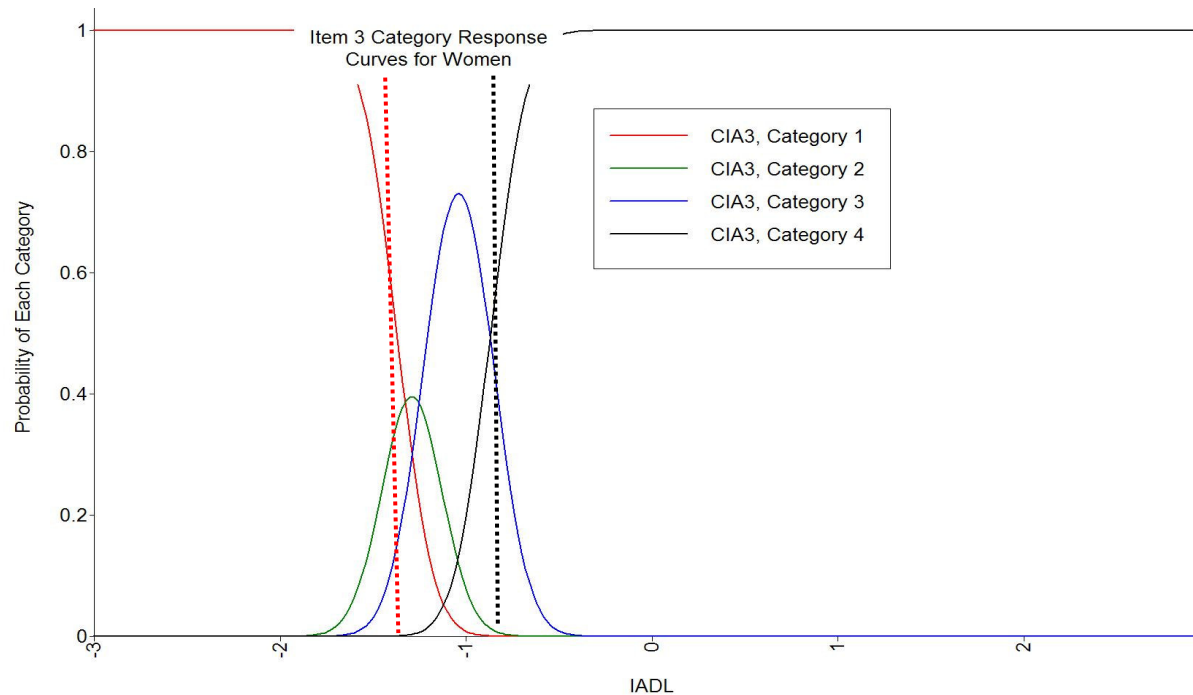
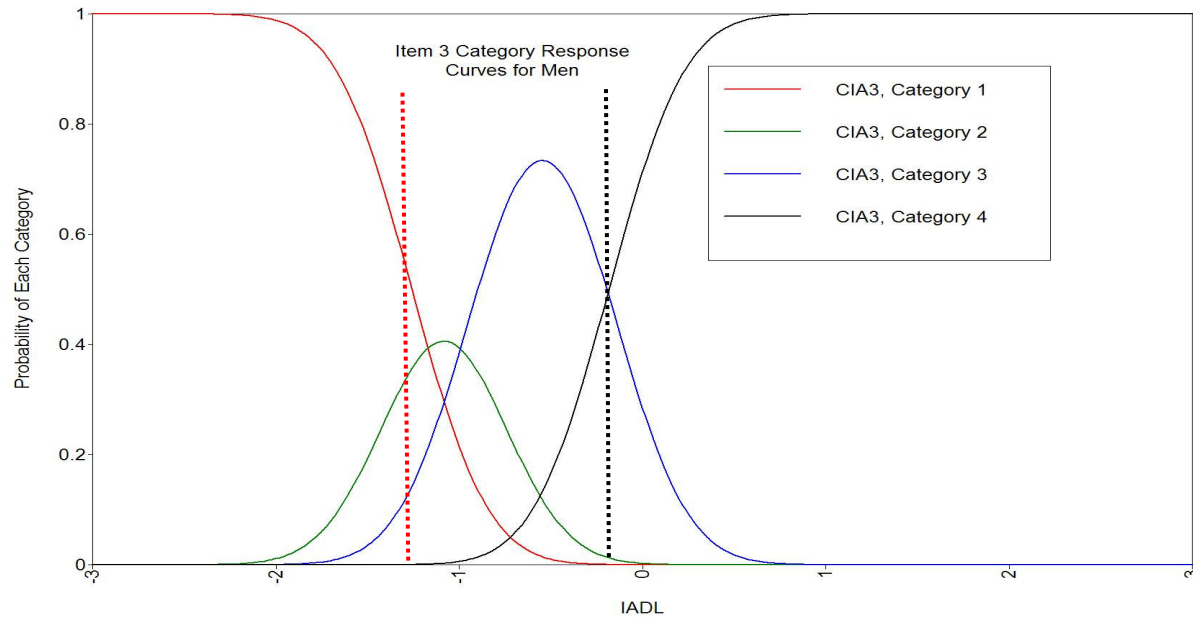
Model 4a. Partial Residual Variance Invariance Model (except for item3 and item5 and item1 and item4 between groups)
This last step proceeds backwards. Because freeing the residual variances is adding parameters, we must estimate this model first.

