



Non-recursive system: peer influence on ambition

This is an example of a non-recursive system. In addition to its non-recursive nature, it involves a feature not previously discussed: direct effects of observed variables on latent variables. In the previous examples, all paths from latent variables have been directed to observed variables or to other latent variables. But in this example we have both observed “causes” and observed indicators of latent variables.

Sociologists have often called attention to the way in which one’s peers – e.g., best friends – influence one’s decisions – e.g., choice of occupation. They have recognized that the relation must be reciprocal – if my best friend influences my choice, I must influence his. Duncan, Haller & Portes (1968) present a simultaneous equation model of peer influences on occupational choice, using a sample of Michigan high-school students paired with their best friends. The authors interpret educational and occupational choices as two indicators of a single latent variable “ambition” and specify the choices. This model reciprocal causation between two latent variables is displayed in the figure below. Note that the variables in this figure are symmetrical with respect to a horizontal line in the middle.

Let

x_1 = respondent’s parental aspiration (REPARASP)

x_2 = respondent’s intelligence (REINTGCE)

x_3 = respondent’s socioeconomic status (RESOCIEC)

x_4 = best friend’s socioeconomic status (BFSOCIEC)

x_5 = best friend’s intelligence (BFINTGCE)

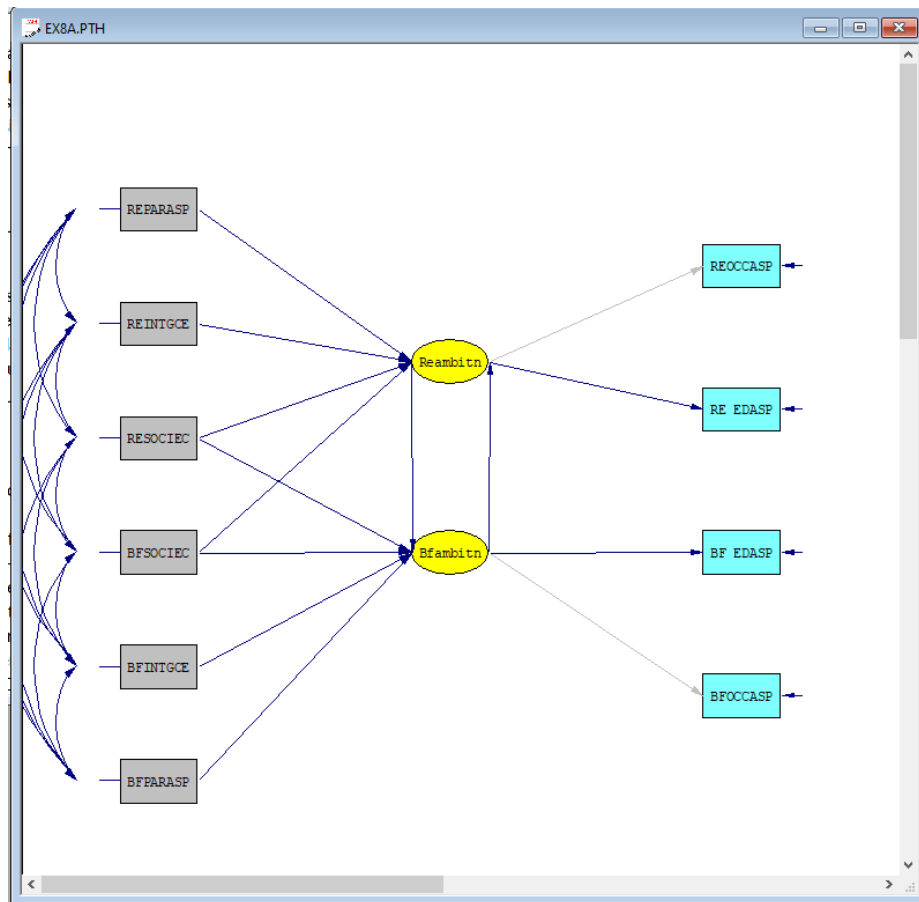
x_6 = best friend’s parental aspiration (BFPARASP)

y_1 = respondent’s occupational aspiration (REOCCASP)

y_2 = respondent's educational aspiration (RE EDASP)

y_3 = best friend's educational aspiration (BF EDASP)

y_4 = best friend's occupational aspiration (BFOCCASP)



The two latent variables are respondent's ambition (Reambitn) and best friend's ambition (Bfambitn).

