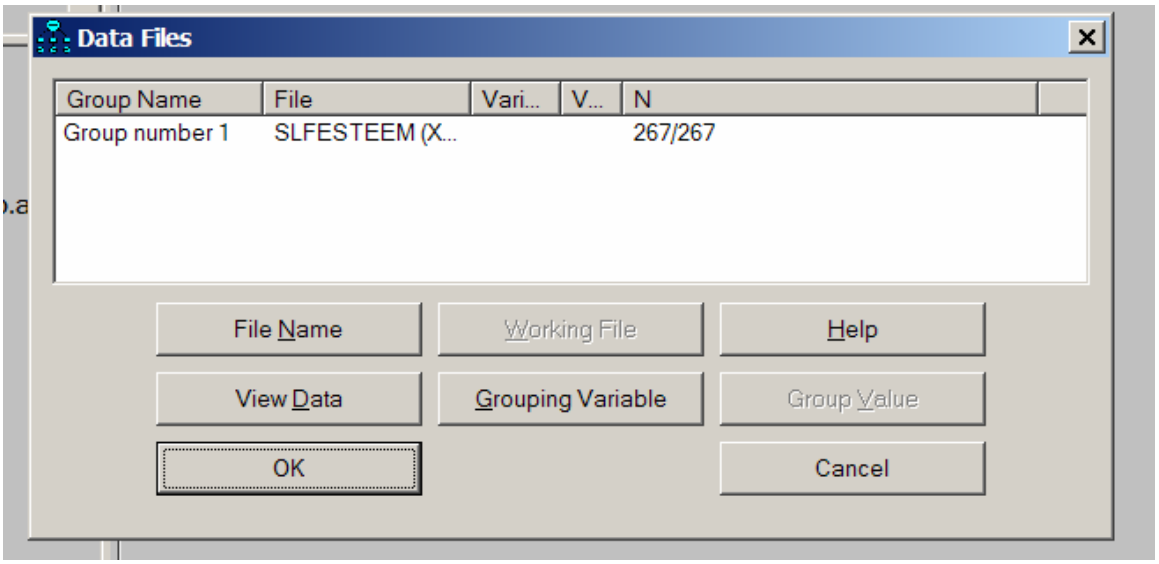
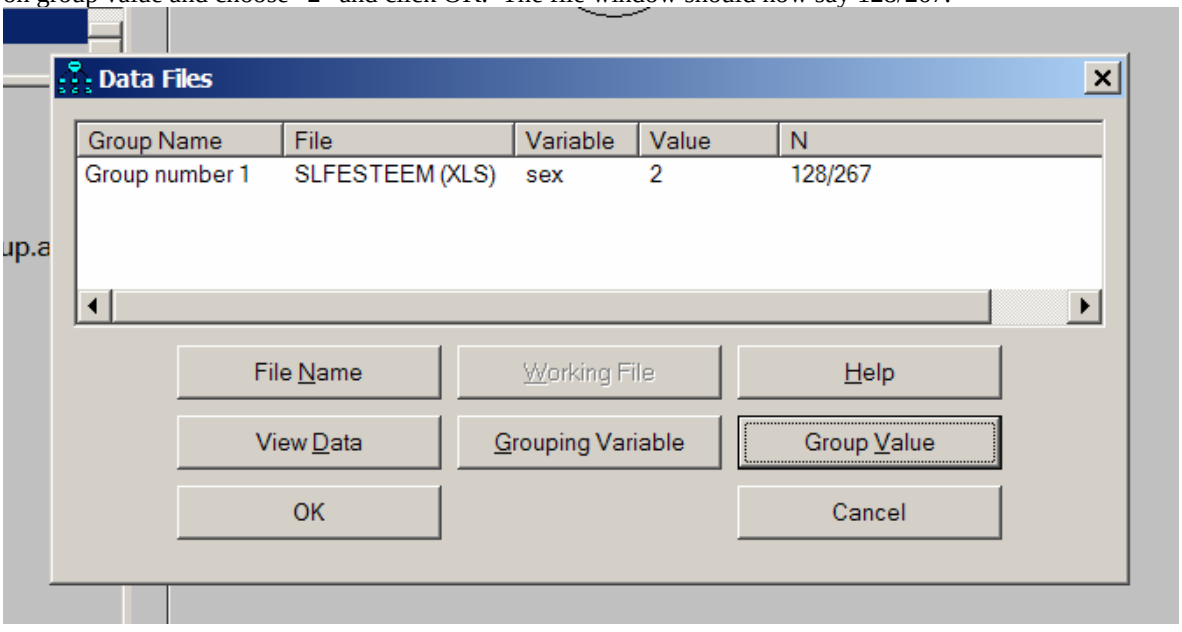
Multiple Group CFA in AMOS – (And Modification Indices and Nested Models)

For this lab we will use the Self-Esteem data. An Excel file of the data is available at _www.biostat.umn.edu/~melanie/PH5482/DATA/index.html and it is called slfesteem1nomiss.xls. We will perform a multiple group CFA for boys and girls to test if the measurement model (Confirmatory factor analysis model) for self-esteem is the same in the two groups.

