SEM in R with *lavaan*

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Loading libraries

```
library(tidyverse)
library(knitr)
library(lavaan)
library(lavaanPlot)
library(psych)
library(DiagrammeR)
library(DiagrammeRsvg)
library(rsvg)
```

Reading data from CSV

```
df <- read_csv("Reading_Header.csv", na = '999999') # specifying missing values while reading data



df <- df %>%
  mutate(across(.cols = c(starts_with('INT'), starts_with('FAM')), .fns = ~as.character(.x))) # categor



glimpse(df)
```

```
## Rows: 537
## Columns: 15
## $ SUBJECT <dbl> 2, 2, 2, 3, 3, 3, 4, 4, 4, 5, 5, 5, 6, 6, 6, 7, 7, 7, 8, 8,...
## $ TEXT    <chr> "Netz", "Wind", "Spek", "Netz", "Wind", "Spek", "Netz", "Wi...
## $ OSPAN   <dbl> 0.7523810, 0.7523810, 0.7523810, 0.7979497, 0.7979497, 0.79...
## $ SSPAN   <dbl> 0.6907937, 0.6907937, 0.6907937, 0.4099440, 0.4099440, 0.40...
## $ COM1    <dbl> 3, 1, 3, 2, 0, 2, 3, 2, 3, 3, 2, 2, 3, 3, 2, 3, 2, 3, 2, 2,...
## $ COM2    <dbl> 3, 1, 2, 2, 0, 2, 2, 1, 2, 3, 1, 1, 3, 3, 3, 3, 2, 2, 1, 0,...
## $ COM3    <dbl> 3, 2, 2, 2, 3, 1, 3, 1, 3, 3, 1, 1, 3, 1, 3, 3, 1, 3, 2, 2,...
## $ INT1    <chr> "3", "1", "1", "2", "1", "2", "2", "2", "2", "3", "1", "1",...
## $ INT2    <chr> "3", "1", "1", "2", "1", "1", "2", "1", "1", "3", "1", "0",...
## $ INT3    <chr> "3", "0", "1", "2", "1", "1", "2", "1", "1", "3", "1", "1",...
## $ FAM1    <chr> "1", "3", "0", "2", "1", "2", "0", "1", "1", "2", "1", "0",...
## $ FAM2    <chr> "2", "2", "0", "3", "0", "1", "1", "2", "2", "3", "1", "1",...
```

```
## $ FAM3    <chr> "1", "2", "0", "2", "1", "1", "1", "1", "1", "3", "1", "1",...
## $ VOL     <dbl> 0.00, 0.25, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00,...
## $ INV     <dbl> 0.2500000, 0.2500000, 0.2500000, 0.6000000, 0.8000000, 0.50...
```

```
summary(df)
```

```
##     SUBJECT          TEXT               OSPAN             SSPAN
##  Min.   :  2.0   Length:537         Min.   :0.02451   Min.   :0.06803
##  1st Qu.: 50.0   Class :character   1st Qu.:0.60915   1st Qu.:0.45971
##  Median : 97.0   Mode  :character   Median :0.74893   Median :0.57576
##  Mean   :100.6                      Mean   :0.70170   Mean   :0.56546
##  3rd Qu.:144.0                      3rd Qu.:0.84944   3rd Qu.:0.68214
##  Max.   :337.0                      Max.   :1.00000   Max.   :1.00000
##                                                       NA's   :3
##       COM1            COM2            COM3           INT1
##  Min.   :0.000   Min.   :0.000   Min.   :0.000   Length:537
##  1st Qu.:1.000   1st Qu.:1.000   1st Qu.:1.000   Class :character
##  Median :2.000   Median :2.000   Median :2.000   Mode  :character
##  Mean   :1.818   Mean   :1.611   Mean   :1.855
##  3rd Qu.:2.000   3rd Qu.:2.000   3rd Qu.:3.000
##  Max.   :3.000   Max.   :3.000   Max.   :3.000
##
##      INT2               INT3               FAM1               FAM2
##  Length:537         Length:537         Length:537         Length:537
##  Class :character   Class :character   Class :character   Class :character
##  Mode  :character   Mode  :character   Mode  :character   Mode  :character
##
##
##
##
##      FAM3                VOL              INV
##  Length:537         Min.   :0.0000   Min.   :0.000
##  Class :character   1st Qu.:0.0000   1st Qu.:0.000
##  Mode  :character   Median :0.0000   Median :0.250
##                     Mean   :0.1316   Mean   :0.265
##                     3rd Qu.:0.2500   3rd Qu.:0.400
##                     Max.   :1.0000   Max.   :1.000
##                     NA's   :9        NA's   :9
```