The data for this example are given in the table below. Standard deviations are not given in Duncan, Haller & Portes (1868). Fictitious standard deviations are used here to emphasize that a covariance matrix must be analyzed to obtain correct standard errors of parameter estimates (see Cudeck, 1989).

Table: Correlations and standard deviations for background and aspiration measures for 329 respondents and their best friends

Respondent										
REINTGCE	1.0000									
REPARASP	0.1839	1.0000								
RESOSIEC	0.2220	0.0489	1.0000							
REOCCASP	0.4105	0.2137	0.3240	1.0000						
RE EDASP	0.4043	0.2742	0.4047	0.6247	1.0000					
Best friend										
BFINTGCE	0.3355	0.0782	0.2302	0.2995	0.2863	1.0000				
BFPARASP	0.1021	0.1147	0.0931	0.0760	0.0702	0.2087	1.0000			
BFSOCIEC	0.1861	0.0186	0.2707	0.2930	0.2407	0.2950	-0.0438	1.0000		
BFOCCASP	0.2598	0.0839	0.2786	0.4216	0.3275	0.5007	0.1988	0.3607	1.0000	
BFE DASP	0.2903	0.1124	0.3054	0.3269	0.3669	0.5191	0.2784	0.4105	0.6406	1.0000
Std. Dev.	1.095	1.071	1.030	0.978	1.001	1.036	1.021	1.002	1.055	1.022

First, we prepare three files: **EX8.LAB**, **EX8.COR**, and **EX8.STD**. **EX8.LAB** contains the names of the variables in free format, as follows:

```
REINTGCE REPARASP RESOCIEC REOCCASP 'RE EDASP'
BFINTGCE BFPARASP BFSOCIEC BFOCCASP 'BF EDASP'
```

Note that, although long names are used in the path diagram, only eight-character names are used in the file as the program can only use labels of at most eight characters. Note also that the order of the labels in the file corresponds to the order of the variables in the correlation matrix in the table, not the order of the variables in the path diagram.

The file **EX8.COR** contains the correlation matrix in free format:

```
1.0000
.1839 1.0000
.2220 .0489 1.0000
.4105 .2137 .3240 1.0000
.4043 .2742 .4047 .6247 1.0000
.3355 .0782 .2302 .2995 .2863 1.0000
.1021 .1147 .0931 .0760 .0702 .2087 1.0000
.1861 .0186 .2707 .2930 .2407 .2950 -.0438 1.0000
.2598 .0839 .2786 .4216 .3275 .5007 .1988 .3607 1.0000
.2903 .1124 .3054 .3269 .3669 .5191 .2784 .4105 .6404 1.0000
```

The file **EX8.STD** contains the standard deviations of the variables:

1.095 1.071 1.030 .978 1.001 1.036 1.021 1.002 1.055 1.022

The input file for this model is as follows (**EX8A.SPL** in the **Simplis Examples** folder):

Peer Influences on Ambition

Observed Variables from File EX8.LAB

Correlation Matrix from File EX8.COR

Standard Deviations from File EX8.STD

Reorder Variables: REPARASP REINTGCE RESOCIEC BFSOCIEC BFINTGCE BFPARASP
REOCCASP 'RE EDASP' 'BF EDASP' BFOCCASP

Sample Size 329

Latent Variables: Reambitn Bfambitn

Relationships

REOCCASP = 1*Reambitn

'RE EDASP' = Reambitn

'BF EDASP' = Bfambitn

BFOCCASP = 1*Bfambitn

Reambitn = Bfambitn REPARASP - BFSOCIEC

Bfambitn = Reambitn RESOCIEC - BFPARASP

Path Diagram

End of Problem

The observed variables may be reordered to correspond with their order in the path diagram. This is done by the two lines:

Reorder Variables: REPARASP REINTGCE RESOCIEC BFSOCIEC BFINTGCE BFPARASP
REOCCASP 'RE EDASP' 'BF EDASP' BFOCCASP

This is not necessary, but it is convenient because it makes the output more readable. It will also produce a path diagram, as shown earlier in this example in conceptual form.