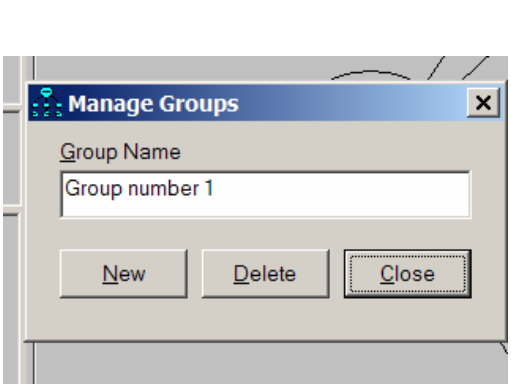
STEP1: Read in the data. Select File→Data Files or click  then click on File Name and find the data you have saved onto your PC. If you read it in correctly it will say 267/267.

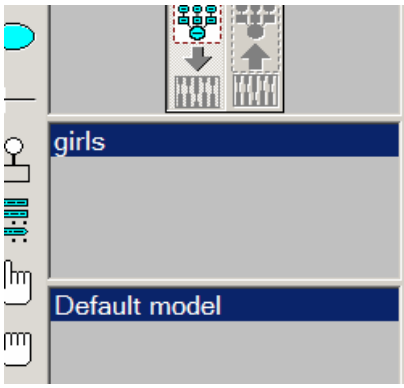


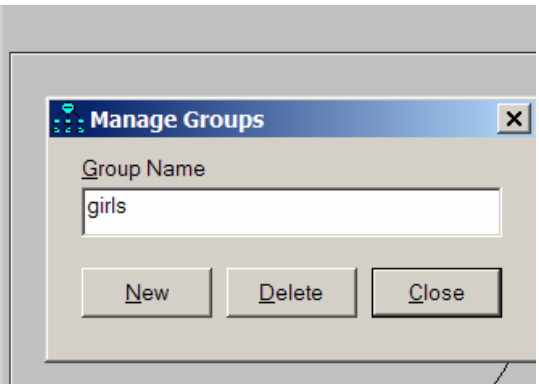
Now in order to subset the data so that it is analyzing just the girls, click on Grouping Variable and then choose Sex and click OK. Now click on group value and choose "2" and click OK. The file window should now say 128/267.

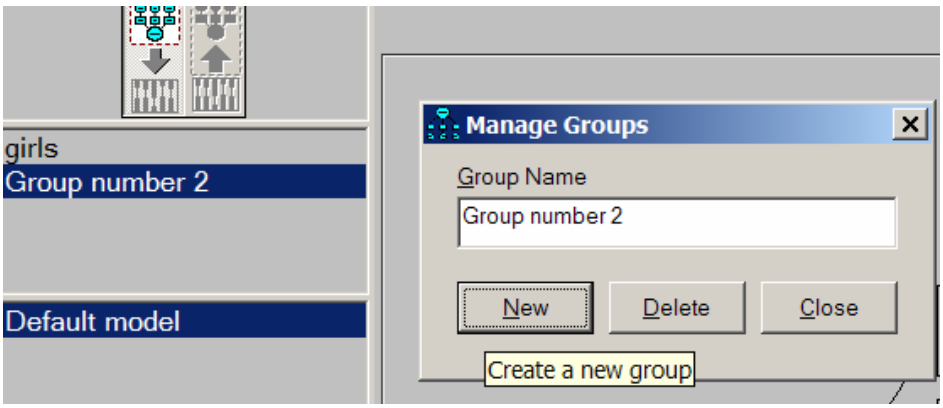


STEP 2: Now we will include the data for the boys and test whether their measurement model is different than the measurement model for the girls. We first need to tell Amos that we will be adding another group. To do this click on Model-Fit→Manage Groups. You will see that the window that pops up says "Group number 1". That is the current name of the girls group. To change this name just type over it "girls" in the window. Then click NEW and you'll see it says "Group number 2". Change this name to say "boys" and then click Close.

