SEM

Brent Rappaport

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Load in data

```
data_wide <- read.csv("/Users/BrentRappaport/Box Sync/WashU/Classes/Longtudinal Methods/1-descriptives-a
data_wide <- data_wide[,-1]

#Make sex_01 a binary variable where 0=Male and 1=Female
data_wide$sex_01 <- data_wide$sex-1

#Make sex_c a factor variable
data_wide$sex_c <- ifelse(data_wide$sex_01==0,"Male","Female")
data_wide$sex_c <- as.factor(data_wide$sex_c)

#Center SES
data_wide$T1Income_to_Need_c <- as.numeric(scale(data_wide$T1Income_to_Need, center=T, scale=F))

#Make age0_ a variable of age from beginning of study (relative age to beginning), rather than aboslute
data_wide <- data_wide %>%
  mutate(age0_1 = age_1 - age_1,
         age0_3 = age_3 - age_1,
         age0_5 = age_5 - age_1,
         age0_10 = age_10 - age_1,
         age0_12 = age_12 - age_1,
         age0_14 = age_14 - age_1,
         age0_16 = age_16 - age_1,
         age0_18 = age_18 - age_1)

#Convert data to long form
data_long <- data_wide %>%
  gather(c(-ID,-sex,-sex_01,-sex_c,-T1_ACES_sum,-ethin,-T1Income_to_Need,-T1Income_to_Need_c,-IQ, -momm
           -momanxie, -momsuici, -momatten, -momsubab, -momschiz, -mompsnos, -momeatdi, -momcondu, -momm
           -rel_affective, -rel_MDD, -mom_MDDBP, -first_MDDBP, -rel_SUD),
         key = "time", value = "value") %>%
  separate(time, into = c("variable", "wave")) %>%
  spread(variable,value)

data_long$wave <- as.integer(data_long$wave)

#sort by id
data_long <- data_long[order(data_long$ID),]
```

Question 1

```
#1. Specify your model: Marker variable approach
mod.1 <- 'peer =~ PPeerScale_1 + TPeerScale_1
          aggression =~ PAggScale_1 + TAggScale_1
```

```
          prosocial =~ PProScale_1 + TProScale_1'

#2. Fit the model
fit.1 <- cfa(mod.1, data=data_wide, missing= "ML")
# other functions include sem, growth, and lavaan. All have different defaults (See below). we will use

#3. Display the summary output
summary(fit.1, fit.measures=TRUE)
```

```
## lavaan (0.5-23.1097) converged normally after 104 iterations
##
##                                                   Used       Total
##   Number of observations                            283         306
##
##   Number of missing patterns                          4
##
##   Estimator                                          ML
##   Minimum Function Test Statistic                27.094
##   Degrees of freedom                                  6
##   P-value (Chi-square)                            0.000
##
## Model test baseline model:
##
##   Minimum Function Test Statistic               207.342
##   Degrees of freedom                                 15
##   P-value                                         0.000
##
## User model versus baseline model:
##
##   Comparative Fit Index (CFI)                     0.890
##   Tucker-Lewis Index (TLI)                        0.726
##
## Loglikelihood and Information Criteria:
##
##   Loglikelihood user model (H0)              -4181.427
##   Loglikelihood unrestricted model (H1)      -4167.880
##
##   Number of free parameters                          21
##   Akaike (AIC)                                8404.855
##   Bayesian (BIC)                              8481.409
##   Sample-size adjusted Bayesian (BIC)         8414.818
##
## Root Mean Square Error of Approximation:
##
##   RMSEA                                          0.111
##   90 Percent Confidence Interval          0.071  0.156
##   P-value RMSEA <= 0.05                          0.008
##
## Standardized Root Mean Square Residual:
##
##   SRMR                                           0.050
##
## Parameter Estimates:
##
```

```
##   Information                                 Observed
##   Standard Errors                             Standard
##
## Latent Variables:
##                   Estimate  Std.Err  z-value  P(>|z|)
##   peer =~
##     PPeerScale_1      1.000
##     TPeerScale_1      1.348    0.262    5.135    0.000
##   aggression =~
##     PAggScale_1       1.000
##     TAggScale_1       1.191    0.285    4.186    0.000
##   prosocial =~
##     PProScale_1       1.000
##     TProScale_1       1.476    0.292    5.051    0.000
##
## Covariances:
##                   Estimate  Std.Err  z-value  P(>|z|)
##   peer ~~
##     aggression        6.009    1.587    3.785    0.000
##     prosocial         6.953    1.579    4.405    0.000
##   aggression ~~
##     prosocial         1.750    0.473    3.703    0.000
##
## Intercepts:
##                   Estimate  Std.Err  z-value  P(>|z|)
##    .PPeerScale_1     60.277    0.533  113.061    0.000
##    .TPeerScale_1     59.308    0.691   85.771    0.000
##    .PAggScale_1      12.830    0.183   70.141    0.000
##    .TAggScale_1      13.004    0.237   54.933    0.000
##    .PProScale_1       6.827    0.178   38.249    0.000
##    .TProScale_1       5.731    0.240   23.922    0.000
##     peer              0.000
##     aggression        0.000
##     prosocial         0.000
##
## Variances:
##                   Estimate  Std.Err  z-value  P(>|z|)
##    .PPeerScale_1     58.115    6.821    8.519    0.000
##    .TPeerScale_1     60.794   10.465    5.809    0.000
##    .PAggScale_1       6.022    0.946    6.369    0.000
##    .TAggScale_1       7.020    1.340    5.240    0.000
##    .PProScale_1       6.297    0.748    8.422    0.000
##    .TProScale_1       6.344    1.290    4.917    0.000
##     peer             22.325    6.673    3.346    0.001
##     aggression        3.447    1.008    3.421    0.001
##     prosocial         2.692    0.754    3.569    0.000
```

```r
#Fixed factor approach
fit.2 <- cfa(mod.1, std.lv=TRUE, data=data_wide, missing= "ML")

summary(fit.2, fit.measures=TRUE, standardized=TRUE)
```

```
## lavaan (0.5-23.1097) converged normally after  88 iterations
##
##                                                   Used       Total
```

```
##   Number of observations                           283         306
##
##   Number of missing patterns                         4
##
##   Estimator                                         ML
##   Minimum Function Test Statistic               27.094
##   Degrees of freedom                                 6
##   P-value (Chi-square)                           0.000
##
## Model test baseline model:
##
##   Minimum Function Test Statistic              207.342
##   Degrees of freedom                                15
##   P-value                                        0.000
##
## User model versus baseline model:
##
##   Comparative Fit Index (CFI)                    0.890
##   Tucker-Lewis Index (TLI)                       0.726
##
## Loglikelihood and Information Criteria:
##
##   Loglikelihood user model (H0)              -4181.427
##   Loglikelihood unrestricted model (H1)      -4167.880
##
##   Number of free parameters                         21
##   Akaike (AIC)                                8404.855
##   Bayesian (BIC)                              8481.409
##   Sample-size adjusted Bayesian (BIC)         8414.818
##
## Root Mean Square Error of Approximation:
##
##   RMSEA                                          0.111
##   90 Percent Confidence Interval          0.071  0.156
##   P-value RMSEA <= 0.05                          0.008
##
## Standardized Root Mean Square Residual:
##
##   SRMR                                           0.050
##
## Parameter Estimates:
##
##   Information                                 Observed
##   Standard Errors                             Standard
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   peer =~
##     PPeerScale_1      4.725    0.706    6.692    0.000    4.725    0.527
##     TPeerScale_1      6.368    0.975    6.532    0.000    6.368    0.633
##   aggression =~
##     PAggScale_1       1.857    0.271    6.842    0.000    1.857    0.603
##     TAggScale_1       2.212    0.344    6.431    0.000    2.212    0.641
##   prosocial =~
```

```
##     PProScale_1       1.641    0.230    7.139    0.000    1.641    0.547
##     TProScale_1       2.422    0.326    7.438    0.000    2.422    0.693
##
## Covariances:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   peer ~~
##     aggression        0.685    0.115    5.981    0.000    0.685    0.685
##     prosocial         0.897    0.115    7.828    0.000    0.897    0.897
##   aggression ~~
##     prosocial         0.575    0.107    5.379    0.000    0.575    0.575
##
## Intercepts:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .PPeerScale_1     60.277    0.533  113.061    0.000   60.277    6.721
##    .TPeerScale_1     59.308    0.691   85.771    0.000   59.308    5.891
##    .PAggScale_1      12.830    0.183   70.141    0.000   12.830    4.169
##    .TAggScale_1      13.004    0.237   54.933    0.000   13.004    3.768
##    .PProScale_1       6.827    0.178   38.249    0.000    6.827    2.277
##    .TProScale_1       5.731    0.240   23.922    0.000    5.731    1.640
##     peer              0.000                             0.000    0.000
##     aggression        0.000                             0.000    0.000
##     prosocial         0.000                             0.000    0.000
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .PPeerScale_1     58.115    6.821    8.519    0.000   58.115    0.722
##    .TPeerScale_1     60.794   10.465    5.809    0.000   60.794    0.600
##    .PAggScale_1       6.022    0.946    6.369    0.000    6.022    0.636
##    .TAggScale_1       7.020    1.340    5.240    0.000    7.020    0.589
##    .PProScale_1       6.297    0.748    8.422    0.000    6.297    0.701
##    .TProScale_1       6.344    1.290    4.917    0.000    6.344    0.520
##     peer              1.000                             1.000    1.000
##     aggression        1.000                             1.000    1.000
##     prosocial         1.000                             1.000    1.000
```

```
#Effects coding approach
mod.3 <- 'peer =~ NA*PPeerScale_1 + pe1*PPeerScale_1 + pe2*TPeerScale_1
          aggression =~ NA*PAggScale_1 +a1*PAggScale_1 + a2*TAggScale_1
          prosocial =~ NA*PProScale_1 + pr1*PProScale_1 + pr2*TProScale_1

     pe1 == 2 - pe2
     a1 == 2 - a2
     pr1 == 2 - pr2
'

fit.3 <- cfa(mod.3, data=data_wide, missing= "ML")
summary(fit.3, fit.measures=TRUE, standardized=TRUE)
```

```
## lavaan (0.5-23.1097) converged normally after  98 iterations
##
##                                                   Used       Total
##   Number of observations                            283         306
##
##   Number of missing patterns                          4
##
```

```
##   Estimator                                         ML
##   Minimum Function Test Statistic               27.094
##   Degrees of freedom                                 6
##   P-value (Chi-square)                           0.000
##
## Model test baseline model:
##
##   Minimum Function Test Statistic              207.342
##   Degrees of freedom                                15
##   P-value                                        0.000
##
## User model versus baseline model:
##
##   Comparative Fit Index (CFI)                    0.890
##   Tucker-Lewis Index (TLI)                       0.726
##
## Loglikelihood and Information Criteria:
##
##   Loglikelihood user model (H0)              -4181.427
##   Loglikelihood unrestricted model (H1)      -4167.880
##
##   Number of free parameters                         21
##   Akaike (AIC)                                8404.855
##   Bayesian (BIC)                              8481.409
##   Sample-size adjusted Bayesian (BIC)         8414.818
##
## Root Mean Square Error of Approximation:
##
##   RMSEA                                          0.111
##   90 Percent Confidence Interval          0.071  0.156
##   P-value RMSEA <= 0.05                          0.008
##
## Standardized Root Mean Square Residual:
##
##   SRMR                                           0.050
##
## Parameter Estimates:
##
##   Information                                 Observed
##   Standard Errors                             Standard
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   peer =~
##     PPrScl_1 (pe1)    0.852    0.095    8.945    0.000    4.725    0.527
##     TPrScl_1 (pe2)    1.148    0.095   12.055    0.000    6.368    0.633
##   aggression =~
##     PAggSc_1  (a1)    0.913    0.119    7.700    0.000    1.857    0.603
##     TAggSc_1  (a2)    1.087    0.119    9.174    0.000    2.212    0.641
##   prosocial =~
##     PPrScl_1 (pr1)    0.808    0.095    8.473    0.000    1.641    0.547
##     TPrScl_1 (pr2)    1.192    0.095   12.510    0.000    2.422    0.693
##
## Covariances:
```

```
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   peer ~~
##     aggression        7.729    1.490    5.187    0.000    0.685    0.685
##     prosocial        10.107    1.557    6.492    0.000    0.897    0.897
##   aggression ~~
##     prosocial         2.375    0.509    4.664    0.000    0.575    0.575
##
## Intercepts:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .PPeerScale_1     60.277    0.533  113.061    0.000   60.277    6.721
##    .TPeerScale_1     59.308    0.691   85.771    0.000   59.308    5.891
##    .PAggScale_1      12.830    0.183   70.141    0.000   12.830    4.169
##    .TAggScale_1      13.004    0.237   54.933    0.000   13.004    3.768
##    .PProScale_1       6.827    0.178   38.249    0.000    6.827    2.277
##    .TProScale_1       5.731    0.240   23.922    0.000    5.731    1.640
##     peer              0.000                             0.000    0.000
##     aggression        0.000                             0.000    0.000
##     prosocial         0.000                             0.000    0.000
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .PPeerScale_1     58.115    6.821    8.519    0.000   58.115    0.722
##    .TPeerScale_1     60.794   10.465    5.809    0.000   60.794    0.600
##    .PAggScale_1       6.022    0.946    6.369    0.000    6.022    0.636
##    .TAggScale_1       7.020    1.340    5.240    0.000    7.020    0.589
##    .PProScale_1       6.297    0.748    8.422    0.000    6.297    0.701
##    .TProScale_1       6.344    1.290    4.917    0.000    6.344    0.520
##     peer             30.764    7.199    4.273    0.000    1.000    1.000
##     aggression        4.139    0.774    5.349    0.000    1.000    1.000
##     prosocial         4.127    0.794    5.194    0.000    1.000    1.000
##
## Constraints:
##                                              |Slack|
##     pe1 - (2-pe2)                              0.000
##     a1 - (2-a2)                                0.000
##     pr1 - (2-pr2)                              0.000
```

Across the three models, the estimates of the latent variables (or the factor loadings) obviously change, but consistently indicate a larger factor loading teacher report onto the latent variable than parent report. This model indicates that the latent variables are accounting for a significant amount of variability in the indicators.

In the fixed factor model, the covariance estimates indicate the correlation between the latent variables, here indicating that the Peer and Prosocial variables are highly correlated (0.897), while Peer and Aggression and Aggression and Prosocial are moderately related (0.685 and 0.575, repectively). The std.all is not introduced in the marker model, but does not change across the fixed factor and effects coding, since it is the standardized indicator of how much variance is being accounted for by the latent variable.

The variance estimates for the latent variables also change. In the first (marker variable approach) and third model (effects coding), the estimates for the latent variables indicate that they are accounting for substantial variance in the scores. In the second model (fixed factor), the variance estimates are fixed to 1, and the variances of the residuals remains unchanged. In the third model (effects coding), the standarized estimates (std.all) are fixed to 1, but the raw estimates show significant variance accounted for.

Question 2

The RMSEA is above 0.1 (0.111), indicating a poor fit, however the SRMR is 0.050 indicating an acceptable fit. The CFI and TFI additionally fall below 0.90 (or 0.93) at 0.890 and 0.726, respectively, suggesting a less than optimal fit. The model indicates 15 degrees of freedom indicating that is it overidentified (good).

