Illustrative Example

For the manuscript "Classification Accuracy of Multidimensional Tests: Quantifying the Impact of Noninvariance"

Contents


```
library(lavaan)
library(tidyverse)
library(knitr)
library(kableExtra)
library(broom)
```

```
# Load the provided code `PartInv_multi.R`
source(here::here("PartInv_multi.R"))
```

Import data

The data are part of the supplemental materials by Oct et al. (2020),[1] and can be obtained at https://journals.sagepub.com/doi/suppl/10.1177/1073191119885018

```
data <- read.table(here::here("IPIPFFM.dat"),
                   header = TRUE)
```

Specify the model

Preliminary analysis showed eight pairs of unique factor covariances need to be freed: A2 and A5, E4 and E7, I2 and I10, I8 and I9, A9 and I9, C3 and E6, A2 and E7, E7 and N2.

[1] Ock, J., McAbee, S. T., Mulfinger, E., & Oswald, F. L. (2020). The practical effects of measurement invariance: Gender invariance in two Big Five personality measures. *Assessment, 27(4)*, 657-674. https://doi.org/10.1177/1073191119885018

```r
model <- 'A =~  a2 + a5  + a7 + a9
          C =~  c3 + c4 + c8 + c9
          E =~ e1 + e4 + e6 + e7
          N =~ n1 + n2 + n6 + n8
          O =~ i2 + i8 + i9 + i10
          a2 ~~ a5
          e4 ~~ e7
          i2 ~~ i10
          i8 ~~ i9
          a9 ~~ i9
          c3 ~~ e6
          a2 ~~ e7
          e7 ~~ n2'
```

Conventional measurement invariance testing suggested the mini-IPIP scale support partial strict invariance across gender. Specifically, four items showed noninvariant intercepts across groups and three items showed noninvariant unique factor variance across groups. The results did not provide information on how these noninvariances may impact personnel selection using the mini-IPIP, so we demonstrated the MCAA framework in this example.

```r
fit_strict <- cfa(model, data = data, group = "sex",
                  group.equal = c("loadings", "Intercepts", "residuals"),
                  group.partial = c("e6 ~ 1", "n1 ~ 1", "n2 ~ 1", "a2 ~ 1",
                                    "n2 ~~ n2", "n1 ~~ n1", "c8 ~~ c8"),
                  estimator = "MLR", std.lv = TRUE)
```

```r
# Fit indices
knitr::kable(
  broom::glance(fit_strict) %>%
    select(AIC, BIC, cfi, chisq, npar, rmsea, srmr, tli, nobs),
  format = "markdown",
  digits = 3
)
```

AIC	BIC	cfi	chisq	npar	rmsea	srmr	tli	nobs
31033.99	31523.85	0.949	464.056	113	0.035	0.057	0.945	564

```r
# extract parameter estimates
result <- lavInspect(fit_strict, what = "est")
```