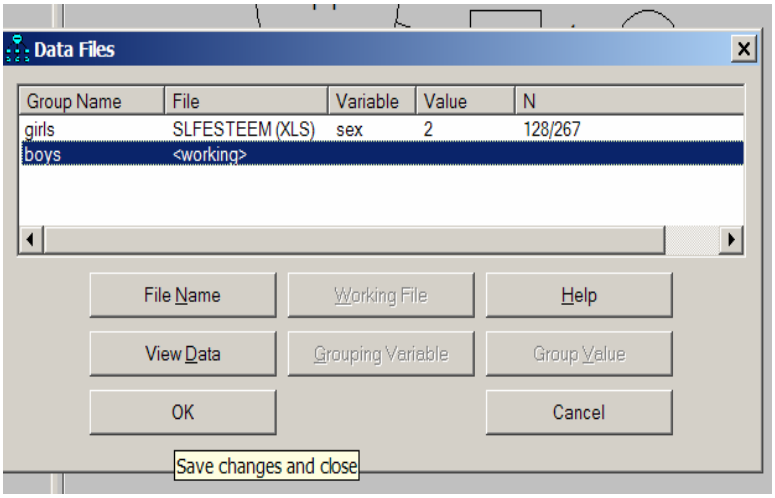


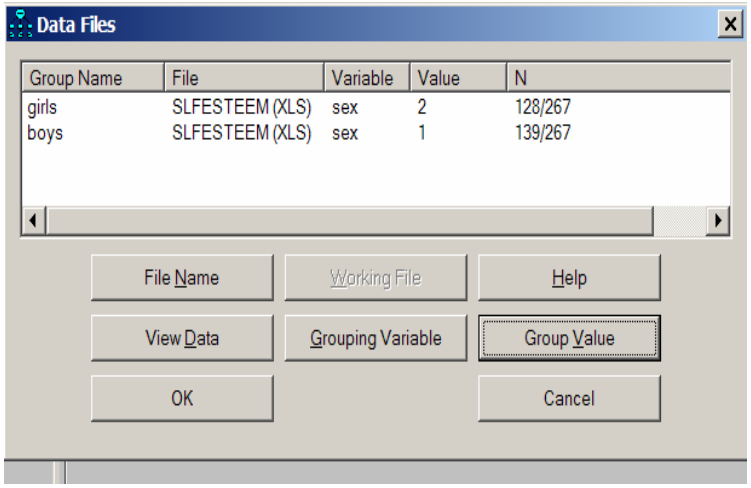




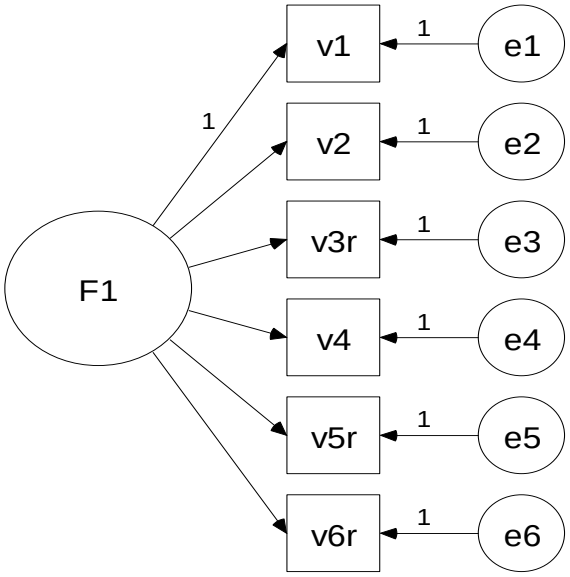


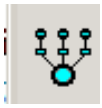
Now you should see in the left side of the Amos window "girls" and "boys" listed. Now we need to attach the slfesteem data set to the boys group name. To do this File → Data files (now you should see both "girls" and "boys" listed under group name but you'll notice that under File for "boys" the file is not there. Click on boys→ then File Name → then find the data again → then you'll see it read in all 267/267 so we need to subset that to boys by clicking Grouping variable → Sex → ok then Group Value → 1 → Ok. If you have done it correctly it should say 139/267 next to the boys.

