

Results Financial Inclusion

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22/11/2020

```
setwd("/home/juan/PaperBrandstat")
```

Let's open the data

```
library(readr)
Brandstat <- read_delim("RawDataBrandstat.csv", ",", escape_double = FALSE, trim_ws = TRUE)

##
## -- Column specification -----
## cols(
##   .default = col_double()
## )
## i Use 'spec()' for the full column specifications.
variable.names(Brandstat)

## [1] "City"      "Sex"      "Strata"    "Age"
## [5] "Occupation" "Education" "Civic_Status" "Home_Structure"
## [9] "Income_Level" "FC1"      "FC2"      "FC3"
## [13] "FC4"      "Aut1"     "Aut2"     "Aut3"
## [17] "Aut4"     "Aut5"     "Aut6"     "Aut7"

automation <- Brandstat[14:20]
FacCond <- Brandstat[10:13]
```

Sample Description

```
library(psych)
describe.by(Brandstat$Age, group = Brandstat$Sex, mat = TRUE, digits = 2)

## Warning: describe.by is deprecated. Please use the describeBy function

##      item group1 vars   n mean   sd median trimmed  mad min max range skew
## X11     1      1    1 248 32.69 11.76    29   31.64 11.86  18  61   43 0.65
## X12     2      2    1 230 32.97 11.87    29   31.84 11.86  18  69   51 0.73
##      kurtosis   se
## X11    -0.77 0.75
## X12    -0.59 0.78

summary(Brandstat$Age)

##      Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    18.00   23.00   29.00   32.82   42.75   69.00
```

```

library(ggplot2)

##
## Attaching package: 'ggplot2'
## The following objects are masked from 'package:psych':
##
##      %+%, alpha
library(ggribes)
s1 <- ggplot(Brandstat, aes(x=Age, y=as.factor(Sex))) + geom_density_ridges(fill="green", alpha = 0.4) +
theme_ridges() + ylab("Sex")

s2 <- ggplot(Brandstat, aes(x=Age, y=as.factor(Strata))) + geom_density_ridges(fill="green", alpha = 0.4) +
theme_ridges() + ylab("Economic Strata")

s3 <- ggplot(Brandstat, aes(x=Age, y=as.factor(Education))) + geom_density_ridges(fill="green", alpha = 0.4) +
theme_ridges() + ylab("Education")

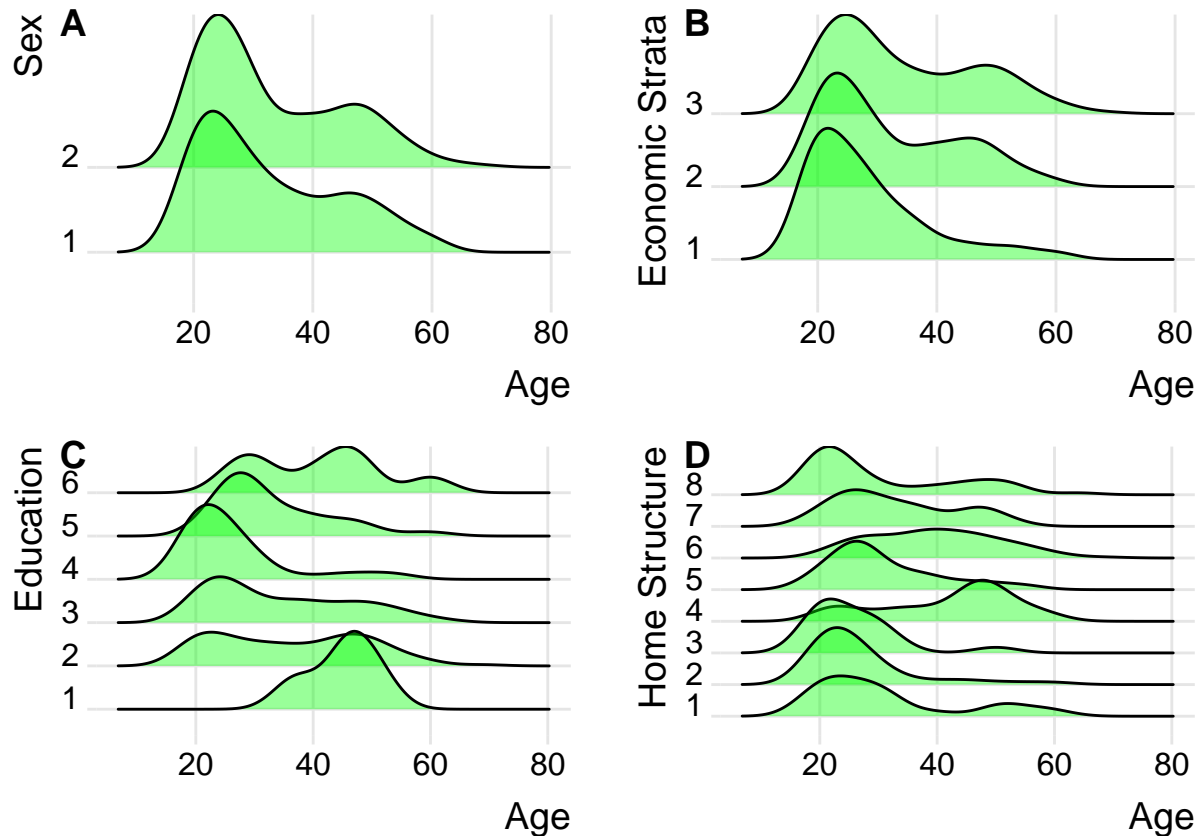
s4 <- ggplot(Brandstat, aes(x=Age, y=as.factor(Home_Structure))) + geom_density_ridges(fill="green", alpha = 0.4) +
theme_ridges() + ylab("Home Structure")

library(ggpubr)

ggarrange(s1, s2, s3, s4, ncol = 2, nrow = 2, labels = c("A", "B", "C", "D"))

## Picking joint bandwidth of 3.56
## Picking joint bandwidth of 3.56
## Picking joint bandwidth of 3.75
## Picking joint bandwidth of 3.75