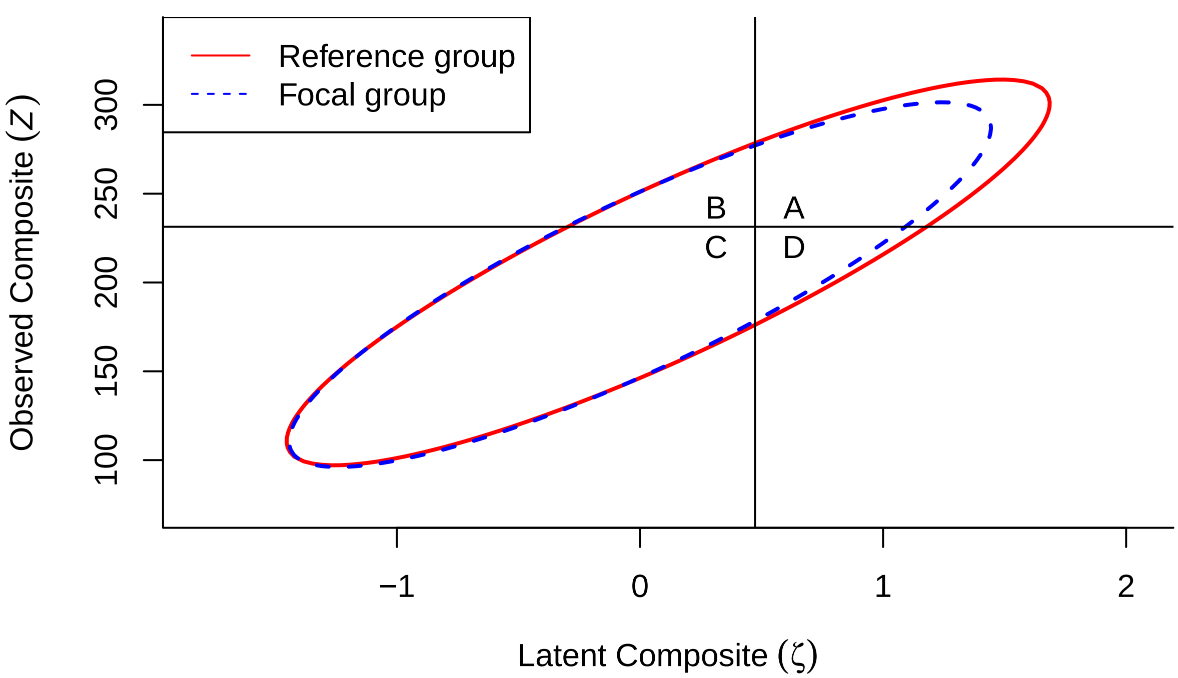
Step 1: Selection Parameters

Because the population sizes for females and for males are roughly equal, we used a mixing proportion(π_g) of 0.5. The weights for latent factors and items were calculated based on the predictive validities reported by previous study (Drasgow et al., 2012). The codes for obtaining the weights can be found in the supplementary materials. For the selection cutoff, we assume that the mini-IPIP is used to select the top 25% of the candidates.

Step 2: Selection Accuracy Under Strict Invariance

To establish the baseline information of using the mini-IPIP for selecting males and females, we first obtained the parameter estimates under full strict invariance. The codes for extracting parameter estimates from *lavaan* model object are provided in the supplementary materials. Our function enables researchers to visualize and quantify the impact of item bias on selection accuracy indices. From the table, we can conclude female candidates would be selected in a slightly higher proportion compared to male candidates if strict invariance holds.

```
strict <- PartInvMulti_we(propsel = .25,
             weights_item = c(3.1385, 3.1385, 3.1385, 3.1385,
                              8.3203, 8.3203, 8.3203, 8.3203,
                              5.1586, 5.1586, 5.1586, 5.1586,
                              -6.5870, -6.5870, -6.5870, -6.5870,
                              1.7957, 1.7957, 1.7957, 1.7957),
             # Agreeableness Conscientiousness Extraversion Neuroticism Openness
             weights_latent = c(0.1256, 0.3328, 0.2063, -0.2635, 0.0718),
             alpha_r = result[[2]]$alpha,
             alpha_f = result[[1]]$alpha,
             psi_r = result[[2]]$psi,
             psi_f = result[[1]]$psi,
             lambda_r = (result[[2]]$lambda + result[[1]]$lambda) / 2,
             nu_r = (result[[2]]$nu + result[[1]]$nu) / 2,
             Theta_r = (result[[2]]$theta + result[[1]]$theta) / 2)
```



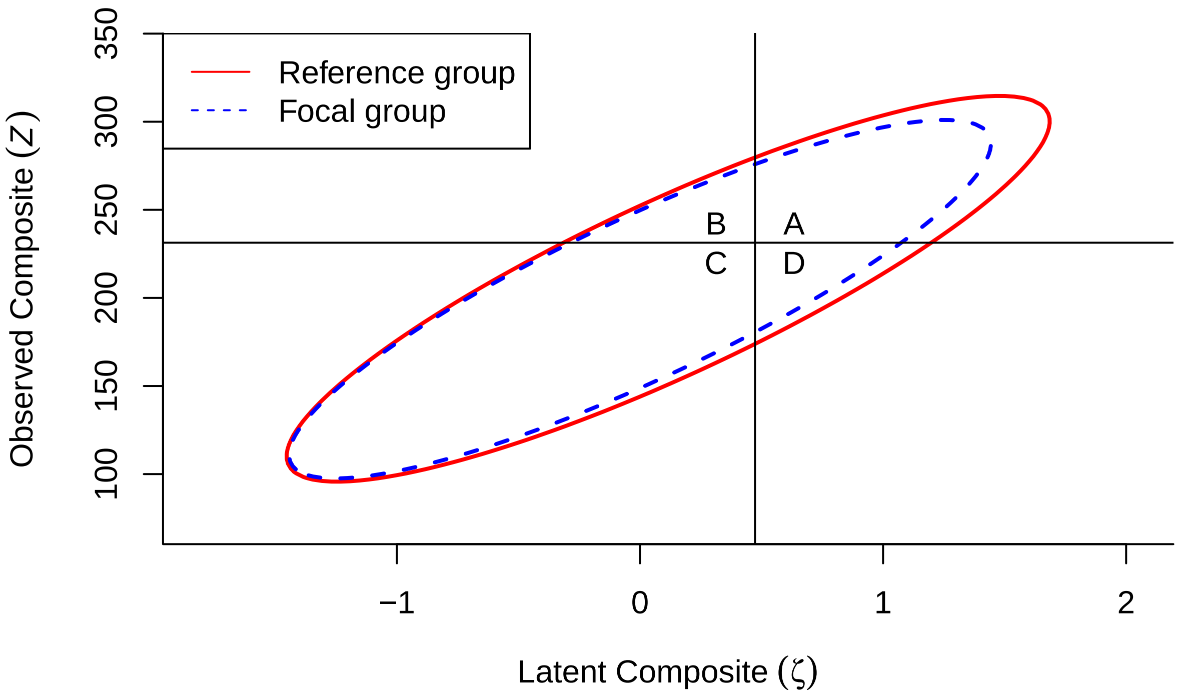
```r
strict[1:5]
```

```
## $propsel
## [1] 0.25
##
## $cutpt_xi
## [1] 0.4732752
##
## $cutpt_z
## [1] 231.3604
##
## $summary
##                       Reference Focal E_R.Focal.
## A (true positive)         0.217 0.153      0.217
## B (false positive)        0.064 0.066      0.064
## C (true negative)         0.647 0.723      0.647
## D (false negative)        0.072 0.058      0.072
## Proportion selected       0.281 0.219      0.281
## Success ratio             0.771 0.700      0.771
## Sensitivity               0.751 0.725      0.751
## Specificity               0.909 0.917      0.909
##
## $ai_ratio
## [1] 1
```