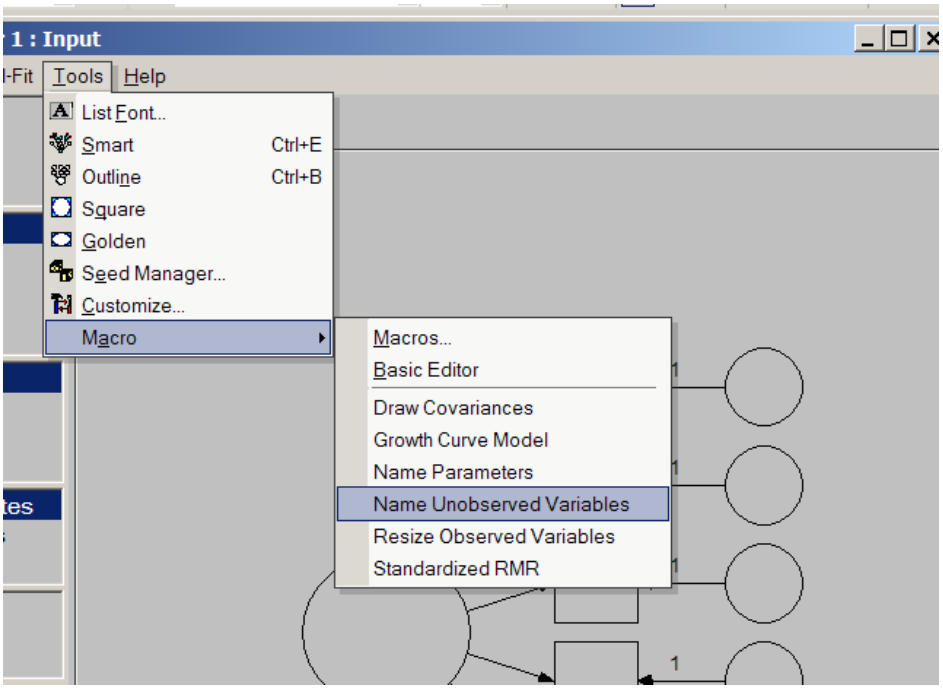




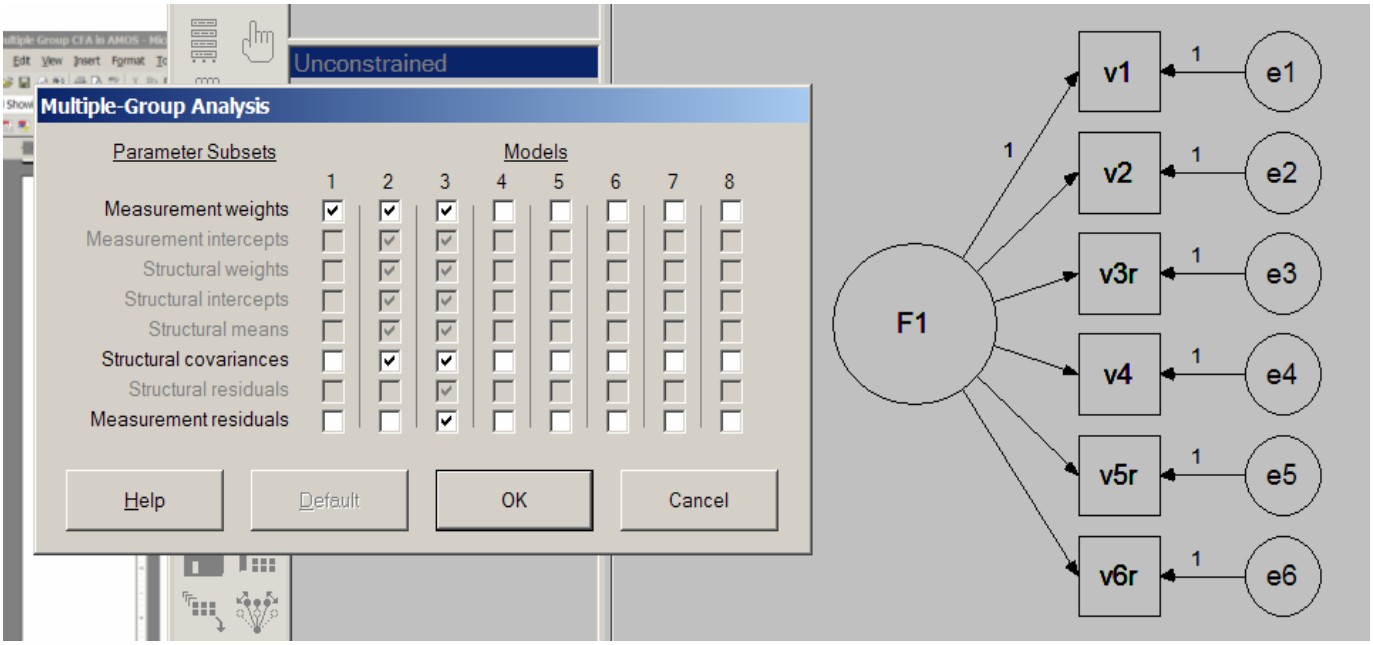
STEP 3: Now draw the following CFA model.