```



Measurement Model of Automation

To examine the factor structure of all the scales employed, we proceed by testing the overall sampling adequacy of the items. These items are susceptible to factorization ($KMO = 0.92$), and the most probable psychometric structure consists of a one-factor model with freely estimated factor loadings. This emerging solution is evident through the statistical significance of the homogeneous items test ($F = 1.763$; $p = 0.0415$) which proved to be better than a psychometric structure of a one-factor model with equal factor loadings for all items captured by the tau-equivalence test ($F = 1.563$; $p = 0.0575$).

```
library(psych)
KMO(automation)

## Kaiser-Meyer-Olkin factor adequacy
## Call: KMO(r = automation)
## Overall MSA = 0.92
## MSA for each item =
## Aut1 Aut2 Aut3 Aut4 Aut5 Aut6 Aut7
## 0.89 0.94 0.93 0.93 0.90 0.93 0.94

library(coefficients)

## Loading required package: rsem
## Loading required package: MASS
## Loading required package: lavaan
## This is lavaan 0.6-7
```

```

## lavaan is BETA software! Please report any bugs.
##
## Attaching package: 'lavaan'
## The following object is masked from 'package:psych':
##
##     cor2cov
##
## Attaching package: 'coefficientsalpha'
## The following object is masked from 'package:ggplot2':
##
##     alpha
## The following objects are masked from 'package:psych':
##
##     alpha, omega
tau.test(automation)

## Warning: Setting row names on a tibble is deprecated.
## Test of tau equivalent
## The robust F statistic is  1.563
## with a p-value  0.0575
##
## Test of homogeneous items
## The robust F statistic is  1.763
## with a p-value  0.0415

The results of the confirmatory factor analysis reveal a reasonable goodness-of-fit for the scale of automation
(CFI = 0.950; TLI = 0.926; RMSEA = 0.142; SRMR = 0.037)

library(lavaan)
aut.model <- "aut =~ Aut1 + Aut2 + Aut3 + Aut4 + Aut5 + Aut6 + Aut7"
fit1 <- lavaan::cfa(aut.model, data=Brandstat, std.lv=TRUE)
summary(fit1, fit.measures=T, standardized=T)

## lavaan 0.6-7 ended normally after 17 iterations
##
##      Estimator                      ML
##      Optimization method          NLMINB
##      Number of free parameters      14
##
##      Number of observations          478
##
## Model Test User Model:
##
##      Test statistic                  149.084
##      Degrees of freedom              14
##      P-value (Chi-square)            0.000
##
## Model Test Baseline Model:
##
##      Test statistic                  2741.418
##      Degrees of freedom              21
##      P-value                        0.000