Code for producing Table-1

Results can be found in Covariances table

```
corr.lv.model <- '

# latent variable definitions

lat_COM =~ COM1 + COM2 + COM3
lat_INT =~ INT1 + INT2 + INT3
lat_FAM =~ FAM1 + FAM2 + FAM3
lat_WMC =~ OSPAN + SSPAN
```

```
# covariances

VOL ~~ INV
lat_INT ~~ lat_WMC
lat_INT ~~ lat_FAM
lat_INT ~~ lat_COM
lat_COM ~~ lat_FAM
lat_COM ~~ lat_WMC
lat_FAM ~~ lat_WMC



'




fit.lv.model <- cfa(model = corr.lv.model, data = df, cluster = 'SUBJECT') # Confirmatory factor model

summary(fit.lv.model, standardized=TRUE) # In covariance table std.lv includes the correlation
```

```
## lavaan 0.6-6 ended normally after 81 iterations
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of free parameters                         44
##
##                                                   Used       Total
##   Number of observations                           525         537
##   Number of clusters [SUBJECT]                     178
##
## Model Test User Model:
##                                                Standard      Robust
##   Test Statistic                                276.379     254.434
##   Degrees of freedom                                 60          60
##   P-value (Chi-square)                            0.000       0.000
##   Scaling correction factor                                   1.086
##         Yuan-Bentler correction (Mplus variant)
##
## Parameter Estimates:
##
##   Standard errors                             Robust.cluster
##   Information                                 Observed
##   Observed information based on                Hessian
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   lat_COM =~
##     COM1              1.000                               0.525    0.582
##     COM2              1.193    0.134    8.919    0.000    0.626    0.662
##     COM3              1.059    0.138    7.692    0.000    0.556    0.580
##   lat_INT =~
##     INT1              1.000                               0.811    0.879
```

```
##     INT2              0.988    0.038   25.796    0.000    0.801    0.866
##     INT3              0.922    0.042   22.153    0.000    0.747    0.830
##   lat_FAM =~
##     FAM1              1.000                               0.827    0.856
##     FAM2              0.907    0.042   21.394    0.000    0.749    0.799
##     FAM3              0.957    0.035   27.384    0.000    0.791    0.880
##   lat_WMC =~
##     OSPAN             1.000                               0.112    0.561
##     SSPAN             1.350    0.535    2.525    0.012    0.151    0.881
##
## Covariances:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   VOL ~~
##     INV             -0.008    0.002   -3.542    0.000   -0.008   -0.145
##   lat_INT ~~
##     lat_WMC           0.001    0.006    0.139    0.890    0.009    0.009
##     lat_FAM           0.335    0.035    9.651    0.000    0.500    0.500
##   lat_COM ~~
##     lat_INT           0.196    0.027    7.289    0.000    0.460    0.460
##     lat_FAM           0.112    0.025    4.521    0.000    0.258    0.258
##     lat_WMC           0.018    0.007    2.499    0.012    0.310    0.310
##   lat_FAM ~~
##     lat_WMC           0.005    0.005    0.989    0.323    0.052    0.052
##
## Intercepts:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .COM1              1.832    0.045   41.168    0.000    1.832    2.031
##    .COM2              1.619    0.041   39.131    0.000    1.619    1.712
##    .COM3              