Binary IFA-IRT Models in Mplus version 8.1

Example data: 635 older adults (age 80-100) self-reporting on 7 items assessing the Instrumental Activities of Daily Living (IADL) as follows:

 Housework (cleaning and laundry): 1=64% Bedmaking: 1=84% 	Two versions of a response format were available:
3. Cooking: 1=77% 4. Everyday shopping: 1=66%	Binary $\rightarrow 0$ = "needs help", 1 = "does not need help" Categorical $\rightarrow 0$ = "can't do it", 1="big problems", 2="some problems", 3="no problems"
 5. Getting to places outside of walking distance: 1=65% 6. Handling banking and other business: 1=73% 7. Using the telephone 1=94% 	Higher scores indicate greater function. We will look at each response format in turn.

Binary 2-PL Model Syntax (left) and 1-PL Model Syntax (right) using ML and a logit scale:

TITLE: Assess binary IADL items using 2PL	TITLE: Assess binary IADL items using 1PL
DATA: FILE IS ADL.dat;	DATA: FILE IS ADL.dat;
VARIABLE: NAMES ARE case dial-dia7 cial-cia7;	VARIABLE: NAMES ARE case dial-dia7 cial-cia7;
USEVARIABLES ARE dial-dia7;	USEVARIABLES ARE dial-dia7;
CATEGORICAL ARE dial-dia7;	CATEGORICAL ARE dial-dia7;
MISSING ARE .;	MISSING ARE .;
IDVARIABLE IS case;	IDVARIABLE IS case;
ANALYSIS: ESTIMATOR IS ML;	ANALYSIS: ESTIMATOR IS ML;
LINK IS LOGIT;	LINK IS LOGIT;
<pre>MODEL: Factor loadings all estimated in 2PL IADL BY dial-dia7*; Item thresholds all estimated [dial\$1-dia7\$1*]; Factor mean=0 and variance=1 for identification [IADL@0]; IADL@1;</pre>	<pre>MODEL: Factor loadings all held equal in 1PL IADL BY dial-dia7* (loading); Item thresholds all estimated [dial\$1-dia7\$1*]; Factor mean=0 and variance=1 for identification [IADL@0]; IADL@1;</pre>
OUTPUT: STDYX; ! Standardized solution	OUTPUT: STDYX; ! Standardized solution
RESIDUAL TECH10; ! Local fit info	RESIDUAL TECH10; ! Local fit info
SAVEDATA: SAVE = FSCORES; ! Save factor scores (thetas)	SAVEDATA: SAVE = FSCORES; ! Save factor scores (thetas)
FILE = IADL_2PLThetas.dat; ! File factor scores saved to	FILE = IADL_1PLThetas.dat; ! File factor scores saved to
PLOT: TYPE IS PLOT1; ! PLOT1 gets you sample descriptives	PLOT: TYPE IS PLOT1; ! PLOT1 gets you sample descriptives
TYPE IS PLOT2; ! PLOT2 gets you the IRT-relevant curves	TYPE IS PLOT2; ! PLOT2 gets you the IRT-relevant curves
TYPE IS PLOT3; ! PLOT3 gets you descriptives for theta	TYPE IS PLOT3; ! PLOT3 gets you descriptives for theta

Binary 2-PL Model Fit (left) and 1-PL Model Fit (right) using ML logit:

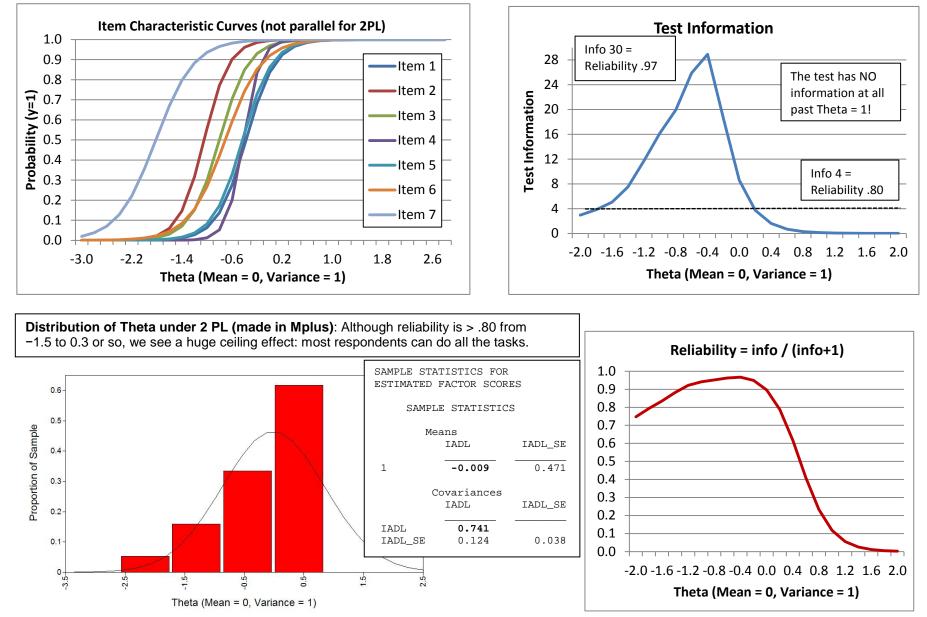
MODEL FIT INFORMATION - 2PL	MODEL FIT INFORMATION - 1 PL
Number of Free Parameters 14	Number of Free Parameters 8
Loglikelihood	Loglikelihood
H0 Value -1454.634	H0 Value -1464.457
Information Criteria	Information Criteria
Akaike (AIC) 2937.268 Bayesian (BIC) 2999.619 Sample-Size Adjusted BIC 2955.170 (n* = (n + 2) / 24)	Akaike (AIC) 2944.915 Bayesian (BIC) 2980.544 Sample-Size Adjusted BIC 2955.144 (n* = (n + 2) / 24)
Chi-Square Test of Model Fit for the Binary and Ordered Catego: (Ordinal) Outcomes	Chi-Square Test of Model Fit for the Binary and Ordered Categorical (Ordinal) Outcomes**
Pearson Chi-Square	Pearson Chi-Square
Value 340.829 Degrees of Freedom 113 P-Value 0.0000	Value296.199Degrees of Freedom118P-Value0.0000
Likelihood Ratio Chi-Square	Likelihood Ratio Chi-Square
Value120.273Degrees of Freedom113P-Value0.3023	Value126.354Degrees of Freedom118P-Value0.2828
Linda Muthén suggests that if these 2 χ^2 values don't match, t should not be used to assess model fit.	they ** Of the 630 cells in the latent class indicator table, 1 were deleted in the calculation of chi-square due to extreme values.
Further, the possible total df for the χ^2 is calculated based on possible response patterns. Here, for 7 binary items: 2PL model: $2^7 = 128$ possible – 7 loadings – 7 thresholds – 1 1PL model: $2^7 = 128$ possible – 1 loading – 7 thresholds – 1	on the same data. So we can't compare the chi-squares to test the difference in model fit, but we can still compare LL values.
However, the 1PL only has df=118 because of the deleted cell	41.

Does the 2-PL fit better than the 1-PL?

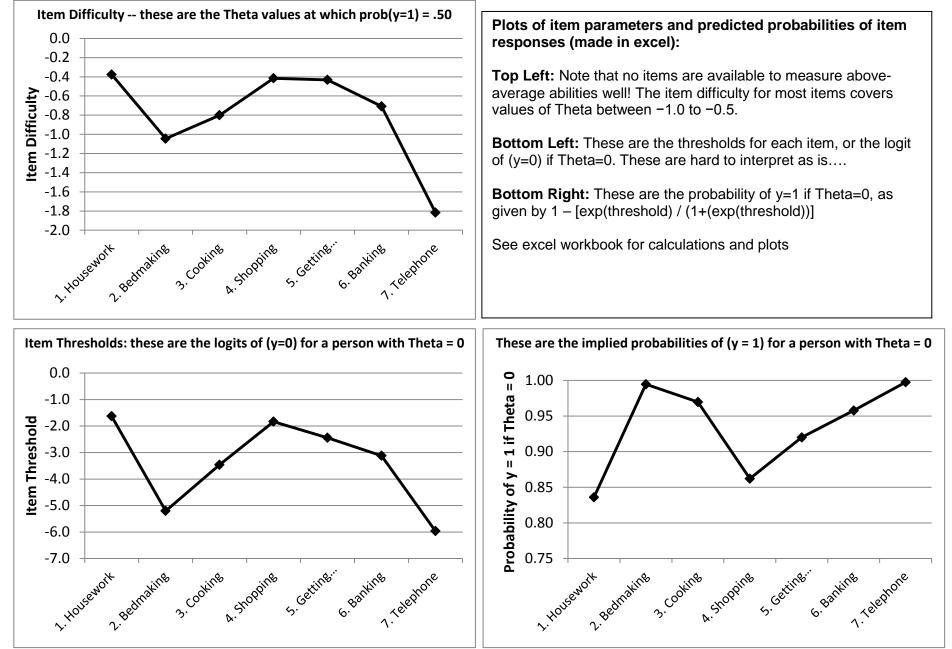
 $\begin{array}{ll} -1454.634^{*}\text{-}2 = 2909.258 \\ -1464.457^{*}\text{-}2 = 2928.914 \end{array} \begin{array}{ll} -2LL \ \text{difference} = 19.946, \ \text{df} = 6, \ \text{p} = .0032 \\ \text{AIC} \ (\text{but not BIC}) \ \text{is smaller for 2PL, too} \end{array}$

3 differently scaled 2-PL solutions from ML logit provided by Mplus – all provide the exact same model predictions!