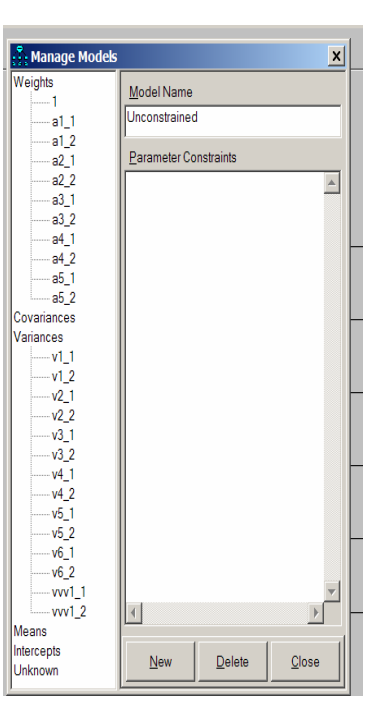


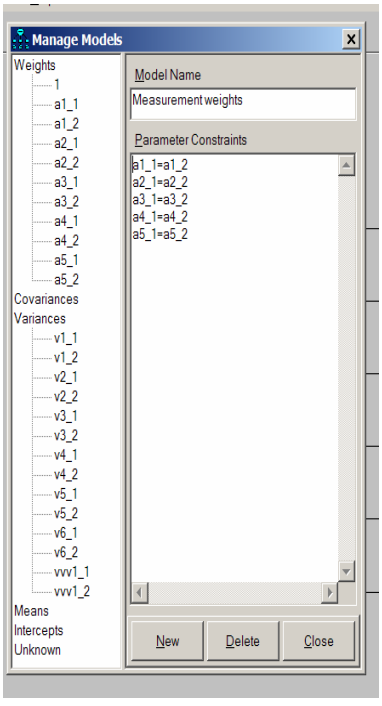
You can do this using the tools  by dragging the oval for the factor and then clicking on it 6 times to get the boxes. Then you can us the  to orientate the observed indicators by clicking on the factor. Then you can put the observed variables names in by clicking on  and dragging the names into the boxes. Finally the factors and errors can be named using the Macro "Name Unobserved Variables"

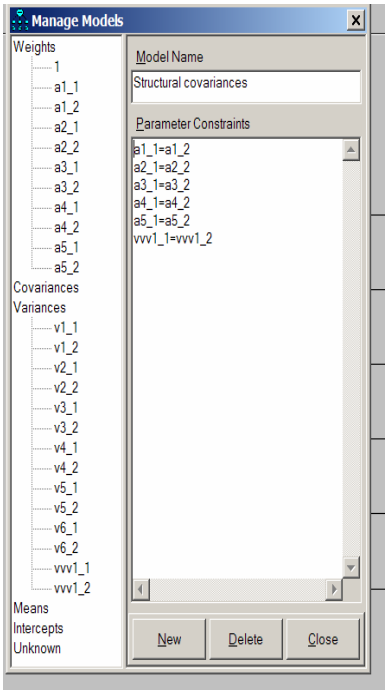


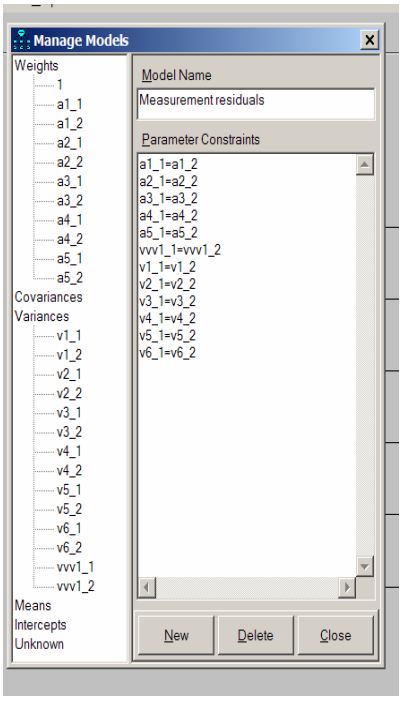
STEP 4: Click on Model fit → Multiple group analysis or click  . A window will pop up listing the different models which will be considered, each one is constraining additional parameters to be equal across the two groups (boys and girls). Click Ok and there should now be 4 models listed in the Amos window… "Unconstrained", "Measurement weights" "structural covariances" and "measurement residuals". The "measurement weights" model is fixing only the factor loadings, the "structural covariances" is additionally fixing the variance of the factor to be the same across groups and the "measurement residuals" is fixing the the covariances and variances of the errors to be the same. You can click on each model in the left side of the Amos window to see what it is constraining. See below:



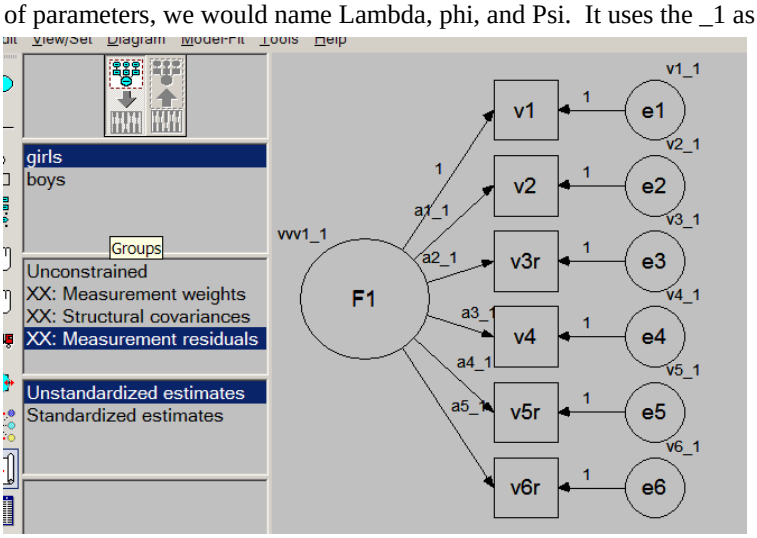


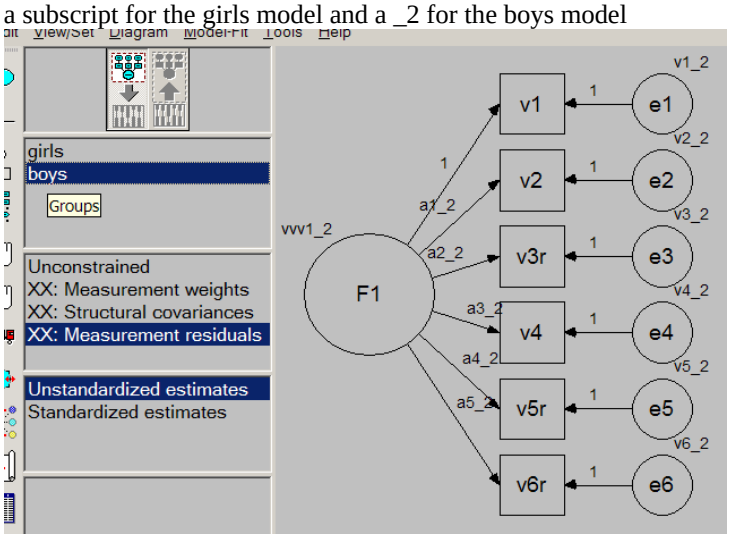






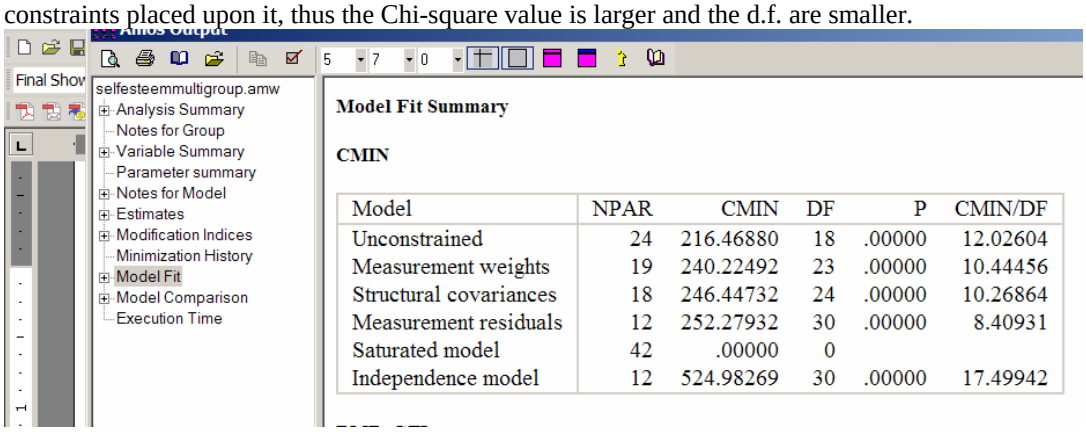
STEP 4 (continued): Notice that AMOS has placed parameter names on the model and that it uses a different naming root for different kinds of parameters, we would name Lambda, phi, and Psi. It uses the _1 as a subscript for the girls model and a _2 for the boys model





STEP 5: Click the abacus  to run the models. If they all worked correctly, each should say OK rather than XX. To look at the results, click on the AMOS output window  and click on Model Fit and Model Comparison.

Here are the chi-square values for the different models and the RMSEA values. Note that each of the multigroup models has more and more constraints placed upon it, thus the Chi-square value is larger and the d.f. are smaller.



Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Unconstrained	24	216.46880	18	.00000	12.02604
Measurement weights	19	240.22492	23	.00000	10.44456
Structural covariances	18	246.44732	24	.00000	10.26864
Measurement residuals	12	252.27932	30	.00000	8.40931
Saturated model	42	.00000	0		
Independence model	12	524.98269	30	.00000	17.49942

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Unconstrained	.20398	.18012	.22877	.00000
Measurement weights	.18879	.16757	.21077	.00000
Structural covariances	.18702	.16624	.20855	.00000
Measurement residuals	.16721	.14849	.18658	.00000
Independence model	.24952	.23104	.26848	.00000

STEP 6: **Modification Indices**: Each model fits pretty badly so we might look at Modification indices.