Step 3: Selection Accuracy Under Partial Strict Invariance

The selection accuracy of mini-IPIP under partial strict invariance can be obtained in the same way as in Step 2, except that `nu_r` and `nu_f` were different for males and for females, as well as `Theta_r` and `Theta_f`. The column E_F(Male) represents the expected proportion selected for male candidates based on the latent score distributions of the female candidates. The AI ratio for male candidates is estimated to be 0.935, indicating a slight disadvantage for male candidates when doing selection using the mini-IPIP.

```r
par_strict <- PartInvMulti_we(propsel = .25,
              weights_item = c(3.1385, 3.1385, 3.1385, 3.1385,
                               8.3203, 8.3203, 8.3203, 8.3203,
                               5.1586, 5.1586, 5.1586, 5.1586,
                               -6.5870, -6.5870, -6.5870, -6.5870,
                               1.7957, 1.7957, 1.7957, 1.7957),
              # Agreeableness Conscientiousness Extraversion Neuroticism Openness
              weights_latent = c(0.1256, 0.3328, 0.2063, -0.2635, 0.0718),
              alpha_r = result[[2]]$alpha,
              alpha_f = result[[1]]$alpha,
              psi_r = result[[2]]$psi,
              psi_f = result[[1]]$psi,
              lambda_r = result[[2]]$lambda,
              nu_r = result[[2]]$nu,
              nu_f = result[[1]]$nu,
              Theta_r = result[[2]]$theta,
              Theta_f = result[[1]]$theta)
```




```
par_strict[1:5]
```

```
## $propsel
## [1] 0.25
##
## $cutpt_xi
## [1] 0.4732752
##
## $cutpt_z
## [1] 231.3297
##
## $summary
##                        Reference Focal E_R.Focal.
## A (true positive)          0.214 0.155      0.220
## B (false positive)         0.065 0.065      0.064
## C (true negative)          0.646 0.724      0.648
## D (false negative)         0.075 0.056      0.069
## Proportion selected        0.279 0.220      0.284
## Success ratio              0.766 0.706      0.775
## Sensitivity                0.741 0.736      0.761
## Specificity                0.908 0.918      0.910
##
## $ai_ratio
## [1] 1.015058
```

Step 4: Compare the Change in Selection Accuracy indices

Comparing the results in Steps 2 and 3, researchers can quantify the impact of item bias on selection accuracy indices. In this example, we see in the presence of item bias, male candidates are selected in a lower proportion compared to when strict invariance holds (24.0% as opposed to 24.8%), whereas female candidates are selected in a higher proportion compared to when strict invariance holds (26.0% as opposed to 25.2%).

Table 2: Impact of Item Bias on Selection Accuracy Indices

	Female	Male	E_F(Male)	Female	Male	E_F(Male)
Proportion selected	0.281	0.219	0.281	0.279	0.220	0.284
Success ratio	0.771	0.700	0.771	0.766	0.706	0.775
Sensitivity	0.751	0.725	0.751	0.741	0.736	0.761
Specificity	0.909	0.917	0.909	0.908	0.918	0.910

Note: The column E_F(Male) shows the expected proportion for male candidates if the latent distributions are the same for both genders.