<pre> ANALYSIS: ESTIMATOR IS WLSMV; PARAMETERIZATION=THETA; SAVEDATA: DIFFTEST=ResidualFree.dat; ! Save free residual info !!! RESIDUAL FIXED MODEL FOR MEN REFERENCE GROUP MODEL: ! Factor loadings all estimated IADL BY cia1* (L1) cia2* (L2) cia3* (L3) cia4* (L4) cia5* (L5) cia6* (L6) cia7* (L7); ! Item thresholds all free [cia1\$1-cia7\$1]; [cia1\$2-cia7\$2]; [cia1\$3-cia7\$3]; ! Item residual variances all fixed=1 cia1-cia7@1; ! Factor mean=0 and variance=1 for identification [IADL@0]; IADL@1; !!! RESIDUAL FREE MODEL FOR WOMEN ALTERNATIVE GROUP MODEL WOMEN: ! Factor loadings all STILL HELD EQUAL IADL BY cia1* (L1) cia2* (L2) cia3* (L3) cia4* (L4) cia5* (L5) cia6* (L6) cia7* (L7); ! Item thresholds NOW HELD EQUAL EXCEPT CIA3 AND CIA5 AND CIA1 [cia3\$1 cia3\$2 cia3\$3]; [cia5\$1 cia5\$2 cia5\$3]; [cia1\$1 cia1\$2 cia1\$3]; [cia4\$1 cia4\$2 cia4\$3]; ! Item residual variances NOW FREE cia1-cia7*; ! Factor mean=FREE and variance=FREE for identification [IADL*]; IADL*; Chi-Square Test of Model Fit Value 48.884* Degrees of Freedom 21** P-Value 0.0005 </pre>	<pre> Residual Variances for MEN ALL 1.0 Residual Variances for WOMEN CIA1 2.507 1.645 1.524 0.127 CIA2 0.520 0.232 2.237 0.025 CIA3 0.264 0.128 2.057 0.040 CIA4 1.001 0.533 1.878 0.060 CIA5 0.868 0.400 2.170 0.030 CIA6 1.594 0.669 2.381 0.017 CIA7 0.709 0.188 3.765 0.000 We then re-estimate partial scalar e to compare this residual free model: ANALYSIS: ESTIMATOR IS WLSMV; PARAMETERIZATION=THETA; DIFFTEST=ResidualFree.dat; SAVEDATA: DIFFTEST=ResidualFixed.dat; ! Save for next comparison MODEL WOMEN: ! Item residual variances NOW FREE for possible items cia1* cia3* cia5* cia4*; THIS IS THE TEST OF PARTIAL SCALAR VS. PARTIAL RESIDUAL INVARIANCE Chi-Square Test for Difference Testing Value 6.993 Degrees of Freedom 3** P-Value 0.0721 ANALYSIS: ESTIMATOR IS WLSMV; PARAMETERIZATION=THETA; DIFFTEST=ResidualFree.dat; SAVEDATA: DIFFTEST=ResidualFixedB.dat; ! Save for next comparison MODEL WOMEN: ! Item residual variances NOW FREE for possible items + cia2 cia1* cia3* cia5* cia4* cia2*; Chi-Square Test for Difference Testing Value 4.310 Degrees of Freedom 2** P-Value 0.1159 We now test structural invariance of factor variance...is this equal to 1? Variances IADL 0.588 0.182 3.229 0.001 </pre>
<pre> ANALYSIS: ESTIMATOR IS WLSMV; PARAMETERIZATION=THETA; DIFFTEST=ResidualFixedB.dat; MODEL WOMEN: ! Factor variance now fixed to 1 IADL@1; </pre>	<pre> THIS IS THE STRUCTURAL TEST OF FACTOR VARIANCE INVARIANCE Chi-Square Test for Difference Testing Value 3.125 Degrees of Freedom 1** P-Value 0.0771 Sort of </pre>