Question 3

```
#Longitudinal CFA
mod.4.full <- '
peer1 =~ PPeerScale_1 + TPeerScale_1
peer2 =~ PPeerScale_3 + TPeerScale_3
peer3 =~ PPeerScale_5 + TPeerScale_5
peer4 =~ PPeerScale_10 + TPeerScale_10
peer5 =~ PPeerScale_12 + TPeerScale_12
peer6 =~ PPeerScale_14 + TPeerScale_14
peer7 =~ PPeerScale_16 + TPeerScale_16
peer8 =~ PPeerScale_18 + TPeerScale_18

agg1 =~ PAggScale_1 + TAggScale_1
agg2 =~ PAggScale_3 + TAggScale_3
agg3 =~ PAggScale_5 + TAggScale_5
agg4 =~ PAggScale_10 + TAggScale_10
agg5 =~ PAggScale_12 + TAggScale_12
agg6 =~ PAggScale_14 + TAggScale_14
agg7 =~ PAggScale_16 + TAggScale_16
agg8 =~ PAggScale_18 + TAggScale_18

pro1 =~ PProScale_1 + TProScale_1
pro2 =~ PProScale_3 + TProScale_3
pro3 =~ PProScale_5 + TProScale_5
pro4 =~ PProScale_10 + TProScale_10
pro5 =~ PProScale_12 + TProScale_12
pro6 =~ PProScale_14 + TProScale_14
pro7 =~ PProScale_16 + TProScale_16
pro8 =~ PProScale_18 + TProScale_18

## correlated residuals across time
PPeerScale_1 ~~ PPeerScale_3 + PPeerScale_5 + PPeerScale_10 + PPeerScale_12 + PPeerScale_14 +
PPeerScale_16 + PPeerScale_18
PPeerScale_3 ~~ PPeerScale_5 + PPeerScale_10 + PPeerScale_12 + PPeerScale_14 +
PPeerScale_16 + PPeerScale_18
PPeerScale_5 ~~ PPeerScale_10 + PPeerScale_12 + PPeerScale_14 + PPeerScale_16 + PPeerScale_18
PPeerScale_10 ~~ PPeerScale_12 + PPeerScale_14 + PPeerScale_16 + PPeerScale_18
PPeerScale_12 ~~ PPeerScale_14 + PPeerScale_16 + PPeerScale_18
PPeerScale_14 ~~ PPeerScale_16 + PPeerScale_18
PPeerScale_16 ~~ PPeerScale_18

TPeerScale_1 ~~ TPeerScale_3 + TPeerScale_5 + TPeerScale_10 + TPeerScale_12 + TPeerScale_14 +
TPeerScale_16 + TPeerScale_18
TPeerScale_3 ~~ TPeerScale_5 + TPeerScale_10 + TPeerScale_12 + TPeerScale_14 +
TPeerScale_16 + TPeerScale_18
TPeerScale_5 ~~ TPeerScale_10 + TPeerScale_12 + TPeerScale_14 + TPeerScale_16 + TPeerScale_18
```

```
TPeerScale_10 ~~ TPeerScale_12 + TPeerScale_14 + TPeerScale_16 + TPeerScale_18
TPeerScale_12 ~~ TPeerScale_14 + TPeerScale_16 + TPeerScale_18
TPeerScale_14 ~~ TPeerScale_16 + TPeerScale_18
TPeerScale_16 ~~ TPeerScale_18

PAggScale_1 ~~ PAggScale_3 + PAggScale_5 + PAggScale_10 + PAggScale_12 + PAggScale_14 +
PAggScale_16 + PAggScale_18
PAggScale_3 ~~ PAggScale_5 + PAggScale_10 + PAggScale_12 + PAggScale_14 +
PAggScale_16 + PAggScale_18
PAggScale_5 ~~ PAggScale_10 + PAggScale_12 + PAggScale_14 + PAggScale_16 + PAggScale_18
PAggScale_10 ~~ PAggScale_12 + PAggScale_14 + PAggScale_16 + PAggScale_18
PAggScale_12 ~~ PAggScale_14 + PAggScale_16 + PAggScale_18
PAggScale_14 ~~ PAggScale_16 + PAggScale_18
PAggScale_16 ~~ PAggScale_18

TAggScale_1 ~~ TAggScale_3 + TAggScale_5 + TAggScale_10 + TAggScale_12 + TAggScale_14 +
TAggScale_16 + TAggScale_18
TAggScale_3 ~~ TAggScale_5 + TAggScale_10 + TAggScale_12 + TAggScale_14 +
TAggScale_16 + TAggScale_18
TAggScale_5 ~~ TAggScale_10 + TAggScale_12 + TAggScale_14 + TAggScale_16 + TAggScale_18
TAggScale_10 ~~ TAggScale_12 + TAggScale_14 + TAggScale_16 + TAggScale_18
TAggScale_12 ~~ TAggScale_14 + TAggScale_16 + TAggScale_18
TAggScale_14 ~~ TAggScale_16 + TAggScale_18
TAggScale_16 ~~ TAggScale_18

PProScale_1 ~~ PProScale_3 + PProScale_5 + PProScale_10 + PProScale_12 + PProScale_14 +
PProScale_16 + PProScale_18
PProScale_3 ~~ PProScale_5 + PProScale_10 + PProScale_12 + PProScale_14 +
PProScale_16 + PProScale_18
PProScale_5 ~~ PProScale_10 + PProScale_12 + PProScale_14 + PProScale_16 + PProScale_18
PProScale_10 ~~ PProScale_12 + PProScale_14 + PProScale_16 + PProScale_18
PProScale_12 ~~ PProScale_14 + PProScale_16 + PProScale_18
PProScale_14 ~~ PProScale_16 + PProScale_18
PProScale_16 ~~ PProScale_18

TProScale_1 ~~ TProScale_3 + TProScale_5 + TProScale_10 + TProScale_12 + TProScale_14 +
TProScale_16 + TProScale_18
TProScale_3 ~~ TProScale_5 + TProScale_10 + TProScale_12 + TProScale_14 +
TProScale_16 + TProScale_18
TProScale_5 ~~ TProScale_10 + TProScale_12 + TProScale_14 + TProScale_16 + TProScale_18
TProScale_10 ~~ TProScale_12 + TProScale_14 + TProScale_16 + TProScale_18
TProScale_12 ~~ TProScale_14 + TProScale_16 + TProScale_18
TProScale_14 ~~ TProScale_16 + TProScale_18
TProScale_16 ~~ TProScale_18
'

mod.4 <- '
peer1 =~ PPeerScale_1 + TPeerScale_1
peer2 =~ PPeerScale_3 + TPeerScale_3
peer3 =~ PPeerScale_5 + TPeerScale_5
peer4 =~ PPeerScale_10 + TPeerScale_10
peer5 =~ PPeerScale_12 + TPeerScale_12
peer6 =~ PPeerScale_14 + TPeerScale_14
```

```
agg1 =~ PAggScale_1 + TAggScale_1
agg2 =~ PAggScale_3 + TAggScale_3
agg3 =~ PAggScale_5 + TAggScale_5
agg4 =~ PAggScale_10 + TAggScale_10
agg5 =~ PAggScale_12 + TAggScale_12
agg6 =~ PAggScale_14 + TAggScale_14

pro1 =~ PProScale_1 + TProScale_1
pro2 =~ PProScale_3 + TProScale_3
pro3 =~ PProScale_5 + TProScale_5
pro4 =~ PProScale_10 + TProScale_10
pro5 =~ PProScale_12 + TProScale_12
pro6 =~ PProScale_14 + TProScale_14

## correlated residuals across time
PPeerScale_1 ~~ PPeerScale_3 + PPeerScale_5 + PPeerScale_10 + PPeerScale_12 + PPeerScale_14
PPeerScale_3 ~~ PPeerScale_5 + PPeerScale_10 + PPeerScale_12 + PPeerScale_14
PPeerScale_5 ~~ PPeerScale_10 + PPeerScale_12 + PPeerScale_14
PPeerScale_10 ~~ PPeerScale_12 + PPeerScale_14
PPeerScale_12 ~~ PPeerScale_14

TPeerScale_1 ~~ TPeerScale_3 + TPeerScale_5 + TPeerScale_10 + TPeerScale_12 + TPeerScale_14
TPeerScale_3 ~~ TPeerScale_5 + TPeerScale_10 + TPeerScale_12 + TPeerScale_14
TPeerScale_5 ~~ TPeerScale_10 + TPeerScale_12 + TPeerScale_14
TPeerScale_10 ~~ TPeerScale_12 + TPeerScale_14
TPeerScale_12 ~~ TPeerScale_14

PAggScale_1 ~~ PAggScale_3 + PAggScale_5 + PAggScale_10 + PAggScale_12 + PAggScale_14
PAggScale_3 ~~ PAggScale_5 + PAggScale_10 + PAggScale_12 + PAggScale_14
PAggScale_5 ~~ PAggScale_10 + PAggScale_12 + PAggScale_14
PAggScale_10 ~~ PAggScale_12 + PAggScale_14
PAggScale_12 ~~ PAggScale_14

TAggScale_1 ~~ TAggScale_3 + TAggScale_5 + TAggScale_10 + TAggScale_12 + TAggScale_14
TAggScale_3 ~~ TAggScale_5 + TAggScale_10 + TAggScale_12 + TAggScale_14
TAggScale_5 ~~ TAggScale_10 + TAggScale_12 + TAggScale_14
TAggScale_10 ~~ TAggScale_12 + TAggScale_14
TAggScale_12 ~~ TAggScale_14

PProScale_1 ~~ PProScale_3 + PProScale_5 + PProScale_10 + PProScale_12 + PProScale_14
PProScale_3 ~~ PProScale_5 + PProScale_10 + PProScale_12 + PProScale_14
PProScale_5 ~~ PProScale_10 + PProScale_12 + PProScale_14
PProScale_10 ~~ PProScale_12 + PProScale_14
PProScale_12 ~~ PProScale_14

TProScale_1 ~~ TProScale_3 + TProScale_5 + TProScale_10 + TProScale_12 + TProScale_14
TProScale_3 ~~ TProScale_5 + TProScale_10 + TProScale_12 + TProScale_14
TProScale_5 ~~ TProScale_10 + TProScale_12 + TProScale_14
TProScale_10 ~~ TProScale_12 + TProScale_14
TProScale_12 ~~ TProScale_14
'

fit.4 <- cfa(mod.4, data=data_wide, missing="ML", std.lv=TRUE)
```

```
inspect(fit.4,"cor.lv")
```

```
##       peer1 peer2 peer3 peer4 peer5 peer6 agg1  agg2  agg3  agg4  agg5
## peer1 1.000
## peer2 0.785 1.000
## peer3 0.875 0.818 1.000
## peer4 0.667 0.461 0.798 1.000
## peer5 0.626 0.655 1.070 1.060 1.000
## peer6 0.626 0.636 0.911 0.794 0.902 1.000
## agg1  0.655 0.421 0.453 0.369 0.226 0.445 1.000
## agg2  0.346 0.452 0.411 0.247 0.229 0.311 0.713 1.000
## agg3  0.500 0.570 0.689 0.438 0.447 0.460 0.833 0.809 1.000
## agg4  0.485 0.396 0.464 0.620 0.406 0.496 0.685 0.577 0.695 1.000
## agg5  0.484 0.328 0.456 0.482 0.597 0.479 0.677 0.604 0.946 0.715 1.000
## agg6  0.578 0.553 0.677 0.470 0.508 0.728 0.802 0.633 0.907 1.008 0.750
## pro1  0.843 0.620 0.598 0.513 0.359 0.444 0.518 0.292 0.449 0.182 0.217
## pro2  0.650 0.993 0.644 0.473 0.377 0.510 0.439 0.599 0.457 0.236 0.080
## pro3  0.391 0.576 0.749 0.590 0.581 0.674 0.489 0.532 0.620 0.336 0.370
## pro4  0.624 0.466 0.700 0.828 0.726 0.777 0.385 0.279 0.391 0.515 0.620
## pro5  0.467 0.593 0.604 0.742 0.865 0.747 0.521 0.560 0.592 0.514 0.825
## pro6  0.658 0.480 0.638 0.607 0.570 0.836 0.552 0.427 0.685 0.498 0.477
##       agg6  pro1  pro2  pro3  pro4  pro5  pro6
## peer1
## peer2
## peer3
## peer4
## peer5
## peer6
## agg1
## agg2
## agg3
## agg4
## agg5
## agg6  1.000
## pro1  0.313 1.000
## pro2  0.351 0.962 1.000
## pro3  0.430 0.761 0.858 1.000
## pro4  0.417 0.470 0.583 0.914 1.000
## pro5  0.658 0.445 0.775 0.789 0.894 1.000
## pro6  0.841 0.668 0.434 0.657 0.695 1.224 1.000
```

```
summary(fit.4, standardized=TRUE, fit.measures=TRUE)
```

```
## lavaan (0.5-23.1097) converged normally after 1106 iterations
##
##                                                   Used       Total
##   Number of observations                            302         306
##
##   Number of missing patterns                        154
##
##   Estimator                                          ML
##   Minimum Function Test Statistic               601.706
##   Degrees of freedom                                351
##   P-value (Chi-square)                            0.000
```

```
##
## Model test baseline model:
##
##   Minimum Function Test Statistic             3901.060
##   Degrees of freedom                              630
##   P-value                                       0.000
##
## User model versus baseline model:
##
##   Comparative Fit Index (CFI)                   0.923
##   Tucker-Lewis Index (TLI)                      0.862
##
## Loglikelihood and Information Criteria:
##
##   Loglikelihood user model (H0)             -20159.009
##   Loglikelihood unrestricted model (H1)     -19858.157
##
##   Number of free parameters                       351
##   Akaike (AIC)                              41020.019
##   Bayesian (BIC)                            42322.379
##   Sample-size adjusted Bayesian (BIC)       41209.199
##
## Root Mean Square Error of Approximation:
##
##   RMSEA                                         0.049
##   90 Percent Confidence Interval          0.042  0.055
##   P-value RMSEA <= 0.05                         0.626
##
## Standardized Root Mean Square Residual:
##
##   SRMR                                          0.072
##
## Parameter Estimates:
##
##   Information                                 Observed
##   Standard Errors                             Standard
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   peer1 =~
##     PPeerScale_1      5.096    0.640    7.968    0.000    5.096    0.566
##     TPeerScale_1      5.996    0.973    6.164    0.000    5.996    0.594
##   peer2 =~
##     PPeerScale_3      5.486    0.563    9.749    0.000    5.486    0.643
##     TPeerScale_3      5.891    0.758    7.772    0.000    5.891    0.670
##   peer3 =~
##     PPeerScale_5      4.224    0.563    7.499    0.000    4.224    0.483
##     TPeerScale_5      6.885    0.861    7.998    0.000    6.885    0.715
##   peer4 =~
##     PPeerScale_10     5.106    0.675    7.563    0.000    5.106    0.560
##     TPeerScale_10     7.022    1.073    6.542    0.000    7.022    0.646
##   peer5 =~
##     PPeerScale_12     6.199    0.578   10.726    0.000    6.199    0.672
##     TPeerScale_12     8.656    0.962    8.995    0.000    8.656    0.796
```

```
##   peer6 =~
##     PPeerScale_14     6.423    0.674    9.527    0.000    6.423    0.654
##     TPeerScale_14     7.970    0.894    8.920    0.000    7.970    0.776
##   agg1 =~
##     PAggScale_1       1.690    0.233    7.264    0.000    1.690    0.546
##     TAggScale_1       2.423    0.353    6.873    0.000    2.423    0.693
##   agg2 =~
##     PAggScale_3       1.601    0.237    6.744    0.000    1.601    0.594
##     TAggScale_3       1.782    0.341    5.224    0.000    1.782    0.593
##   agg3 =~
##     PAggScale_5       1.633    0.225    7.250    0.000    1.633    0.583
##     TAggScale_5       1.379    0.268    5.148    0.000    1.379    0.519
##   agg4 =~
##     PAggScale_10      1.841    0.230    8.017    0.000    1.841    0.732
##     TAggScale_10      1.856    0.312    5.955    0.000    1.856    0.643
##   agg5 =~
##     PAggScale_12      1.439    0.188    7.635    0.000    1.439    0.645
##     TAggScale_12      1.659    0.327    5.069    0.000    1.659    0.544
##   agg6 =~
##     PAggScale_14      1.295    0.155    8.377    0.000    1.295    0.642
##     TAggScale_14      1.799    0.258    6.983    0.000    1.799    0.703
##   pro1 =~
##     PProScale_1       1.344    0.221    6.092    0.000    1.344    0.453
##     TProScale_1       2.499    0.362    6.902    0.000    2.499    0.718
##   pro2 =~
##     PProScale_3       1.312    0.198    6.616    0.000    1.312    0.457
##     TProScale_3       2.210    0.335    6.588    0.000    2.210    0.644
##   pro3 =~
##     PProScale_5       1.485    0.209    7.119    0.000    1.485    0.516
##     TProScale_5       2.472    0.328    7.541    0.000    2.472    0.739
##   pro4 =~
##     PProScale_10      1.009    0.226    4.466    0.000    1.009    0.374
##     TProScale_10      2.272    0.560    4.055    0.000    2.272    0.622
##   pro5 =~
##     PProScale_12      1.227    0.199    6.169    0.000    1.227    0.425
##     TProScale_12      2.423    0.396    6.118    0.000    2.423    0.653
##   pro6 =~
##     PProScale_14      1.239    0.207    5.997    0.000    1.239    0.440
##     TProScale_14      2.743    0.390    7.033    0.000    2.743    0.728
##
## Covariances:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##  .PPeerScale_1 ~~
##    .PPeerScale_3     21.969    4.443    4.945    0.000   21.969    0.453
##    .PPeerScale_5     26.160    4.759    5.497    0.000   26.160    0.459
##    .PPeerScale_10    18.896    5.134    3.680    0.000   18.896    0.336
##    .PPeerScale_12    15.508    4.534    3.420    0.001   15.508    0.305
##    .PPeerScale_14    14.051    5.082    2.765    0.006   14.051    0.254
##  .PPeerScale_3 ~~
##    .PPeerScale_5     32.253    4.526    7.126    0.000   32.253    0.645
##    .PPeerScale_10    26.818    4.574    5.863    0.000   26.818    0.544
##    .PPeerScale_12    16.325    4.314    3.784    0.000   16.325    0.366
##    .PPeerScale_14    18.945    4.723    4.011    0.000   18.945    0.390
##  .PPeerScale_5 ~~
```

```
##    .PPeerScale_10    36.720    5.255    6.988    0.000   36.720    0.634
##    .PPeerScale_12    18.668    4.750    3.930    0.000   18.668    0.356
##    .PPeerScale_14    26.659    5.135    5.192    0.000   26.659    0.468
##  .PPeerScale_10 ~~
##    .PPeerScale_12    22.175    5.387    4.117    0.000   22.175    0.429
##    .PPeerScale_14    33.305    5.567    5.982    0.000   33.305    0.593
##  .PPeerScale_12 ~~
##    .PPeerScale_14    28.045    5.504    5.095    0.000   28.045    0.552
##  .TPeerScale_1 ~~
##    .TPeerScale_3      0.800    6.367    0.126    0.900    0.800    0.015
##    .TPeerScale_5     -8.932    7.910   -1.129    0.259   -8.932   -0.163
##    .TPeerScale_10    -2.300    8.956   -0.257    0.797   -2.300   -0.034
##    .TPeerScale_12     2.459    7.737    0.318    0.751    2.459    0.046
##    .TPeerScale_14     1.140    8.148    0.140    0.889    1.140    0.022
##  .TPeerScale_3 ~~
##    .TPeerScale_5    -13.169    5.957   -2.211    0.027  -13.169   -0.300
##    .TPeerScale_10    -4.421    6.760   -0.654    0.513   -4.421   -0.082
##    .TPeerScale_12    -7.631    6.601   -1.156    0.248   -7.631   -0.178
##    .TPeerScale_14    -2.835    6.259   -0.453    0.651   -2.835   -0.067
##  .TPeerScale_5 ~~
##    .TPeerScale_10     9.469    9.325    1.015    0.310    9.469    0.169
##    .TPeerScale_12   -12.496    8.779   -1.423    0.155  -12.496   -0.282
##    .TPeerScale_14    -0.160    7.959   -0.020    0.984   -0.160   -0.004
##  .TPeerScale_10 ~~
##    .TPeerScale_12    -2.153   10.601   -0.203    0.839   -2.153   -0.039
##    .TPeerScale_14    10.188    8.834    1.153    0.249   10.188    0.190
##  .TPeerScale_12 ~~
##    .TPeerScale_14    -4.200    8.042   -0.522    0.601   -4.200   -0.098
##  .PAggScale_1 ~~
##    .PAggScale_3       3.595    0.580    6.199    0.000    3.595    0.640
##    .PAggScale_5       3.279    0.585    5.608    0.000    3.279    0.556
##    .PAggScale_10      1.358    0.506    2.683    0.007    1.358    0.306
##    .PAggScale_12      0.749    0.472    1.587    0.113    0.749    0.169
##    .PAggScale_14      1.592    0.421    3.778    0.000    1.592    0.396
##  .PAggScale_3 ~~
##    .PAggScale_5       3.210    0.568    5.649    0.000    3.210    0.651
##    .PAggScale_10      1.278    0.476    2.682    0.007    1.278    0.344
##    .PAggScale_12      1.080    0.435    2.480    0.013    1.080    0.292
##    .PAggScale_14      1.065    0.373    2.855    0.004    1.065    0.318
##  .PAggScale_5 ~~
##    .PAggScale_10      2.080    0.490    4.248    0.000    2.080    0.534
##    .PAggScale_12      0.928    0.479    1.938    0.053    0.928    0.239
##    .PAggScale_14      1.131    0.384    2.945    0.003    1.131    0.321
##  .PAggScale_10 ~~
##    .PAggScale_12      1.798    0.446    4.033    0.000    1.798    0.615
##    .PAggScale_14      0.513    0.388    1.321    0.187    0.513    0.193
##  .PAggScale_12 ~~
##    .PAggScale_14      0.637    0.317    2.012    0.044    0.637    0.241
##  .TAggScale_1 ~~
##    .TAggScale_3       1.268    0.950    1.335    0.182    1.268    0.208
##    .TAggScale_5       1.087    0.753    1.444    0.149    1.087    0.190
##    .TAggScale_10      0.309    0.766    0.404    0.686    0.309    0.056
##    .TAggScale_12     -0.125    0.842   -0.149    0.882   -0.125   -0.019
##    .TAggScale_14      0.816    0.753    1.083    0.279    0.816    0.178
```

```
##  .TAggScale_3 ~~
##    .TAggScale_5       1.204    0.648    1.859    0.063    1.204    0.219
##    .TAggScale_10      1.025    0.682    1.503    0.133    1.025    0.192
##    .TAggScale_12      0.948    0.896    1.058    0.290    0.948    0.153
##    .TAggScale_14      0.402    0.598    0.671    0.502    0.402    0.091
##  .TAggScale_5 ~~
##    .TAggScale_10      0.667    0.596    1.119    0.263    0.667    0.133
##    .TAggScale_12     -0.010    0.643   -0.015    0.988   -0.010   -0.002
##    .TAggScale_14      0.313    0.518    0.604    0.546    0.313    0.076
##  .TAggScale_10 ~~
##    .TAggScale_12      1.349    0.748    1.805    0.071    1.349    0.239
##    .TAggScale_14      0.281    0.668    0.421    0.674    0.281    0.070
##  .TAggScale_12 ~~
##    .TAggScale_14     -0.209    0.578   -0.361    0.718   -0.209   -0.045
##  .PProScale_1 ~~
##    .PProScale_3       3.012    0.565    5.331    0.000    3.012    0.446
##    .PProScale_5       3.334    0.564    5.913    0.000    3.334    0.511
##    .PProScale_10      2.791    0.531    5.256    0.000    2.791    0.421
##    .PProScale_12      2.179    0.518    4.205    0.000    2.179    0.315
##    .PProScale_14      1.647    0.525    3.134    0.002    1.647    0.246
##  .PProScale_3 ~~
##    .PProScale_5       2.995    0.532    5.635    0.000    2.995    0.476
##    .PProScale_10      2.976    0.530    5.620    0.000    2.976    0.465
##    .PProScale_12      2.588    0.540    4.791    0.000    2.588    0.388
##    .PProScale_14      2.760    0.522    5.287    0.000    2.760    0.428
##  .PProScale_5 ~~
##    .PProScale_10      2.855    0.526    5.432    0.000    2.855    0.462
##    .PProScale_12      3.395    0.520    6.535    0.000    3.395    0.528
##    .PProScale_14      2.516    0.499    5.043    0.000    2.516    0.404
##  .PProScale_10 ~~
##    .PProScale_12      4.154    0.546    7.615    0.000    4.154    0.635
##    .PProScale_14      3.330    0.539    6.181    0.000    3.330    0.526
##  .PProScale_12 ~~
##    .PProScale_14      3.057    0.569    5.374    0.000    3.057    0.463
##  .TProScale_1 ~~
##    .TProScale_3      -0.306    1.148   -0.267    0.790   -0.306   -0.048
##    .TProScale_5      -0.114    1.079   -0.106    0.916   -0.114   -0.021
##    .TProScale_10     -0.082    1.210   -0.067    0.946   -0.082   -0.012
##    .TProScale_12      0.579    1.175    0.493    0.622    0.579    0.085
##    .TProScale_14     -2.537    1.338   -1.896    0.058   -2.537   -0.406
##  .TProScale_3 ~~
##    .TProScale_5      -1.284    1.101   -1.167    0.243   -1.284   -0.217
##    .TProScale_10      0.327    1.393    0.235    0.815    0.327    0.043
##    .TProScale_12     -0.566    1.254   -0.452    0.652   -0.566   -0.077
##    .TProScale_14      0.876    1.218    0.719    0.472    0.876    0.129
##  .TProScale_5 ~~
##    .TProScale_10     -1.876    1.381   -1.359    0.174   -1.876   -0.291
##    .TProScale_12     -0.804    1.120   -0.718    0.473   -0.804   -0.127
##    .TProScale_14     -0.283    1.081   -0.262    0.794   -0.283   -0.049
##  .TProScale_10 ~~
##    .TProScale_12     -0.124    1.570   -0.079    0.937   -0.124   -0.015
##    .TProScale_14      0.537    1.467    0.366    0.715    0.537    0.073
##  .TProScale_12 ~~
##    .TProScale_14     -3.793    1.541   -2.461    0.014   -3.793   -0.522
```

```
##   peer1 ~~
##     peer2           0.785    0.103    7.656    0.000    0.785    0.785
##     peer3           0.875    0.114    7.660    0.000    0.875    0.875
##     peer4           0.667    0.140    4.757    0.000    0.667    0.667
##     peer5           0.626    0.107    5.856    0.000    0.626    0.626
##     peer6           0.626    0.120    5.236    0.000    0.626    0.626
##     agg1            0.655    0.114    5.741    0.000    0.655    0.655
##     agg2            0.346    0.127    2.717    0.007    0.346    0.346
##     agg3            0.500    0.130    3.836    0.000    0.500    0.500
##     agg4            0.485    0.122    3.981    0.000    0.485    0.485
##     agg5            0.484    0.129    3.763    0.000    0.484    0.484
##     agg6            0.578    0.119    4.866    0.000    0.578    0.578
##     pro1            0.843    0.120    7.025    0.000    0.843    0.843
##     pro2            0.650    0.134    4.846    0.000    0.650    0.650
##     pro3            0.391    0.119    3.294    0.001    0.391    0.391
##     pro4            0.624    0.230    2.714    0.007    0.624    0.624
##     pro5            0.467    0.144    3.246    0.001    0.467    0.467
##     pro6            0.658    0.146    4.499    0.000    0.658    0.658
##   peer2 ~~
##     peer3           0.818    0.091    8.994    0.000    0.818    0.818
##     peer4           0.461    0.113    4.095    0.000    0.461    0.461
##     peer5           0.655    0.094    6.932    0.000    0.655    0.655
##     peer6           0.636    0.094    6.774    0.000    0.636    0.636
##     agg1            0.421    0.106    3.956    0.000    0.421    0.421
##     agg2            0.452    0.107    4.234    0.000    0.452    0.452
##     agg3            0.570    0.117    4.866    0.000    0.570    0.570
##     agg4            0.396    0.104    3.801    0.000    0.396    0.396
##     agg5            0.328    0.119    2.764    0.006    0.328    0.328
##     agg6            0.553    0.106    5.200    0.000    0.553    0.553
##     pro1            0.620    0.109    5.700    0.000    0.620    0.620
##     pro2            0.993    0.103    9.618    0.000    0.993    0.993
##     pro3            0.576    0.105    5.473    0.000    0.576    0.576
##     pro4            0.466    0.164    2.842    0.004    0.466    0.466
##     pro5            0.593    0.124    4.787    0.000    0.593    0.593
##     pro6            0.480    0.116    4.122    0.000    0.480    0.480
##   peer3 ~~
##     peer4           0.798    0.091    8.790    0.000    0.798    0.798
##     peer5           1.070    0.088   12.182    0.000    1.070    1.070
##     peer6           0.911    0.084   10.793    0.000    0.911    0.911
##     agg1            0.453    0.125    3.623    0.000    0.453    0.453
##     agg2            0.411    0.129    3.194    0.001    0.411    0.411
##     agg3            0.689    0.129    5.360    0.000    0.689    0.689
##     agg4            0.464    0.116    3.994    0.000    0.464    0.464
##     agg5            0.456    0.130    3.502    0.000    0.456    0.456
##     agg6            0.677    0.114    5.960    0.000    0.677    0.677
##     pro1            0.598    0.128    4.664    0.000    0.598    0.598
##     pro2            0.644    0.137    4.686    0.000    0.644    0.644
##     pro3            0.749    0.109    6.893    0.000    0.749    0.749
##     pro4            0.700    0.171    4.084    0.000    0.700    0.700
##     pro5            0.604    0.130    4.632    0.000    0.604    0.604
##     pro6            0.638    0.131    4.884    0.000    0.638    0.638
##   peer4 ~~
##     peer5           1.060    0.084   12.685    0.000    1.060    1.060
##     peer6           0.794    0.085    9.284    0.000    0.794    0.794
```

```
##     agg1             0.369    0.136    2.707    0.007    0.369    0.369
##     agg2             0.247    0.147    1.689    0.091    0.247    0.247
##     agg3             0.438    0.150    2.912    0.004    0.438    0.438
##     agg4             0.620    0.113    5.476    0.000    0.620    0.620
##     agg5             0.482    0.149    3.234    0.001    0.482    0.482
##     agg6             0.470    0.122    3.858    0.000    0.470    0.470
##     pro1             0.513    0.128    4.017    0.000    0.513    0.513
##     pro2             0.473    0.141    3.363    0.001    0.473    0.473
##     pro3             0.590    0.107    5.495    0.000    0.590    0.590
##     pro4             0.828    0.157    5.283    0.000    0.828    0.828
##     pro5             0.742    0.137    5.425    0.000    0.742    0.742
##     pro6             0.607    0.142    4.268    0.000    0.607    0.607
##   peer5 ~~
##     peer6            0.902    0.062   14.515    0.000    0.902    0.902
##     agg1             0.226    0.111    2.033    0.042    0.226    0.226
##     agg2             0.229    0.116    1.976    0.048    0.229    0.229
##     agg3             0.447    0.110    4.072    0.000    0.447    0.447
##     agg4             0.406    0.098    4.164    0.000    0.406    0.406
##     agg5             0.597    0.103    5.780    0.000    0.597    0.597
##     agg6             0.508    0.098    5.178    0.000    0.508    0.508
##     pro1             0.359    0.109    3.301    0.001    0.359    0.359
##     pro2             0.377    0.125    3.005    0.003    0.377    0.377
##     pro3             0.581    0.089    6.514    0.000    0.581    0.581
##     pro4             0.726    0.163    4.455    0.000    0.726    0.726
##     pro5             0.865    0.108    8.029    0.000    0.865    0.865
##     pro6             0.570    0.117    4.889    0.000    0.570    0.570
##   peer6 ~~
##     agg1             0.445    0.114    3.891    0.000    0.445    0.445
##     agg2             0.311    0.119    2.610    0.009    0.311    0.311
##     agg3             0.460    0.120    3.832    0.000    0.460    0.460
##     agg4             0.496    0.097    5.094    0.000    0.496    0.496
##     agg5             0.479    0.117    4.091    0.000    0.479    0.479
##     agg6             0.728    0.090    8.077    0.000    0.728    0.728
##     pro1             0.444    0.111    4.000    0.000    0.444    0.444
##     pro2             0.510    0.124    4.115    0.000    0.510    0.510
##     pro3             0.674    0.091    7.407    0.000    0.674    0.674
##     pro4             0.777    0.160    4.858    0.000    0.777    0.777
##     pro5             0.747    0.114    6.544    0.000    0.747    0.747
##     pro6             0.836    0.112    7.474    0.000    0.836    0.836
##   agg1 ~~
##     agg2             0.713    0.092    7.738    0.000    0.713    0.713
##     agg3             0.833    0.102    8.190    0.000    0.833    0.833
##     agg4             0.685    0.109    6.296    0.000    0.685    0.685
##     agg5             0.677    0.141    4.790    0.000    0.677    0.677
##     agg6             0.802    0.101    7.965    0.000    0.802    0.802
##     pro1             0.518    0.114    4.537    0.000    0.518    0.518
##     pro2             0.439    0.130    3.387    0.001    0.439    0.439
##     pro3             0.489    0.122    4.007    0.000    0.489    0.489
##     pro4             0.385    0.171    2.254    0.024    0.385    0.385
##     pro5             0.521    0.135    3.876    0.000    0.521    0.521
##     pro6             0.552    0.141    3.901    0.000    0.552    0.552
##   agg2 ~~
##     agg3             0.809    0.104    7.767    0.000    0.809    0.809
##     agg4             0.577    0.121    4.765    0.000    0.577    0.577
```