```

```

##
## User Model versus Baseline Model:
##
##   Comparative Fit Index (CFI)                0.950
##   Tucker-Lewis Index (TLI)                  0.926
##
## Loglikelihood and Information Criteria:
##
##   Loglikelihood user model (H0)              -7248.230
##   Loglikelihood unrestricted model (H1)       -7173.688
##
##   Akaike (AIC)                             14524.460
##   Bayesian (BIC)                           14582.834
##   Sample-size adjusted Bayesian (BIC)       14538.400
##
## Root Mean Square Error of Approximation:
##
##   RMSEA                                     0.142
##   90 Percent confidence interval - lower     0.122
##   90 Percent confidence interval - upper     0.163
##   P-value RMSEA <= 0.05                    0.000
##
## Standardized Root Mean Square Residual:
##
##   SRMR                                     0.037
##
## Parameter Estimates:
##
##   Standard errors                          Standard
##   Information                             Expected
##   Information saturated (h1) model         Structured
##
## Latent Variables:
##
##           Estimate  Std.Err  z-value  P(>|z|)  Std.lv  Std.all
##   aut =~
##     Aut1           2.812    0.114   24.714    0.000    2.812    0.891
##     Aut2           2.612    0.122   21.421    0.000    2.612    0.815
##     Aut3           2.371    0.123   19.234    0.000    2.371    0.758
##     Aut4           2.387    0.115   20.760    0.000    2.387    0.799
##     Aut5           2.870    0.120   23.986    0.000    2.870    0.876
##     Aut6           2.296    0.113   20.237    0.000    2.296    0.785
##     Aut7           2.668    0.115   23.241    0.000    2.668    0.859
##
## Variances:
##
##           Estimate  Std.Err  z-value  P(>|z|)  Std.lv  Std.all
##     .Aut1           2.045    0.173   11.796    0.000    2.045    0.205
##     .Aut2           3.440    0.253   13.595    0.000    3.440    0.335
##     .Aut3           4.164    0.293   14.196    0.000    4.164    0.426
##     .Aut4           3.238    0.235   13.807    0.000    3.238    0.362
##     .Aut5           2.510    0.203   12.351    0.000    2.510    0.233
##     .Aut6           3.283    0.235   13.954    0.000    3.283    0.384
##     .Aut7           2.534    0.198   12.805    0.000    2.534    0.263
##     aut             1.000

```

```
library(semTools)

##
## #####
## This is semTools 0.5-3
## All users of R (or SEM) are invited to submit functions or ideas for functions.
## #####
##
## Attaching package: 'semTools'
## The following object is masked from 'package:psych':
##
##     skew
## The following object is masked from 'package:readr':
##
##     clipboard
reliability(fit1)
```

```
##           aut
## alpha  0.9380854
## omega  0.9386485
## omega2 0.9386485
## omega3 0.9366932
## avevar 0.6875174
```

The emerging psychometric structure is depicted in the following picture.