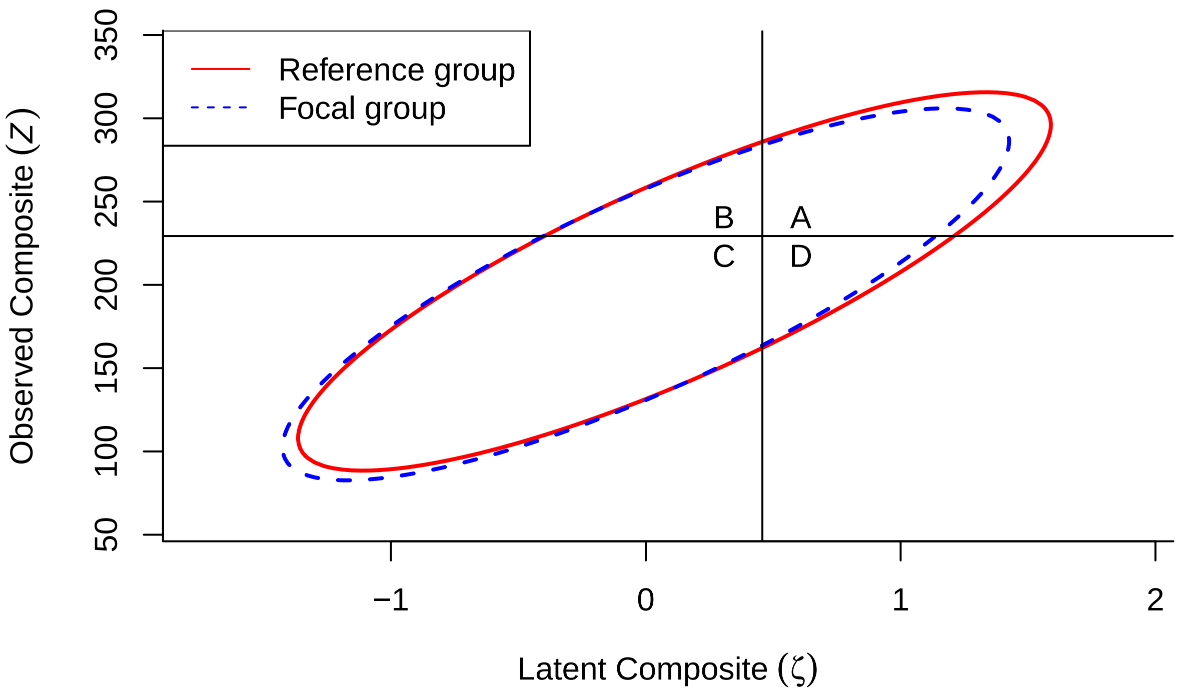
Compare MCAA With Separate Unidimensional Analyses

Compare Partial Invariance With Dropping Noninvariant items

Sometimes researchers may want to remove the noninvariant items in the selection criteria. While this removes item biases, it may result in less effective classification due to reduced test length and thus decreased reliability. To illustrate this, we rerun MCAA without the items that showed noninvariance across genders (i.e., A2, C8, E6, N1, and N2). The table below shows

```
# Try removing noninvariant items (A2, )
model_reduced <- "A =~  a5 + a7 + a9
                  C =~  c3 + c4 + c9
                  E =~ e1 + e4 + e7
                  N =~ ln * n6 + ln * n8
                  O =~ i2 + i8 + i9 + i10
                  e4 ~~ e7
                  i2 ~~ i10
                  i8 ~~ i9
                  a9 ~~ i9"
fit_reduced <- cfa(model_reduced,
  data = data, group = "sex",
  group.equal = c("loadings", "Intercepts", "residuals"),
  estimator = "MLR", std.lv = TRUE
)
pars_reduced <- lavInspect(fit_reduced, what = "est")
reduced <- PartInvMulti_we(
  propsel = .25,
  weights_item = c(c(3.1385, 3.1385, 3.1385) * 4 / 3,
                   c(8.3203, 8.3203, 8.3203) * 4 / 3,
                   c(5.1586, 5.1586, 5.1586) * 4 / 3,
                   c(-6.5870, -6.5870) * 4 / 2,
                   1.7957, 1.7957, 1.7957, 1.7957),
```

```
  weights_latent = c(0.1256, 0.3328, 0.2063, -0.2635, 0.0718),
  alpha_r = pars_reduced[[2]]$alpha,
  alpha_f = pars_reduced[[1]]$alpha,
  psi_r = pars_reduced[[2]]$psi,
  psi_f = pars_reduced[[1]]$psi,
  lambda_r = pars_reduced[[1]]$lambda,
  nu_r = pars_reduced[[1]]$nu,
  Theta_r = pars_reduced[[1]]$theta
)
```



The table below shows lower selection accuracy with 15 invariant items for both groups, compared to 20 items with the five biased items.