MODIFICATION INDICES

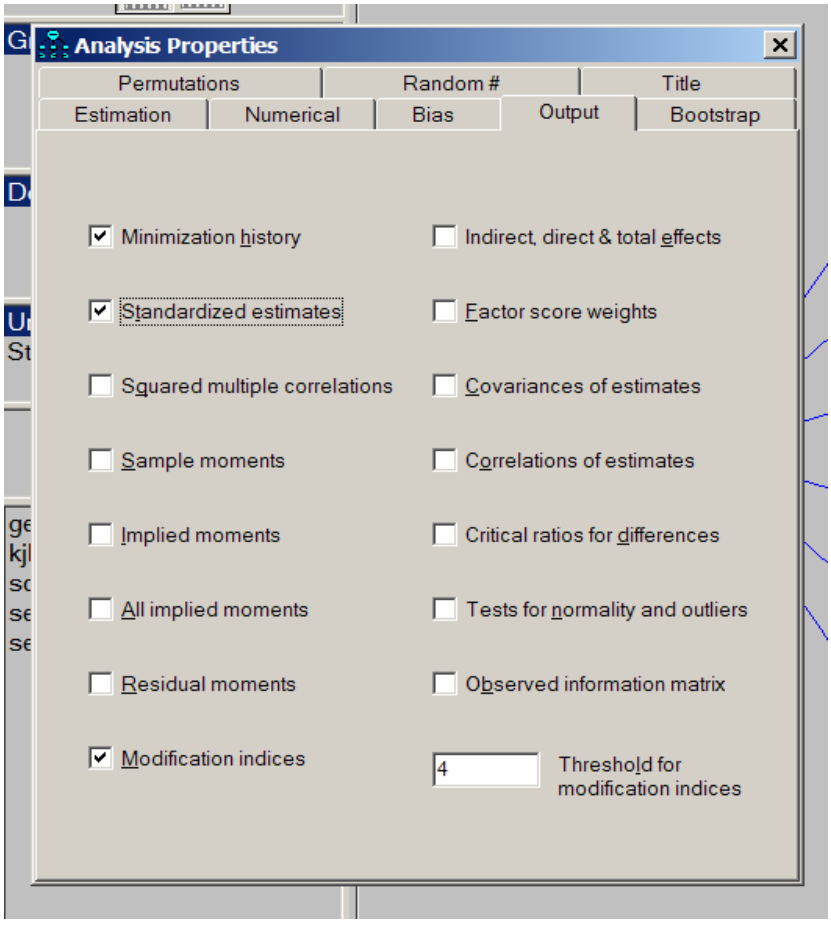
From the AMOS Help…

Amos computes a modification index for each parameter that is fixed at a constant value and for each parameter that is required to equal some other parameter. The modification index for a parameter is an estimate of the amount by which the discrepancy function would decrease if the analysis were repeated with the constraints on that parameter removed. The actual decrease that would occur may be much greater.

Amos computes modification indices not only for parameters that are explicitly constrained, but also for parameters that are implicitly assumed to be zero. For example, a modification index is computed for every covariance that is fixed at zero by default.

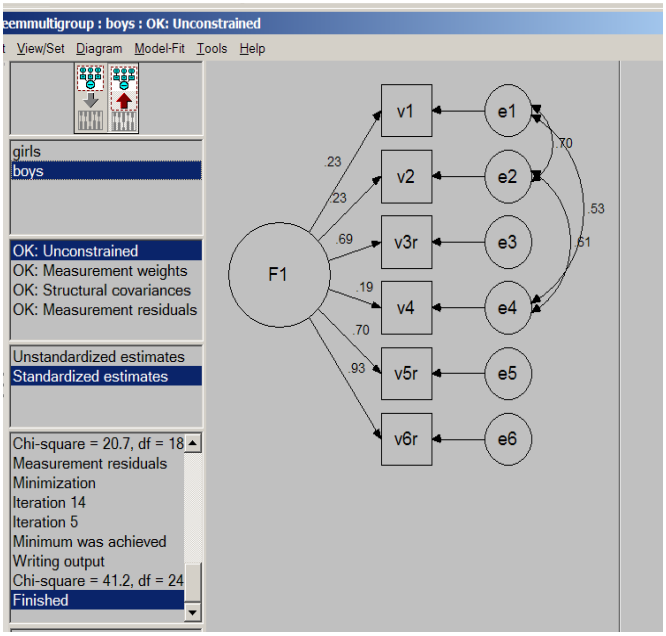
Amos also computes modification indices for paths that do not appear in a model, giving the approximate amount by which the discrepancy function would decrease if such a path were introduced. There are, however, two types of nonexistent paths for which Amos does not compute a modification index. First, Amos does not compute a modification index for a nonexistent path which, if introduced, would convert an exogenous variable into an endogenous variable. Second, Amos does not compute a modification index for a nonexistent path that, if introduced, would create an indirect path from a variable to itself where none already exists. In particular, Amos does not compute a modification index for a nonexistent path that, if introduced, would convert a recursive model to a nonrecursive one.
Each time Amos displays a modification index for a parameter, it also displays an estimate of the amount by which the parameter would change from its current, constrained value if the constraints on it were removed.
Specifying a small value for *Threshold* can result in the output of a large number of modification indices.