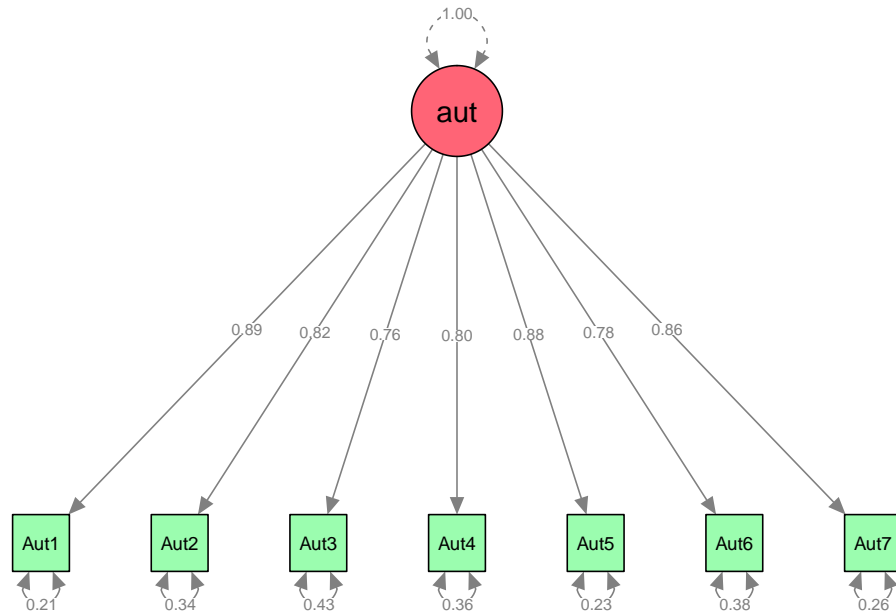
```
library(semPlot)

## Registered S3 methods overwritten by 'lme4':
##   method      from
##   cooks.distance.influence.merMod car
##   influence.merMod      car
##   dfbeta.influence.merMod      car
##   dfbetas.influence.merMod      car

## Registered S3 methods overwritten by 'huge':
##   method      from
##   plot.sim    BDgraph
##   print.sim   BDgraph

semPaths(fit1, whatLabels = "stand", layout = "tree", color = list(
  lat = rgb(255, 100, 118, maxColorValue = 255),
  man = rgb(155, 253, 175, maxColorValue = 255)),
  mar = c(10, 5, 10, 5), intercepts = FALSE, residuls = FALSE, nCharNodes = 0)

## Warning in qgraph::qgraph(Edgelist, labels = nLab, bidirectional = Bidir, : The
## following arguments are not documented and likely not arguments of qgraph and
## thus ignored: residuls
```



Measurement Model Facilitating Conditions

The items of the scale of Facilitating conditions are also susceptible to factorization ($KMO = 0.67$), and the most probable psychometric structure consists of a one-factor model.

```
library(psych)
KMO(FacCond)
```

```
## Kaiser-Meyer-Olkin factor adequacy
## Call: KMO(r = FacCond)
## Overall MSA = 0.67
## MSA for each item =
## FC1 FC2 FC3 FC4
## 0.65 0.74 0.73 0.64
```

```
library(coefficientsalpha)
tau.test(FacCond)
```

```
## Warning: Setting row names on a tibble is deprecated.

## Test of tau equivalent
## The robust F statistic is 7.37
## with a p-value 0
##
## Test of homogeneous items
## The robust F statistic is 0.427
## with a p-value 0.6528
```