1.867    0.046   40.384    0.000    1.867    1.947
##    .INT1              2.716    0.038   72.142    0.000    2.716    2.945
##    .INT2              2.560    0.035   72.325    0.000    2.560    2.767
##    .INT3              2.438    0.036   66.991    0.000    2.438    2.709
##    .FAM1              2.286    0.039   57.968    0.000    2.286    2.368
##    .FAM2              2.543    0.045   56.168    0.000    2.543    2.710
##    .FAM3              2.301    0.042   55.230    0.000    2.301    2.559
##    .OSPAN             0.707    0.015   47.508    0.000    0.707    3.545
##    .SSPAN             0.568    0.013   44.104    0.000    0.568    3.311
##     VOL               0.130    0.011   12.013    0.000    0.130    0.572
##     INV               0.264    0.012   21.624    0.000    0.264    1.091
##     lat_COM           0.000                               0.000    0.000
##     lat_INT           0.000                               0.000    0.000
##     lat_FAM           0.000                               0.000    0.000
##     lat_WMC           0.000                               0.000    0.000
##
## Variances:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .COM1              0.538    0.046   11.632    0.000    0.538    0.662
##    .COM2              0.503    0.054    9.399    0.000    0.503    0.562
##    .COM3              0.610    0.054   11.286    0.000    0.610    0.664
##    .INT1              0.194    0.025    7.684    0.000    0.194    0.228
##    .INT2              0.214    0.033    6.585    0.000    0.214    0.250
##    .INT3              0.252    0.031    8.036    0.000    0.252    0.311
##    .FAM1              0.248    0.025    9.925    0.000    0.248    0.267
##    .FAM2              0.319    0.036    8.806    0.000    0.319    0.362
```

```
##    .FAM3              0.182    0.028    6.394    0.000    0.182    0.225
##    .OSPAN             0.027    0.006    4.843    0.000    0.027    0.685
##    .SSPAN             0.007    0.008    0.806    0.420    0.007    0.224
##     VOL               0.052    0.006    8.949    0.000    0.052    1.000
##     INV               0.058    0.005   12.514    0.000    0.058    1.000
##     lat_COM           0.275    0.048    5.796    0.000    1.000    1.000
##     lat_INT           0.657    0.045   14.643    0.000    1.000    1.000
##     lat_FAM           0.683    0.045   15.063    0.000    1.000    1.000
##     lat_WMC           0.013    0.006    2.196    0.028    1.000    1.000
```

```r
# Estimating Cronbach's alpha for Latent variable

alpha(df %>% select(starts_with("COM"))) # Estimate for Comprehension
```

```
##
## Reliability analysis
## Call: alpha(x = df %>% select(starts_with("COM")))
##
##   raw_alpha std.alpha G6(smc) average_r S/N   ase mean   sd median_r
##       0.64      0.64    0.54      0.37 1.7 0.027  1.8 0.71     0.36
##
##  lower alpha upper     95% confidence boundaries
## 0.58 0.64 0.69
##
##  Reliability if an item is dropped:
##      raw_alpha std.alpha G6(smc) average_r S/N alpha se var.r med.r
## COM1      0.53      0.53    0.36      0.36 1.1    0.040    NA  0.36
## COM2      0.50      0.50    0.34      0.34 1.0    0.043    NA  0.34
## COM3      0.58      0.58    0.41      0.41 1.4    0.036    NA  0.41
##
##  Item statistics
##        n raw.r std.r r.cor r.drop mean   sd
## COM1 537  0.75  0.76  0.57   0.45  1.8 0.91
## COM2 537  0.78  0.77  0.59   0.47  1.6 0.94
## COM3 537  0.75  0.74  0.52   0.42  1.9 0.96
##
## Non missing response frequency for each item
##         0    1    2    3 miss
## COM1 0.09 0.25 0.42 0.25    0
## COM2 0.13 0.33 0.35 0.20    0
## COM3 0.10 0.25 0.35 0.30    0
```