The model is specified in the form of relationships. The first four relationships specify how the y-variables, i.e., the four variables on the right side in the path diagram, depend on the two latent variables. The 1* in the first and the last of these four relationships means that these paths should be fixed at 1.00. This defines the units of measurement of the two latent variables Reambitn and Bfambitn to be the same as that of REOCCASP and BFOCCASP, respectively. Since the observed variables REOCCASP and BFOCCASP are measured in the same unit, this implies that the two latent variables Reambitn and Bfambitn are in the same units also, which is necessary to be able to compare the path coefficients between respondent and best friend.

The last two relationships specify how the two latent variables Reambitn and Bfambitn depend on the x-variables.

In this model we are interested in testing the hypothesis that the effect of Reambitn on Bfambitn is equal to the effect of Bfambitn on Reambitn. This means that we must estimate these two paths under the constraint that they are equal. LISREL handles all such problems under the heading *equality constraints*. For this model, this is achieved by specifying

```
Set Path from Reambitn to Bfambitn equal to Path from Bfambitn to Reambitn
```

or

```
Let Path from Reambitn to Bfambitn = Path from Bfambitn to Reambitn
```

in the input file. The statement “path from A to B” can also be expressed as “path to B from A”. There are various alternative ways of specifying the same thing. Almost any free form may be used as long as:

- The line begins with Set or Let.
- There are two pairs of variables mentioned on the line.

The simplest form is perhaps

```
Set Reambitn -> Bfambitn = Bfambitn -> Reambitn
```

Where, as before, the symbol -> is used to denote a path.

The model without the equality constraint imposed results in a chi-square of

Degrees of Freedom for (C1)-(C2)	16
Maximum Likelihood Ratio Chi-Square (C1)	26.975 (P = 0.0418)

When the equality constraint is imposed (see **EX8B.SPL**),

Degrees of Freedom for (C1)-(C2)	17
Maximum Likelihood Ratio Chi-Square (C1)	27.043 (P = 0.0574)

The difference in chi-square, 0.07, may be used as a chi-square test statistic with one degree of freedom for testing the hypothesis that the reciprocal paths between the latent variables are equal. Thus, there is good evidence that the two reciprocal paths are equal.

One may also be interested in the hypothesis of complete symmetry between best friend and respondent, i.e., that the model is completely symmetric above and below a horizontal line in the middle of the path diagram. To test this hypothesis, one must include all the following equality constraints in the input file (see file **EX8C.SPL**):

```
Set Reambitn -> Bfambitn = Bfambitn -> Reambitn  
Set REPARASP -> Reambitn = BFPARASP -> Bfambitn
```

```
Set REINTGCE -> Reambitn = BFINTGCE -> Bfambitn
Set RESOCIEC -> Reambitn = BFSOCIEC -> Bfambitn
Set BFSOCIEC -> Reambitn = RESOCIEC -> Bfambitn
Set Reambitn -> 'RE EDASP' = Bfambitn -> 'BF EDASP'
```

The overall chi-square for this model is

Degrees of Freedom for (C1)-(C2)	22
Maximum Likelihood Ratio Chi-Square (C1)	32.131 (P = 0.0752)

Using the initial model as base model, the chi-square difference is 5.14 with 6 degrees of freedom, so the hypothesis of complete symmetry cannot be rejected.

This analysis of Model 8C specifies complete symmetry by putting equality constraints on the corresponding paths in the path diagram. It is also reasonable to assume that the error variances are equal between the respondent and the best friend for each observed and latent variables.

To specify equal error variances for the two latent variables, include a line:

```
Set the Error Variances of Reambitn and Bfambitn Equal
```

Similarly, set the error variances equal for each of the observed variables (see file **EX8D.SPL**):

```
Set the Error Variances of REOCCASP and BFOCCASP Equal
Set the Error Variances of 'RE EDASP' and 'BF EDASP' Equal
```

The overall chi-square for Model 8D is

Degrees of Freedom for (C1)-(C2)	25
Maximum Likelihood Ratio Chi-Square (C1)	33.541 (P = 0.1181)

The difference from the previous model is 1.41 with 3 degrees of freedom. Hence, there is good evidence that the error variances are also equal.