The Measurement model of facilitating conditions reveals also a reasonable goodness-of-fit, as can be seen in the following results (CFI = 0.996; TLI = 0.987; RMSEA = 0.034; SRMR = 0.018)

```
library(lavaan)
fc.model <- "FC =~ FC1 + FC2 + FC3 + FC4"
fit2 <- lavaan::cfa(fc.model, data=Brandstat, std.lv=TRUE)
summary(fit2, fit.measures=T, standardized=T)
```

```
## lavaan 0.6-7 ended normally after 27 iterations
##
##      Estimator                      ML
##      Optimization method          NLMINB
##      Number of free parameters      8
##
##      Number of observations          478
##
## Model Test User Model:
##
##      Test statistic                  3.113
##      Degrees of freedom              2
##      P-value (Chi-square)            0.211
##
## Model Test Baseline Model:
##
##      Test statistic                  266.994
##      Degrees of freedom              6
##      P-value                        0.000
##
## User Model versus Baseline Model:
##
##      Comparative Fit Index (CFI)      0.996
##      Tucker-Lewis Index (TLI)        0.987
##
## Loglikelihood and Information Criteria:
##
##      Loglikelihood user model (H0)      -4365.125
##      Loglikelihood unrestricted model (H1) -4363.568
##
##      Akaike (AIC)                     8746.249
##      Bayesian (BIC)                    8779.606
##      Sample-size adjusted Bayesian (BIC) 8754.215
##
## Root Mean Square Error of Approximation:
##
##      RMSEA                            0.034
##      90 Percent confidence interval - lower 0.000
##      90 Percent confidence interval - upper 0.103
##      P-value RMSEA <= 0.05              0.543
##
## Standardized Root Mean Square Residual:
##
##      SRMR                            0.018
##
## Parameter Estimates:
##
```



```
## Standard errors
## Information
## Information saturated (h1) model
##
## Latent Variables:
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all
## FC =~
## FC1 1.668 0.128 13.013 0.000 1.668 0.696
## FC2 0.620 0.170 3.651 0.000 0.620 0.196
## FC3 1.374 0.127 10.826 0.000 1.374 0.554
## FC4 1.607 0.120 13.408 0.000 1.607 0.725
##
## Variances:
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all
## .FC1 2.957 0.344 8.604 0.000 2.957 0.515
## .FC2 9.665 0.635 15.215 0.000 9.665 0.962
## .FC3 4.269 0.340 12.563 0.000 4.269 0.693
## .FC4 2.334 0.305 7.661 0.000 2.334 0.475
## FC 1.000 1.000
```

```
inspect(fit2, "rsquare")
```

```
## FC1 FC2 FC3 FC4
## 0.485 0.038 0.307 0.525
```

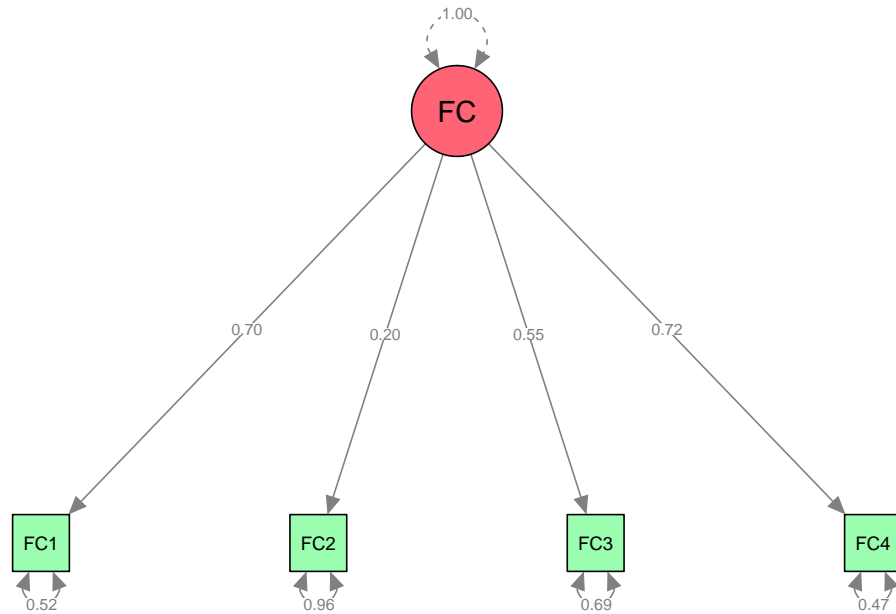
```
library(semTools)
reliability(fit2)
```

```
## FC
## alpha 0.5714467
## omega 0.5908010
## omega2 0.5908010
## omega3 0.5905017
## avevar 0.2842474
```