Table 3: Impact of Item Bias on Selection Accuracy Indices

	Female	Male	E_F(Male)
Proportion selected	0.279	0.221	0.279
Success ratio	0.724	0.669	0.724
Sensitivity	0.710	0.686	0.710
Specificity	0.892	0.907	0.892

Appendix: Parameter estimates for the partial strict invariance model

```r
# Show parameter estimates
parameterEstimates(fit_strict)
```

```
##     lhs op rhs block group label    est    se      z pvalue ci.lower ci.upper
## 1     A =~  a2     1     1  .p1.  0.322 0.055  5.878  0.000    0.215    0.429
## 2     A =~  a5     1     1  .p2.  0.655 0.060 10.841  0.000    0.537    0.773
## 3     A =~  a7     1     1  .p3.  0.645 0.054 11.912  0.000    0.539    0.751
## 4     A =~  a9     1     1  .p4.  0.745 0.056 13.284  0.000    0.636    0.855
## 5     C =~  c3     1     1  .p5.  0.570 0.052 10.947  0.000    0.468    0.672
## 6     C =~  c4     1     1  .p6.  0.341 0.049  7.037  0.000    0.246    0.436
## 7     C =~  c8     1     1  .p7.  0.398 0.049  8.100  0.000    0.301    0.494
## 8     C =~  c9     1     1  .p8.  0.745 0.081  9.170  0.000    0.586    0.905
## 9     E =~  e1     1     1  .p9.  0.657 0.050 13.147  0.000    0.559    0.755
## 10    E =~  e4     1     1 .p10.  0.803 0.069 11.594  0.000    0.667    0.939
## 11    E =~  e6     1     1 .p11.  0.799 0.062 12.841  0.000    0.677    0.920
## 12    E =~  e7     1     1 .p12.  0.686 0.062 10.993  0.000    0.564    0.808
## 13    N =~  n1     1     1 .p13.  0.507 0.057  8.964  0.000    0.396    0.618
## 14    N =~  n2     1     1 .p14.  0.824 0.063 13.080  0.000    0.701    0.948
## 15    N =~  n6     1     1 .p15.  0.600 0.053 11.245  0.000    0.495    0.704
## 16    N =~  n8     1     1 .p16.  0.825 0.064 12.803  0.000    0.699    0.952
## 17    O =~  i2     1     1 .p17.  0.512 0.081  6.356  0.000    0.354    0.670
## 18    O =~  i8     1     1 .p18.  0.425 0.080  5.344  0.000    0.269    0.581
## 19    O =~  i9     1     1 .p19.  0.485 0.075  6.457  0.000    0.338    0.632
## 20    O =~ i10     1     1 .p20.  0.570 0.091  6.273  0.000    0.392    0.748
## 21   a2 ~~  a5     1     1        0.172 0.041  4.221  0.000    0.092    0.252
## 22   e4 ~~  e7     1     1       -0.107 0.078 -1.379  0.168   -0.259    0.045
## 23   i2 ~~ i10     1     1        0.312 0.089  3.521  0.000    0.138    0.486
## 24   i8 ~~  i9     1     1        0.457 0.098  4.653  0.000    0.265    0.650
## 25   a9 ~~  i9     1     1        0.149 0.047  3.145  0.002    0.056    0.242
## 26   c3 ~~  e6     1     1       -0.232 0.074 -3.136  0.002   -0.377   -0.087
## 27   a2 ~~  e7     1     1        0.012 0.045  0.269  0.788   -0.076    0.100
## 28   e7 ~~  n2     1     1       -0.023 0.050 -0.451  0.652   -0.121    0.076
## 29   a2 ~~  a2     1     1 .p29.  0.544 0.050 10.946  0.000    0.447    0.641
## 30   a5 ~~  a5     1     1 .p30.  0.536 0.055  9.759  0.000    0.429    0.644
## 31   a7 ~~  a7     1     1 .p31.  0.410 0.053  7.704  0.000    0.306    0.515
## 32   a9 ~~  a9     1     1 .p32.  0.356 0.054  6.611  0.000    0.251    0.462
## 33   c3 ~~  c3     1     1 .p33.  0.935 0.074 12.559  0.000    0.789    1.081
## 34   c4 ~~  c4     1     1 .p34.  0.410 0.039 10.578  0.000    0.334    0.486
## 35   c8 ~~  c8     1     1        0.495 0.064  7.756  0.000    0.370    0.620
## 36   c9 ~~  c9     1     1 .p36.  0.925 0.115  8.019  0.000    0.699    1.151
## 37   e1 ~~  e1     1     1 .p37.  0.784 0.058 13.555  0.000    0.671    0.898
## 38   e4 ~~  e4     1     1 .p38.  0.991 0.090 11.035  0.000    0.815    1.168
## 39   e6 ~~  e6     1     1 .p39.  0.881 0.073 12.136  0.000    0.739    1.023
## 40   e7 ~~  e7     1     1 .p40.  0.612 0.069  8.919  0.000    0.477    0.746
## 41   n1 ~~  n1     1     1        0.663 0.083  7.966  0.000    0.500    0.826
## 42   n2 ~~  n2     1     1        0.570 0.092  6.221  0.000    0.390    0.749
## 43   n6 ~~  n6     1     1 .p43.  0.748 0.059 12.641  0.000    0.632    0.864
## 44   n8 ~~  n8     1     1 .p44.  0.652 0.075  8.691  0.000    0.505    0.799
## 45   i2 ~~  i2     1     1 .p45.  0.735 0.090  8.123  0.000    0.558    0.912
## 46   i8 ~~  i8     1     1 .p46.  1.182 0.094 12.529  0.000    0.997    1.367
## 47   i9 ~~  i9     1     1 .p47.  1.015 0.090 11.268  0.000    0.839    1.192
```

```