			Tv	vo-Tailed	WHERE THE LOG	IT IS DISCRI	MINATION	J*(THETA -	DIFFICULTY)
	Estimate	S.E.	Est./S.E.	P-Value					,
	S = CHANGE IN LOG				Item Discrimina	tions = SLOPE C	F ICC AT F	P=.50	
ADL BY	5 = CHANGE IN LOG	HI(I=I) PE	R UNII CHANG	SE IN INEIA	IADL BY				
	1 200	0 5 6 0		0 000	DIA1	4.328	0.560	7.725	0.000
DIA1	4.328	0.560	7.725	0.000	DIA2	4.978	0.808	6.159	0.000
DIA2	4.978	0.808	6.159	0.000	DIA3	4.323	0.570	7.579	0.000
DIA3	4.323	0.570	7.579	0.000	DIA4	7.511	1.696	4.429	0.000
DIA4	7.511	1.696	4.429	0.000	DIAS	4.248	0.527	8.062	0.000
DIA5	4.248	0.527	8.062	0.000	DIAG	3.451	0.401	8.6002	0.000
DIA6	3.451	0.401	8.600	0.000					
DIA7	3.283	0.601	5.467	0.000	DIA7	3.283	0.601	5.467	0.000
					Item Difficulti	es = LOCATION C	F ITEM ON	LATENT TRAI	T at P=.50, LOGI
	XPECTED LOGIT(Y=0	•			DIA1\$1	-0.376	0.052	-7.298	0.000
DIA1\$1	-1.629	0.295	-5.516	0.000	DIA2\$1	-1.045	0.065	-15.978	0.000
DIA2\$1	-5.202	0.770	-6.754	0.000	DIA3\$1	-0.801	0.059	-13.562	0.000
DIA3\$1	-3.462	0.441	-7.842	0.000	DIA4\$1	-0.415	0.047	-8.849	0.000
DIA4\$1	-3.120	0.744	-4.193	0.000	DIA431 DIA5\$1	-0.432	0.047	-8.296	0.000
DIA5\$1	-1.833	0.298	-6.158	0.000					
DIA6\$1	-2.442	0.292	-8.368	0.000	DIA6\$1	-0.708	0.060	-11.889	0.000
DIA7\$1	-5.962	0.858	-6.951	0.000	DIA7\$1	-1.816	0.126	-14.454	0.000
	Estimate S IN STANDARDIZED		Est./S.E. loading*SD(P-Value Theta)/SD(Y)	IFA model: Logit Threshold = expe When *-1, thresh	ected logit of (y=0) for s	someone with	
IADL BY DIA1 DIA2 DIA3 DIA4	S IN STANDARDIZED 0.922 0.940 0.922 0.972	<pre>0 METRIC =</pre>	loading*SD(51.712 52.557 50.622 80.380	Theta)/SD(Y) 0.000 0.000 0.000 0.000	Threshold = expe When *-1, thresh Loading = regres	ected logit of (hold becomes int	y=0) for s ercept: ex ogit on The	someone with spected logi	t for (y=1) inst
IADL BY DIA1 DIA2 DIA3 DIA4 DIA5	S IN STANDARDIZED 0.922 0.940 0.922 0.972 0.920	0 METRIC = 0.018 0.018 0.018 0.012 0.018	loading*SD(51.712 52.557 50.622 80.380 52.291	Theta)/SD(Y) 0.000 0.000 0.000 0.000 0.000 0.000	Threshold = expe When *-1, thresh Loading = regres = change	ected logit of (wold becomes int ssion of item lo	y=0) for s ercept: ex ogit on The	someone with spected logi	t for (y=1) inst
IADL BY DIA1 DIA2 DIA3 DIA4 DIA5 DIA6	S IN STANDARDIZED 0.922 0.940 0.922 0.922 0.972 0.920 0.885	0 METRIC = 0.018 0.018 0.018 0.012 0.018 0.022	loading*SD(51.712 52.557 50.622 80.380 52.291 39.729	Theta)/SD(Y) 0.000 0.000 0.000 0.000 0.000 0.000 0.000	Threshold = expe When *-1, thresh Loading = regres = change IFA Models:	ected logit of (wold becomes int sion of item lo in logit(y) fo	y=0) for s ercept: ex ogit on The or a one-ur	someone with spected logi eta hit change i	t for (y=1) inst n Theta
EADL BY DIA1 DIA2 DIA3 DIA4 DIA5	S IN STANDARDIZED 0.922 0.940 0.922 0.972 0.920	0 METRIC = 0.018 0.018 0.018 0.012 0.018	loading*SD(51.712 52.557 50.622 80.380 52.291	Theta)/SD(Y) 0.000 0.000 0.000 0.000 0.000 0.000	Threshold = expe When *-1, thresh Loading = regres = change	cted logit of (old becomes int sion of item lo in logit(y) fo 1.629 + 4.328(y=0) for s ercept: ex ogit on The or a one-ur Theta) →	if Theta=0,	t for (y=1) inst n Theta , prob(y=1)= .83
ADL BY DIA1 DIA2 DIA3 DIA4 DIA5 DIA6 DIA7	S IN STANDARDIZED 0.922 0.940 0.922 0.922 0.972 0.920 0.885	0 METRIC = 0.018 0.018 0.018 0.012 0.018 0.022 0.037	51.712 52.557 50.622 80.380 52.291 39.729 23.380	Theta)/SD(Y) 0.000 0.000 0.000 0.000 0.000 0.000 0.000	Threshold = expe When *-1, thresh Loading = regres = change <u>IFA Models:</u> Logit (DIA1=1) =	cted logit of (old becomes int sion of item lo in logit(y) fo 1.629 + 4.328(y=0) for s ercept: ex ogit on The or a one-ur Theta) →	if Theta=0,	t for (y=1) inst n Theta , prob(y=1)= .83
ADL BY DIA1 DIA2 DIA3 DIA4 DIA5 DIA6 DIA7	S IN STANDARDIZED 0.922 0.940 0.922 0.972 0.972 0.920 0.885 0.875	0 METRIC = 0.018 0.018 0.018 0.012 0.018 0.022 0.037	51.712 52.557 50.622 80.380 52.291 39.729 23.380	Theta)/SD(Y) 0.000 0.000 0.000 0.000 0.000 0.000 0.000	Threshold = expe When *-1, thresh Loading = regres = change <u>IFA Models:</u> Logit (DIA1=1) =	cted logit of (old becomes int sion of item lo in logit(y) fo 1.629 + 4.328(y=0) for s ercept: ex ogit on The or a one-ur Theta) →	if Theta=0,	t for (y=1) inst n Theta , prob(y=1)= .83
TADL BY DIA1 DIA2 DIA3 DIA4 DIA5 DIA6 DIA7 THRESHOLDS IN	S IN STANDARDIZED 0.922 0.940 0.922 0.972 0.920 0.885 0.875 STANDARDIZED METR	0 METRIC = 0.018 0.018 0.012 0.012 0.018 0.022 0.037 PIC = thres	loading*SD(51.712 52.557 50.622 80.380 52.291 39.729 23.380 hold/SD(Y)	<pre>fheta)/SD(Y) 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000</pre>	Threshold = expe When *-1, thresh Loading = regres = change <u>IFA Models:</u> Logit (DIA1=1) =	cted logit of (old becomes int sion of item lo in logit(y) fo 1.629 + 4.328(y=0) for s ercept: ex ogit on The or a one-ur Theta) →	if Theta=0,	t for (y=1) inst n Theta , prob(y=1)= .83
TADL BY DIA1 DIA2 DIA3 DIA4 DIA5 DIA6 DIA7 THRESHOLDS IN DIA1\$1 DIA2\$1	S IN STANDARDIZED 0.922 0.940 0.922 0.972 0.920 0.885 0.875 STANDARDIZED METR -0.347	<pre>0 METRIC =</pre>	loading*SD(51.712 52.557 50.622 80.380 52.291 39.729 23.380 hold/SD(Y) -7.303	<pre>fheta)/SD(Y) 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000</pre>	Threshold = expe When *-1, thresh Loading = regres = change <u>IFA Models:</u> Logit (DIA1=1) = Logit (DIA7=1) =	cted logit of (nold becomes int sion of item lo in logit(y) fo 1.629 + 4.328(5.962 + 3.283(y=0) for s ercept: ex ogit on The r a one-un Theta) → Theta) →	if Theta=0,	t for (y=1) inst n Theta , prob(y=1)= .83 , prob(y=1)= .99
IADL BY DIA1 DIA2 DIA3 DIA4 DIA5 DIA6 DIA7 THRESHOLDS IN DIA1\$1 DIA2\$1 DIA3\$1	S IN STANDARDIZED 0.922 0.940 0.922 0.972 0.920 0.885 0.875 STANDARDIZED METR -0.347 -0.982 -0.739	<pre>0 METRIC =</pre>	loading*SD(51.712 52.557 50.622 80.380 52.291 39.729 23.380 hold/SD(Y) -7.303 -17.409 -14.373	<pre>Fheta)/SD(Y) 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000</pre>	Threshold = expe When *-1, thresh Loading = regres = change <u>IFA Models:</u> Logit (DIA1=1) =	cted logit of (nold becomes int sion of item lo in logit(y) fo 1.629 + 4.328(5.962 + 3.283(y=0) for s ercept: ex ogit on The r a one-un Theta) → Theta) →	if Theta=0,	t for (y=1) inst n Theta , prob(y=1)= .83 , prob(y=1)= .99