The emerging psychometric structure is depicted in the following picture.

```
library(semPlot)
semPaths(fit2, whatLabels = "stand", layout = "tree", color = list(
  lat = rgb(255, 100, 118, maxColorValue = 255),
  man = rgb(155, 253, 175, maxColorValue = 255)),
  mar = c(10, 5, 10, 5), intercepts = FALSE, residuls = FALSE, nCharNodes = 0)
```

```
## Warning in qgraph::qgraph(Edgelist, labels = nLab, bidirectional = Bidir, : The
## following arguments are not documented and likely not arguments of qgraph and
## thus ignored: residuls
```



Structural Model: Facilitating Conditions as Predictor of Automation

Our structural model posits that facilitating conditions predicts the acceptance of technology through the automation of financial processes. This set of relationships are summarized and illustrated as follows

```
library(lavaan);
modelData <- Brandstat
model<-"
! regressions
  Automation=~Aut__Aut1*Aut1
  Automation=~Aut__Aut2*Aut2
  Automation=~Aut__Aut3*Aut3
  Automation=~Aut__Aut4*Aut4
  Automation=~Aut__Aut5*Aut5
  Automation=~Aut__Aut6*Aut6
  Automation=~Aut__Aut7*Aut7
  Facilitating_Conditions=~Facilitating_Conditions__FC1*FC1
  Facilitating_Conditions=~Facilitating_Conditions__FC4*FC4
  Facilitating_Conditions=~Facilitating_Conditions__FC2*FC2
  Facilitating_Conditions=~Facilitating_Conditions__FC3*FC3
  Facilitating_Conditions=~Facilitating_Conditions__Automation*Automation
! residuals, variances and covariances
  Automation ~~ 1.0*Automation
  Aut1 ~~ VAR_Aut1*Aut1
```

```

Aut2 ~~ VAR_Aut2*Aut2
Aut3 ~~ VAR_Aut3*Aut3
Aut4 ~~ VAR_Aut4*Aut4
Aut5 ~~ VAR_Aut5*Aut5
Aut6 ~~ VAR_Aut6*Aut6
Aut7 ~~ VAR_Aut7*Aut7
Facilitating_Conditions ~~ 1.0*Facilitating_Conditions
FC1 ~~ VAR_FC1*FC1
FC4 ~~ VAR_FC4*FC4
FC2 ~~ VAR_FC2*FC2
FC3 ~~ VAR_FC3*FC3
! observed means
Aut1~1;
Aut2~1;
Aut3~1;
Aut4~1;
Aut5~1;
Aut6~1;
Aut7~1;
FC1~1;
FC4~1;
FC2~1;
FC3~1;
";
result<- sem(model, data=modelData);
summary(result, fit.measures=TRUE);

```

```
## lavaan 0.6-7 ended normally after 33 iterations
```

```

##
##      Estimator                      ML
##      Optimization method          NLMINB
##      Number of free parameters      32
##
##      Number of observations          478
##
## Model Test User Model:
##
##      Test statistic                  574.732
##      Degrees of freedom              45
##      P-value (Chi-square)            0.000
##
## Model Test Baseline Model:
##
##      Test statistic                  3117.042
##      Degrees of freedom              55
##      P-value                        0.000
##
## User Model versus Baseline Model:
##
##      Comparative Fit Index (CFI)      0.827
##      Tucker-Lewis Index (TLI)        0.789
##
## Loglikelihood and Information Criteria:
##

