Final additional analyses for fSRM

1 Equality constraints

Two kind of equality constraints can be distinguished. First of all a researcher can be interested in comparing two separate groups in terms of one (or more) SRM-components. The currently used method in the scientific literature is the chi-square difference test, like Eichelsheim and colleagues used. The deltamethod however, is computationally much faster and only one analyses needs to be performed, rather than having a separate analyses for each possible SRM-effect. The R-code for both the means and the variances were separately uploaded on Github on 6/7/2013. Simulationstudies depicted that both methods are comparable in terms of power and type one error. Consequently, the deltamethod is most recommended for this type of analyses.
Secondly, when only one group is considered it can be interesting to evaluate whether or not some parameters differ significantly by role. One method is to perform an analyses in line with Kenny et al. (2006). These authors used a chi-square difference test in order to compare a constrained model with an unconstrained model. Unfortunately this has the disadvantages for an R-package of being computationally very slow because at least two models need to be fitted in order to compare them. A better option is to perform a Wald test, since it can evaluate the desired equality constraints after the basic fSRM-function has run. There is no need to construct or fit a new seperate model. The formula of this Wald test is depicted in equation 1 and can be easily extracted from the lavaanoutput.

$$\left(\frac{\theta}{se(\theta)}\right)^2 \tag{1}$$

Even though it is not possible to compare for example all four of the actor effects at once (because that results in an error), there is an easy solution. When only three out of four actor components are included in the calculation the fourth is already defined because the sum of the four components needs to be zero. This Wald-method was extensively tested and evaluated and compared with the chi-square difference test.
The files $WaldAct200sim.R$ and $WaldPar200sim.R$ contain the R-code for the calculations of the Type I error rate. The first part of this code describes the data simulation (based on the true values of the 4person.sav, with all actor effects are fixed to the same value). In the second part equation 1 is calculated for different sample sizes with 200 simulations (the analyses with 500 simulations are still running). The results are depicted in Table 1, which reflects that it didn't mattered which actor effect was not included in the wald formula. Only the sample size had an effect on the Type I error rate.

n	actmo	actfa	actc1	actc2
25	9.5	9.5	9.5	9.5
50	7.0	7.0	7.0	7.0
100	5.0	5.0	5.0	5.0

Table 1: Percentage of Type I error for the actor effects. The column name contains the SRM effect that was left out of the Wald formula.

Additionally, the files $ChiAct200sim.R$ and $ChiPar200sim.R$ contain the R-code for the same analyses with the chi-square test. The results for the chi-square difference test and this Wald test were identical.

This Wald method can of course be applied to different effects of interest. For example as Kenny, Kashy, & Cook (2006) investigated with the chi-square difference test whether or not there is significant more actor variance for mothers than for fathers in a particular group. Likewise it can be interesting to evaluate if dyadic reciprocity correlations differ significantly from each other or not.

2 Type of correlations between error terms

In order to calculate the SRM relationship effects separate from the residuals the use of multiple indicators for each observed relationship is indispensable. In current literature two different methods have been described:

- Kashy, Kenny & Cook (2006) allowed correlations between all the items that measured the first half of the scale (and in a similar fashion he also allowed the items of the second half of the scale to correlate).
- Branje et al. (2003) only allowed correlations between the items of the same rater for a particular indicator (e.g. for the first indicator they allowed correlations between MF, MC1, MC2). Both Branje and Eichelsheim let us know they only used this kind of correlations in their studies.

3 Dataset Eichelsheim et al. (2011)

In this paper the construct negativity is measured in two different groups with two indicators for each observed relationship. The goal of my analyses was to reproduce their results with our code. After the datacleaning aspect preliminary analyses revealed the exact same results as in their paper. Consequently the EQS-code that Bill used for the SRM analyses was examined very thoroughly. You can find this EQS-code in the attachment, together with the dataset *Branje.sav*.
The first interesting finding was that they allowed correlations between the same indicators (e.g. all the first indicators across observed relationships were allowed to correlate). This makes sense because Bill Cook preformed these analyses. A closer examination revealed that two correlations were (accidentally) missing:

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E26,E4
E26,E8
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Secondly, in EQS the user explicitly has to transform a covariance structure into a mean structure model by adding a constant $V999$. The user explicitly had to add the associated value, the corresponding residuals (D_i) are added automatically by EQS[1]. This results for example in the following equations:

```
F1 = 1.83*V999 + D1;
F2 = -0.24*V999 + D2;
F3 = -0.24*V999 + D3;
F4 = 0.16*V999 + D4;
F5 = 0.33*V999 + D5;
F6 = -0.23*V999 + D6;
F7 = 0.17*V999 + D7;
F8 = 0.30*V999 + D8;
```

[1] I had a meeting with Prof. Rosseel and he told me that in lavaan there is no distinction between the E_i and the D_i, in lavaan they are all just considered as variances.

It is not completely clear to me yet how he calculated this value, especially because the same values are used for the two separate groups. Eichelsheim et al. (2011) wrote: "As is the case with standard structured means analyses, the observed mean scores for each relationships were used to predict latent means, namely in this case, the means of the SRM effects." Therefor I calculated the SRM means with the formulas of Cook & Kenny (2004; see $V999calculation.R$. When the means were calculated for both groups at the same time the results were very different from those in the paper/EQS syntax. When only the first group was taken into account the results were almost identical to those in the EQS syntax.
Finally, the reciprocities and the constraints were added in EQS. The following constraint written in the second group makes clear that the mean actor effect of the mother in the first group needs to be equal to the mean actor effect in the second group:

```
(1,f2,v999)=(2,f2,v999);
```

When looking at the output of this EQS-syntax it is clear that this code (with the equality constraint for the mother actor effect) is used to report about the fitindices. Nonetheless one degree of freedom is added in the paper (maybe just because of this equality constraint? Or because the variance of V999 was taken into account?).
The R-code $transformationEichelsheim.R$ is an exact translation of this EQS-code. Consequently the output reflected identical means and variances to those in EQS when the label $mimic$ = "EQS" was used in the fitting function and negative variances were fixed to zero. Since only the family effect had a negative variance, no covariances needed to be fixed to zero.
Concerning the fitindices the value and df of 'independence model chi-square' of EQS are identical to the 'Model test baseline model' of lavaan. There is a difference though for the other fitindices, but this is due to the fact that they are only based on the covariance matrix (not the means) and used a slightly different calculation.
In sum: the results of the analyses in lavaan are identical in terms of means, variances, significance level and interpretations of the fitindices.