EADL BY DIA1 DIA2 DIA3 DIA4 DIA5 DIA6 DIA7 CHRESHOLDS IN DIA1\$1 DIA2\$1 DIA3\$1 DIA4\$1	S IN STANDARDIZED 0.922 0.940 0.922 0.972 0.920 0.885 0.875 STANDARDIZED METR -0.347 -0.982 -0.739 -0.404	<pre>0 METRIC = 0.018 0.018 0.012 0.018 0.022 0.037 CIC = thres 0.048 0.056 0.051 0.045</pre>	loading*SD(51.712 52.557 50.622 80.380 52.291 39.729 23.380 hold/SD(Y) -7.303 -17.409 -14.373 -8.928	<pre>Fheta)/SD(Y) 0.000</pre>	Threshold = expe When *-1, thresh Loading = regres = change <u>IFA Models:</u> Logit (DIA1=1) = Logit (DIA7=1) = USING RESULTS	<pre>cted logit of (nold becomes int ssion of item lo in logit(y) fo = 1.629 + 4.328(= 5.962 + 3.283(S FROM IRT MO</pre>	y=0) for s ercept: ex ogit on The r a one-ur Theta) → Theta) →	someone with spected logi eta hit change in if Theta=0, if Theta=0, EHT PANEL)	t for (y=1) inst n Theta , prob(y=1)= .83 , prob(y=1)= .99
IADL BY DIA1 DIA2 DIA3 DIA4 DIA5 DIA6 DIA7 THRESHOLDS IN DIA1\$1 DIA2\$1 DIA3\$1 DIA4\$1 DIA5\$1	S IN STANDARDIZED 0.922 0.940 0.922 0.972 0.920 0.885 0.875 STANDARDIZED METH -0.347 -0.982 -0.739 -0.404 -0.397	<pre>0 METRIC =</pre>	loading*SD(51.712 52.557 50.622 80.380 52.291 39.729 23.380 hold/SD(Y) -7.303 -17.409 -14.373 -8.928 -8.348	<pre>Fheta)/SD(Y) 0.000</pre>	Threshold = expe When *-1, thresh Loading = regres = change <u>IFA Models:</u> Logit (DIA1=1) = Logit (DIA7=1) = USING RESULTS IRT model: Logit	<pre>cted logit of (nold becomes int ssion of item lo in logit(y) fo : 1.629 + 4.328(: 5.962 + 3.283(G FROM IRT MC :(y=1) = a(theta)</pre>	y=0) for s ercept: ex ogit on The or a one-ur Theta) → Theta) → ODEL (RIC a - difficu	Someone with spected logi eta it change i: if Theta=0, if Theta=0, SHT PANEL) alty)	t for (y=1) inst n Theta , prob(y=1)= .83 , prob(y=1)= .99
ADL BY DIA1 DIA2 DIA3 DIA4 DIA5 DIA6 DIA7 PHRESHOLDS IN DIA1\$1 DIA2\$1 DIA3\$1 DIA4\$1 DIA5\$1 DIA5\$1 DIA6\$1	S IN STANDARDIZED 0.922 0.940 0.922 0.972 0.920 0.885 0.875 STANDARDIZED METR -0.347 -0.982 -0.739 -0.404 -0.397 -0.626	<pre>0 METRIC = 0.018 0.018 0.012 0.018 0.022 0.037 CIC = thres 0.048 0.056 0.051 0.045 0.048 0.050</pre>	loading*SD(2 51.712 52.557 50.622 80.380 52.291 39.729 23.380 hold/SD(Y) -7.303 -17.409 -14.373 -8.928 -8.348 -12.558	<pre>Fheta)/SD(Y) 0.000</pre>	Threshold = expe When *-1, thresh Loading = regres = change <u>IFA Models:</u> Logit (DIA1=1) = Logit (DIA7=1) = USING RESULTS <u>IRT model: Logit</u> a = discriminati	<pre>cted logit of (nold becomes int ssion of item lo in logit(y) fo : 1.629 + 4.328(: 5.962 + 3.283(G FROM IRT MC :(y=1) = a(theta on (rescaled sl</pre>	y=0) for s ercept: ex ogit on The or a one-un Theta) → Theta) → ODEL (RIC <u>a - difficu</u> ope) = loa	Someone with spected logi eta it change i: if Theta=0, if Theta=0, SHT PANEL) alty) ading/1.7	t for (y=1) inst n Theta , prob(y=1)= .83 , prob(y=1)= .99
ADL BY DIA1 DIA2 DIA3 DIA4 DIA5 DIA6 DIA7 HRESHOLDS I DIA1\$1 DIA2\$1 DIA3\$1 DIA3\$1 DIA4\$1 DIA5\$1	S IN STANDARDIZED 0.922 0.940 0.922 0.972 0.920 0.885 0.875 STANDARDIZED METH -0.347 -0.982 -0.739 -0.404 -0.397	<pre>0 METRIC =</pre>	loading*SD(51.712 52.557 50.622 80.380 52.291 39.729 23.380 hold/SD(Y) -7.303 -17.409 -14.373 -8.928 -8.348	<pre>Fheta)/SD(Y) 0.000</pre>	Threshold = expe When *-1, thresh Loading = regres = change <u>IFA Models:</u> Logit (DIA1=1) = Logit (DIA7=1) = USING RESULTS IRT model: Logit	<pre>cted logit of (nold becomes int ssion of item lo in logit(y) fo : 1.629 + 4.328(: 5.962 + 3.283(G FROM IRT MC :(y=1) = a(theta on (rescaled sl</pre>	y=0) for s ercept: ex ogit on The or a one-un Theta) → Theta) → ODEL (RIC <u>a - difficu</u> ope) = loa	Someone with spected logi eta it change i: if Theta=0, if Theta=0, SHT PANEL) alty) ading/1.7	t for (y=1) inst n Theta , prob(y=1)= .83 , prob(y=1)= .99
ADL BY DIA1 DIA2 DIA3 DIA4 DIA5 DIA6 DIA7 PHRESHOLDS IN DIA1\$1 DIA2\$1 DIA3\$1 DIA4\$1 DIA4\$1 DIA5\$1 DIA6\$1 DIA7\$1 PHAESHOLDS IN PHAESHOLDS I	S IN STANDARDIZED 0.922 0.940 0.922 0.972 0.920 0.885 0.875 STANDARDIZED METH -0.347 -0.982 -0.739 -0.404 -0.397 -0.626 -1.590 mdardized loading	<pre>0 METRIC = 0.018 0.018 0.012 0.018 0.022 0.037 Provide the set 0.048 0.056 0.051 0.045 0.048 0.050 0.080</pre>	<pre>bading*SD(2 51.712 52.557 50.622 80.380 52.291 39.729 23.380 bold/SD(Y) -7.303 -17.409 -14.373 -8.928 -8.348 -12.558 -19.949</pre>	<pre>Fheta)/SD(Y) 0.000</pre>	Threshold = expe When *-1, thresh Loading = regres = change <u>IFA Models:</u> Logit (DIA1=1) = Logit (DIA7=1) = USING RESULTS <u>IRT model: Logit</u> a = discriminati	<pre>cted logit of (nold becomes int ssion of item lo in logit(y) fo : 1.629 + 4.328(: 5.962 + 3.283(G FROM IRT MC :(y=1) = a(theta on (rescaled sl</pre>	y=0) for s ercept: ex ogit on The or a one-un Theta) → Theta) → ODEL (RIC <u>a - difficu</u> ope) = loa	Someone with spected logi eta it change i: if Theta=0, if Theta=0, SHT PANEL) alty) ading/1.7	t for (y=1) inst n Theta , prob(y=1)= .83 , prob(y=1)= .99
ADL BY DIA1 DIA2 DIA3 DIA4 DIA5 DIA6 DIA7 HRESHOLDS IN DIA1\$1 DIA2\$1 DIA3\$1 DIA4\$1 DIA4\$1 DIA5\$1	S IN STANDARDIZED 0.922 0.940 0.922 0.972 0.920 0.885 0.875 STANDARDIZED METH -0.347 -0.982 -0.739 -0.404 -0.397 -0.626 -1.590 mdardized loading 0.851	<pre>0 METRIC = 0.018 0.018 0.012 0.018 0.022 0.037 PIC = thres 0.048 0.056 0.051 0.045 0.048 0.050 0.080</pre>	<pre>10ading*SD(2 51.712 52.557 50.622 80.380 52.291 39.729 23.380 hold/SD(Y) -7.303 -17.409 -14.373 -8.928 -8.348 -12.558 -19.949 25.856</pre>	<pre>fheta)/SD(Y) 0.000</pre>	Threshold = expe When *-1, thresh Loading = regres = change <u>IFA Models:</u> Logit (DIA1=1) = Logit (DIA7=1) = USING RESULTS <u>IRT model: Logit</u> a = discriminati	<pre>cted logit of (nold becomes int ssion of item lo in logit(y) fo : 1.629 + 4.328(: 5.962 + 3.283(G FROM IRT MC :(y=1) = a(theta on (rescaled sl</pre>	y=0) for s ercept: ex ogit on The or a one-un Theta) → Theta) → ODEL (RIC <u>a - difficu</u> ope) = loa	Someone with spected logi eta it change i: if Theta=0, if Theta=0, SHT PANEL) alty) ading/1.7	t for (y=1) inst n Theta , prob(y=1)= .83 , prob(y=1)= .99