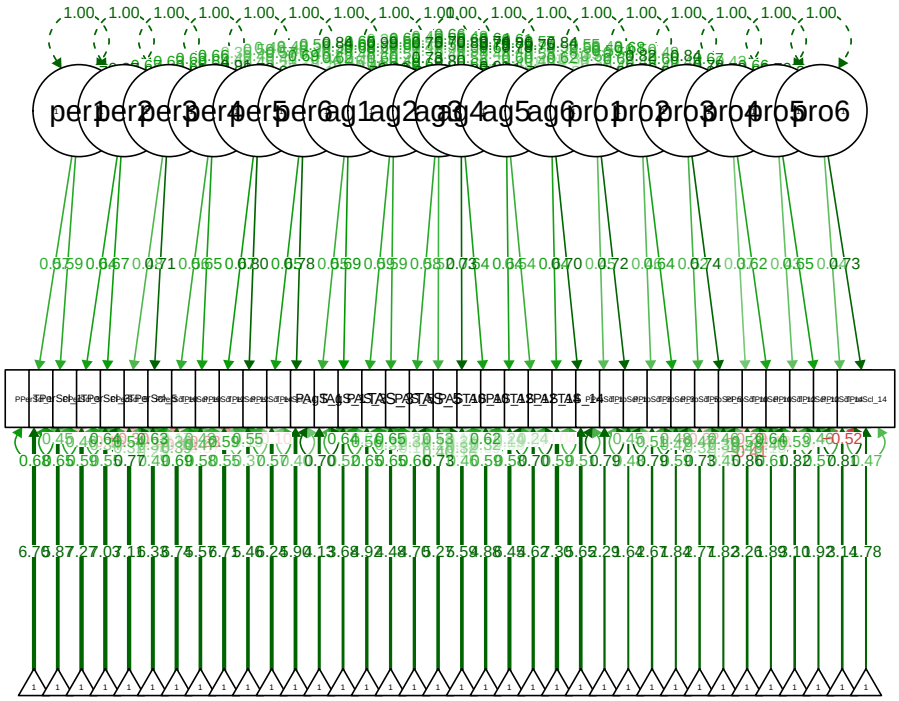
```
##     agg5             0.604    0.137    4.427    0.000    0.604    0.604
##     agg6             0.633    0.132    4.802    0.000    0.633    0.633
##     pro1             0.292    0.130    2.252    0.024    0.292    0.292
##     pro2             0.599    0.125    4.805    0.000    0.599    0.599
##     pro3             0.532    0.119    4.472    0.000    0.532    0.532
##     pro4             0.279    0.170    1.643    0.100    0.279    0.279
##     pro5             0.560    0.138    4.048    0.000    0.560    0.560
##     pro6             0.427    0.136    3.147    0.002    0.427    0.427
##   agg3 ~~
##     agg4             0.695    0.113    6.139    0.000    0.695    0.695
##     agg5             0.946    0.149    6.337    0.000    0.946    0.946
##     agg6             0.907    0.123    7.386    0.000    0.907    0.907
##     pro1             0.449    0.134    3.342    0.001    0.449    0.449
##     pro2             0.457    0.142    3.205    0.001    0.457    0.457
##     pro3             0.620    0.123    5.027    0.000    0.620    0.620
##     pro4             0.391    0.182    2.152    0.031    0.391    0.391
##     pro5             0.592    0.139    4.260    0.000    0.592    0.592
##     pro6             0.685    0.137    4.988    0.000    0.685    0.685
##   agg4 ~~
##     agg5             0.715    0.106    6.756    0.000    0.715    0.715
##     agg6             1.008    0.092   10.963    0.000    1.008    1.008
##     pro1             0.182    0.128    1.416    0.157    0.182    0.182
##     pro2             0.236    0.138    1.703    0.089    0.236    0.236
##     pro3             0.336    0.112    3.008    0.003    0.336    0.336
##     pro4             0.515    0.155    3.332    0.001    0.515    0.515
##     pro5             0.514    0.124    4.148    0.000    0.514    0.514
##     pro6             0.498    0.119    4.189    0.000    0.498    0.498
##   agg5 ~~
##     agg6             0.750    0.134    5.603    0.000    0.750    0.750
##     pro1             0.217    0.128    1.694    0.090    0.217    0.217
##     pro2             0.080    0.141    0.570    0.569    0.080    0.080
##     pro3             0.370    0.123    3.009    0.003    0.370    0.370
##     pro4             0.620    0.171    3.629    0.000    0.620    0.620
##     pro5             0.825    0.136    6.065    0.000    0.825    0.825
##     pro6             0.477    0.134    3.559    0.000    0.477    0.477
##   agg6 ~~
##     pro1             0.313    0.126    2.493    0.013    0.313    0.313
##     pro2             0.351    0.141    2.486    0.013    0.351    0.351
##     pro3             0.430    0.113    3.790    0.000    0.430    0.430
##     pro4             0.417    0.161    2.582    0.010    0.417    0.417
##     pro5             0.658    0.125    5.269    0.000    0.658    0.658
##     pro6             0.841    0.111    7.587    0.000    0.841    0.841
##   pro1 ~~
##     pro2             0.962    0.129    7.478    0.000    0.962    0.962
##     pro3             0.761    0.104    7.323    0.000    0.761    0.761
##     pro4             0.470    0.176    2.671    0.008    0.470    0.470
##     pro5             0.445    0.160    2.788    0.005    0.445    0.445
##     pro6             0.668    0.167    4.009    0.000    0.668    0.668
##   pro2 ~~
##     pro3             0.858    0.125    6.857    0.000    0.858    0.858
##     pro4             0.583    0.181    3.225    0.001    0.583    0.583
##     pro5             0.775    0.160    4.851    0.000    0.775    0.775
##     pro6             0.434    0.157    2.759    0.006    0.434    0.434
##   pro3 ~~
```

```
##     pro4              0.914    0.164    5.582    0.000    0.914    0.914
##     pro5              0.789    0.117    6.714    0.000    0.789    0.789
##     pro6              0.657    0.126    5.227    0.000    0.657    0.657
##   pro4 ~~
##     pro5              0.894    0.153    5.840    0.000    0.894    0.894
##     pro6              0.695    0.169    4.107    0.000    0.695    0.695
##   pro5 ~~
##     pro6              1.224    0.174    7.052    0.000    1.224    1.224
##
## Intercepts:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .PPeerScale_1     60.344    0.530  113.923    0.000   60.344    6.697
##    .TPeerScale_1     59.230    0.697   85.008    0.000   59.230    5.870
##    .PPeerScale_3     62.021    0.515  120.454    0.000   62.021    7.275
##    .TPeerScale_3     61.773    0.634   97.398    0.000   61.773    7.030
##    .PPeerScale_5     62.256    0.531  117.193    0.000   62.256    7.114
##    .TPeerScale_5     61.023    0.661   92.303    0.000   61.023    6.334
##    .PPeerScale_10    61.468    0.570  107.823    0.000   61.468    6.739
##    .TPeerScale_10    60.514    0.792   76.395    0.000   60.514    5.569
##    .PPeerScale_12    61.906    0.559  110.679    0.000   61.906    6.710
##    .TPeerScale_12    59.415    0.770   77.139    0.000   59.415    5.464
##    .PPeerScale_14    61.339    0.619   99.142    0.000   61.339    6.242
##    .TPeerScale_14    60.598    0.765   79.254    0.000   60.598    5.900
##    .PAggScale_1      12.798    0.181   70.543    0.000   12.798    4.133
##    .TAggScale_1      12.859    0.235   54.672    0.000   12.859    3.678
##    .PAggScale_3      13.252    0.162   81.682    0.000   13.252    4.920
##    .TAggScale_3      13.458    0.221   60.837    0.000   13.458    4.481
##    .PAggScale_5      13.158    0.170   77.423    0.000   13.158    4.699
##    .TAggScale_5      14.012    0.189   74.019    0.000   14.012    5.272
##    .PAggScale_10     14.064    0.158   88.828    0.000   14.064    5.593
##    .TAggScale_10     14.076    0.214   65.877    0.000   14.076    4.875
##    .PAggScale_12     14.400    0.137  105.347    0.000   14.400    6.453
##    .TAggScale_12     14.094    0.230   61.175    0.000   14.094    4.623
##    .PAggScale_14     14.730    0.128  114.742    0.000   14.730    7.295
##    .TAggScale_14     14.470    0.192   75.526    0.000   14.470    5.652
##    .PProScale_1       6.803    0.175   38.931    0.000    6.803    2.292
##    .TProScale_1       5.705    0.236   24.161    0.000    5.705    1.640
##    .PProScale_3       7.665    0.174   44.050    0.000    7.665    2.670
##    .TProScale_3       6.319    0.247   25.616    0.000    6.319    1.842
##    .PProScale_5       7.958    0.176   45.163    0.000    7.958    2.765
##    .TProScale_5       6.086    0.234   25.991    0.000    6.086    1.820
##    .PProScale_10      8.803    0.170   51.747    0.000    8.803    3.260
##    .TProScale_10      6.920    0.275   25.128    0.000    6.920    1.893
##    .PProScale_12      8.933    0.176   50.771    0.000    8.933    3.096
##    .TProScale_12      7.120    0.272   26.193    0.000    7.120    1.919
##    .PProScale_14      8.843    0.181   48.904    0.000    8.843    3.140
##    .TProScale_14      6.711    0.286   23.464    0.000    6.711    1.781
##     peer1             0.000                              0.000    0.000
##     peer2             0.000                              0.000    0.000
##     peer3             0.000                              0.000    0.000
##     peer4             0.000                              0.000    0.000
##     peer5             0.000                              0.000    0.000
##     peer6             0.000                              0.000    0.000
##     agg1              0.000                              0.000    0.000
```

```
##     agg2              0.000                                0.000    0.000
##     agg3              0.000                                0.000    0.000
##     agg4              0.000                                0.000    0.000
##     agg5              0.000                                0.000    0.000
##     agg6              0.000                                0.000    0.000
##     pro1              0.000                                0.000    0.000
##     pro2              0.000                                0.000    0.000
##     pro3              0.000                                0.000    0.000
##     pro4              0.000                                0.000    0.000
##     pro5              0.000                                0.000    0.000
##     pro6              0.000                                0.000    0.000
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .PPeerScale_1     55.223    6.450    8.562    0.000   55.223    0.680
##    .TPeerScale_1     65.878   10.037    6.563    0.000   65.878    0.647
##    .PPeerScale_3     42.594    5.382    7.915    0.000   42.594    0.586
##    .TPeerScale_3     42.514    6.633    6.410    0.000   42.514    0.551
##    .PPeerScale_5     58.731    5.888    9.974    0.000   58.731    0.767
##    .TPeerScale_5     45.410    9.652    4.704    0.000   45.410    0.489
##    .PPeerScale_10    57.127    7.271    7.857    0.000   57.127    0.687
##    .TPeerScale_10    68.757   13.407    5.128    0.000   68.757    0.582
##    .PPeerScale_12    46.694    5.794    8.059    0.000   46.694    0.549
##    .TPeerScale_12    43.335   11.477    3.776    0.000   43.335    0.366
##    .PPeerScale_14    55.301    7.127    7.760    0.000   55.301    0.573
##    .TPeerScale_14    41.959    9.727    4.313    0.000   41.959    0.398
##    .PAggScale_1       6.728    0.792    8.500    0.000    6.728    0.702
##    .TAggScale_1       6.351    1.419    4.474    0.000    6.351    0.520
##    .PAggScale_3       4.694    0.724    6.480    0.000    4.694    0.647
##    .TAggScale_3       5.844    1.066    5.484    0.000    5.844    0.648
##    .PAggScale_5       5.173    0.674    7.678    0.000    5.173    0.660
##    .TAggScale_5       5.162    0.698    7.396    0.000    5.162    0.731
##    .PAggScale_10      2.935    0.721    4.069    0.000    2.935    0.464
##    .TAggScale_10      4.891    0.886    5.518    0.000    4.891    0.587
##    .PAggScale_12      2.910    0.491    5.925    0.000    2.910    0.584
##    .TAggScale_12      6.541    0.982    6.661    0.000    6.541    0.704
##    .PAggScale_14      2.399    0.346    6.931    0.000    2.399    0.588
##    .TAggScale_14      3.318    0.658    5.043    0.000    3.318    0.506
##    .PProScale_1       7.000    0.738    9.490    0.000    7.000    0.795
##    .TProScale_1       5.857    1.594    3.673    0.000    5.857    0.484
##    .PProScale_3       6.518    0.636   10.250    0.000    6.518    0.791
##    .TProScale_3       6.890    1.268    5.434    0.000    6.890    0.585
##    .PProScale_5       6.075    0.680    8.934    0.000    6.075    0.734
##    .TProScale_5       5.075    1.352    3.754    0.000    5.075    0.454
##    .PProScale_10      6.275    0.696    9.015    0.000    6.275    0.860
##    .TProScale_10      8.193    2.392    3.424    0.001    8.193    0.613
##    .PProScale_12      6.819    0.657   10.386    0.000    6.819    0.819
##    .TProScale_12      7.897    1.623    4.865    0.000    7.897    0.574
##    .PProScale_14      6.393    0.669    9.556    0.000    6.393    0.806
##    .TProScale_14      6.675    1.754    3.806    0.000    6.675    0.470
##     peer1             1.000                                1.000    1.000
##     peer2             1.000                                1.000    1.000
##     peer3             1.000                                1.000    1.000
##     peer4             1.000                                1.000    1.000
```

```
##      peer5             1.000                                1.000    1.000
##      peer6             1.000                                1.000    1.000
##      agg1              1.000                                1.000    1.000
##      agg2              1.000                                1.000    1.000
##      agg3              1.000                                1.000    1.000
##      agg4              1.000                                1.000    1.000
##      agg5              1.000                                1.000    1.000
##      agg6              1.000                                1.000    1.000
##      pro1              1.000                                1.000    1.000
##      pro2              1.000                                1.000    1.000
##      pro3              1.000                                1.000    1.000
##      pro4              1.000                                1.000    1.000
##      pro5              1.000                                1.000    1.000
##      pro6              1.000                                1.000    1.000
```

```
semPaths(fit.4, what="std")
```