Final Model: Partial Measurement Invariance, No Structural Invariance

UNSTANDARDIZED MODEL RESULTS (IFA MODEL SOLUTION)					UNSTANDARDIZED MODEL RESULTS (IFA MODEL SOLUTION)							
	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value		Estimate	S.E.	Est./S.E.	Two-Tailed P-Value			
Group MEN					Group WOMEN							
FACTOR LOADINGS: CHANGE IN PROBIT FOR 1-UNIT CHANGE IN THETA					FACTOR LOADINGS: CHANGE IN PROBIT FOR 1-UNIT CHANGE IN THETA							
IADL	BY				IADL	BY						
CIA1		6.155	1.692	3.637	0.000	CIA1		6.155	1.692	3.637	0.000	
CIA2		3.120	0.512	6.089	0.000	CIA2		3.120	0.512	6.089	0.000	
CIA3		3.075	0.438	7.015	0.000	CIA3		3.075	0.438	7.015	0.000	
CIA4		4.329	0.930	4.655	0.000	CIA4		4.329	0.930	4.655	0.000	
CIA5		2.580	0.375	6.876	0.000	CIA5		2.580	0.375	6.876	0.000	
CIA6		2.372	0.322	7.364	0.000	CIA6		2.372	0.322	7.364	0.000	
CIA7		1.291	0.206	6.265	0.000	CIA7		1.291	0.206	6.265	0.000	
Means: MEAN OF THETA					Means: MEAN DIFFERENCE OF THETA IN WOMEN							
IADL		0.000	0.000	999.000	999.000	IADL		-0.220	0.137	-1.605	0.109	
Thresholds: NEGATIVE OF EXPECTED PROBIT WHEN THETA=0					Thresholds: NEGATIVE OF EXPECTED PROBIT WHEN THETA=0							
CIA1\$1		-7.795	2.108	-3.698	0.000	CIA1\$1		-8.372	2.407	-3.479	0.001	housework
CIA1\$2		-5.370	1.546	-3.473	0.001	CIA1\$2		-6.392	1.841	-3.471	0.001	
CIA1\$3		-0.864	0.703	-1.229	0.219	CIA1\$3		-2.437	0.959	-2.540	0.011	
CIA2\$1		-4.464	0.635	-7.028	0.000	CIA2\$1		-4.464	0.635	-7.028	0.000	
CIA2\$2		-3.799	0.561	-6.770	0.000	CIA2\$2		-3.799	0.561	-6.770	0.000	
CIA2\$3		-2.549	0.457	-5.583	0.000	CIA2\$3		-2.549	0.457	-5.583	0.000	
CIA3\$1		-3.865	0.479	-8.065	0.000	CIA3\$1		-4.157	0.553	-7.516	0.000	cooking
CIA3\$2		-2.799	0.447	-6.256	0.000	CIA3\$2		-3.644	0.496	-7.350	0.000	
CIA3\$3		-0.561	0.324	-1.734	0.083	CIA3\$3		-2.552	0.403	-6.338	0.000	
CIA4\$1		-5.414	1.035	-5.229	0.000	CIA4\$1		-5.485	1.163	-4.716	0.000	shopping