ADL BY DIA1 DIA2 DIA3 DIA4 DIA5 DIA6 DIA7 PHRESHOLDS IN DIA1\$1 DIA2\$1 DIA3\$1 DIA4\$1 DIA4\$1 DIA5\$1 DIA6\$1 DIA7\$1 PHRESUQARE = STAX	S IN STANDARDIZED 0.922 0.940 0.922 0.972 0.920 0.885 0.875 STANDARDIZED METH -0.347 -0.982 -0.739 -0.404 -0.397 -0.626 -1.590 mdardized loading	<pre>0 METRIC = 0.018 0.018 0.012 0.018 0.022 0.037 Provide the set 0.048 0.056 0.051 0.045 0.048 0.050 0.080</pre>	<pre>bading*SD(2 51.712 52.557 50.622 80.380 52.291 39.729 23.380 bold/SD(Y) -7.303 -17.409 -14.373 -8.928 -8.348 -12.558 -19.949</pre>	<pre>Fheta)/SD(Y) 0.000</pre>	Threshold = expe When *-1, thresh Loading = regres = change <u>IFA Models:</u> Logit (DIA1=1) = Logit (DIA7=1) = USING RESULTS <u>IRT model: Logit</u> a = discriminati b = difficulty (teted logit of (nold becomes int sion of item lo in logit(y) fo 1.629 + 4.328(5.962 + 3.283(5 FROM IRT MC $\frac{1}{2}(y=1) = a(theta)$ non (rescaled sl location on lat	y=0) for s ercept: ex ogit on The r a one-un Theta) → Theta) → DDEL (RIC <u>a - difficu</u> ope) = loa ent metric	Someone with spected logi ata if change i: if Theta=0, if Theta=0, SHT PANEL) alty) ading/1.7 c) = thresho	t for (y=1) inst n Theta , prob(y=1)= .83 , prob(y=1)= .99 : ld/loading
ADL BY DIA1 DIA2 DIA3 DIA4 DIA5 DIA6 DIA7 PHRESHOLDS IN DIA1\$1 DIA2\$1 DIA2\$1 DIA3\$1 DIA4\$1 DIA5\$1 DIA5\$1 DIA6\$1 DIA7\$1 PHRESHOLDS IN PHRESHOLDS IN PHRE	S IN STANDARDIZED 0.922 0.940 0.922 0.972 0.920 0.885 0.875 STANDARDIZED METH -0.347 -0.982 -0.739 -0.404 -0.397 -0.626 -1.590 mdardized loading 0.851	<pre>0 METRIC = 0.018 0.018 0.012 0.018 0.022 0.037 PIC = thres 0.048 0.056 0.051 0.045 0.048 0.050 0.080</pre>	<pre>10ading*SD(2 51.712 52.557 50.622 80.380 52.291 39.729 23.380 hold/SD(Y) -7.303 -17.409 -14.373 -8.928 -8.348 -12.558 -19.949 25.856</pre>	<pre>fheta)/SD(Y) 0.000</pre>	Threshold = expe When *-1, thresh Loading = regres = change IFA Models: Logit (DIA1=1) = Logit (DIA7=1) = USING RESULTS IRT model: Logit a = discriminati b = difficulty (IRT Models: Logit (DIA1=1) =	teted logit of (nold becomes int sion of item lo in logit(y) fo 1.629 + 4.328(5.962 + 3.283(FROM IRT MC $\frac{(y=1) = a(theta)}{10cation on lat}$ + 4.328*(Theta -	y=0) for s ercept: ex ogit on The r a one-un Theta) → Theta) → DDEL (RIC <u>a - difficu</u> ope) = loa ent metric	Someone with spected logi ata if change i: if Theta=0, if Theta=0, SHT PANEL) alty) ding/1.7 c) = thresho if Theta=0,	<pre>t for (y=1) inst n Theta , prob(y=1)= .83 , prob(y=1)= .99 : ld/loading , prob(y=1)= .83</pre>
EADL BY DIA1 DIA2 DIA3 DIA4 DIA5 DIA6 DIA6 DIA7 CHRESHOLDS IN DIA1\$1 DIA2\$1 DIA3\$1 DIA4\$1 DIA5\$1 DIA6\$1 DIA7\$1 State	S IN STANDARDIZED 0.922 0.940 0.922 0.972 0.920 0.885 0.875 STANDARDIZED METR -0.347 -0.982 -0.739 -0.404 -0.397 -0.626 -1.590 mdardized loading 0.851 0.883	<pre>0 METRIC = 0.018 0.018 0.012 0.018 0.022 0.037 CIC = thres 0.048 0.056 0.051 0.045 0.048 0.050 0.080</pre>	<pre>10ading*SD(2 51.712 52.557 50.622 80.380 52.291 39.729 23.380 hold/SD(Y) -7.303 -17.409 -14.373 -8.928 -8.348 -12.558 -19.949 25.856 26.278</pre>	<pre>fheta)/SD(Y) 0.000</pre>	Threshold = expe When *-1, thresh Loading = regres = change IFA Models: Logit (DIA1=1) = Logit (DIA7=1) = USING RESULTS IRT model: Logit a = discriminati b = difficulty (IRT Models:	teted logit of (nold becomes int sion of item lo in logit(y) fo 1.629 + 4.328(5.962 + 3.283(FROM IRT MC $\frac{(y=1) = a(theta)}{10cation on lat}$ + 4.328*(Theta -	y=0) for s ercept: ex ogit on The r a one-un Theta) → Theta) → DDEL (RIC <u>a - difficu</u> ope) = loa ent metric	Someone with spected logi ata if change i: if Theta=0, if Theta=0, SHT PANEL) alty) ding/1.7 c) = thresho if Theta=0,	<pre>t for (y=1) inst n Theta , prob(y=1)= .83 , prob(y=1)= .99 : ld/loading , prob(y=1)= .83</pre>
EADL BY DIA1 DIA2 DIA3 DIA4 DIA5 DIA6 DIA7 CHRESHOLDS IN DIA1\$1 DIA2\$1 DIA3\$1 DIA4\$1 DIA5\$1 DIA6\$1 DIA7\$1 R-SQUARE = stat DIA1 DIA2 DIA3	S IN STANDARDIZED 0.922 0.940 0.922 0.972 0.920 0.885 0.875 STANDARDIZED METH -0.347 -0.982 -0.739 -0.404 -0.397 -0.626 -1.590 mdardized loading 0.851 0.883 0.850	<pre>0 METRIC =</pre>	loading*SD(51.712 52.557 50.622 80.380 52.291 39.729 23.380 hold/SD(Y) -7.303 -17.409 -14.373 -8.928 -8.348 -12.558 -19.949 25.856 26.278 25.311	<pre>Fheta)/SD(Y) 0.000</pre>	Threshold = expe When *-1, thresh Loading = regres = change IFA Models: Logit (DIA1=1) = Logit (DIA7=1) = USING RESULTS IRT model: Logit a = discriminati b = difficulty (IRT Models: Logit (DIA1=1) =	teted logit of (nold becomes int sion of item lo in logit(y) fo 1.629 + 4.328(5.962 + 3.283(FROM IRT MC $\frac{(y=1) = a(theta)}{10cation on lat}$ + 4.328*(Theta -	y=0) for s ercept: ex ogit on The r a one-un Theta) → Theta) → DDEL (RIC <u>a - difficu</u> ope) = loa ent metric	Someone with spected logi ata if change i: if Theta=0, if Theta=0, SHT PANEL) alty) ding/1.7 c) = thresho if Theta=0,	<pre>t for (y=1) inst n Theta , prob(y=1)= .83 , prob(y=1)= .99 : ld/loading , prob(y=1)= .83</pre>
LADL BY DIA1 DIA2 DIA3 DIA4 DIA5 DIA6 DIA7 THRESHOLDS IN DIA1\$1 DIA2\$1 DIA3\$1 DIA4\$1 DIA5\$1 DIA6\$1 DIA7\$1 R-SQUARE = star DIA1 DIA2 DIA3 DIA4	S IN STANDARDIZET 0.922 0.940 0.922 0.972 0.920 0.885 0.875 STANDARDIZED METH -0.347 -0.982 -0.739 -0.404 -0.397 -0.626 -1.590 mdardized loading 0.851 0.883 0.850 0.945	<pre>0 METRIC =</pre>	loading*SD(2 51.712 52.557 50.622 80.380 52.291 39.729 23.380 hold/SD(Y) -7.303 -17.409 -14.373 -8.928 -8.348 -12.558 -19.949 25.856 26.278 25.311 40.190	<pre>Fheta)/SD(Y) 0.000</pre>	Threshold = expe When *-1, thresh Loading = regres = change IFA Models: Logit (DIA1=1) = Logit (DIA7=1) = USING RESULTS IRT model: Logit a = discriminati b = difficulty (IRT Models: Logit (DIA1=1) =	teted logit of (nold becomes int sion of item lo in logit(y) fo 1.629 + 4.328(5.962 + 3.283(FROM IRT MC $\frac{(y=1) = a(theta)}{10cation on lat}$ + 4.328*(Theta -	y=0) for s ercept: ex ogit on The r a one-un Theta) → Theta) → DDEL (RIC <u>a - difficu</u> ope) = loa ent metric	Someone with spected logi ata if change i: if Theta=0, if Theta=0, SHT PANEL) alty) ding/1.7 c) = thresho if Theta=0,	<pre>t for (y=1) inst n Theta , prob(y=1)= .83 , prob(y=1)= .99 : ld/loading , prob(y=1)= .83</pre>