The first model (non-autoregressive) shows acceptable fit with the RMSEA and SRMR below 0.10 and the CFI above 0.9 (0.923 to be exact). There is a consistently larger factor loading of the teacher-report scores on the latent variables at each wave for the peer and prosocial scale (but not for the aggression scale where the loadings are equal). The most interesting thing to appear in the model is the significant correlations between the parent scores over time, but not the teacher scores. This is to be expected since the parents remain the same over this time, while the teachers change year to year.

```
#Longitudinal path model predicting later times by previous times (autoregressive)
mod.5.full <- '
##define latent variables
peer1 =~ L1*PPeerScale_1 + L2*TPeerScale_1
peer2 =~ L1*PPeerScale_3 + L2*TPeerScale_3
peer3 =~ L1*PPeerScale_5 + L2*TPeerScale_5
peer4 =~ L1*PPeerScale_10 + L2*TPeerScale_10
peer5 =~ L1*PPeerScale_12 + L2*TPeerScale_12
peer6 =~ L1*PPeerScale_14 + L2*TPeerScale_14
```

```
peer7 =~ L1*PPeerScale_16 + L2*TPeerScale_16
peer8 =~ L1*PPeerScale_18 + L2*TPeerScale_18

agg1 =~ L1*PAggScale_1 + L2*TAggScale_1
agg2 =~ L1*PAggScale_3 + L2*TAggScale_3
agg3 =~ L1*PAggScale_5 + L2*TAggScale_5
agg4 =~ L1*PAggScale_10 + L2*TAggScale_10
agg5 =~ L1*PAggScale_12 + L2*TAggScale_12
agg6 =~ L1*PAggScale_14 + L2*TAggScale_14
agg7 =~ L1*PAggScale_16 + L2*TAggScale_16
agg8 =~ L1*PAggScale_18 + L2*TAggScale_18

pro1 =~ L1*PProScale_1 + L2*TProScale_1
pro2 =~ L1*PProScale_3 + L2*TProScale_3
pro3 =~ L1*PProScale_5 + L2*TProScale_5
pro4 =~ L1*PProScale_10 + L2*TProScale_10
pro5 =~ L1*PProScale_12 + L2*TProScale_12
pro6 =~ L1*PProScale_14 + L2*TProScale_14
pro7 =~ L1*PProScale_16 + L2*TProScale_16
pro8 =~ L1*PProScale_18 + L2*TProScale_18

## free latent variances at later times (only set the scale once)
peer2 ~~ NA*peer2
peer3 ~~ NA*peer3
peer4 ~~ NA*peer4
peer5 ~~ NA*peer5
peer6 ~~ NA*peer6
peer7 ~~ NA*peer7
peer8 ~~ NA*peer8

agg2 ~~ NA*agg2
agg3 ~~ NA*agg3
agg4 ~~ NA*agg4
agg5 ~~ NA*agg5
agg6 ~~ NA*agg6
agg7 ~~ NA*agg7
agg8 ~~ NA*agg8

pro2 ~~ NA*pro2
pro3 ~~ NA*pro3
pro4 ~~ NA*pro4
pro5 ~~ NA*pro5
pro6 ~~ NA*pro6
pro7 ~~ NA*pro7
pro8 ~~ NA*pro8

peer2 ~~ peer1
peer3 ~~ peer2
peer4 ~~ peer3
peer5 ~~ peer4
peer6 ~~ peer5
peer7 ~~ peer6
peer8 ~~ peer7
```

```
agg2 ~~ agg1
agg3 ~~ agg2
agg4 ~~ agg3
agg5 ~~ agg4
agg6 ~~ agg5
agg7 ~~ agg6
agg8 ~~ agg7

pro2 ~~ pro1
pro3 ~~ pro2
pro4 ~~ pro3
pro5 ~~ pro4
pro6 ~~ pro5
pro7 ~~ pro6
pro8 ~~ pro7

## correlated residuals across time
PPeerScale_1 ~~ PPeerScale_3 + PPeerScale_5 + PPeerScale_10 + PPeerScale_12 + PPeerScale_14 +
PPeerScale_16 + PPeerScale_18
PPeerScale_3 ~~ PPeerScale_5 + PPeerScale_10 + PPeerScale_12 + PPeerScale_14 +
PPeerScale_16 + PPeerScale_18
PPeerScale_5 ~~ PPeerScale_10 + PPeerScale_12 + PPeerScale_14 + PPeerScale_16 + PPeerScale_18
PPeerScale_10 ~~ PPeerScale_12 + PPeerScale_14 + PPeerScale_16 + PPeerScale_18
PPeerScale_12 ~~ PPeerScale_14 + PPeerScale_16 + PPeerScale_18
PPeerScale_14 ~~ PPeerScale_16 + PPeerScale_18
PPeerScale_16 ~~ PPeerScale_18

TPeerScale_1 ~~ TPeerScale_3 + TPeerScale_5 + TPeerScale_10 + TPeerScale_12 + TPeerScale_14 +
TPeerScale_16 + TPeerScale_18
TPeerScale_3 ~~ TPeerScale_5 + TPeerScale_10 + TPeerScale_12 + TPeerScale_14 +
TPeerScale_16 + TPeerScale_18
TPeerScale_5 ~~ TPeerScale_10 + TPeerScale_12 + TPeerScale_14 + TPeerScale_16 + TPeerScale_18
TPeerScale_10 ~~ TPeerScale_12 + TPeerScale_14 + TPeerScale_16 + TPeerScale_18
TPeerScale_12 ~~ TPeerScale_14 + TPeerScale_16 + TPeerScale_18
TPeerScale_14 ~~ TPeerScale_16 + TPeerScale_18
TPeerScale_16 ~~ TPeerScale_18

PAggScale_1 ~~ PAggScale_3 + PAggScale_5 + PAggScale_10 + PAggScale_12 + PAggScale_14 +
PAggScale_16 + PAggScale_18
PAggScale_3 ~~ PAggScale_5 + PAggScale_10 + PAggScale_12 + PAggScale_14 +
PAggScale_16 + PAggScale_18
PAggScale_5 ~~ PAggScale_10 + PAggScale_12 + PAggScale_14 + PAggScale_16 + PAggScale_18
PAggScale_10 ~~ PAggScale_12 + PAggScale_14 + PAggScale_16 + PAggScale_18
PAggScale_12 ~~ PAggScale_14 + PAggScale_16 + PAggScale_18
PAggScale_14 ~~ PAggScale_16 + PAggScale_18
PAggScale_16 ~~ PAggScale_18

TAggScale_1 ~~ TAggScale_3 + TAggScale_5 + TAggScale_10 + TAggScale_12 + TAggScale_14 +
TAggScale_16 + TAggScale_18
TAggScale_3 ~~ TAggScale_5 + TAggScale_10 + TAggScale_12 + TAggScale_14 +
TAggScale_16 + TAggScale_18
TAggScale_5 ~~ TAggScale_10 + TAggScale_12 + TAggScale_14 + TAggScale_16 + TAggScale_18
TAggScale_10 ~~ TAggScale_12 + TAggScale_14 + TAggScale_16 + TAggScale_18
```

```
TAggScale_12 ~~ TAggScale_14 + TAggScale_16 + TAggScale_18
TAggScale_14 ~~ TAggScale_16 + TAggScale_18
TAggScale_16 ~~ TAggScale_18

PProScale_1 ~~ PProScale_3 + PProScale_5 + PProScale_10 + PProScale_12 + PProScale_14 +
PProScale_16 + PProScale_18
PProScale_3 ~~ PProScale_5 + PProScale_10 + PProScale_12 + PProScale_14 +
PProScale_16 + PProScale_18
PProScale_5 ~~ PProScale_10 + PProScale_12 + PProScale_14 + PProScale_16 + PProScale_18
PProScale_10 ~~ PProScale_12 + PProScale_14 + PProScale_16 + PProScale_18
PProScale_12 ~~ PProScale_14 + PProScale_16 + PProScale_18
PProScale_14 ~~ PProScale_16 + PProScale_18
PProScale_16 ~~ PProScale_18

TProScale_1 ~~ TProScale_3 + TProScale_5 + TProScale_10 + TProScale_12 + TProScale_14 +
TProScale_16 + TProScale_18
TProScale_3 ~~ TProScale_5 + TProScale_10 + TProScale_12 + TProScale_14 +
TProScale_16 + TProScale_18
TProScale_5 ~~ TProScale_10 + TProScale_12 + TProScale_14 + TProScale_16 + TProScale_18
TProScale_10 ~~ TProScale_12 + TProScale_14 + TProScale_16 + TProScale_18
TProScale_12 ~~ TProScale_14 + TProScale_16 + TProScale_18
TProScale_14 ~~ TProScale_16 + TProScale_18
TProScale_16 ~~ TProScale_18
'

mod.5 <- '
##define latent variables
peer1 =~ L1*PPeerScale_1 + L2*TPeerScale_1
peer2 =~ L1*PPeerScale_3 + L2*TPeerScale_3
peer3 =~ L1*PPeerScale_5 + L2*TPeerScale_5
peer4 =~ L1*PPeerScale_10 + L2*TPeerScale_10
peer5 =~ L1*PPeerScale_12 + L2*TPeerScale_12
peer6 =~ L1*PPeerScale_14 + L2*TPeerScale_14

agg1 =~ L1*PAggScale_1 + L2*TAggScale_1
agg2 =~ L1*PAggScale_3 + L2*TAggScale_3
agg3 =~ L1*PAggScale_5 + L2*TAggScale_5
agg4 =~ L1*PAggScale_10 + L2*TAggScale_10
agg5 =~ L1*PAggScale_12 + L2*TAggScale_12
agg6 =~ L1*PAggScale_14 + L2*TAggScale_14

pro1 =~ L1*PProScale_1 + L2*TProScale_1
pro2 =~ L1*PProScale_3 + L2*TProScale_3
pro3 =~ L1*PProScale_5 + L2*TProScale_5
pro4 =~ L1*PProScale_10 + L2*TProScale_10
pro5 =~ L1*PProScale_12 + L2*TProScale_12
pro6 =~ L1*PProScale_14 + L2*TProScale_14

## free latent variances at later times (only set the scale once)
peer2 ~~ NA*peer2
peer3 ~~ NA*peer3
peer4 ~~ NA*peer4
peer5 ~~ NA*peer5
```

```
peer6 ~~ NA*peer6

agg2 ~~ NA*agg2
agg3 ~~ NA*agg3
agg4 ~~ NA*agg4
agg5 ~~ NA*agg5
agg6 ~~ NA*agg6

pro2 ~~ NA*pro2
pro3 ~~ NA*pro3
pro4 ~~ NA*pro4
pro5 ~~ NA*pro5
pro6 ~~ NA*pro6

peer2 ~~ peer1
peer3 ~~ peer2
peer4 ~~ peer3
peer5 ~~ peer4
peer6 ~~ peer5

agg2 ~~ agg1
agg3 ~~ agg2
agg4 ~~ agg3
agg5 ~~ agg4
agg6 ~~ agg5

pro2 ~~ pro1
pro3 ~~ pro2
pro4 ~~ pro3
pro5 ~~ pro4
pro6 ~~ pro5

## correlated residuals across time
PPeerScale_1 ~~ PPeerScale_3 + PPeerScale_5 + PPeerScale_10 + PPeerScale_12 + PPeerScale_14
PPeerScale_3 ~~ PPeerScale_5 + PPeerScale_10 + PPeerScale_12 + PPeerScale_14
PPeerScale_5 ~~ PPeerScale_10 + PPeerScale_12 + PPeerScale_14
PPeerScale_10 ~~ PPeerScale_12 + PPeerScale_14
PPeerScale_12 ~~ PPeerScale_14

TPeerScale_1 ~~ TPeerScale_3 + TPeerScale_5 + TPeerScale_10 + TPeerScale_12 + TPeerScale_14
TPeerScale_3 ~~ TPeerScale_5 + TPeerScale_10 + TPeerScale_12 + TPeerScale_14
TPeerScale_5 ~~ TPeerScale_10 + TPeerScale_12 + TPeerScale_14
TPeerScale_10 ~~ TPeerScale_12 + TPeerScale_14
TPeerScale_12 ~~ TPeerScale_14

PAggScale_1 ~~ PAggScale_3 + PAggScale_5 + PAggScale_10 + PAggScale_12 + PAggScale_14
PAggScale_3 ~~ PAggScale_5 + PAggScale_10 + PAggScale_12 + PAggScale_14
PAggScale_5 ~~ PAggScale_10 + PAggScale_12 + PAggScale_14
PAggScale_10 ~~ PAggScale_12 + PAggScale_14
PAggScale_12 ~~ PAggScale_14

TAggScale_1 ~~ TAggScale_3 + TAggScale_5 + TAggScale_10 + TAggScale_12 + TAggScale_14
TAggScale_3 ~~ TAggScale_5 + TAggScale_10 + TAggScale_12 + TAggScale_14
```

```
TAggScale_5 ~~ TAggScale_10 + TAggScale_12 + TAggScale_14
TAggScale_10 ~~ TAggScale_12 + TAggScale_14
TAggScale_12 ~~ TAggScale_14

PProScale_1 ~~ PProScale_3 + PProScale_5 + PProScale_10 + PProScale_12 + PProScale_14
PProScale_3 ~~ PProScale_5 + PProScale_10 + PProScale_12 + PProScale_14
PProScale_5 ~~ PProScale_10 + PProScale_12 + PProScale_14
PProScale_10 ~~ PProScale_12 + PProScale_14
PProScale_12 ~~ PProScale_14

TProScale_1 ~~ TProScale_3 + TProScale_5 + TProScale_10 + TProScale_12 + TProScale_14
TProScale_3 ~~ TProScale_5 + TProScale_10 + TProScale_12 + TProScale_14
TProScale_5 ~~ TProScale_10 + TProScale_12 + TProScale_14
TProScale_10 ~~ TProScale_12 + TProScale_14
TProScale_12 ~~ TProScale_14
'

fit.5 <- sem(mod.5, data=data_wide, missing = "ML", std.lv=TRUE, control=list(iter.max=1000), verbose=F
summary(fit.5, standardized=TRUE, fit.measures=TRUE)
```

```
## ** WARNING ** lavaan (0.5-23.1097) did NOT converge after 1000 iterations
## ** WARNING ** Estimates below are most likely unreliable
##
##                                                   Used       Total
##   Number of observations                           302         306
##
##   Number of missing patterns                       154
##
##   Estimator                                         ML
##   Minimum Function Test Statistic                   NA
##   Degrees of freedom                                NA
##   P-value                                           NA
##
## Parameter Estimates:
##
##   Information                                 Observed
##   Standard Errors                             Standard
##
## Latent Variables:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   peer1 =~
##     PPerScl_1 (L1)    1.604       NA                     1.604    0.183
##     TPerScl_1 (L2)    2.200       NA                     2.200    0.215
##   peer2 =~
##     PPerScl_3 (L1)    1.604       NA                     4.719    0.574
##     TPerScl_3 (L2)    2.200       NA                     6.474    0.716
##   peer3 =~
##     PPerScl_5 (L1)    1.604       NA                     4.020    0.461
##     TPerScl_5 (L2)    2.200       NA                     5.515    0.608
##   peer4 =~
##     PPrScl_10 (L1)    1.604       NA                     4.874    0.544
##     TPrScl_10 (L2)    2.200       NA                     6.688    0.624
##   peer5 =~
##     PPrScl_12 (L1)    1.604       NA                     5.914    0.662
```

```
##     TPrScl_12 (L2)    2.200       NA                      8.113    0.755
##   peer6 =~
##     PPrScl_14 (L1)    1.604       NA                      5.902    0.620
##     TPrScl_14 (L2)    2.200       NA                      8.097    0.784
##   agg1 =~
##     PAggScl_1 (L1)    1.604       NA                      1.604    0.523
##     TAggScl_1 (L2)    2.200       NA                      2.200    0.644
##   agg2 =~
##     PAggScl_3 (L1)    1.604       NA                      1.400    0.527
##     TAggScl_3 (L2)    2.200       NA                      1.921    0.638
##   agg3 =~
##     PAggScl_5 (L1)    1.604       NA                      1.291    0.480
##     TAggScl_5 (L2)    2.200       NA                      1.772    0.630
##   agg4 =~
##     PAggSc_10 (L1)    1.604       NA                      1.571    0.646
##     TAggSc_10 (L2)    2.200       NA                      2.156    0.719
##   agg5 =~
##     PAggSc_12 (L1)    1.604       NA                      1.299    0.592
##     TAggSc_12 (L2)    2.200       NA                      1.782    0.583
##   agg6 =~
##     PAggSc_14 (L1)    1.604       NA                      1.226    0.609
##     TAggSc_14 (L2)    2.200       NA                      1.682    0.678
##   pro1 =~
##     PProScl_1 (L1)    1.604       NA                      1.604    0.531
##     TProScl_1 (L2)    2.200       NA                      2.200    0.649
##   pro2 =~
##     PProScl_3 (L1)    1.604       NA                      1.485    0.505
##     TProScl_3 (L2)    2.200       NA                      2.037    0.607
##   pro3 =~
##     PProScl_5 (L1)    1.604       NA                      1.703    0.579
##     TProScl_5 (L2)    2.200       NA                      2.336    0.700
##   pro4 =~
##     PPrScl_10 (L1)    1.604       NA                      1.270    0.458
##     TPrScl_10 (L2)    2.200       NA                      1.743    0.490
##   pro5 =~
##     PPrScl_12 (L1)    1.604       NA                      1.480    0.494
##     TPrScl_12 (L2)    2.200       NA                      2.031    0.569
##   pro6 =~
##     PPrScl_14 (L1)    1.604       NA                      1.579    0.538
##     TPrScl_14 (L2)    2.200       NA                      2.166    0.619
##
## Covariances:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   peer1 ~~
##     peer2             5.100       NA                      1.733    1.733
##   peer2 ~~
##     peer3             6.129       NA                      0.831    0.831
##   peer3 ~~
##     peer4             5.947       NA                      0.780    0.780
##   peer4 ~~
##     peer5            11.956       NA                      1.067    1.067
##   peer5 ~~
##     peer6            12.100       NA                      0.892    0.892
##   agg1 ~~
```

```
##     agg2              0.596       NA                    0.683    0.683
##   agg2 ~~
##     agg3              0.550       NA                    0.781    0.781
##   agg3 ~~
##     agg4              0.523       NA                    0.662    0.662
##   agg4 ~~
##     agg5              0.527       NA                    0.664    0.664
##   agg5 ~~
##     agg6              0.442       NA                    0.713    0.713
##   pro1 ~~
##     pro2              0.886       NA                    0.957    0.957
##   pro2 ~~
##     pro3              0.879       NA                    0.894    0.894
##   pro3 ~~
##     pro4              0.776       NA                    0.923    0.923
##   pro4 ~~
##     pro5              0.648       NA                    0.886    0.886
##   pro5 ~~
##     pro6              1.115       NA                    1.227    1.227
##  .PPeerScale_1 ~~
##    .PPeerScale_3     24.736       NA                   24.736    0.427
##    .PPeerScale_5     28.019       NA                   28.019    0.421
##    .PPeerScale_10    20.800       NA                   20.800    0.322
##    .PPeerScale_12    15.719       NA                   15.719    0.273
##    .PPeerScale_14    15.105       NA                   15.105    0.235
##  .PPeerScale_3 ~~
##    .PPeerScale_5     32.988       NA                   32.988    0.633
##    .PPeerScale_10    27.099       NA                   27.099    0.535
##    .PPeerScale_12    15.298       NA                   15.298    0.339
##    .PPeerScale_14    18.807       NA                   18.807    0.373
##  .PPeerScale_5 ~~
##    .PPeerScale_10    36.683       NA                   36.683    0.631
##    .PPeerScale_12    16.984       NA                   16.984    0.328
##    .PPeerScale_14    25.783       NA                   25.783    0.446
##  .PPeerScale_10 ~~
##    .PPeerScale_12    20.707       NA                   20.707    0.412
##    .PPeerScale_14    32.669       NA                   32.669    0.582
##  .PPeerScale_12 ~~
##    .PPeerScale_14    27.629       NA                   27.629    0.552
##  .TPeerScale_1 ~~
##    .TPeerScale_3      2.184       NA                    2.184    0.035
##    .TPeerScale_5     -3.337       NA                   -3.337   -0.046
##    .TPeerScale_10    -0.196       NA                   -0.196   -0.002
##    .TPeerScale_12     7.675       NA                    7.675    0.109
##    .TPeerScale_14     2.113       NA                    2.113    0.033
##  .TPeerScale_3 ~~
##    .TPeerScale_5    -12.551       NA                  -12.551   -0.276
##    .TPeerScale_10    -4.207       NA                   -4.207   -0.080
##    .TPeerScale_12    -8.730       NA                   -8.730   -0.196
##    .TPeerScale_14    -4.818       NA                   -4.818   -0.119
##  .TPeerScale_5 ~~
##    .TPeerScale_10    12.457       NA                   12.457    0.206
##    .TPeerScale_12    -6.682       NA                   -6.682   -0.132
##    .TPeerScale_14     1.093       NA                    1.093    0.024
```

```
##  .TPeerScale_10 ~~
##    .TPeerScale_12     1.996       NA                     1.996    0.034
##    .TPeerScale_14    11.285       NA                    11.285    0.210
##  .TPeerScale_12 ~~
##    .TPeerScale_14    -1.874       NA                    -1.874   -0.041
##  .PAggScale_1 ~~
##    .PAggScale_3       3.815       NA                     3.815    0.647
##    .PAggScale_5       3.598       NA                     3.598    0.583
##    .PAggScale_10      1.707       NA                     1.707    0.352
##    .PAggScale_12      0.899       NA                     0.899    0.194
##    .PAggScale_14      1.787       NA                     1.787    0.429
##  .PAggScale_3 ~~
##    .PAggScale_5       3.524       NA                     3.524    0.661
##    .PAggScale_10      1.609       NA                     1.609    0.384
##    .PAggScale_12      1.328       NA                     1.328    0.333
##    .PAggScale_14      1.241       NA                     1.241    0.345
##  .PAggScale_5 ~~
##    .PAggScale_10      2.431       NA                     2.431    0.555
##    .PAggScale_12      1.323       NA                     1.323    0.317
##    .PAggScale_14      1.319       NA                     1.319    0.350
##  .PAggScale_10 ~~
##    .PAggScale_12      2.058       NA                     2.058    0.627
##    .PAggScale_14      0.789       NA                     0.789    0.266
##  .PAggScale_12 ~~
##    .PAggScale_14      0.794       NA                     0.794    0.281
##  .TAggScale_1 ~~
##    .TAggScale_3       1.275       NA                     1.275    0.211
##    .TAggScale_5       1.088       NA                     1.088    0.191
##    .TAggScale_10      0.118       NA                     0.118    0.022
##    .TAggScale_12     -0.383       NA                    -0.383   -0.059
##    .TAggScale_14      0.923       NA                     0.923    0.194
##  .TAggScale_3 ~~
##    .TAggScale_5       0.981       NA                     0.981    0.194
##    .TAggScale_10      0.749       NA                     0.749    0.155
##    .TAggScale_12      0.630       NA                     0.630    0.110
##    .TAggScale_14      0.337       NA                     0.337    0.080
##  .TAggScale_5 ~~
##    .TAggScale_10      0.208       NA                     0.208    0.046
##    .TAggScale_12     -0.432       NA                    -0.432   -0.080
##    .TAggScale_14      0.047       NA                     0.047    0.012
##  .TAggScale_10 ~~
##    .TAggScale_12      1.223       NA                     1.223    0.236
##    .TAggScale_14     -0.119       NA                    -0.119   -0.031
##  .TAggScale_12 ~~
##    .TAggScale_14     -0.298       NA                    -0.298   -0.066
##  .PProScale_1 ~~
##    .PProScale_3       2.738       NA                     2.738    0.421
##    .PProScale_5       3.004       NA                     3.004    0.489
##    .PProScale_10      2.676       NA                     2.676    0.424
##    .PProScale_12      2.079       NA                     2.079    0.312
##    .PProScale_14      1.466       NA                     1.466    0.232
##  .PProScale_3 ~~
##    .PProScale_5       2.777       NA                     2.777    0.456
##    .PProScale_10      2.933       NA                     2.933    0.469
```

```