```r
alpha(df %>% select(starts_with("INT")) %>% mutate_all(as.numeric)) # Estimate for Interest
```

```
##
## Reliability analysis
## Call: alpha(x = df %>% select(starts_with("INT")) %>% mutate_all(as.numeric))
##
##   raw_alpha std.alpha G6(smc) average_r S/N    ase mean   sd median_r
##        0.9       0.9    0.85      0.74 8.6 0.0078  1.6 0.84     0.74
##
##  lower alpha upper     95% confidence boundaries
## 0.88 0.9 0.91
```

```
##
##  Reliability if an item is dropped:
##      raw_alpha std.alpha G6(smc) average_r S/N alpha se var.r med.r
## INT1      0.84      0.84    0.72      0.72 5.2    0.014    NA  0.72
## INT2      0.85      0.85    0.74      0.74 5.7    0.013    NA  0.74
## INT3      0.87      0.87    0.76      0.76 6.4    0.012    NA  0.76
##
##  Item statistics
##        n raw.r std.r r.cor r.drop mean   sd
## INT1 537  0.92  0.92  0.86   0.81  1.7 0.93
## INT2 537  0.91  0.91  0.84   0.80  1.5 0.93
## INT3 537  0.90  0.90  0.82   0.78  1.4 0.90
##
## Non missing response frequency for each item
##         0    1    2    3 miss
## INT1 0.11 0.28 0.39 0.21    0
## INT2 0.14 0.34 0.36 0.17    0
## INT3 0.18 0.33 0.39 0.11    0
```

```
alpha(df %>% select(starts_with("FAM")) %>% mutate_all(as.numeric)) # Estimate for Familarity
```

```
##
## Reliability analysis
## Call: alpha(x = df %>% select(starts_with("FAM")) %>% mutate_all(as.numeric))
##
##   raw_alpha std.alpha G6(smc) average_r S/N    ase mean   sd median_r
##       0.88      0.88    0.84      0.71 7.5 0.0089  1.4 0.84     0.69
##
##  lower alpha upper     95% confidence boundaries
## 0.86 0.88 0.9
##
##  Reliability if an item is dropped:
##      raw_alpha std.alpha G6(smc) average_r S/N alpha se var.r med.r
## FAM1      0.82      0.82    0.69      0.69 4.6    0.016    NA  0.69
## FAM2      0.87      0.87    0.77      0.77 6.6    0.011    NA  0.77
## FAM3      0.81      0.81    0.68      0.68 4.3    0.016    NA  0.68
##
##  Item statistics
##        n raw.r std.r r.cor r.drop mean   sd
## FAM1 537  0.91  0.91  0.84   0.78  1.3 0.96
## FAM2 537  0.88  0.88  0.77   0.73  1.5 0.94
## FAM3 537  0.91  0.91  0.85   0.80  1.3 0.90
##
## Non missing response frequency for each item
##         0    1    2    3 miss
## FAM1 0.25 0.34 0.29 0.12    0
## FAM2 0.16 0.29 0.39 0.15    0
## FAM3 0.21 0.38 0.32 0.09    0
```

```
alpha(df %>% select(ends_with("PAN")))  # Estimate for WMC
```

```
##
## Reliability analysis
```

```
## Call: alpha(x = df %>% select(ends_with("PAN")))
##
##   raw_alpha std.alpha G6(smc) average_r S/N   ase mean   sd median_r
##       0.66      0.67     0.5       0.5   2 0.029 0.63 0.16      0.5
##
##  lower alpha upper     95% confidence boundaries
## 0.61 0.66 0.72
##
##  Reliability if an item is dropped:
##       raw_alpha std.alpha G6(smc) average_r S/N alpha se var.r med.r
## OSPAN      0.50       0.5    0.25       0.5  NA       NA  0.50   0.5
## SSPAN      0.25       0.5      NA        NA  NA       NA  0.25   0.5
##
##  Item statistics
##         n raw.r std.r r.cor r.drop mean   sd
## OSPAN 537  0.89  0.87  0.61    0.5 0.70 0.20
## SSPAN 534  0.84  0.87  0.61    0.5 0.57 0.17
```

Code for producing Table-2 and Tbale-3

In the regression table Std.all includes the estimates in Table-2 and Std.lv includes estimate for Table-3. I am not clear why the sign is opposite with respect to the sign in the paper in Table-3.