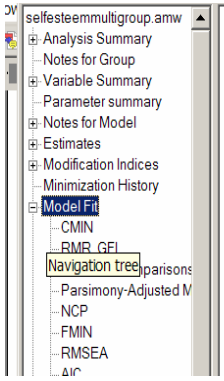
Under Analysis Properties,  hit the Output tab, then check the boxes for “Standardized estimates”, “Modification Indices”



Close this window by clicking the x in upper right corner, then run the model by hitting the abacus 

STEP 7: Click on the Modification indices in the output spreadsheet . What paths do the modification indices suggest should be added in order to get a better model fit. Play around with adding some correlations between the error terms to get a better model fit according to the Chi-square value.





Model Fit Summary

CMIN

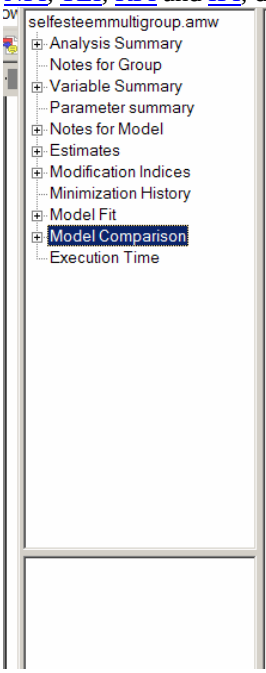
Model	NPAR	CMIN	DF	P	CMIN/DF
Unconstrained	30	17.79353	12	.12211	1.48279
Measurement weights	25	20.72086	17	.23903	1.21887
Structural covariances	24	20.74144	18	.29266	1.15230
Measurement residuals	18	41.20109	24	.01583	1.71671
Saturated model	42	.00000	0		
Independence model	12	188.17466	30	.00000	6.27249
Zero model	0	795.00000	42	.00000	18.92857

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Unconstrained	.04268	.00000	.08172	.57180
Measurement weights	.02874	.00000	.06570	.79629
Structural covariances	.02397	.00000	.06189	.84593
Measurement residuals	.05201	.02254	.07833	.41961
Independence model	.14105	.12213	.16069	.00000

Nested Model Comparisons

From Amos Help…
Amos examines every pair of models in which one model of the pair can be obtained by constraining the parameters of the other. For every such pair of "nested" models, several statistics for comparing the two models are displayed here.
Let the more constrained of the two models have a discrepancy of $\chi 2\_1$ with degrees of freedom df_1, and let the less constrained model have a discrepancy of $\chi 2\_2$ with degrees of freedom df_2. Then Amos computes the statistic $\chi 2\_1 - \chi 2\_2$, which, if the more constrained model is correct, has a chi-square distribution with degrees of freedom equal to df_1 – df_2. It can be used to test the null hypothesis that the more constrained model is correct under the assumption that the less constrained model is correct. Amos also reports the changes in the fit measures, NFI, TLI, RFI and IFI, described in Appendix C.



Nested Model Comparisons

Assuming model Unconstrained to be correct:

Model	DF	CMIN	P	NFI Delta-1	IFI Delta-2	RFI rho-1	TLI rho2
Measurement weights	5	2.74993	.73847	.00524	.00536	-.01737	-.01843
Structural covariances	6	2.76041	.83826	.00526	.00538	-.02140	-.02270
Measurement residuals	12	19.81605	.07065	.03775	.03863	.00193	.00205

Assuming model Measurement weights to be correct:

Model	DF	CMIN	P	NFI Delta-1	IFI Delta-2	RFI rho-1	TLI rho2
Structural covariances	1	.01048	.91847	.00002	.00002	-.00403	-.00427
Measurement residuals	7	17.06612	.01697	.03251	.03360	.01931	.02048

Assuming model Structural covariances to be correct:

Model	DF	CMIN	P	NFI Delta-1	IFI Delta-2	RFI rho-1	TLI rho2
Measurement residuals	6	17.05564	.00908	.03249	.03364	.02334	.02475