##    .PProScale_12      2.550       NA                    2.550    0.386
##    .PProScale_14      2.723       NA                    2.723    0.434
##  .PProScale_5 ~~
##    .PProScale_10      2.617       NA                    2.617    0.443
##    .PProScale_12      3.269       NA                    3.269    0.524
##    .PProScale_14      2.422       NA                    2.422    0.409
##  .PProScale_10 ~~
##    .PProScale_12      4.127       NA                    4.127    0.643
##    .PProScale_14      3.254       NA                    3.254    0.534
##  .PProScale_12 ~~
##    .PProScale_14      2.645       NA                    2.645    0.411
##  .TProScale_1 ~~
##    .TProScale_3       0.338       NA                    0.338    0.049
##    .TProScale_5       0.423       NA                    0.423    0.069
##    .TProScale_10      0.323       NA                    0.323    0.040
##    .TProScale_12      1.032       NA                    1.032    0.137
##    .TProScale_14     -1.751       NA                   -1.751   -0.247
##  .TProScale_3 ~~
##    .TProScale_5      -0.934       NA                   -0.934   -0.147
##    .TProScale_10      0.739       NA                    0.739    0.089
##    .TProScale_12      0.064       NA                    0.064    0.008
##    .TProScale_14      0.783       NA                    0.783    0.107
##  .TProScale_5 ~~
##    .TProScale_10     -0.743       NA                   -0.743   -0.100
##    .TProScale_12     -0.249       NA                   -0.249   -0.036
##    .TProScale_14      0.274       NA                    0.274    0.042
##  .TProScale_10 ~~
##    .TProScale_12      0.881       NA                    0.881    0.097
##    .TProScale_14      1.022       NA                    1.022    0.120
##  .TProScale_12 ~~
##    .TProScale_14     -1.961       NA                   -1.961   -0.243
##   peer1 ~~
##     peer3             4.817       NA                    1.922    1.922
##     peer4             4.250       NA                    1.398    1.398
##     peer5             5.037       NA                    1.366    1.366
##     peer6             5.036       NA                    1.368    1.368
##     agg1              1.536       NA                    1.536    1.536
##     agg2              0.724       NA                    0.829    0.829
##     agg3              0.892       NA                    1.108    1.108
##     agg4              0.993       NA                    1.014    1.014
##     agg5              0.893       NA                    1.103    1.103
##     agg6              0.983       NA                    1.286    1.286
##     pro1              2.080       NA                    2.080    2.080
##     pro2              1.490       NA                    1.609    1.609
##     pro3              1.150       NA                    1.083    1.083
##     pro4              1.492       NA                    1.883    1.883
##     pro5              1.159       NA                    1.255    1.255
##     pro6              1.631       NA                    1.656    1.656
##   peer2 ~~
##     peer4             3.745       NA                    0.419    0.419
##     peer5             7.310       NA                    0.674    0.674
##     peer6             6.988       NA                    0.645    0.645
##     agg1              1.078       NA                    0.366    0.366
##     agg2              1.083       NA                    0.422    0.422
```

```
##     agg3              1.299       NA                    0.548    0.548
##     agg4              1.038       NA                    0.360    0.360
##     agg5              0.676       NA                    0.284    0.284
##     agg6              1.244       NA                    0.553    0.553
##     pro1              1.862       NA                    0.633    0.633
##     pro2              2.724       NA                    1.000    1.000
##     pro3              1.960       NA                    0.627    0.627
##     pro4              1.347       NA                    0.578    0.578
##     pro5              1.765       NA                    0.650    0.650
##     pro6              1.486       NA                    0.513    0.513
##   peer3 ~~
##     peer5            10.421       NA                    1.127    1.127
##     peer6             8.845       NA                    0.959    0.959
##     agg1              1.012       NA                    0.404    0.404
##     agg2              0.791       NA                    0.362    0.362
##     agg3              1.442       NA                    0.714    0.714
##     agg4              1.063       NA                    0.433    0.433
##     agg5              0.882       NA                    0.435    0.435
##     agg6              1.340       NA                    0.699    0.699
##     pro1              1.577       NA                    0.629    0.629
##     pro2              1.586       NA                    0.683    0.683
##     pro3              2.186       NA                    0.821    0.821
##     pro4              1.606       NA                    0.809    0.809
##     pro5              1.543       NA                    0.667    0.667
##     pro6              1.752       NA                    0.710    0.710
##   peer4 ~~
##     peer6             8.659       NA                    0.774    0.774
##     agg1              0.954       NA                    0.314    0.314
##     agg2              0.481       NA                    0.181    0.181
##     agg3              0.976       NA                    0.399    0.399
##     agg4              1.784       NA                    0.599    0.599
##     agg5              1.061       NA                    0.431    0.431
##     agg6              1.008       NA                    0.434    0.434
##     pro1              1.540       NA                    0.506    0.506
##     pro2              1.356       NA                    0.482    0.482
##     pro3              1.934       NA                    0.599    0.599
##     pro4              2.055       NA                    0.854    0.854
##     pro5              2.224       NA                    0.793    0.793
##     pro6              1.991       NA                    0.665    0.665
##   peer5 ~~
##     agg1              0.598       NA                    0.162    0.162
##     agg2              0.578       NA                    0.179    0.179
##     agg3              1.221       NA                    0.411    0.411
##     agg4              1.353       NA                    0.374    0.374
##     agg5              1.753       NA                    0.587    0.587
##     agg6              1.380       NA                    0.489    0.489
##     pro1              1.299       NA                    0.352    0.352
##     pro2              1.351       NA                    0.396    0.396
##     pro3              2.300       NA                    0.587    0.587
##     pro4              2.366       NA                    0.810    0.810
##     pro5              3.086       NA                    0.907    0.907
##     pro6              2.243       NA                    0.618    0.618
##   peer6 ~~
##     agg1              1.460       NA                    0.397    0.397
```

```
##     agg2             0.852       NA                    0.265    0.265
##     agg3             1.296       NA                    0.437    0.437
##     agg4             1.691       NA                    0.469    0.469
##     agg5             1.344       NA                    0.451    0.451
##     agg6             2.043       NA                    0.726    0.726
##     pro1             1.618       NA                    0.440    0.440
##     pro2             1.851       NA                    0.543    0.543
##     pro3             2.654       NA                    0.679    0.679
##     pro4             2.460       NA                    0.844    0.844
##     pro5             2.602       NA                    0.766    0.766
##     pro6             3.083       NA                    0.851    0.851
##   agg1 ~~
##     agg3             0.618       NA                    0.767    0.767
##     agg4             0.613       NA                    0.625    0.625
##     agg5             0.532       NA                    0.656    0.656
##     agg6             0.580       NA                    0.759    0.759
##     pro1             0.526       NA                    0.526    0.526
##     pro2             0.408       NA                    0.440    0.440
##     pro3             0.537       NA                    0.506    0.506
##     pro4             0.374       NA                    0.473    0.473
##     pro5             0.480       NA                    0.520    0.520
##     pro6             0.555       NA                    0.563    0.563
##   agg2 ~~
##     agg4             0.452       NA                    0.529    0.529
##     agg5             0.407       NA                    0.576    0.576
##     agg6             0.396       NA                    0.593    0.593
##     pro1             0.279       NA                    0.319    0.319
##     pro2             0.490       NA                    0.605    0.605
##     pro3             0.489       NA                    0.528    0.528
##     pro4             0.236       NA                    0.341    0.341
##     pro5             0.466       NA                    0.578    0.578
##     pro6             0.381       NA                    0.443    0.443
##   agg3 ~~
##     agg5             0.594       NA                    0.911    0.911
##     agg6             0.558       NA                    0.906    0.906
##     pro1             0.390       NA                    0.484    0.484
##     pro2             0.348       NA                    0.467    0.467
##     pro3             0.561       NA                    0.657    0.657
##     pro4             0.343       NA                    0.538    0.538
##     pro5             0.454       NA                    0.611    0.611
##     pro6             0.579       NA                    0.730    0.730
##   agg4 ~~
##     agg6             0.766       NA                    1.023    1.023
##     pro1             0.145       NA                    0.148    0.148
##     pro2             0.201       NA                    0.222    0.222
##     pro3             0.330       NA                    0.318    0.318
##     pro4             0.423       NA                    0.545    0.545
##     pro5             0.474       NA                    0.524    0.524
##     pro6             0.473       NA                    0.490    0.490
##   agg5 ~~
##     pro1             0.150       NA                    0.185    0.185
##     pro2             0.041       NA                    0.055    0.055
##     pro3             0.292       NA                    0.339    0.339
##     pro4             0.419       NA                    0.653    0.653
```

```
##     pro5              0.614       NA                       0.821    0.821
##     pro6              0.369       NA                       0.462    0.462
##   agg6 ~~
##     pro1              0.222       NA                       0.290    0.290
##     pro2              0.260       NA                       0.368    0.368
##     pro3              0.359       NA                       0.443    0.443
##     pro4              0.311       NA                       0.514    0.514
##     pro5              0.482       NA                       0.683    0.683
##     pro6              0.633       NA                       0.841    0.841
##   pro1 ~~
##     pro3              0.834       NA                       0.785    0.785
##     pro4              0.399       NA                       0.504    0.504
##     pro5              0.419       NA                       0.454    0.454
##     pro6              0.637       NA                       0.647    0.647
##   pro2 ~~
##     pro4              0.449       NA                       0.613    0.613
##     pro5              0.663       NA                       0.776    0.776
##     pro6              0.449       NA                       0.492    0.492
##   pro3 ~~
##     pro5              0.779       NA                       0.795    0.795
##     pro6              0.695       NA                       0.665    0.665
##   pro4 ~~
##     pro6              0.578       NA                       0.742    0.742
##
## Intercepts:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .PPeerScale_1     60.352       NA                       60.352    6.901
##    .TPeerScale_1     59.522       NA                       59.522    5.822
##    .PPeerScale_3     62.041       NA                       62.041    7.543
##    .TPeerScale_3     61.692       NA                       61.692    6.823
##    .PPeerScale_5     62.213       NA                       62.213    7.138
##    .TPeerScale_5     61.144       NA                       61.144    6.737
##    .PPeerScale_10    61.460       NA                       61.460    6.863
##    .TPeerScale_10    60.611       NA                       60.611    5.656
##    .PPeerScale_12    61.929       NA                       61.929    6.933
##    .TPeerScale_12    59.528       NA                       59.528    5.542
##    .PPeerScale_14    61.346       NA                       61.346    6.441
##    .TPeerScale_14    60.631       NA                       60.631    5.867
##    .PAggScale_1      12.797       NA                       12.797    4.174
##    .TAggScale_1      12.894       NA                       12.894    3.774
##    .PAggScale_3      13.255       NA                       13.255    4.990
##    .TAggScale_3      13.466       NA                       13.466    4.475
##    .PAggScale_5      13.174       NA                       13.174    4.895
##    .TAggScale_5      13.986       NA                       13.986    4.977
##    .PAggScale_10     14.069       NA                       14.069    5.786
##    .TAggScale_10     14.049       NA                       14.049    4.684
##    .PAggScale_12     14.400       NA                       14.400    6.561
##    .TAggScale_12     14.095       NA                       14.095    4.612
##    .PAggScale_14     14.731       NA                       14.731    7.321
##    .TAggScale_14     14.494       NA                       14.494    5.843
##    .PProScale_1       6.802       NA                        6.802    2.252
##    .TProScale_1       5.734       NA                        5.734    1.693
##    .PProScale_3       7.667       NA                        7.667    2.607
##    .TProScale_3       6.309       NA                        6.309    1.878
```

```
##    .PProScale_5       7.958       NA                     7.958    2.706
##    .TProScale_5       6.099       NA                     6.099    1.827
##    .PProScale_10      8.794       NA                     8.794    3.170
##    .TProScale_10      6.943       NA                     6.943    1.952
##    .PProScale_12      8.933       NA                     8.933    2.983
##    .TProScale_12      7.179       NA                     7.179    2.012
##    .PProScale_14      8.837       NA                     8.837    3.013
##    .TProScale_14      6.776       NA                     6.776    1.937
##     peer1             0.000                              0.000    0.000
##     peer2             0.000                              0.000    0.000
##     peer3             0.000                              0.000    0.000
##     peer4             0.000                              0.000    0.000
##     peer5             0.000                              0.000    0.000
##     peer6             0.000                              0.000    0.000
##     agg1              0.000                              0.000    0.000
##     agg2              0.000                              0.000    0.000
##     agg3              0.000                              0.000    0.000
##     agg4              0.000                              0.000    0.000
##     agg5              0.000                              0.000    0.000
##     agg6              0.000                              0.000    0.000
##     pro1              0.000                              0.000    0.000
##     pro2              0.000                              0.000    0.000
##     pro3              0.000                              0.000    0.000
##     pro4              0.000                              0.000    0.000
##     pro5              0.000                              0.000    0.000
##     pro6              0.000                              0.000    0.000
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##     peer2             8.659       NA                     1.000    1.000
##     peer3             6.284       NA                     1.000    1.000
##     peer4             9.240       NA                     1.000    1.000
##     peer5            13.599       NA                     1.000    1.000
##     peer6            13.545       NA                     1.000    1.000
##     agg2              0.763       NA                     1.000    1.000
##     agg3              0.649       NA                     1.000    1.000
##     agg4              0.960       NA                     1.000    1.000
##     agg5              0.656       NA                     1.000    1.000
##     agg6              0.584       NA                     1.000    1.000
##     pro2              0.858       NA                     1.000    1.000
##     pro3              1.127       NA                     1.000    1.000
##     pro4              0.627       NA                     1.000    1.000
##     pro5              0.852       NA                     1.000    1.000
##     pro6              0.970       NA                     1.000    1.000
##    .PPeerScale_1     73.911       NA                    73.911    0.966
##    .TPeerScale_1     99.677       NA                    99.677    0.954
##    .PPeerScale_3     45.391       NA                    45.391    0.671
##    .TPeerScale_3     39.845       NA                    39.845    0.487
##    .PPeerScale_5     59.808       NA                    59.808    0.787
##    .TPeerScale_5     51.948       NA                    51.948    0.631
##    .PPeerScale_10    56.441       NA                    56.441    0.704
##    .TPeerScale_10    70.119       NA                    70.119    0.611
##    .PPeerScale_12    44.810       NA                    44.810    0.562
##    .TPeerScale_12    49.555       NA                    49.555    0.429
```

```
##    .PPeerScale_14    55.874       NA                    55.874    0.616
##    .TPeerScale_14    41.237       NA                    41.237    0.386
##    .PAggScale_1       6.831       NA                     6.831    0.726
##    .TAggScale_1       6.831       NA                     6.831    0.585
##    .PAggScale_3       5.096       NA                     5.096    0.722
##    .TAggScale_3       5.365       NA                     5.365    0.592
##    .PAggScale_5       5.575       NA                     5.575    0.770
##    .TAggScale_5       4.758       NA                     4.758    0.603
##    .PAggScale_10      3.445       NA                     3.445    0.583
##    .TAggScale_10      4.351       NA                     4.351    0.484
##    .PAggScale_12      3.131       NA                     3.131    0.650
##    .TAggScale_12      6.167       NA                     6.167    0.660
##    .PAggScale_14      2.546       NA                     2.546    0.629
##    .TAggScale_14      3.324       NA                     3.324    0.540
##    .PProScale_1       6.550       NA                     6.550    0.718
##    .TProScale_1       6.634       NA                     6.634    0.578
##    .PProScale_3       6.442       NA                     6.442    0.745
##    .TProScale_3       7.130       NA                     7.130    0.632
##    .PProScale_5       5.750       NA                     5.750    0.665
##    .TProScale_5       5.686       NA                     5.686    0.510
##    .PProScale_10      6.082       NA                     6.082    0.790
##    .TProScale_10      9.622       NA                     9.622    0.760
##    .PProScale_12      6.776       NA                     6.776    0.756
##    .TProScale_12      8.606       NA                     8.606    0.676
##    .PProScale_14      6.108       NA                     6.108    0.710
##    .TProScale_14      7.545       NA                     7.545    0.616
##     peer1             1.000                              1.000    1.000
##     agg1              1.000                              1.000    1.000
##     pro1              1.000                              1.000    1.000
```