```

```

## Loglikelihood user model (H0) -11770.307
## Loglikelihood unrestricted model (H1) -11482.941
##
## Akaike (AIC) 23604.615
## Bayesian (BIC) 23738.042
## Sample-size adjusted Bayesian (BIC) 23636.478
##
## Root Mean Square Error of Approximation:
##
## RMSEA 0.157
## 90 Percent confidence interval - lower 0.146
## 90 Percent confidence interval - upper 0.169
## P-value RMSEA <= 0.05 0.000
##
## Standardized Root Mean Square Residual:
##
## SRMR 0.169
##
## Parameter Estimates:
##
## Standard errors Standard
## Information Expected
## Information saturated (h1) model Structured
##
## Latent Variables:
## Estimate Std.Err z-value P(>|z|)
##
## Automation =~
## At1 (A__A1) 1.000
## At2 (A__A2) 1.948 0.109 17.934 0.000
## At3 (A__A3) 1.828 0.108 16.939 0.000
## At4 (A__A4) 1.825 0.101 18.047 0.000
## At5 (A__A5) 2.101 0.108 19.395 0.000
## At6 (A__A6) 1.769 0.099 17.792 0.000
## At7 (A__A7) 2.031 0.102 19.997 0.000
## Facilitating_Conditions =~
## FC1 (F_C__FC1) 1.000
## FC4 (F_C__FC4) 1.435 0.126 11.353 0.000
## FC2 (F_C__FC2) 0.682 0.179 3.815 0.000
## FC3 (F_C__FC3) 1.323 0.137 9.642 0.000
## Atm (F_C__A) 0.597 0.078 7.618 0.000
##
## Intercepts:
## Estimate Std.Err z-value P(>|z|)
## .Aut1 4.977 0.113 44.215 0.000
## .Aut2 5.073 0.135 37.566 0.000
## .Aut3 4.339 0.133 32.680 0.000
## .Aut4 4.228 0.126 33.570 0.000
## .Aut5 5.103 0.137 37.282 0.000
## .Aut6 4.105 0.123 33.256 0.000
## .Aut7 4.757 0.129 36.832 0.000
## .FC1 7.709 0.101 76.419 0.000
## .FC4 8.130 0.099 81.897 0.000
## .FC2 6.816 0.145 47.116 0.000
## .FC3 7.255 0.112 64.858 0.000

```

```

##      .Automation      0.000
##      Fclttnng_Cndtns  0.000
##
## Variances:
##              Estimate Std.Err  z-value  P(>|z|)
##      .Atmt           1.000
##      .Aut1 (VAR_A1)    4.700    0.312   15.058   0.000
##      .Aut2 (VAR_A2)    3.573    0.269   13.270   0.000
##      .Aut3 (VAR_A3)    3.895    0.284   13.695   0.000
##      .Aut4 (VAR_A4)    3.062    0.232   13.215   0.000
##      .Aut5 (VAR_A5)    2.966    0.240   12.377   0.000
##      .Aut6 (VAR_A6)    3.039    0.228   13.338   0.000
##      .Aut7 (VAR_A7)    2.379    0.201   11.864   0.000
##      Fc_C            1.000
##      .FC1 (VAR_FC1)    3.865    0.277   13.931   0.000
##      .FC4 (VAR_FC4)    2.651    0.310    8.561   0.000
##      .FC2 (VAR_FC2)    9.538    0.634   15.040   0.000
##      .FC3 (VAR_FC3)    4.230    0.364   11.629   0.000