The estimated theta scores are supposed to have a mean of 0 and a variance of 1, but this table shows that they have a variance of only .741 instead. Such shrinkage is why it can be problematic to use these estimated theta scores as observed variables in other analyses.



Here is another estimation approach: a 2PL vs. a 1PL for Binary Responses using WLSMV Probit model

DAT:FILE IS ADL.dat;VARIABLE:NAMES ARE case dial-dia 7 ical-cia 7; USEVARIABLES ARE dial-dia 7; CATEGORICAL ARE dial-dia 7; MISSING ARE .; IDVARIABLE is case;ANALYSIE:ESTIMATOR IS WLSWY, PARAMETERIZATION IS THETA; MODEL:Y Factor loadings all estimated in 2PL I Then thresholds all estimated [dial51-dia751*1];USEVARIABLES ARE dial-dia 7; USEVARIABLES ARE dial-d
USEVARIABLES ARE dial-dia7; CATEGORICAL ARE dial-dia7; MISSING ARE .; IDVARIABLE is case; MODEL: 1 Factor loadings all estimated [dial51-dia73:1; 1 Factor mean=0 and variance=1 for identification [IADL@0]; IADL@1; 0UTFUT: STDYX Residual; ! Standardised solution, local fit SAVEDATA: DIFFTEST-2PL.dat; ! Save info from bigger model IADL@0]; IADL@1; 0UTFUT: STDYX Residual; ! Standardised solution, local fit SAVEDATA: DIFFTEST-2PL.dat; ! Save info from bigger model IADL@0]; IADL@1; 0UTFUT: STDYX Residual; ! Standardised solution, local fit SAVEDATA: DIFFTEST-2PL.dat; ! Save info from bigger model IADL@0]; IADL@1; 0UTFUT: STDYX Residual; ! Standardised solution, local fit SAVEDATA: DIFFTEST-2PL.dat; ! Save info from bigger model IADL@0]; IADL@1; 0UTFUT: STDYX Residual; ! Standardised solution, local fit SAVEDATA: DIFFTEST-2PL.dat; ! Save factor scores saved to FLOT: TYPE IS FLOTI FLOT2 FLOT3; ! Get IRT plots MODEL FIT INFORMATION Number of Free Parameters 14 Chi-Square Test of Model Fit P-Value 0.0000 * The chi-square value for MLM, NLMV, MLR, ULSMV, WLSM and WLSMV cannot be used for chi-square difference testing in the regular way. MLM, MLR and MLSM (hi-square difference testing is done Using the DIFFTEST option. * The chi-square value for MLM, NLMV, MLR, ULSMV, WLSM and WLSMV cannot be used for chi-square difference testing is done Using the DIFFTEST option. * The chi-square value for MLM, NLMV, MLR, ULSMV, WLSM and WLSMV cannot be used for chi-square difference testing is done Using the DIFFTEST option. * The chi-square value for MLM, NLMV, WLSM difference testing is done Using the DIFFTEST option. * The chi-square Value 010000 * The chi-square value for MLM, NLMV, WLSM difference testing is done Using the DIFFTEST option. * The Chi-square Value 010000 * The chi-square Value 0100000 * The chi-square Value 010000 * The
CATEGORICAL ARE dial-dia7; MISSING ARE.; IDVARIABLE is case; MISSING ARE.; IDVARIABLE is case;ANALYSIS: BSTMATOR IS WLSNY; PARAMETERIZATION IS THETA; MODEL:ISTEMATOR IS WLSNY; PARAMETERIZATION IS THETA; MISSING ARE.; IDVARIABLE is case;1 Factor loadings all estimated in 2PL IADL BY dial-dia7\$;"; I Factor mean=0 and variance=1 for identification [IADL@0]; IADL@1;ISTEMATOR IS WLSNY; PARAMETERIZATION IS THETA; DIFFTEST=2PL.dat; ! Use saved info from bigger model (dial\$1-dia7\$;"; ! Factor mean=0 and variance=1 for identification [IADL@0]; IADL@1;OUTPUT: STDYX Residual; ! Standardized solution, local fit SAVE = FSCORES; ! Save factor scores (thetas) FILE IS IADL_2PLThetas.dat; ! File factor scores saved toPLOT: TYPE IS PLOTI PLOT2 PLOT3; ! Get IRT plotsMODEL FIT INFORMATION Number of Free ParametersNumber of Free Parameters14 ValueChi-Square Test of Model Fit ValueValueValueValue* The chi-square value for NLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used for chi-square value for ifference testing is done using the UFFTENT option.* The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used for chi-square difference testing is done using the DIFFTEST option.* The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used for chi-square difference testing is done using the DIFFTEST option.* The chi-square value for MLM, MLMV, MLSMV WLSM and WLSMV cannot be used for chi-square difference testing is done using the DIFFTEST option.* The chi-square value for MLM, MLMV, MLSMV WLSM and WLSMV cannot be used for chi-square difference testing is doard us
MISSING ARE .; IDVARIABLE is case; ANALYSIS: ESTIMATOR IS WLSMY; PARAMETERIZATION IS THETA; MODEL:MISSING ARE .; IDVARIABLE is case;NAMALYSIS: ESTIMATOR IS WLSMY; PARAMETERIZATION IS THETA; DIFFEST-2PL.dat; ! Use saved info from bigger model (idais1-dia7*;1);Iben thresholds all estimated (idais1-dia7*;1);Pactor mean=0 and variance=1 for identification (IADL@0); IADL@1;(Indl@0); IADL@1;OUTPUT: STDYX Residual; ! standardized solution, local fit SAVEDATA: DIFFTEST-2PL.dat; ! Save info from bigger model SAVE STOXR Residual; ! Standardized solution, local fit SAVEDATA: DIFFTEST-2PL.dat; ! Save info from bigger model (IADL@0); IADL@1;WODEL FIT INFORMATIONNumber of Free Parameters14Chi-Square Test of Model Fit Value54.820* 0.0000Value camot be used for chi-square difference testing is done using the usepite.54.820* 0.0000* The chi-square value for MLM, MLMV, MLR, ULSWV, WLSM and WLSWV cannot be used for chi-square difference testing is done using the DIFFTEST option.PLOT: TYPE IS PLOTI PLOT2 PLOT3; ! Get IRT plots* The chi-square value for MLM, MLWV, MLSW, WLSM and WLSWV cannot be used for chi-square difference testing is done using the DIFFTEST option.Number of Free Parameters 20 0.0000* The chi-square value for MLM, MLWV, WLSWV and WLSWV cannot be used for chi-square difference testing is done using the DIFFTEST option.Number of Free Parameters 20 0.0000* The chi-square value for MLM, MLWV, WLSWV and WLSWV cannot be used for chi-square difference testing is done using the DIFFTEST option.Number of Free Parameters 20 0.0000
MISSING ARE .; IDVARIABLE is case;NMALYSIS: ESTIMATOR IS WLSMY, PARAMETERIZATION IS THETA;MODEL:1 Factor loadings all estimated in 2PL TADL BY dial-dia7;IDL BY dial-dia7;! Flem thresholds all estimated[dials1-dia7;1;];! Factor mean=0 and variance=1 for identification[IADL09]; IADL09;[IADL09]; IADL09;(IADL09]; IADL09;(IADL09); IADL09;OUTPUT:STDYX Residual; ! Standardized solution, local fit SAVEDATA: DIFFTEST-2PL.dat; ! Save info from bigger modelSAVE PESCORES; I Save info from bigger modelSAVE PESCORES; I Save factor scores (thetas) FILE IS IADL_2PLThetas.dat; ! File factor scores saved toPLOT:TYPE IS PLOTI PLOT2 PLOT3; ! Get IRT plotsMODEL FIT INFORMATIONNumber of Free Parameters14Chi-Square Test of Model Fit Value54.820* 0.0000Value54.820* 0.0000* The chi-square value for MLM, MLMV, MLR, ULSWV, WLSM and WLSWV cannot be used for chi-square difference testing is done using the UIFFTEST option.* The chi-square value for MLM, MLWV, MLR, ULSWV, WLSM and WLSWV cannot be used for chi-square difference testing is done using the DIFFTEST option.* The chi-square value for MLM, WLSWV difference testing is done using the DIFFTEST option.17.874 Degrees of Freedom 20 P-Value* The chi-square value for MLM, WLSWV difference testing is done using the DIFFTEST option.20 Chi-Square Test for Difference Testing Value* The chi-square value for MLM, WLSWV difference testing is done using the DIFFTEST option.20 Chi-Square Test for Differen
NARLYSIS: ESTIMATOR IS WLSNY; PARAMETERIZATION IS THETA; MODEL:
NODEL:! Factor loadings all estimated[dialf-dia7*;! Lem thresholds all estimated[dialf-dia7*;! Item thresholds all estimated[dialf-dia7*;! Item thresholds all estimated[dialf-dia7*;! Item thresholds all estimated[dialf-dia7*];! Factor mean=0 and variance=1 for identification[Idalf-dia7];OUTPUT:STDYX Residual; ! Standardized solution, local fitSAVEE aFGCRES;! Save factor scores (thetas)FILE IS IADL_2PLThetas.dat; ! File factor scores (thetas)FLOT:TYPE IS PLOTI PLOT2 PLOT3; ! Get IRT plotsMODEL FIT INFORMATIONFLOT:Number of Free Parameters14Chi-Square Test of Model Fit54.820*Value54.820*Degrees of Freedom14P-Value0.0000* The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMVcannot be used for chi-square difference testing in the regular way.MLM, MLM and WLSM Chi-square difference testing is described on theMplus website.MAN.YSM, and ULSMV difference testing is doserWILM, MLM DUFFING ULSMV difference testing is doserPuse Soft Freedom20P-Value0.0000Chi-Square Test of Difference TestingMLM, MLM DUFFING ULSMV difference testing is doserWLM, MLM DUFFING Toption.Sume Soft Freedom0 Enterprese of Freedom6
<pre>! Factor loadings all estimated in 2PL TADL BY dial-dia7*; ! Item thresholds all estimated [dial\$1-dia7\$!']; ! Tem thresholds all estimated [dial\$1-dia7\$!']; ! Factor mean0 and variance=1 for identification [IADL@0]; IADL@1; OUTPUT: STDYX Residual; ! Standardized solution, local fit SAVEDATA: DIFFTEST=2PL.dat; ! Save factor scores (thetas) FILE IS IADL_2PLThetas.dat; ! File factor scores (thetas) FILE IS IADL_2PLThetas.dat; ! File factor scores (thetas) FILE IS IADL_2PLThetas.dat; ! File factor scores saved to MODEL FIT INFORMATION Number of Free Parameters 14 Chi-Square Test of Model Fit Value 54.820* Degrees of Freedom 14 P-Value 0.0000 * The chi-square difference testing is described on the Mplus website. MLMV, MLSWV, and ULSWV difference testing is described on the Mplus website. MLMV, MLSWV, and ULSWV difference testing is done using the DIFFTEST option.</pre>
IADL BY dial-dia7; ! Item thresholds all estimated [dial\$1-dia7\$1*1; ! Item thresholds all estimated [dial\$1-dia7\$1*1; ! Pactor mean=0 and variance=1 for identification [IADL@0]; IADL@1; OUTPUT: STAVE are factor scores (thetas) SAVEDATA: DIFFTEST=2PL.dat; ! Save factor scores (thetas) FILE IS IADL_2PLThetas.dat; FLOT: TYPE IS PLOT1 PLOT2 PLOT3; ! Get IRT plots OUTPUT: MODEL FIT INFORMATION FLOT: Number of Free Parameters 14 Value 54.820* Degrees of Freedom 14 P-value 0.0000 * The chi-square value for MLM, MLMV, MLSM, ULSMV, MLSM and WLSMV, MLM, MLR and WLSM chi-square difference testing is described on the Wplus website. MMUV, WLSMV, and ULSMV difference testing is done using the DIFFTEST option.
<pre>! Item thresholds all estimated [dial\$1-dia7\$1*]; ! Factor leadings all equal in IPL IDE IDE IDE IDE IDE SAVE and variance=1 for identification IDE IDE SAVE and variance=1 for identification IDE IDE SAVE and variance=1 for identification IDE SAVE and variance=1 for identification IDE IDE SAVE and variance=1 for identification IDE SAVE and varian</pre>