Longitudinal path model did not converge after 1000 iterations!

```
#Longitudinal growth model with a fixed slope
mod.6.fixed <- ' i =~ 1*PPeerScale_1 + 1*PPeerScale_3 + 1*PPeerScale_5 +  1*PPeerScale_10 + 1*PPeerScale
                      1*PPeerScale_14 + 1*PPeerScale_16 + 1*PPeerScale_18
                s =~ 0*PPeerScale_1 + 1*PPeerScale_3 + 2*PPeerScale_5 +  3*PPeerScale_10 + 4*PPeerScale
                      5*PPeerScale_14 + 6*PPeerScale_16 + 7*PPeerScale_18

                s ~~ 0*s #fixed slopes, no variance'
fit.6.fixed <- growth(mod.6.fixed, missing = "ML", data = data_wide)
inspect(fit.6.fixed, "cov.lv")
```

```
##   i      s
## i 37.746
## s  0.998  0.000
```

```
#slope is 0.000

#Longitudinal growth model with a random slope an 6 month time metric (i.e. 1 unit = one 6 month period
mod.6.random <- ' i =~ 1*PPeerScale_1 + 1*PPeerScale_3 + 1*PPeerScale_5 +  1*PPeerScale_10 + 1*PPeerScal
                      1*PPeerScale_14 + 1*PPeerScale_16 + 1*PPeerScale_18
                 s =~ 0*PPeerScale_1 + 2*PPeerScale_3 + 4*PPeerScale_5 +  9*PPeerScale_10 + 11*PPeerSca
                      13*PPeerScale_14 + 15*PPeerScale_16 + 17*PPeerScale_18'
fit.6.random <- growth(mod.6.random, missing = "FIML", data = data_wide)
```

```r
#Calculate a more precise time metric
apply(data_wide[,82:89], 2, mean, na.rm=T)
```

```
##   age0_1   age0_3   age0_5  age0_10  age0_12  age0_14  age0_16  age0_18
## 0.000000 1.022622 2.012532 4.597019 5.724867 6.709552 7.955476 9.164656
```

```r
#Longitudinal growth model with a random slope and more precise time metric (i.e. 1 unit = 1 year)
mod.6.precise <- ' i =~ 1*PPeerScale_1 + 1*PPeerScale_3 + 1*PPeerScale_5 +  1*PPeerScale_10 + 1*PPeerSca
                       1*PPeerScale_14 + 1*PPeerScale_16 + 1*PPeerScale_18
                   s =~ 0*PPeerScale_1 + 1.022622*PPeerScale_3 + 2.012532*PPeerScale_5 +  4.597019*PPeerS
                       5.724867*PPeerScale_12 + 6.709552*PPeerScale_14 + 7.955476*PPeerScale_16 +
                       9.164656*PPeerScale_18'
fit.6.precise <- growth(mod.6.precise, missing = "FIML", data = data_wide)

#Mulitlevel model with a random slope
mod.6.MLM <- lmer(PPeerScale ~ age0 + (age0 | ID), data_long)
summary(mod.6.MLM)
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula: PPeerScale ~ age0 + (age0 | ID)
##    Data: data_long
##
## REML criterion at convergence: 11238.1
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -6.8136 -0.3847  0.1067  0.4964  2.8507
##
## Random effects:
##  Groups   Name        Variance Std.Dev. Corr
##  ID       (Intercept) 49.7981  7.0568
##           age0         0.8674  0.9313   -0.36
##  Residual             30.4889  5.5217
## Number of obs: 1660, groups:  ID, 298
##
## Fixed effects:
##             Estimate Std. Error t value
## (Intercept) 61.16479    0.47041  130.03
## age0         0.14442    0.07681    1.88
##
## Correlation of Fixed Effects:
##      (Intr)
## age0 -0.481
```

```r
summary(fit.6.precise)
```

```
## lavaan (0.5-23.1097) converged normally after 117 iterations
##
##                                                   Used       Total
##   Number of observations                           302         306
##
##   Number of missing patterns                        52
##
##   Estimator                                         ML
##   Minimum Function Test Statistic               75.186
```

```
##   Degrees of freedom                                31
##   P-value (Chi-square)                           0.000
##
## Parameter Estimates:
##
##   Information                                 Observed
##   Standard Errors                             Standard
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)
##   i =~
##     PPeerScale_1      1.000
##     PPeerScale_3      1.000
##     PPeerScale_5      1.000
##     PPeerScale_10     1.000
##     PPeerScale_12     1.000
##     PPeerScale_14     1.000
##     PPeerScale_16     1.000
##     PPeerScale_18     1.000
##   s =~
##     PPeerScale_1      0.000
##     PPeerScale_3      1.023
##     PPeerScale_5      2.013
##     PPeerScale_10     4.597
##     PPeerScale_12     5.725
##     PPeerScale_14     6.710
##     PPeerScale_16     7.955
##     PPeerScale_18     9.165
##
## Covariances:
##                    Estimate  Std.Err  z-value  P(>|z|)
##   i ~~
##     s                -2.300    0.721   -3.191    0.001
##
## Intercepts:
##                    Estimate  Std.Err  z-value  P(>|z|)
##    .PPeerScale_1      0.000
##    .PPeerScale_3      0.000
##    .PPeerScale_5      0.000
##    .PPeerScale_10     0.000
##    .PPeerScale_12     0.000
##    .PPeerScale_14     0.000
##    .PPeerScale_16     0.000
##    .PPeerScale_18     0.000
##     i                61.337    0.474  129.331    0.000
##     s                 0.121    0.077    1.564    0.118
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)
##    .PPeerScale_1     40.855    4.693    8.706    0.000
##    .PPeerScale_3     27.885    3.442    8.102    0.000
##    .PPeerScale_5     24.093    2.915    8.266    0.000
##    .PPeerScale_10    31.176    3.487    8.940    0.000
##    .PPeerScale_12    30.816    3.419    9.014    0.000
```

```
##    .PPeerScale_14    28.606    3.655    7.826    0.000
##    .PPeerScale_16    29.246    5.140    5.690    0.000
##    .PPeerScale_18    32.290    8.094    3.989    0.000
##     i                49.535    5.556    8.915    0.000
##     s                 0.826    0.138    6.002    0.000
```