```
myModel <- readLines("model.lav")


cat(myModel, fill = TRUE)
```

```
##  # latent variable definitions   lat_COM =~ COM1 + COM2 + COM3
## lat_INT =~ INT1 + INT2 + INT3 lat_FAM =~ FAM1 + FAM2 + FAM3
## lat_WMC =~ OSPAN + SSPAN    # regressions
## lat_COM ~ a * lat_WMC + b * lat_INT + c * lat_FAM + VOL + INV
## VOL ~ d * lat_WMC + e * lat_INT + f * lat_FAM
## INV ~ g * lat_WMC + h * lat_INT + i * lat_FAM     # variances and covariances
## VOL ~~ INV lat_INT ~~ lat_WMC lat_FAM ~~ lat_WMC lat_INT ~~ lat_FAM
```

```
fit <- sem(model = myModel, data = df, cluster = 'SUBJECT')

summary(fit, standardized=TRUE)
```

```
## lavaan 0.6-6 ended normally after 114 iterations
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of free parameters                         52
##
##                                                   Used       Total
##   Number of observations                           525         537
##   Number of clusters [SUBJECT]                     178
##
## Model Test User Model:
##                                                Standard      Robust
```

```
##   Test Statistic                                99.488      94.087
##   Degrees of freedom                            52          52
##   P-value (Chi-square)                          0.000       0.000
##   Scaling correction factor                                 1.057
##        Yuan-Bentler correction (Mplus variant)
##
## Parameter Estimates:
##
##   Standard errors                         Robust.cluster
##   Information                                  Observed
##   Observed information based on                Hessian
##
## Latent Variables:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   lat_COM =~
##     COM1             1.000                               0.526    0.583
##     COM2             1.154    0.119    9.730    0.000    0.607    0.642
##     COM3             1.090    0.136    8.026    0.000    0.573    0.598
##   lat_INT =~
##     INT1             1.000                               0.815    0.884
##     INT2             0.977    0.038   25.847    0.000    0.796    0.861
##     INT3             0.916    0.041   22.330    0.000    0.747    0.830
##   lat_FAM =~
##     FAM1             1.000                               0.827    0.857
##     FAM2             0.906    0.042   21.382    0.000    0.749    0.798
##     FAM3             0.956    0.035   27.328    0.000    0.791    0.880
##   lat_WMC =~
##     OSPAN            1.000                               0.112    0.560
##     SSPAN            1.359    0.572    2.375    0.018    0.152    0.884
##
## Regressions:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   lat_COM ~
##     lat_WMC    (a)    1.140    0.347    3.284    0.001    0.242    0.242
##     lat_INT    (b)    0.188    0.046    4.097    0.000    0.291    0.291
##     lat_FAM    (c)    0.012    0.039    0.300    0.765    0.018    0.018
##     VOL              -0.643    0.138   -4.642    0.000   -1.222   -0.279
##     INV              -0.538    0.129   -4.175    0.000   -1.023   -0.247
##   VOL ~
##     lat_WMC    (d)   -0.279    0.159   -1.756    0.079   -0.031   -0.136
##     lat_INT    (e)   -0.091    0.016   -5.679    0.000   -0.075   -0.326
##     lat_FAM    (f)    0.008    0.014    0.555    0.579    0.006    0.028
##   INV ~
##     lat_WMC    (g)   -0.225    0.122   -1.846    0.065   -0.025   -0.104
##     lat_INT    (h)   -0.082    0.016   -5.047    0.000   -0.067   -0.276
##     lat_FAM    (i)   -0.009    0.015   -0.572    0.567   -0.007   -0.030
##
## Covariances:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##  .VOL ~~
##    .INV              -0.014    0.002   -5.619    0.000   -0.014   -0.280
##   lat_INT ~~
##     lat_WMC           0.001    0.006    0.157    0.875    0.010    0.010
##   lat_FAM ~~
```