[dial\$1-diar\$1*]; IADL BY dial-diar\$1* (Loading); ! Factor mean=0 and variance=1 for identification [IADL@0]; IADL@1; Itam thresholds all estimated [dial\$1-diar\$1*]; OUTPUT: STDYX Residual; ! Standardized solution, local fit SAVEDATA: Item thresholds all estimated [dial\$1-diar\$1*]; SAVE = FSCORES; ! Save factor scores (thetas) FILE IS IADL_2PLThetas.dat; ! File factor scores saved to PLOT: TYPE IS PLOT1 PLOT2 PLOT3; ! Get IRT plots MODEL FIT INFORMATION PLOT: Number of Free Parameters 14 Chi-Square Test of Model Fit P-Value 54.820* 0.0000 Value 54.820* Degrees of Freedom 14 Chi-square value for MLM, MLWV, MLR, ULSMV, MLSM and WLSMV, MLM, MLR and WLSM chi-square difference testing is described on the Wplus website. 10.0000 * The chi-square difference testing is described on the Wplus website. 10.8300 MLSW * The DIFFITST option. 0.01000 VISW
<pre>! Factor mean=0 and variance=1 for identification [TADL@0]; TADL@1; OUTPUT: STDYX Residual; ! Standardized solution, local fit SAVEDATA: DIFFTEST=2PL.dat; ! Save info from bigger model SAVE = FSCORES; ! Save factor scores (thetas) FILE IS TADL_2PLThetas.dat; ! File factor scores saved to PLOT: TYPE IS PLOT1 PLOT2 PLOT3; ! Get IRT plots Number of Free Parameters 14 Chi-Square Test of Model Fit Degrees of Freedom 14 P-Value 54.820* Degrees of Freedom 14 P-Value 0.0000 * The chi-square difference testing is described on the Mplus website. MLMV, MLSMV, MLSMV, difference testing is described on the Mplus website. MLMV, WLSMV, and ULSMV difference testing is done using the DIFFTEST option.< /pre></pre>
[IADL@0]; IADL@1;[dial\$1-dia7\$1*];OUTPUT:STDYX Residual; ! Standardized solution, local fitSAVEDATA:DIFFTEST=2PL.dat; ! Save info from bigger modelSAVE = FSCORES;! Save factor scores (thetas)FILE IS IADL_2PLThetas.dat; ! File factor scores saved toPLOT:TYPE IS PLOTI PLOT2 PLOT3; ! Get IRT plotsMODEL FIT INFORMATIONFLOT:Number of Free Parameters14Chi-Square Test of Model Fit0.0000Value54.820*Degrees of Freedom14P-Value0.0000*The chi-square difference testing in the regular way.MM, MLR and WLSM chi-square difference testing is described on the Mplus website. MLWV, WLSM, and ULSMV difference testing is described on the Mplus website. MLWV, WLSM, and ULSMV difference testing is described on the Mplus website. MLWV, WLSM, and ULSMV difference testing is described on the Mplus website. MLWV, WLSM, and ULSMV difference testing is described on the Mplus website. MLWV, WLSM, and ULSMV difference testing is described on the Mplus website. MLWV, WLSM, and ULSMV difference testing is described on the Mplus website. MLWV, WLSM, and ULSMV difference testing is described on the Mplus website. MLWV, WLSMA du ULSMV difference testing is described on the Mplus website. MLWV, WLSMA du ULSMV difference testing is described on the Mplus website. MLWV, WLSMA du ULSMV difference testing is done using the DIFFTEST option.If dial\$1-dia7\$1*];Image: PLOT Store Parameter Store Parameter Store Parameter Store Parameter Store
OUTPUT: STDYX Residual; ! Standardized solution, local fit SAVEDATA: DIFFTEST=2PL.dat; ! Save info from bigger model SAVE = FSCORES; ! Save factor scores (thetas) FILE IS IADL_2PLThetas.dat; ! File factor scores saved to PLOT: TYPE IS PLOTI PLOT2 PLOT3; ! Get IRT plots MODEL FIT INFORMATION PLOT: TYPE IS PLOTI PLOT2 PLOT3; ! Get IRT plots Number of Free Parameters 14 MODEL FIT INFORMATION PLOT: TYPE IS PLOT1 PLOT2 PLOT3; ! Get IRT plots Number of Free Parameters 14 MODEL FIT INFORMATION Number of Free Parameters 8 Chi-Square Test of Model Fit 0.0000 0.0000 64.889* 20 * The chi-square value for MLM, MLMY, MLR, ULSMY, WLSM and WLSMV cannot be used for chi-square difference testing in the regular way. Num. Yulue 64.889* 20 MULN, MLR and WLSM chi-square difference testing is described on the Mplus website. MLMV, WLSMV, and ULSMV difference testing is done using the DIFFTEST option. Chi-Square Test for Difference Testing 0.0000 Chi-Square Test of Freedom 6 6 6 6
OUTPUT: STDYX Residual; ! Standardized solution, local fit SAVEDATA: DIFFTEST=2PL.dat; ! Save info from bigger model SAVE = FSCORES; ! Save factor scores (thetas) FILE IS IADL_2PLThetas.dat; ! File factor scores saved to PLOT: TYPE IS PLOT1 PLOT2 PLOT3; ! Get IRT plots MODEL FIT INFORMATION PLOT: TYPE IS PLOT1 PLOT2 PLOT3; ! Get IRT plots Number of Free Parameters 14 MODEL FIT INFORMATION PLOT: TYPE IS PLOT1 PLOT2 PLOT3; ! Get IRT plots Number of Free Parameters 14 MODEL FIT INFORMATION Number of Free Parameters 8 Value 54.820* 0.0000 Chi-Square Test of Model Fit 0.0000 * The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV Number of Free Parameters 8 * The chi-square difference testing in the regular way. 0.0000 20 * The chi-square difference testing is described on the Mplus website. MLWV, WLSMV, and ULSMV difference testing is done 0.0000 * Difference Test for Difference Test for Difference Testing 0.0000 20 * The chi-square difference testing is done 0.0000 20
SAVEDATA: DIFFTEST=2PL.dat; ! Save info from bigger model SAVE = FSCORES; ! Save factor scores (thetas) FILE IS IADL_2PLThetas.dat; ! File factor scores saved to PLOT: TYPE IS PLOT1 PLOT2 PLOT3; ! Get IRT plots MODEL FIT INFORMATION PLOT: TYPE IS PLOT1 PLOT2 PLOT3; ! Get IRT plots Number of Free Parameters 14 MODEL FIT INFORMATION PLOT: TYPE IS PLOT1 PLOT2 PLOT3; ! Get IRT plots Number of Free Parameters 14 MODEL FIT INFORMATION Number of Free Parameters 8 Value 54.820* MODEL FIT INFORMATION Number of Free Parameters 8 * The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used for chi-square difference testing in the regular way. 0.0000 Chi-Square Test for Difference Testing MUM, MLR and WLSM chi-square difference testing is described on the Mplus website. MLMV, WLSMV, and ULSMV difference testing is done using the DIFFTEST option. 10.874 Degrees of Freedom 6
SAVE = FSCORES; ! Save factor scores (thetas) FILE IS IADL_2PLIThetas.dat; ! File factor scores saved to PLOT: TYPE IS PLOT1 PLOT2 PLOT3; ! Get IRT plots MODEL FIT INFORMATION PLOT: TYPE IS PLOT1 PLOT2 PLOT3; ! Get IRT plots Number of Free Parameters 14 MODEL FIT INFORMATION PLOT: TYPE IS PLOT1 PLOT2 PLOT3; ! Get IRT plots Number of Free Parameters 14 MODEL FIT INFORMATION Number of Free Parameters 8 Value 54.820* MODEL FIT INFORMATION Number of Free Parameters 8 * The chi-square value for MLM, MLWV, MLR, ULSMV, WLSM and WLSMV cannot be used for chi-square difference testing in the regular way. Chi-Square Test of Model Fit Value 64.889* Mplus website. 0.0000 P-Value 0.0000 0.0000 * The chi-square difference testing is described on the Mplus website. MLMV, wilference testing is described on the Mplus website. 0.1000 Chi-Square Test for Difference Testing using the DIFTEST option. 0.0000
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SAVE = FSCORES; ! Save factor scores (thetas) PLOT: TYPE IS PLOT1 PLOT2 PLOT3; ! Get IRT plots MODEL FIT INFORMATION PLOT: TYPE IS PLOT1 PLOT2 PLOT3; ! Get IRT plots Number of Free Parameters 14 MODEL FIT INFORMATION PLOT: TYPE IS PLOT1 PLOT2 PLOT3; ! Get IRT plots Chi-Square Test of Model Fit Value 54.820* Number of Free Parameters 8 Value 54.820* Number of Free Parameters 8 Value 54.820* Number of Free Parameters 8 Value 64.889* 0.0000 * The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used for chi-square difference testing in the regular way. Chi-Square Test for Difference Testing Mplus website. MLSMV, MLSMV difference testing is done using the DIFFTEST option. 0.0000 Chi-Square Test for Difference Testing Value 17.874 Degrees of Freedom 6 6
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MODEL FIT INFORMATION PLOT: TYPE IS PLOT1 PLOT2 PLOT3; ! Get IRT plots Number of Free Parameters 14 Chi-Square Test of Model Fit MODEL FIT INFORMATION Value 54.820* Degrees of Freedom 14 P-Value 0.0000 * The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used for chi-square difference testing in the regular way. Number of Free Parameters 8 MLM, MLR and WLSMV, MLSM, VLSMV difference testing is described on the Mplus website. MLSMV, MLSMV difference testing is done using the DIFFTEST option. Chi-Square Test for Difference Testing
Number of Free Parameters 14 MODEL FIT INFORMATION Chi-Square Test of Model Fit Value 54.820* Number of Free Parameters 8 Degrees of Freedom 14 Number of Free Parameters 8 P-Value 0.0000 Chi-Square Test of Model Fit Value 64.889* * The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used for chi-square difference testing in the regular way. Degrees of Freedom 20 * MLM, MLR and WLSM chi-square difference testing is described on the Wplus website. MLMV, WLSMV, and ULSMV difference testing is done Chi-Square Test for Difference Testing 0.0000 Chi-Square Test for Difference Testing 0.1000 0.0000 0.0000 Chi-Square Test for Difference Testing 0.0000 0.0000 Walue 17.874 0.0000 Value 17.874 0.0000 Value 0.0000 0.0000
Number of Free Parameters 14 MODEL FIT INFORMATION Chi-Square Test of Model Fit Value 54.820* Number of Free Parameters 8 Degrees of Freedom 14 Number of Free Parameters 8 P-Value 0.0000 Chi-Square Test of Model Fit Value 64.889* * The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used for chi-square difference testing in the regular way. Degrees of Freedom 20 * MLM, MLR and WLSM chi-square difference testing is described on the Wplus website. MLMV, WLSMV, and ULSMV difference testing is done Chi-Square Test for Difference Testing 0.0000 Chi-Square Test for Difference Testing 0.1000 0.0000 0.0000 Chi-Square Test for Difference Testing 0.0000 0.0000 Walue 17.874 0.0000 Value 17.874 0.0000 Value 0.0000 0.0000
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P-Value0.0000Value64.889** The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used for chi-square difference testing in the regular way.Degrees of Freedom20* MLM, MLR and WLSM chi-square difference testing is described on the Mplus website. MLMV, WLSMV, and ULSMV difference testing is doneChi-Square Test for Difference Testing0.0000Value17.874Degrees of Freedom6
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Mplus website.MLMV, WLSMV, and ULSMV difference testing is doneValue17.874using the DIFFTEST option.Degrees of Freedom6
using the DIFFTEST option. Degrees of Freedom 6
using the DIFFTEST option. Degrees of Freedom 6
RMSEA (Root Mean Square Error Of Approximation)
Estimate 0.068 RMSEA (Root Mean Square Error Of Approximation)
90 Percent C.I. 0.049 0.087 Estimate 0.059
Probability RMSEA <= .05 0.055 90 Percent C.I. 0.044 0.076
Probability RMSEA <= .05 0.154
CFI/TLI
CFI 0.997 CFI/TLI
TLI 0.995 CFI 0.996
TLI 0.996
Chi-Square Test of Model Fit for the Baseline Model Value 12351,798 SRMR (Standardized Root Mean Square Residual)
Degrees of Freedom 21 Value 0.056
P-Value 0.0000 The Chi-Square for Difference Testing tells us directly that the
WRMR (Weighted Root Mean Square Residual)
(now under WLSMV, same as it did under ML).