The mean estimate from the growth model (intercept= 61.337, and slope= 0.121) differs slightly from the fixed effects of the multilevel model (intercept= 61.165, slope= 0.144). The variance of the growth model (intercept= 49.535, slope= 0.826), also differs slightly from the random effect of the multilevel model (intercept= 49.80, slope= 0.867).

Question 5

```
#Longitudinal growth model with a random slope, constraining residual variances to 0
mod.7 <- ' i =~ 1*PPeerScale_1 + 1*PPeerScale_3 + 1*PPeerScale_5 +  1*PPeerScale_10 + 1*PPeerScale_12 +
                      1*PPeerScale_14 + 1*PPeerScale_16 + 1*PPeerScale_18
                s =~ 0*PPeerScale_1 + 2*PPeerScale_3 + 4*PPeerScale_5 +  9*PPeerScale_10 + 11*PPeerSca
                      13*PPeerScale_14 + 15*PPeerScale_16 + 17*PPeerScale_18

PPeerScale_1 ~~ 0*PPeerScale_1
PPeerScale_3 ~~ 0*PPeerScale_3
PPeerScale_5 ~~ 0*PPeerScale_5
PPeerScale_10 ~~ 0*PPeerScale_10
PPeerScale_12 ~~ 0*PPeerScale_12
PPeerScale_14 ~~ 0*PPeerScale_14
PPeerScale_16 ~~ 0*PPeerScale_16
PPeerScale_18 ~~ 0*PPeerScale_18
'
#fit.7 <- growth(mod.7, missing="ML", data=data_wide)
#inspect(fit.7, "cov.lv")
```

Model won't run.

Question 6

```
#Longitudinal growth model with a fixed slope
mod.6.fixed <- ' i =~ 1*PPeerScale_1 + 1*PPeerScale_3 + 1*PPeerScale_5 +  1*PPeerScale_10 + 1*PPeerScale
                      1*PPeerScale_14 + 1*PPeerScale_16 + 1*PPeerScale_18
                s =~ 0*PPeerScale_1 + 2*PPeerScale_3 + 4*PPeerScale_5 +  9*PPeerScale_10 + 11*PPeerSca
                      13*PPeerScale_14 + 15*PPeerScale_16 + 17*PPeerScale_18

                s ~~ 0*s #fixed slopes, no variance'
fit.6.fixed <- growth(mod.6.fixed, missing = "ML", data = data_wide)
summary(fit.6.fixed)
```

```
## lavaan (0.5-23.1097) converged normally after 102 iterations
##
##                                                   Used       Total
##   Number of observations                            302         306
##
##   Number of missing patterns                         52
##
```

```
##   Estimator                                         ML
##   Minimum Function Test Statistic             155.961
##   Degrees of freedom                               32
##   P-value (Chi-square)                          0.000
##
## Parameter Estimates:
##
##   Information                                 Observed
##   Standard Errors                             Standard
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)
##   i =~
##     PPeerScale_1      1.000
##     PPeerScale_3      1.000
##     PPeerScale_5      1.000
##     PPeerScale_10     1.000
##     PPeerScale_12     1.000
##     PPeerScale_14     1.000
##     PPeerScale_16     1.000
##     PPeerScale_18     1.000
##   s =~
##     PPeerScale_1      0.000
##     PPeerScale_3      2.000
##     PPeerScale_5      4.000
##     PPeerScale_10     9.000
##     PPeerScale_12    11.000
##     PPeerScale_14    13.000
##     PPeerScale_16    15.000
##     PPeerScale_18    17.000
##
## Covariances:
##                    Estimate  Std.Err  z-value  P(>|z|)
##   i ~~
##     s                 0.377    0.165    2.282    0.022
##
## Intercepts:
##                    Estimate  Std.Err  z-value  P(>|z|)
##    .PPeerScale_1      0.000
##    .PPeerScale_3      0.000
##    .PPeerScale_5      0.000
##    .PPeerScale_10     0.000
##    .PPeerScale_12     0.000
##    .PPeerScale_14     0.000
##    .PPeerScale_16     0.000
##    .PPeerScale_18     0.000
##     i                61.326    0.448  136.957    0.000
##     s                 0.062    0.031    2.014    0.044
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)
##     s                 0.000
##    .PPeerScale_1     53.576    5.167   10.369    0.000
##    .PPeerScale_3     37.989    4.066    9.344    0.000
```

```
##    .PPeerScale_5     29.102    3.333    8.731    0.000
##    .PPeerScale_10    30.482    3.489    8.736    0.000
##    .PPeerScale_12    33.846    3.666    9.232    0.000
##    .PPeerScale_14    37.351    4.275    8.736    0.000
##    .PPeerScale_16    41.767    6.144    6.799    0.000
##    .PPeerScale_18    43.096    8.566    5.031    0.000
##     i                37.866    4.623    8.191    0.000
```

The model now does not allow for variance around the slope (since it is fixed), but does not affect the estimates (i.e. fixed effects). Interestingly, the relationship between the intercept and slope switches signs, and is now negative, whereas before it was positive.

Question 7

```
#Longitudinal growth model with a random slope, with a different time metric
mod.6.centered <- ' i =~ 1*PPeerScale_1 + 1*PPeerScale_3 + 1*PPeerScale_5 +  1*PPeerScale_10 + 1*PPeerS
                       1*PPeerScale_14 + 1*PPeerScale_16 + 1*PPeerScale_18
                   s =~ -8*PPeerScale_1 + -6*PPeerScale_3 + -4*PPeerScale_5 +  1*PPeerScale_10 + 3*PPeerS
                       5*PPeerScale_14 + 7*PPeerScale_16 + 9*PPeerScale_18'
fit.6.centered <- growth(mod.6.centered, missing = "FIML", data = data_wide)

summary(fit.6.centered)
```

```
## lavaan (0.5-23.1097) converged normally after  94 iterations
##
##                                                   Used       Total
##   Number of observations                            302         306
##
##   Number of missing patterns                         52
##
##   Estimator                                          ML
##   Minimum Function Test Statistic                73.992
##   Degrees of freedom                                 31
##   P-value (Chi-square)                            0.000
##
## Parameter Estimates:
##
##   Information                                 Observed
##   Standard Errors                             Standard
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)
##   i =~
##     PPeerScale_1      1.000
##     PPeerScale_3      1.000
##     PPeerScale_5      1.000
##     PPeerScale_10     1.000
##     PPeerScale_12     1.000
##     PPeerScale_14     1.000
##     PPeerScale_16     1.000
##     PPeerScale_18     1.000
##   s =~
##     PPeerScale_1     -8.000
```

```
##     PPeerScale_3     -6.000
##     PPeerScale_5     -4.000
##     PPeerScale_10     1.000
##     PPeerScale_12     3.000
##     PPeerScale_14     5.000
##     PPeerScale_16     7.000
##     PPeerScale_18     9.000
##
## Covariances:
##                    Estimate  Std.Err  z-value  P(>|z|)
##   i ~~
##     s                 0.620    0.297    2.088    0.037
##
## Intercepts:
##                    Estimate  Std.Err  z-value  P(>|z|)
##    .PPeerScale_1      0.000
##    .PPeerScale_3      0.000
##    .PPeerScale_5      0.000
##    .PPeerScale_10     0.000
##    .PPeerScale_12     0.000
##    .PPeerScale_14     0.000
##    .PPeerScale_16     0.000
##    .PPeerScale_18     0.000
##     i                61.836    0.419  147.444    0.000
##     s                 0.062    0.041    1.525    0.127
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)
##    .PPeerScale_1     40.519    4.695    8.630    0.000
##    .PPeerScale_3     27.747    3.441    8.064    0.000
##    .PPeerScale_5     24.196    2.914    8.302    0.000
##    .PPeerScale_10    31.108    3.487    8.922    0.000
##    .PPeerScale_12    30.718    3.410    9.008    0.000
##    .PPeerScale_14    28.187    3.643    7.738    0.000
##    .PPeerScale_16    29.641    5.153    5.752    0.000
##    .PPeerScale_18    32.970    8.045    4.098    0.000
##     i                44.721    4.369   10.236    0.000
##     s                 0.232    0.038    6.067    0.000
```

```
summary(fit.6.random)
```

```
## lavaan (0.5-23.1097) converged normally after 135 iterations
##
##                                                   Used       Total
##   Number of observations                            302         306
##
##   Number of missing patterns                         52
##
##   Estimator                                          ML
##   Minimum Function Test Statistic                73.992
##   Degrees of freedom                                 31
##   P-value (Chi-square)                            0.000
##
## Parameter Estimates:
##
```

```
##   Information                                 Observed
##   Standard Errors                             Standard
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)
##   i =~
##     PPeerScale_1      1.000
##     PPeerScale_3      1.000
##     PPeerScale_5      1.000
##     PPeerScale_10     1.000
##     PPeerScale_12     1.000
##     PPeerScale_14     1.000
##     PPeerScale_16     1.000
##     PPeerScale_18     1.000
##   s =~
##     PPeerScale_1      0.000
##     PPeerScale_3      2.000
##     PPeerScale_5      4.000
##     PPeerScale_10     9.000
##     PPeerScale_12    11.000
##     PPeerScale_14    13.000
##     PPeerScale_16    15.000
##     PPeerScale_18    17.000
##
## Covariances:
##                    Estimate  Std.Err  z-value  P(>|z|)
##   i ~~
##     s                -1.234    0.382   -3.234    0.001
##
## Intercepts:
##                    Estimate  Std.Err  z-value  P(>|z|)
##    .PPeerScale_1      0.000
##    .PPeerScale_3      0.000
##    .PPeerScale_5      0.000
##    .PPeerScale_10     0.000
##    .PPeerScale_12     0.000
##    .PPeerScale_14     0.000
##    .PPeerScale_16     0.000
##    .PPeerScale_18     0.000
##     i                61.339    0.476  128.953    0.000
##     s                 0.062    0.041    1.525    0.127
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)
##    .PPeerScale_1     40.519    4.695    8.630    0.000
##    .PPeerScale_3     27.747    3.441    8.064    0.000
##    .PPeerScale_5     24.196    2.914    8.302    0.000
##    .PPeerScale_10    31.108    3.487    8.922    0.000
##    .PPeerScale_12    30.718    3.410    9.008    0.000
##    .PPeerScale_14    28.187    3.643    7.738    0.000
##    .PPeerScale_16    29.641    5.153    5.752    0.000
##    .PPeerScale_18    32.971    8.045    4.098    0.000
##     i                49.632    5.586    8.885    0.000
##     s                 0.232    0.038    6.067    0.000
```

The mean estimates and variance of the intercept changes slightly, since 0 now indicates the mean between the 4th and 5th wave rather than the 1st wave. The covariance between the intercept and slope flips sign, however this is harder to intepret given that the intercept is now halfway through the trajectory and not at the beginning. It does not seem to affect the fit statistics though.

Question 8

```
fit.8.precise <- growth(mod.6.precise, missing = "FIML", estimator = "MLR", data = data_wide)
summary(fit.8.precise)
```

```
## lavaan (0.5-23.1097) converged normally after 117 iterations
##
##                                                   Used       Total
##   Number of observations                           302         306
##
##   Number of missing patterns                        52
##
##   Estimator                                         ML      Robust
##   Minimum Function Test Statistic               75.186      60.401
##   Degrees of freedom                                31          31
##   P-value (Chi-square)                           0.000       0.001
##   Scaling correction factor                                  1.245
##     for the Yuan-Bentler correction
##
## Parameter Estimates:
##
##   Information                                 Observed
##   Standard Errors                    Robust.huber.white
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)
##   i =~
##     PPeerScale_1      1.000
##     PPeerScale_3      1.000
##     PPeerScale_5      1.000
##     PPeerScale_10     1.000
##     PPeerScale_12     1.000
##     PPeerScale_14     1.000
##     PPeerScale_16     1.000
##     PPeerScale_18     1.000
##   s =~
##     PPeerScale_1      0.000
##     PPeerScale_3      1.023
##     PPeerScale_5      2.013
##     PPeerScale_10     4.597
##     PPeerScale_12     5.725
##     PPeerScale_14     6.710
##     PPeerScale_16     7.955
##     PPeerScale_18     9.165
##
## Covariances:
##                    Estimate  Std.Err  z-value  P(>|z|)
##   i ~~
```

```
##     s                -2.300    0.822   -2.798    0.005
##
## Intercepts:
##                    Estimate  Std.Err  z-value  P(>|z|)
##    .PPeerScale_1      0.000
##    .PPeerScale_3      0.000
##    .PPeerScale_5      0.000
##    .PPeerScale_10     0.000
##    .PPeerScale_12     0.000
##    .PPeerScale_14     0.000
##    .PPeerScale_16     0.000
##    .PPeerScale_18     0.000
##     i                61.337    0.499  122.809    0.000
##     s                 0.121    0.082    1.465    0.143
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)
##    .PPeerScale_1     40.855    8.823    4.630    0.000
##    .PPeerScale_3     27.885    8.162    3.416    0.001
##    .PPeerScale_5     24.093    3.752    6.422    0.000
##    .PPeerScale_10    31.176    4.923    6.333    0.000
##    .PPeerScale_12    30.816    9.265    3.326    0.001
##    .PPeerScale_14    28.606    6.525    4.384    0.000
##    .PPeerScale_16    29.246    6.830    4.282    0.000
##    .PPeerScale_18    32.290   12.336    2.618    0.009
##     i                49.535    7.071    7.005    0.000
##     s                 0.826    0.179    4.615    0.000
```

```
summary(fit.6.precise)
```