```
##     lat_WMC           0.005    0.005    0.975    0.330    0.052    0.052
##   lat_INT ~~
##     lat_FAM           0.336    0.035    9.668    0.000    0.499    0.499
##
## Intercepts:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .COM1              2.058    0.063   32.769    0.000    2.058    2.281
##    .COM2              1.880    0.067   27.855    0.000    1.880    1.987
##    .COM3              2.113    0.068   30.988    0.000    2.113    2.203
##    .INT1              2.716    0.038   72.142    0.000    2.716    2.945
##    .INT2              2.560    0.035   72.325    0.000    2.560    2.767
##    .INT3              2.438    0.036   66.991    0.000    2.438    2.709
##    .FAM1              2.286    0.039   57.968    0.000    2.286    2.368
##    .FAM2              2.543    0.045   56.168    0.000    2.543    2.710
##    .FAM3              2.301    0.042   55.230    0.000    2.301    2.559
##    .OSPAN             0.707    0.015   47.508    0.000    0.707    3.545
##    .SSPAN             0.568    0.013   44.104    0.000    0.568    3.311
##    .VOL               0.130    0.011   12.013    0.000    0.130    0.572
##    .INV               0.264    0.012   21.624    0.000    0.264    1.091
##    .lat_COM           0.000                              0.000    0.000
##     lat_INT           0.000                              0.000    0.000
##     lat_FAM           0.000                              0.000    0.000
##     lat_WMC           0.000                              0.000    0.000
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .COM1              0.537    0.045   11.960    0.000    0.537    0.660
##    .COM2              0.527    0.051   10.395    0.000    0.527    0.588
##    .COM3              0.591    0.052   11.283    0.000    0.591    0.643
##    .INT1              0.186    0.025    7.465    0.000    0.186    0.219
##    .INT2              0.222    0.032    6.958    0.000    0.222    0.259
##    .INT3              0.252    0.031    8.205    0.000    0.252    0.312
##    .FAM1              0.247    0.025    9.894    0.000    0.247    0.265
##    .FAM2              0.319    0.036    8.824    0.000    0.319    0.363
##    .FAM3              0.183    0.028    6.421    0.000    0.183    0.226
##    .OSPAN             0.027    0.006    4.577    0.000    0.027    0.687
##    .SSPAN             0.006    0.009    0.742    0.458    0.006    0.219
##    .VOL               0.046    0.005    8.873    0.000    0.046    0.883
##    .INV               0.053    0.005   11.472    0.000    0.053    0.903
##    .lat_COM           0.167    0.035    4.820    0.000    0.603    0.603
##     lat_INT           0.665    0.045   14.787    0.000    1.000    1.000
##     lat_FAM           0.684    0.045   15.054    0.000    1.000    1.000
##     lat_WMC           0.012    0.006    2.102    0.036    1.000    1.000
```

Code for producing Figure-2

```
labels = list(lat_INT = "Interest", lat_FAM = "Familarity", lat_WMC = "WMC", lat_COM = "Reading", VOL =


grph <- lavaanPlot(model = fit, stand = TRUE,
           labels = labels, node_options = list(shape = "box", fontname = "Helvetica"),
           edge_options = list(color = "grey"), coef = TRUE)
```

```
tmp<-capture.output(rsvg_png(charToRaw(export_svg(grph)),'SEM.png'))

cat('![Structural equation model with estimated standardized coefficients.](SEM.png){#fig:SEM}\n\n')
```

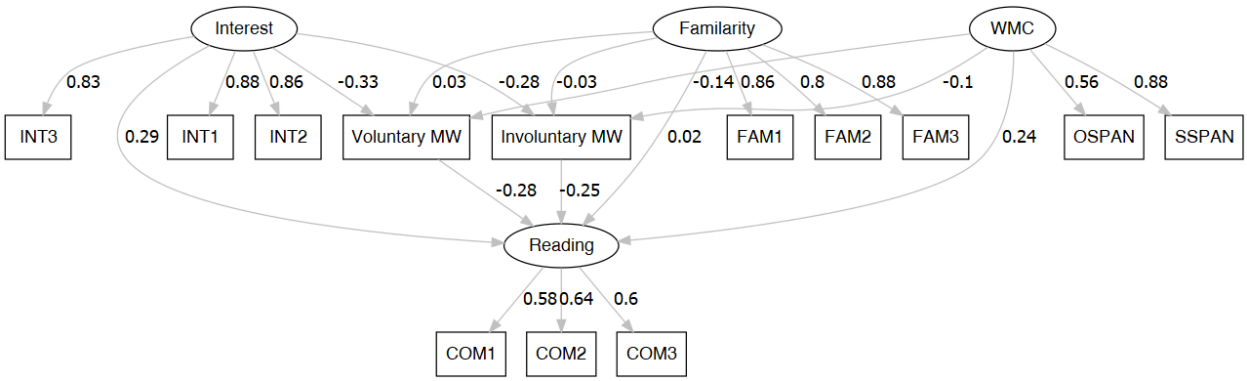

Figure 1: Structural equation model with estimated standardized coefficients.