Here are the parameter estimates under WLSMV Theta Parameterization (Probit) for the 2PL version of binary items

0110111011101	ZED MODEL RESU	ILTS (IFA		•						
		6 5		wo-Tailed						DBIT METRIC
	Estimate	S.E.	Est./S.E.	P-Value	WHERE TH	E PROBIT 1	S DISCR	IMINATIO	ON*(THETA	A - DIFFICULTY
FACTOR LOADING	S = CHANGE IN PRO	BIT(Y=1) P	PER UNIT CHA	NGE IN THETA	Item Discr	iminations				
IADL BY					IADL E	Y				
DIA1	2.686	0.317	8.461	0.000	DIA1		2.686	0.317	8.461	0.000
DIA2	2.941	0.493	5.966	0.000	DIA2		2.941	0.493	5.966	0.000
DIA3	2.803	0.384	7.290	0.000	DIA3		2.803	0.384	7.290	0.000
DIA4	3.654	0.575	6.356	0.000	DIA4		3.654	0.575	6.356	0.000
DIA5	2.486	0.294	8.449	0.000	DIA5		2.486	0.294	8.449	0.000
DIA6	1.991	0.223	8.940	0.000	DIAG		1.991	0.223	8.940	0.000
DIA7	1.571	0.299	5.246	0.000	DIA0 DIA7		1.571	0.223	5.246	0.000
					Item Diffi	gultion	1.571	0.299	5.240	0.000
HRESHOLDS = E	XPECTED PROBIT(Y=	0) WHEN TH	IETA TS 0				0 274		6 742	0.000
DIA1\$1	-1.004	0.179	-5.607	0.000	DIA1\$1		-0.374	0.055	-6.743	
DIA2\$1	-3.097	0.481	-6.444	0.000	DIA2\$1		-1.053	0.069	-15.360	0.000
DIA2\$1 DIA3\$1	-2.221	0.481	-7.240	0.000	DIA3\$1		-0.792	0.062	-12.863	0.000
DIA3\$1 DIA4\$1	-2.221	0.298	-5.312	0.000	DIA4\$1		-0.433	0.054	-7.982	0.000
					DIA5\$1		-0.425	0.056	-7.607	0.000
DIA5\$1	-1.057	0.174	-6.071	0.000	DIA6\$1		-0.699	0.063	-11.084	
DIA6\$1 DIA7\$1	-1.391 -2.946	0.166 0.398	-8.359 -7.401	0.000 0.000	DIA7\$1		-1.875	0.154	-12.191	0.000
	RESULTS (STAN					7*probit, or				
				Two-Tailed	10910 - 11	, propro, or	110010 -	20920/20		
	Estimate	S.E.	Est./S.E.	P-Value	IFA model:	PROBIT(y) =	-thresho	ld + loadi	lng(Theta)	
	Estimate	S.E.	Est./S.E.			PROBIT(y) = = expected p				th Theta=0
FACTOR LOADING	Estimate S IN STANDARDIZED			P-Value	Threshold	= expected p	robit of	(y=0) for	someone wi	th Theta=0 or (y=1) instead
FACTOR LOADING				P-Value	Threshold When *-1,	= expected p	robit of intercept	(y=0) for : expecte	someone wi d probit f	
	S IN STANDARDIZED		loading*SD(P-Value	Threshold When *-1,	= expected p threshold >	robit of intercept	(y=0) for : expecte	someone wi d probit f	
IADL BY	s in standardized 0.937	• METRIC = 0.013	loading*SD(69.487	P-Value Theta)/SD(Y) 0.000	Threshold When *-1,	= expected p threshold >	robit of intercept	(y=0) for : expecte	someone wi d probit f	
IADL BY DIA1 DIA2	S IN STANDARDIZED 0.937 0.947	• METRIC = 0.013 0.016	loading*SD(69.487 57.551	P-Value Theta)/SD(Y) 0.000 0.000	Threshold When *-1, Loading =	= expected p threshold → regression o	robit of intercept f item pro	(y=0) for : expecte obit on Th	someone wi d probit f neta	
IADL BY DIA1 DIA2 DIA3	S IN STANDARDIZED 0.937 0.947 0.942	0.013 0.016 0.015	loading*SD(69.487 57.551 64.551	P-Value Theta)/SD(Y) 0.000 0.000 0.000	Threshold When *-1, Loading = IRT model:	<pre>= expected p threshold → regression o Probit(y=1)</pre>	robit of intercept f item pro = a(theta	(y=0) for : expecte obit on Th a - diffic	someone wi d probit f neta culty)	
IADL BY DIA1 DIA2 DIA3 DIA4	S IN STANDARDIZED 0.937 0.947 0.942 0.965	0.013 0.016 0.015 0.011	loading*SD (69.487 57.551 64.551 91.196	P-Value Theta)/SD(Y) 0.000 0.000 0.000 0.000	Threshold When *-1, Loading = <u>IRT model:</u> a = discri	<pre>= expected p threshold → regression o Probit(y=1) mination (re</pre>	robit of intercept f item pro = a(theta scaled slo	(y=0) for :: expected obit on The a - difficed ope) = los	someone wi d probit f neta culty) ading/1	or (y=1) instead
IADL BY DIA1 DIA2 DIA3 DIA4 DIA5	S IN STANDARDIZED 0.937 0.947 0.942 0.965 0.928	0 METRIC = 0.013 0.016 0.015 0.011 0.015	69.487 57.551 64.551 91.196 60.671	P-Value Theta)/SD(Y) 0.000 0.000 0.000 0.000 0.000	Threshold When *-1, Loading = <u>IRT model:</u> a = discri	<pre>= expected p threshold → regression o Probit(y=1)</pre>	robit of intercept f item pro = a(theta scaled slo	(y=0) for :: expected obit on The a - difficed ope) = los	someone wi d probit f neta culty) ading/1	or (y=1) instead
IADL BY DIA1 DIA2 DIA3 DIA4 DIA5 DIA6	S IN STANDARDIZED 0.937 0.947 0.942 0.965 0.928 0.894	<pre>0 METRIC =</pre>	69.487 57.551 64.551 91.196 60.671 44.371	P-Value Theta)/SD(Y) 0.000 0.000 0.000 0.000 0.000 0.000	Threshold When *-1, Loading = <u>IRT model:</u> a = discri	<pre>= expected p threshold → regression o Probit(y=1) mination (re</pre>	robit of intercept f item pro = a(theta scaled slo	(y=0) for :: expected obit on The a - difficed ope) = los	someone wi d probit f neta culty) ading/1	or (y=1) instead
IADL BY DIA1 DIA2 DIA3 DIA4 DIA5	S IN STANDARDIZED 0.937 0.947 0.942 0.965 0.928	0 METRIC = 0.013 0.016 0.015 0.011 0.015	69.487 57.551 64.551 91.196 60.671	P-Value Theta)/SD(Y) 0.000 0.000 0.000 0.000 0.000	Threshold When *-1, Loading = <u>IRT model:</u> a = discri	<pre>= expected p threshold → regression o Probit(y=1) mination (re</pre>	robit of intercept f item pro = a(theta scaled slo	(y=0) for :: expected obit on The a - difficed ope) = los	someone wi d probit f neta culty) ading/1	or (y=1) instead
IADL BY DIA1 DIA2 DIA3 DIA4 DIA5 DIA6 DIA7	S IN STANDARDIZED 0.937 0.947 0.942 0.965 0.928 0.894	0 METRIC = 0.013 0.016 0.015 0.011 0.015 0.020 0.046	loading*SD(69.487 57.551 64.551 91.196 60.671 44.371 18.195	P-Value Theta)/SD(Y) 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000	Threshold When *-1, Loading = <u>IRT model:</u> a = discri b = diffic	<pre>= expected p threshold → regression o Probit(y=1) mination (re ulty (locati</pre>	robit of intercept f item pro = a(theta scaled slo on on late	(y=0) for : expected obit on The a - difficed ope) = losed ent metriced	someone wi d probit f heta culty) ading/1 c) = thresh	or (y=1) instead nold/loading
IADL BY DIA1 DIA2 DIA3 DIA4 DIA5 DIA6 DIA7	S IN STANDARDIZED 0.937 0.947 0.942 0.965 0.928 0.894 0.844	0 METRIC = 0.013 0.016 0.015 0.011 0.015 0.020 0.046	loading*SD(69.487 57.551 64.551 91.196 60.671 44.371 18.195	P-Value Theta)/SD(Y) 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000	Threshold When *-1, Loading = <u>IRT model:</u> a = discri b = diffic	<pre>= expected p threshold → regression o Probit(y=1) mination (re ulty (locati T VIA STAN</pre>	robit of intercept f item pro = a(theta scaled slo on on late DARDIZE	(y=0) for : expected obit on Th a - diffic ope) = low ent metric D RESIDU	someone wi d probit f heta culty) ading/1 c) = thresh JAL CORRE	or (y=1) instead hold/loading ELATIONS
IADL BY DIA1 DIA2 DIA3 DIA4 DIA5 DIA6 DIA7 Thresholds IN DIA1\$1	S IN STANDARDIZED 0.937 0.947 0.942 0.965 0.928 0.894 0.844 STANDARDIZED MET -0.350	<pre>0 METRIC =</pre>	loading*SD(69.487 57.551 64.551 91.196 60.671 44.371 18.195 eshold/SD(Y) -6.790	P-Value Theta)/SD(Y) 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000	Threshold When *-1, Loading = <u>IRT model:</u> a = discri b = diffic	<pre>= expected p threshold → regression o Probit(y=1) mination (re ulty (locati T VIA STAN</pre>	robit of intercept f item pro = a(theta scaled slo on on late DARDIZE	(y=0) for : expected obit on Th a - diffic ope) = low ent metric D RESIDU	someone wi d probit f heta culty) ading/1 c) = thresh JAL CORRE	or (y=1) instead nold/loading
IADL BY DIA1 DIA2 DIA3 DIA4 DIA5 DIA6 DIA7 Thresholds IN DIA1\$1 DIA2\$1	S IN STANDARDIZED 0.937 0.947 0.942 0.965 0.928 0.894 0.844 STANDARDIZED MET -0.350 -0.997	<pre>0 METRIC =</pre>	loading*SD(69.487 57.551 64.551 91.196 60.671 44.371 18.195 eshold/SD(Y) -6.790 -16.474	P-Value Theta)/SD(Y) 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000	Threshold When *-1, Loading = <u>IRT model:</u> a = discri b = diffic	<pre>= expected p threshold → regression o Probit(y=1) mination (re ulty (locati T VIA STAN</pre>	robit of intercept f item pro = a(theta scaled slo on on late DARDIZE	(y=0) for : expected obit on Th a - diffic ope) = low ent metric D RESIDU	someone wi d probit f heta culty) ading/1 c) = thresh JAL CORRE	or (y=1) instead hold/loading ELATIONS
IADL BY DIA1 DIA2 DIA3 DIA4 DIA5 DIA6 DIA7 Thresholds IN DIA1\$1 DIA2\$1 DIA3\$1	S IN STANDARDIZED 0.937 0.947 0.942 0.965 0.928 0.894 0.844 STANDARDIZED MET -0.350 -0.997 -0.746	<pre>0 METRIC =</pre>	loading*SD(69.487 57.551 64.551 91.196 60.671 44.371 18.195 eshold/SD(Y) -6.790 -16.474 -13.326	P-Value Theta)/SD(Y) 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000	Threshold When *-1, Loading = <u>IRT model:</u> a = discri b = diffic	<pre>= expected p threshold → regression o Probit(y=1) mination (re ulty (locati T VIA STAN</pre>	robit of intercept f item pro = a(theta scaled slo on on late DARDIZE	(y=0) for : expected obit on Th a - diffic ope) = low ent metric D RESIDU	someone wi d probit f heta culty) ading/1 c) = thresh JAL CORRE	or (y=1) instead hold/loading ELATIONS
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CLDP 948 Example 5 page 8 Extensive Results Section (in which model fit via WLSMV is reported first, followed by full-information MML as "better" version of model parameters). Note this is *way* more text than one would typically write, but I provide it here for completeness:

Psychometric assessment for the extent to which a single latent trait could predict that pattern of association among these 7 binary items was conducted using Item Factor Analysis (IFA) in *Mplus* v 8.1 (Muthén and Muthén, 1998–2017). These models use a link function (i.e., logit or probit) and a conditional Bernoulli response distribution to predict the conditional probability of a response = 1 (instead of 0) from a linear model as $Link(y_{is} = 1) = -\tau_i + \lambda_i F_s$. In this item model, $-\tau_i$ is the negative of an item-specific threshold (which becomes an intercept when multiplied by -1) that gives the link-transformed probability of response $y_{is} = 1$ (for item *i* and subject *s*) at a latent trait score *F* for subject *s* of 0, and λ is a factor loading for the expected change in the link-transformed response for a one-unit change in F_s . No separate item-specific residual variances can be estimated given these items' binary response options.

The current gold standard of estimation for IFA models is marginal maximum likelihood (MML), in which the term marginal refers to the full-information process of allowing all possible trait values for each person in the analysis using adaptive Gaussian guadrature with 15 points per factor. Accordingly, measures of model fit when using MML involve the contingency table of all possible responses to all items. In our 7 items, the full contingency table generates up to 2' = 128possible cells. Consequently, no measures of absolute fit would be valid for the current sample of 635 respondents (which would need a minimum expected count of 5 respondents within each possible cell). Instead, we conducted assessment of model fit via a limited-information diagonally weighted least squares estimator using a mean- and variance-corrected x2 (i.e., WLSMV in Mplus with the THETA parameterization and a probit link function). In the WLSMV estimator, the item responses are first summarized into an estimated tetrachoric correlation matrix using the cross-tabulation of responses for each possible pair of items. The IFA models are then fitted to the estimated polychoric correlation matrix, such that traditional measures of global and local absolute fit (i.e., traditional in confirmatory factor analyses of continuous responses) can be computed by comparing the model-predicted and data-estimated polychoric correlation matrices. In addition to x2 tests of absolute fit, it also provides the Comparative Fit Index (CFI), the Standardized Root Mean Square Residual (SRMR), and the Root Mean Square Error of Approximation (RMSEA). The CFI indexes the fit of the specified model relative to a null model (of no tetrachoric correlations across items), in which CFI values ≥ .95 indicate excellent fit. Conversely, the SRMR and RMSEA index the fit of the specified model relative to a saturated model (i.e., the data-estimated tetrachoric correlations), in which SRMR and RMSEA values ≤ .05 indicate excellent fit. RMSEA also offers a 90% confidence interval and a significance test of "close fit" with a null hypothesis of .05. Local misfit can be diagnosed by examining the specific sources of discrepancy between the model-predicted and data-estimated tetrachoric correlations (i.e., as available using the RESIDUAL option in Mplus). Finally, the fit of nested models can be compared using the DIFFTEST procedure in Mplus.

A single-trait model was first fit for the seven binary items using WLSMV, in which the latent trait mean and variance were fixed for identification to 0 and 1, respectively, and separate thresholds and factor loadings were estimated for each item. This model exhibited acceptable fit by every measure except the χ^2 test of absolute fit, χ^2 (14) = 54.820, p < .001, CFI = .997, SRMR = .037, RMSEA = .068 [CI = .049–.087, p = .055]. Examination of local misfit revealed all discrepancies between the model-predicted and data-estimated tetrachoric correlations were less than .112 in absolute value, indicating no practically significant bivariate item misfit. A reduced model in which all loadings were constrained equal across items fit significantly worse, DIFFTEST(6) = 17.874, p = .007, indicating differences in item discrimination (i.e., the extent to which each item was related to the latent trait). Thus, the original model was retained for further examination using full-information marginal maximum likelihood (MML) estimation instead.

Model parameters obtained using MML and a logit link are shown in Table 1, which includes the IFA item parameters (thresholds and loadings), as well as their Item Response Theory (IRT) analogous parameter of item difficulty, computed as $b_i = \tau_i/\lambda_i$; IRT discrimination a_i is the same as the loading λ_i in this case. The net result of these item parameters can be described more succinctly by examining the overall reliability with which the latent trait has been measured. In IFA or IRT models—as in any kind of psychometric model with a nonlinear relationship between the item response and the latent trait—reliability is trait-specific, most often characterized by a quantity known as *test information*. For ease of interpretation, the test information function created by the items was converted to a traditional measure of reliability that ranges from 0 to 1 as reliability = information / (information +1). Figure 1 shows that test reliability is ≥.80 only from ~1.8 SD below the mean to 0.20 SD above the mean, after which point reliability drops off precipitously due to a lack of items with difficulty levels above 0.

(Table 1 would have all estimated IFA item parameters and their SEs, as well IRT parameters (and SEs if available); Figure 1 is in Example 5 spreadsheet) References: Muthén, L. K., & Muthén, B.O. (1998–2017). Mplus User's Guide (Eighth Edition). Los Angeles, CA: Muthén & Muthén.