## 48  i10 ~~ i10     1     1 .p48.  0.786 0.122   6.449  0.000    0.547    1.024
## 49    A ~~   A     1     1         1.000 0.000      NA     NA    1.000    1.000
## 50    C ~~   C     1     1         1.000 0.000      NA     NA    1.000    1.000
## 51    E ~~   E     1     1         1.000 0.000      NA     NA    1.000    1.000
## 52    N ~~   N     1     1         1.000 0.000      NA     NA    1.000    1.000
## 53    O ~~   O     1     1         1.000 0.000      NA     NA    1.000    1.000
## 54    A ~~   C     1     1         0.031 0.098   0.313  0.754   -0.162    0.223
## 55    A ~~   E     1     1         0.398 0.091   4.383  0.000    0.220    0.576
## 56    A ~~   N     1     1        -0.191 0.097  -1.960  0.050   -0.381    0.000
## 57    A ~~   O     1     1         0.416 0.113   3.676  0.000    0.194    0.638
## 58    C ~~   E     1     1         0.052 0.106   0.485  0.627   -0.157    0.260
## 59    C ~~   N     1     1        -0.159 0.104  -1.523  0.128   -0.364    0.046
## 60    C ~~   O     1     1        -0.009 0.134  -0.070  0.944   -0.272    0.253
## 61    E ~~   N     1     1        -0.041 0.101  -0.405  0.685   -0.239    0.157
## 62    E ~~   O     1     1         0.672 0.103   6.503  0.000    0.470    0.875
## 63    N ~~   O     1     1        -0.059 0.129  -0.458  0.647   -0.311    0.194
## 64   a2 ~1         1     1         3.944 0.056  70.735  0.000    3.835    4.054
## 65   a5 ~1         1     1 .p65.  3.562 0.062  57.403  0.000    3.440    3.684
## 66   a7 ~1         1     1 .p66.  3.999 0.055  72.486  0.000    3.891    4.107
## 67   a9 ~1         1     1 .p67.  3.618 0.059  61.186  0.000    3.503    3.734
## 68   c3 ~1         1     1 .p68.  3.287 0.059  56.183  0.000    3.173    3.402
## 69   c4 ~1         1     1 .p69.  4.263 0.039 109.524  0.000    4.187    4.339
## 70   c8 ~1         1     1 .p70.  4.181 0.044  94.704  0.000    4.095    4.268
## 71   c9 ~1         1     1 .p71.  3.599 0.071  50.883  0.000    3.461    3.738
## 72   e1 ~1         1     1 .p72.  2.270 0.060  38.013  0.000    2.153    2.387
## 73   e4 ~1         1     1 .p73.  2.924 0.071  41.218  0.000    2.785    3.063
## 74   e6 ~1         1     1         3.012 0.078  38.552  0.000    2.859    3.165
## 75   e7 ~1         1     1 .p75.  3.091 0.061  50.674  0.000    2.971    3.210
## 76   n1 ~1         1     1         2.259 0.062  36.249  0.000    2.137    2.382
## 77   n2 ~1         1     1         2.460 0.072  33.974  0.000    2.318    2.602
## 78   n6 ~1         1     1 .p78.  2.324 0.058  39.856  0.000    2.209    2.438
## 79   n8 ~1         1     1 .p79.  2.279 0.071  31.976  0.000    2.139    2.418
## 80   i2 ~1         1     1 .p80.  3.972 0.055  72.365  0.000    3.864    4.079
## 81   i8 ~1         1     1 .p81.  3.590 0.062  57.626  0.000    3.468    3.712
## 82   i9 ~1         1     1 .p82.  3.615 0.061  59.144  0.000    3.495    3.735
## 83  i10 ~1         1     1 .p83.  4.072 0.063  64.852  0.000    3.948    4.195
## 84    A ~1         1     1         0.000 0.000      NA     NA    0.000    0.000
## 85    C ~1         1     1         0.000 0.000      NA     NA    0.000    0.000
## 86    E ~1         1     1         0.000 0.000      NA     NA    0.000    0.000
## 87    N ~1         1     1         0.000 0.000      NA     NA    0.000    0.000
## 88    O ~1         1     1         0.000 0.000      NA     NA    0.000    0.000
## 89    A =~  a2     2     2  .p1.  0.322 0.055   5.878  0.000    0.215    0.429
## 90    A =~  a5     2     2  .p2.  0.655 0.060  10.841  0.000    0.537    0.773
## 91    A =~  a7     2     2  .p3.  0.645 0.054  11.912  0.000    0.539    0.751
## 92    A =~  a9     2     2  .p4.  0.745 0.056  13.284  0.000    0.636    0.855
## 93    C =~  c3     2     2  .p5.  0.570 0.052  10.947  0.000    0.468    0.672
## 94    C =~  c4     2     2  .p6.  0.341 0.049   7.037  0.000    0.246    0.436
## 95    C =~  c8     2     2  .p7.  0.398 0.049   8.100  0.000    0.301    0.494
## 96    C =~  c9     2     2  .p8.  0.745 0.081   9.170  0.000    0.586    0.905
## 97    E =~  e1     2     2  .p9.  0.657 0.050  13.147  0.000    0.559    0.755
## 98    E =~  e4     2     2 .p10.  0.803 0.069  11.594  0.000    0.667    0.939
## 99    E =~  e6     2     2 .p11.  0.799 0.062  12.841  0.000    0.677    0.920
## 100   E =~  e7     2     2 .p12.  0.686 0.062  10.993  0.000    0.564    0.808
## 101   N =~  n1     2     2 .p13.  0.507 0.057   8.964  0.000    0.396    0.618
```

```