CIA4\$2		-4.374	0.842	-5.192	0.000	CIA4\$2		-3.789	0.805	-4.706	0.000	
CIA4\$3		-2.270	0.613	-3.704	0.000	CIA4\$3		-1.640	0.557	-2.944	0.003	
CIA5\$1		-4.617	0.574	-8.037	0.000	CIA5\$1		-3.937	0.630	-6.247	0.000	getting
CIA5\$2		-2.624	0.376	-6.984	0.000	CIA5\$2		-2.085	0.356	-5.859	0.000	around
CIA5\$3		-1.192	0.300	-3.971	0.000	CIA5\$3		-0.674	0.337	-1.999	0.046	
CIA6\$1		-3.915	0.382	-10.251	0.000	CIA6\$1		-3.915	0.382	-10.251	0.000	
CIA6\$2		-2.783	0.353	-7.885	0.000	CIA6\$2		-2.783	0.353	-7.885	0.000	
CIA6\$3		-1.802	0.336	-5.359	0.000	CIA6\$3		-1.802	0.336	-5.359	0.000	
CIA7\$1		-3.509	0.314	-11.185	0.000	CIA7\$1		-3.509	0.314	-11.185	0.000	
CIA7\$2		-2.794	0.256	-10.919	0.000	CIA7\$2		-2.794	0.256	-10.919	0.000	
CIA7\$3		-1.965	0.217	-9.046	0.000	CIA7\$3		-1.965	0.217	-9.046	0.000	
Variances: VARIANCE OF THETA					Variances: VARIANCE OF THETA							
IADL		1.000	0.000	999.000	999.000	IADL		0.588	0.182	3.229	0.001	
Residual Variances (ALL FIXED=1)					Residual Variances (NOT ALL FIXED=1)							
CIA1		1.000	0.000	999.000	999.000	CIA1		2.346	1.527	1.536	0.125	
CIA2		1.000	0.000	999.000	999.000	CIA2		0.479	0.196	2.445	0.014	
CIA3		1.000	0.000	999.000	999.000	CIA3		0.244	0.112	2.177	0.029	
CIA4		1.000	0.000	999.000	999.000	CIA4		1.030	0.560	1.841	0.066	
CIA5		1.000	0.000	999.000	999.000	CIA5		0.814	0.351	2.318	0.020	
CIA6		1.000	0.000	999.000	999.000	CIA6		1.000	0.000	999.000	999.000	
CIA7		1.000	0.000	999.000	999.000	CIA7		1.000	0.000	999.000	999.000	

Item 3 Category Response Curves for Men (top) and Women (bottom)



Women require less theta to still be cooking...

Men:

0 vs 123 threshold = -3.865 → b= -1.257

01 vs 23 threshold = -2.799 → b= -0.910

012 vs 3 threshold = -0.561 → b= -0.182

Women:

0 vs 123 threshold = -4.157 → b= -1.476

01 vs 23 threshold = -3.644 → b= -1.259

012 vs 3 threshold = -2.552 → b= -0.795

After correcting for differences in group variances, the cooking item 3 is actually less discriminating in women.