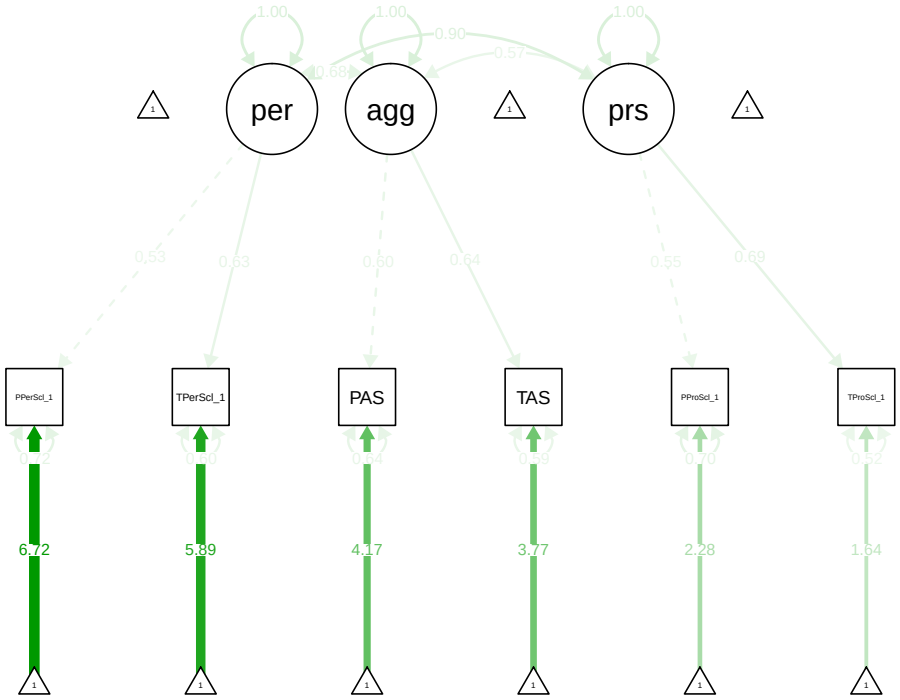
```
## lavaan (0.5-23.1097) converged normally after 117 iterations
##
##                                                   Used       Total
##   Number of observations                            302         306
##
##   Number of missing patterns                         52
##
##   Estimator                                          ML
##   Minimum Function Test Statistic                75.186
##   Degrees of freedom                                 31
##   P-value (Chi-square)                            0.000
##
## Parameter Estimates:
##
##   Information                                 Observed
##   Standard Errors                             Standard
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)
##   i =~
##     PPeerScale_1      1.000
##     PPeerScale_3      1.000
##     PPeerScale_5      1.000
##     PPeerScale_10     1.000
##     PPeerScale_12     1.000
```

```
##     PPeerScale_14     1.000
##     PPeerScale_16     1.000
##     PPeerScale_18     1.000
##   s =~
##     PPeerScale_1      0.000
##     PPeerScale_3      1.023
##     PPeerScale_5      2.013
##     PPeerScale_10     4.597
##     PPeerScale_12     5.725
##     PPeerScale_14     6.710
##     PPeerScale_16     7.955
##     PPeerScale_18     9.165
##
## Covariances:
##                    Estimate  Std.Err  z-value  P(>|z|)
##   i ~~
##     s                -2.300    0.721   -3.191    0.001
##
## Intercepts:
##                    Estimate  Std.Err  z-value  P(>|z|)
##    .PPeerScale_1      0.000
##    .PPeerScale_3      0.000
##    .PPeerScale_5      0.000
##    .PPeerScale_10     0.000
##    .PPeerScale_12     0.000
##    .PPeerScale_14     0.000
##    .PPeerScale_16     0.000
##    .PPeerScale_18     0.000
##     i                61.337    0.474  129.331    0.000
##     s                 0.121    0.077    1.564    0.118
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)
##    .PPeerScale_1     40.855    4.693    8.706    0.000
##    .PPeerScale_3     27.885    3.442    8.102    0.000
##    .PPeerScale_5     24.093    2.915    8.266    0.000
##    .PPeerScale_10    31.176    3.487    8.940    0.000
##    .PPeerScale_12    30.816    3.419    9.014    0.000
##    .PPeerScale_14    28.606    3.655    7.826    0.000
##    .PPeerScale_16    29.246    5.140    5.690    0.000
##    .PPeerScale_18    32.290    8.094    3.989    0.000
##     i                49.535    5.556    8.915    0.000
##     s                 0.826    0.138    6.002    0.000
```

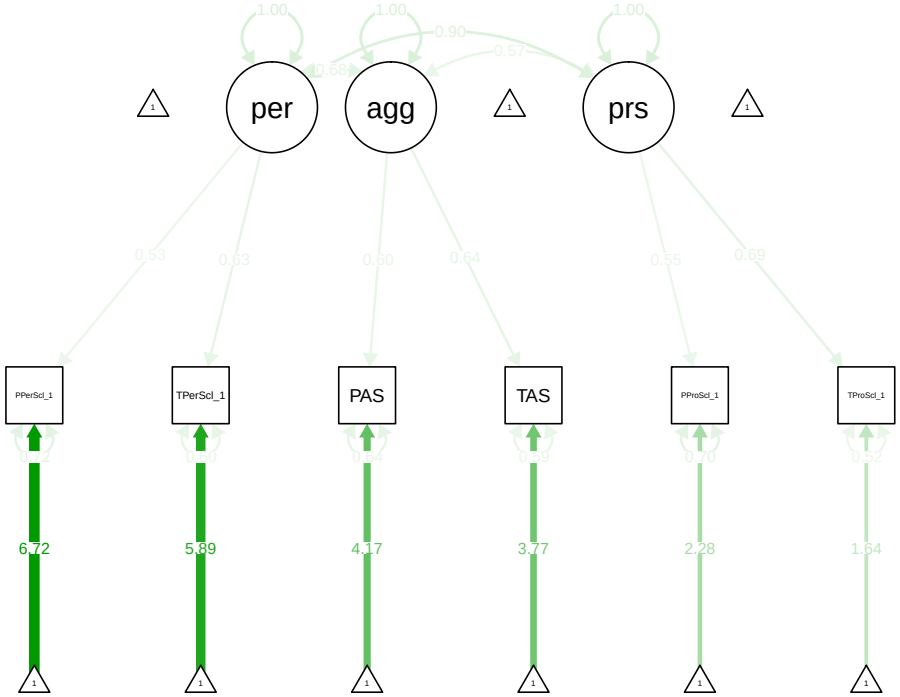
Changing the estimator to MLR seemed to only add to the fit statistics, adding an extra "Robust" column to indicate the robust goodness of fit.

Question 9

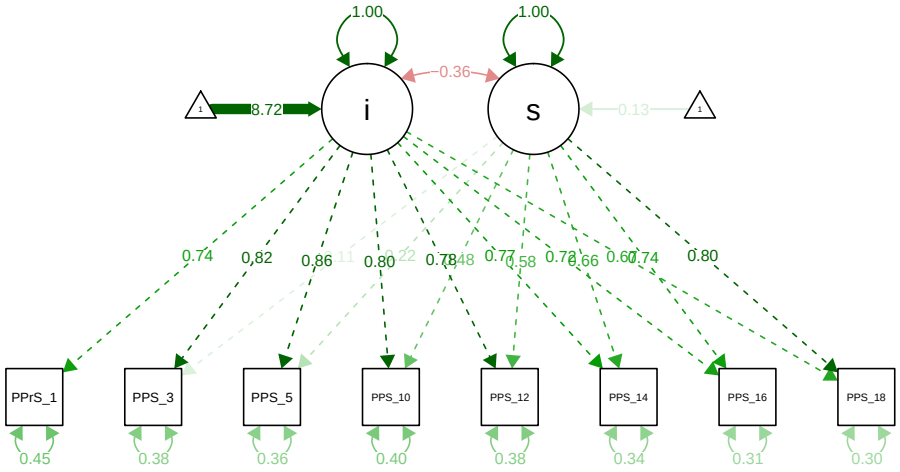
```
semPaths(fit.1, what="std")
```




```
semPaths(fit.3, what="std")
```




```
semPaths(fit.6.precise, what="std")
```




```
semPaths(fit.8.precise, what="std")
```

Extra: multivariate growth curves

```
#multiple MDDPRP by 100 to make it easier to analyze
data_wide <- data_wide %>%
  mutate(MDDPRP_100_1 = MDDPRP_1*100,
         MDDPRP_100_3 = MDDPRP_3*100,
         MDDPRP_100_5 = MDDPRP_5*100,
         MDDPRP_100_10 = MDDPRP_10*100,
         MDDPRP_100_12 = MDDPRP_12*100,
         MDDPRP_100_14 = MDDPRP_14*100,
         MDDPRP_100_16 = MDDPRP_16*100,
         MDDPRP_100_18 = MDDPRP_18*100)

#Multivariate growth curve
model.bi <- '
    #create peer growth model
                  i.p =~ 1*PPeerScale_1 + 1*PPeerScale_3 + 1*PPeerScale_5 +  1*PPeerScale_10 + 1*PPeerS
                         1*PPeerScale_14 + 1*PPeerScale_16 + 1*PPeerScale_18
                  s.p =~ 0*PPeerScale_1 + 1.022622*PPeerScale_3 + 2.012532*PPeerScale_5 +  4.597019*PPe
                         5.724867*PPeerScale_12 + 6.709552*PPeerScale_14 + 7.955476*PPeerScale_16 +
                         9.164656*PPeerScale_18
    # create depression growth model
                  i.d =~ 1*MDDPRP_100_1 + 1*MDDPRP_100_3 + 1*MDDPRP_100_5 +  1*MDDPRP_100_10 + 1*MDDPRP
                         1*MDDPRP_100_14 + 1*MDDPRP_100_16 + 1*MDDPRP_100_18
                  s.d =~ 0*MDDPRP_100_1 + 1.022622*MDDPRP_100_3 + 2.012532*MDDPRP_100_5 +  4.597019*MDD
                         5.724867*MDDPRP_100_12 + 6.709552*MDDPRP_100_14 + 7.955476*MDDPRP_100_16 +
                         9.164656*MDDPRP_100_18
    # add time-invariant covariates
```

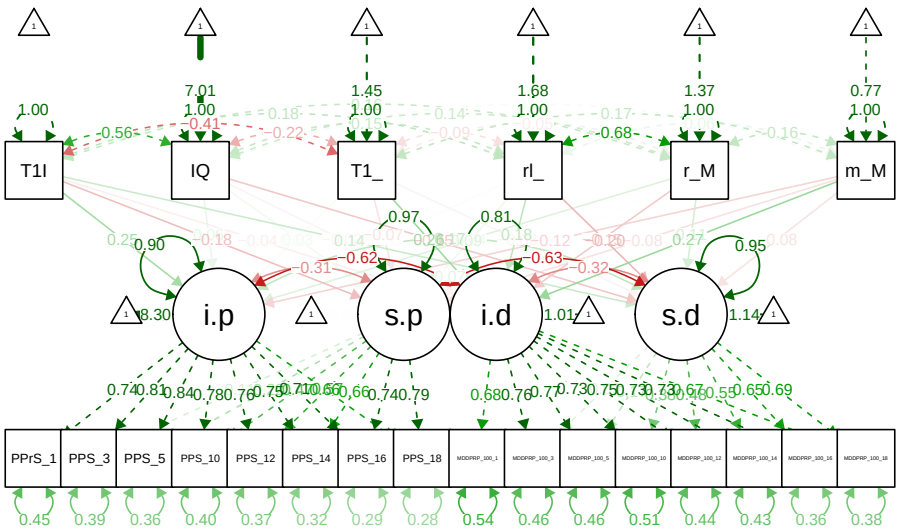
```
              i.p ~ T1Income_to_Need_c + IQ + T1_ACES_sum + rel_affective + rel_MDD + mom_MDDBP
              s.p ~ T1Income_to_Need_c + IQ + T1_ACES_sum + rel_affective + rel_MDD + mom_MDDBP
              i.d ~ T1Income_to_Need_c + IQ + T1_ACES_sum + rel_affective + rel_MDD + mom_MDDBP
              s.d ~ T1Income_to_Need_c + IQ + T1_ACES_sum + rel_affective + rel_MDD + mom_MDDBP

'

fit.bi <- growth(model.bi, data = data_wide, missing="FIML")
summary(fit.bi)
```

```
## lavaan (0.5-23.1097) converged normally after 272 iterations
##
##   Number of observations                           306
##
##   Number of missing patterns                       105
##
##   Estimator                                         ML
##   Minimum Function Test Statistic              371.660
##   Degrees of freedom                               194
##   P-value (Chi-square)                           0.000
##
## Parameter Estimates:
##
##   Information                                 Observed
##   Standard Errors                             Standard
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)
##   i.p =~
##     PPeerScale_1      1.000
##     PPeerScale_3      1.000
##     PPeerScale_5      1.000
##     PPeerScale_10     1.000
##     PPeerScale_12     1.000
##     PPeerScale_14     1.000
##     PPeerScale_16     1.000
##     PPeerScale_18     1.000
##   s.p =~
##     PPeerScale_1      0.000
##     PPeerScale_3      1.023
##     PPeerScale_5      2.013
##     PPeerScale_10     4.597
##     PPeerScale_12     5.725
##     PPeerScale_14     6.710
##     PPeerScale_16     7.955
##     PPeerScale_18     9.165
##   i.d =~
##     MDDPRP_100_1      1.000
##     MDDPRP_100_3      1.000
##     MDDPRP_100_5      1.000
##     MDDPRP_100_10     1.000
##     MDDPRP_100_12     1.000
##     MDDPRP_100_14     1.000
##     MDDPRP_100_16     1.000
```

```
##     MDDPRP_100_18     1.000
##   s.d =~
##     MDDPRP_100_1      0.000
##     MDDPRP_100_3      1.023
##     MDDPRP_100_5      2.013
##     MDDPRP_100_10     4.597
##     MDDPRP_100_12     5.725
##     MDDPRP_100_14     6.710
##     MDDPRP_100_16     7.955
##     MDDPRP_100_18     9.165
##
## Regressions:
##                   Estimate  Std.Err  z-value  P(>|z|)
##   i.p ~
##     T1Incom_t_Nd_c    1.453    0.568    2.559    0.011
##     IQ                0.028    0.047    0.591    0.554
##     T1_ACES_sum       0.057    0.265    0.215    0.830
##     rel_affective    -0.067    0.996   -0.067    0.947
##     rel_MDD           0.786    0.829    0.949    0.343
##     mom_MDDBP        -1.171    0.668   -1.752    0.080
##   s.p ~
##     T1Incom_t_Nd_c   -0.138    0.088   -1.562    0.118
##     IQ                0.002    0.007    0.298    0.766
##     T1_ACES_sum      -0.036    0.044   -0.807    0.419
##     rel_affective     0.060    0.168    0.354    0.723
##     rel_MDD           0.007    0.142    0.051    0.959
##     mom_MDDBP        -0.107    0.113   -0.945    0.345
##   i.d ~
##     T1Incom_t_Nd_c   -0.312    0.640   -0.488    0.626
##     IQ               -0.017    0.051   -0.337    0.736
##     T1_ACES_sum       1.147    0.316    3.629    0.000
##     rel_affective     2.318    1.190    1.947    0.051
##     rel_MDD          -1.579    0.991   -1.594    0.111
##     mom_MDDBP         3.215    0.804    3.999    0.000
##   s.d ~
##     T1Incom_t_Nd_c    0.111    0.104    1.076    0.282
##     IQ               -0.010    0.008   -1.190    0.234
##     T1_ACES_sum      -0.015    0.052   -0.285    0.775
##     rel_affective    -0.295    0.197   -1.494    0.135
##     rel_MDD           0.138    0.166    0.828    0.408
##     mom_MDDBP        -0.102    0.130   -0.784    0.433
##
## Covariances:
##                   Estimate  Std.Err  z-value  P(>|z|)
##  .i.p ~~
##    .s.p             -1.877    0.680   -2.760    0.006
##    .i.d            -30.710    4.644   -6.613    0.000
##    .s.d              1.019    0.730    1.396    0.163
##  .s.p ~~
##    .i.d              0.492    0.722    0.681    0.496
##    .s.d             -0.514    0.119   -4.315    0.000
##  .i.d ~~
##    .s.d             -2.190    1.018   -2.152    0.031
##
```

```
## Intercepts:
##                    Estimate  Std.Err  z-value  P(>|z|)
##    .PPeerScale_1      0.000
##    .PPeerScale_3      0.000
##    .PPeerScale_5      0.000
##    .PPeerScale_10     0.000
##    .PPeerScale_12     0.000
##    .PPeerScale_14     0.000
##    .PPeerScale_16     0.000
##    .PPeerScale_18     0.000
##    .MDDPRP_100_1      0.000
##    .MDDPRP_100_3      0.000
##    .MDDPRP_100_5      0.000
##    .MDDPRP_100_10     0.000
##    .MDDPRP_100_12     0.000
##    .MDDPRP_100_14     0.000
##    .MDDPRP_100_16     0.000
##    .MDDPRP_100_18     0.000
##    .i.p              58.026    4.969   11.677    0.000
##    .s.p              -0.005    0.708   -0.007    0.995
##    .i.d               8.364    5.446    1.536    0.125
##    .s.d               1.063    0.859    1.237    0.216
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)
##    .PPeerScale_1     39.338    4.472    8.797    0.000
##    .PPeerScale_3     28.947    3.480    8.319    0.000
##    .PPeerScale_5     24.906    2.946    8.453    0.000
##    .PPeerScale_10    31.770    3.495    9.089    0.000
##    .PPeerScale_12    30.610    3.323    9.212    0.000
##    .PPeerScale_14    28.383    3.547    8.001    0.000
##    .PPeerScale_16    27.819    4.796    5.800    0.000
##    .PPeerScale_18    31.649    7.656    4.134    0.000
##    .MDDPRP_100_1     82.095    8.623    9.520    0.000
##    .MDDPRP_100_3     54.828    6.075    9.024    0.000
##    .MDDPRP_100_5     53.384    5.707    9.355    0.000
##    .MDDPRP_100_10    65.443    6.936    9.436    0.000
##    .MDDPRP_100_12    54.041    5.973    9.048    0.000
##    .MDDPRP_100_14    54.713    6.390    8.563    0.000
##    .MDDPRP_100_16    47.167    8.235    5.727    0.000
##    .MDDPRP_100_18    57.816   13.903    4.158    0.000
##    .i.p              43.978    5.119    8.592    0.000
##    .s.p               0.812    0.135    6.009    0.000
##    .i.d              56.052    7.554    7.420    0.000
##    .s.d               0.827    0.202    4.097    0.000
```

```
semPaths(fit.bi, what="std")
```



Higher intercept peer score (better relationships) is associated with a lower intercept of depression symptoms. In line with this, the slope of peer and depression are anti-correlated; that is, decreasing in peer is related to an increase in depressive symptoms. Finally, the intercept and slope of peer are anti-correlated, as is the intercept and slope of depressive symptoms.

For the covariates, a higher initial peer score was associated with higher SES, but not higher IQ or fewer advserse events. Higher initial depressive symptoms predicted more adverse events and a greater likelihood of mother having an affective disorder (MDD or BP), however, SES was unrelated to initial depressive symptoms.