## 102   N =~  n2     2     2 .p14.  0.824 0.063  13.080  0.000    0.701    0.948
## 103   N =~  n6     2     2 .p15.  0.600 0.053  11.245  0.000    0.495    0.704
## 104   N =~  n8     2     2 .p16.  0.825 0.064  12.803  0.000    0.699    0.952
## 105   O =~  i2     2     2 .p17.  0.512 0.081   6.356  0.000    0.354    0.670
## 106   O =~  i8     2     2 .p18.  0.425 0.080   5.344  0.000    0.269    0.581
## 107   O =~  i9     2     2 .p19.  0.485 0.075   6.457  0.000    0.338    0.632
## 108   O =~ i10     2     2 .p20.  0.570 0.091   6.273  0.000    0.392    0.748
## 109  a2 ~~  a5     2     2        0.099 0.041   2.396  0.017    0.018    0.180
## 110  e4 ~~  e7     2     2       -0.083 0.068  -1.219  0.223   -0.216    0.050
## 111  i2 ~~ i10     2     2        0.275 0.101   2.722  0.006    0.077    0.474
## 112  i8 ~~  i9     2     2        0.580 0.090   6.437  0.000    0.403    0.757
## 113  a9 ~~  i9     2     2       -0.006 0.037  -0.148  0.882   -0.078    0.067
## 114  c3 ~~  e6     2     2       -0.030 0.059  -0.506  0.613   -0.144    0.085
## 115  a2 ~~  e7     2     2       -0.116 0.039  -2.980  0.003   -0.191   -0.040
## 116  e7 ~~  n2     2     2       -0.146 0.053  -2.783  0.005   -0.249   -0.043
## 117  a2 ~~  a2     2     2 .p29.  0.544 0.050  10.946  0.000    0.447    0.641
## 118  a5 ~~  a5     2     2 .p30.  0.536 0.055   9.759  0.000    0.429    0.644
## 119  a7 ~~  a7     2     2 .p31.  0.410 0.053   7.704  0.000    0.306    0.515
## 120  a9 ~~  a9     2     2 .p32.  0.356 0.054   6.611  0.000    0.251    0.462
## 121  c3 ~~  c3     2     2 .p33.  0.935 0.074  12.559  0.000    0.789    1.081
## 122  c4 ~~  c4     2     2 .p34.  0.410 0.039  10.578  0.000    0.334    0.486
## 123  c8 ~~  c8     2     2        0.705 0.093   7.606  0.000    0.523    0.886
## 124  c9 ~~  c9     2     2 .p36.  0.925 0.115   8.019  0.000    0.699    1.151
## 125  e1 ~~  e1     2     2 .p37.  0.784 0.058  13.555  0.000    0.671    0.898
## 126  e4 ~~  e4     2     2 .p38.  0.991 0.090  11.035  0.000    0.815    1.168
## 127  e6 ~~  e6     2     2 .p39.  0.881 0.073  12.136  0.000    0.739    1.023
## 128  e7 ~~  e7     2     2 .p40.  0.612 0.069   8.919  0.000    0.477    0.746
## 129  n1 ~~  n1     2     2        0.944 0.078  12.028  0.000    0.790    1.097
## 130  n2 ~~  n2     2     2        0.959 0.116   8.259  0.000    0.731    1.186
## 131  n6 ~~  n6     2     2 .p43.  0.748 0.059  12.641  0.000    0.632    0.864
## 132  n8 ~~  n8     2     2 .p44.  0.652 0.075   8.691  0.000    0.505    0.799
## 133  i2 ~~  i2     2     2 .p45.  0.735 0.090   8.123  0.000    0.558    0.912
## 134  i8 ~~  i8     2     2 .p46.  1.182 0.094  12.529  0.000    0.997    1.367
## 135  i9 ~~  i9     2     2 .p47.  1.015 0.090  11.268  0.000    0.839    1.192
## 136 i10 ~~ i10     2     2 .p48.  0.786 0.122   6.449  0.000    0.547    1.024
## 137   A ~~   A     2     2        0.562 0.114   4.945  0.000    0.339    0.785
## 138   C ~~   C     2     2        1.455 0.251   5.797  0.000    0.963    1.947
## 139   E ~~   E     2     2        0.979 0.130   7.559  0.000    0.725    1.233
## 140   N ~~   N     2     2        1.114 0.167   6.657  0.000    0.786    1.442
## 141   O ~~   O     2     2        1.859 0.468   3.973  0.000    0.942    2.777
## 142   A ~~   C     2     2       -0.036 0.081  -0.443  0.658   -0.195    0.123
## 143   A ~~   E     2     2        0.135 0.065   2.093  0.036    0.009    0.262
## 144   A ~~   N     2     2       -0.159 0.078  -2.036  0.042   -0.313   -0.006
## 145   A ~~   O     2     2        0.294 0.109   2.703  0.007    0.081    0.507
## 146   C ~~   E     2     2        0.114 0.100   1.140  0.254   -0.082    0.311
## 147   C ~~   N     2     2       -0.310 0.118  -2.635  0.008   -0.541   -0.079
## 148   C ~~   O     2     2       -0.245 0.159  -1.538  0.124   -0.557    0.067
## 149   E ~~   N     2     2       -0.175 0.091  -1.929  0.054   -0.354    0.003
## 150   E ~~   O     2     2        0.455 0.137   3.308  0.001    0.185    0.724
## 151   N ~~   O     2     2       -0.055 0.131  -0.420  0.674   -0.311    0.201
## 152  a2 ~1         2     2        4.098 0.063  65.328  0.000    3.975    4.221
## 153  a5 ~1         2     2 .p65.  3.562 0.062  57.403  0.000    3.440    3.684
## 154  a7 ~1         2     2 .p66.  3.999 0.055  72.486  0.000    3.891    4.107
## 155  a9 ~1         2     2 .p67.  3.618 0.059  61.186  0.000    3.503    3.734
```