```

```
standardizedSolution(result)
```

```

##              lhs op              rhs est.std  se      z
## 1      Automation ==      Aut1    0.473 0.018 26.664
## 2      Automation ==      Aut2    0.768 0.021 36.151
## 3      Automation ==      Aut3    0.733 0.024 31.167
## 4      Automation ==      Aut4    0.772 0.021 36.779
## 5      Automation ==      Aut5    0.818 0.018 45.619
## 6      Automation ==      Aut6    0.763 0.022 35.377
## 7      Automation ==      Aut7    0.838 0.017 50.512
## 8  Facilitating_Conditions ==      FC1    0.453 0.013 35.072
## 9  Facilitating_Conditions ==      FC4    0.661 0.049 13.474
## 10 Facilitating_Conditions ==      FC2    0.216 0.055  3.902
## 11 Facilitating_Conditions ==      FC3    0.541 0.049 11.008
## 12 Facilitating_Conditions ==      Automation 0.513 0.050 10.333
## 13      Automation ~~      Automation 0.737 0.051 14.495
## 14      Aut1 ~~      Aut1    0.776 0.017 46.196
## 15      Aut2 ~~      Aut2    0.410 0.033 12.553
## 16      Aut3 ~~      Aut3    0.462 0.035 13.393
## 17      Aut4 ~~      Aut4    0.404 0.032 12.459
## 18      Aut5 ~~      Aut5    0.331 0.029 11.301
## 19      Aut6 ~~      Aut6    0.417 0.033 12.672
## 20      Aut7 ~~      Aut7    0.298 0.028 10.738
## 21 Facilitating_Conditions ~~ Facilitating_Conditions 1.000 0.000   NA
## 22      FC1 ~~      FC1    0.794 0.012 67.769
## 23      FC4 ~~      FC4    0.563 0.065  8.670
## 24      FC2 ~~      FC2    0.953 0.024 39.979
## 25      FC3 ~~      FC3    0.707 0.053 13.294
## 26      Aut1 ~1      2.022 0.071 28.540
## 27      Aut2 ~1      1.718 0.072 24.030
## 28      Aut3 ~1      1.495 0.066 22.568
## 29      Aut4 ~1      1.535 0.067 22.881
## 30      Aut5 ~1      1.705 0.071 23.999
## 31      Aut6 ~1      1.521 0.067 22.774
## 32      Aut7 ~1      1.685 0.070 23.898
## 33      FC1 ~1      3.495 0.110 31.876

```

```

## 34          FC4 ~1          3.746 0.129 29.095
## 35          FC2 ~1          2.155 0.083 25.851
## 36          FC3 ~1          2.967 0.106 27.978
## 37      Automation ~1          0.000 0.000    NA
## 38 Facilitating_Conditions ~1 0.000 0.000    NA
##      pvalue ci.lower ci.upper
## 1         0    0.438    0.508
## 2         0    0.727    0.810
## 3         0    0.687    0.779
## 4         0    0.731    0.813
## 5         0    0.783    0.853
## 6         0    0.721    0.806
## 7         0    0.805    0.870
## 8         0    0.428    0.479
## 9         0    0.565    0.757
## 10        0    0.107    0.324
## 11        0    0.445    0.637
## 12        0    0.415    0.610
## 13        0    0.638    0.837
## 14        0    0.743    0.809
## 15        0    0.346    0.474
## 16        0    0.395    0.530
## 17        0    0.340    0.467
## 18        0    0.274    0.389
## 19        0    0.353    0.482
## 20        0    0.244    0.353
## 21       NA    1.000    1.000
## 22        0    0.771    0.817
## 23        0    0.436    0.690
## 24        0    0.907    1.000
## 25        0    0.603    0.811
## 26        0    1.883    2.161
## 27        0    1.578    1.858
## 28        0    1.365    1.625
## 29        0    1.404    1.667
## 30        0    1.566    1.845
## 31        0    1.390    1.652
## 32        0    1.546    1.823
## 33        0    3.280    3.710
## 34        0    3.494    3.998
## 35        0    1.992    2.318
## 36        0    2.759    3.174
## 37       NA    0.000    0.000
## 38       NA    0.000    0.000

```

```
inspect(result, "rsquare")
```

```

## Automation      Aut1      Aut2      Aut3      Aut4      Aut5      Aut6
##      0.263      0.224      0.590      0.538      0.596      0.669      0.583
##      Aut7      FC1      FC4      FC2      FC3
##      0.702      0.206      0.437      0.047      0.293

```

```

library(semPlot)
semPaths(result, whatLabels = "std", layout = "spring", color = list(
  lat = rgb(255, 100, 118, maxColorValue = 255),

```

```

man = rgb(155, 253, 175, maxColorValue = 255)),
mar = c(10, 5, 10, 5), intercepts = FALSE, residuls = FALSE, nCharNodes = 0)

```

```

## Warning in qgraph::qgraph(Edgelist, labels = nLab, bidirectional = Bidir, : The
## following arguments are not documented and likely not arguments of qgraph and
## thus ignored: residuls

```