Code for producing Table-4

```
df %>% select(-SUBJECT, -TEXT) %>% lowerCor(digits = 2)
```

```
##       OSPAN SSPAN COM1  COM2  COM3  INT1  INT2  INT3  FAM1  FAM2  FAM3
## OSPAN  1.00
## SSPAN  0.50  1.00
## COM1   0.11  0.21  1.00
## COM2   0.14  0.14  0.41  1.00
## COM3   0.15  0.15  0.34  0.36  1.00
## INT1   0.11  0.05  0.22  0.29  0.29  1.00
## INT2   0.08 -0.03  0.18  0.28  0.24  0.76  1.00
## INT3   0.05 -0.05  0.18  0.26  0.27  0.74  0.72  1.00
## FAM1   0.01  0.00  0.05  0.13  0.10  0.34  0.37  0.32  1.00
## FAM2   0.11  0.07  0.11  0.21  0.20  0.41  0.48  0.40  0.68  1.00
## FAM3   0.03  0.06  0.11  0.17  0.15  0.36  0.40  0.34  0.77  0.69  1.00
## VOL   -0.05 -0.13 -0.24 -0.21 -0.24 -0.30 -0.27 -0.25 -0.08 -0.17 -0.12
## INV   -0.13 -0.08 -0.15 -0.21 -0.22 -0.28 -0.21 -0.24 -0.17 -0.14 -0.13
##       VOL   INV
## VOL  1.00
## INV -0.15  1.00
```

```
describe(df %>% select(-SUBJECT, -TEXT)) %>% rownames_to_column() %>% kable(digits = 2)
```

rowname	vars	n	mean	sd	median	trimmed	mad	min	max	range	skew	kurtosis	se
OSPAN	1	537	0.70	0.20	0.75	0.73	0.16	0.02	1	0.98	-1.17	1.07	0.01
SSPAN	2	534	0.57	0.17	0.58	0.57	0.16	0.07	1	0.93	-0.28	0.05	0.01
COM1	3	537	1.82	0.91	2.00	1.88	1.48	0.00	3	3.00	-0.35	-0.67	0.04

rowname	vars	n	mean	sd	median	trimmed	mad	min	max	range	skew	kurtosis	se
COM2	4	537	1.61	0.94	2.00	1.64	1.48	0.00	3	3.00	-0.08	-0.91	0.04
COM3	5	537	1.85	0.96	2.00	1.94	1.48	0.00	3	3.00	-0.38	-0.87	0.04
INT1	6	537	1.70	0.93	2.00	1.75	1.48	0.00	3	3.00	-0.23	-0.81	0.04
INT2	7	537	1.55	0.93	2.00	1.56	1.48	0.00	3	3.00	-0.05	-0.86	0.04
INT3	8	537	1.43	0.90	1.00	1.41	1.48	0.00	3	3.00	-0.07	-0.83	0.04
FAM1	9	537	1.28	0.96	1.00	1.23	1.48	0.00	3	3.00	0.20	-0.96	0.04
FAM2	10	537	1.53	0.94	2.00	1.54	1.48	0.00	3	3.00	-0.13	-0.88	0.04
FAM3	11	537	1.30	0.90	1.00	1.26	1.48	0.00	3	3.00	0.14	-0.80	0.04
VOL	12	528	0.13	0.23	0.00	0.08	0.00	0.00	1	1.00	2.10	4.40	0.01
INV	13	528	0.27	0.24	0.25	0.24	0.37	0.00	1	1.00	0.81	0.40	0.01