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## 156  c3 ~1          2     2 .p68.  3.287 0.059  56.183  0.000    3.173    3.402
## 157  c4 ~1          2     2 .p69.  4.263 0.039 109.524  0.000    4.187    4.339
## 158  c8 ~1          2     2 .p70.  4.181 0.044  94.704  0.000    4.095    4.268
## 159  c9 ~1          2     2 .p71.  3.599 0.071  50.883  0.000    3.461    3.738
## 160  e1 ~1          2     2 .p72.  2.270 0.060  38.013  0.000    2.153    2.387
## 161  e4 ~1          2     2 .p73.  2.924 0.071  41.218  0.000    2.785    3.063
## 162  e6 ~1          2     2        3.428 0.089  38.528  0.000    3.253    3.602
## 163  e7 ~1          2     2 .p75.  3.091 0.061  50.674  0.000    2.971    3.210
## 164  n1 ~1          2     2        2.566 0.071  35.974  0.000    2.427    2.706
## 165  n2 ~1          2     2        2.699 0.094  28.652  0.000    2.515    2.884
## 166  n6 ~1          2     2 .p78.  2.324 0.058  39.856  0.000    2.209    2.438
## 167  n8 ~1          2     2 .p79.  2.279 0.071  31.976  0.000    2.139    2.418
## 168  i2 ~1          2     2 .p80.  3.972 0.055  72.365  0.000    3.864    4.079
## 169  i8 ~1          2     2 .p81.  3.590 0.062  57.626  0.000    3.468    3.712
## 170  i9 ~1          2     2 .p82.  3.615 0.061  59.144  0.000    3.495    3.735
## 171 i10 ~1          2     2 .p83.  4.072 0.063  64.852  0.000    3.948    4.195
## 172   A ~1          2     2        0.743 0.083   8.936  0.000    0.580    0.905
## 173   C ~1          2     2        0.140 0.115   1.219  0.223   -0.085    0.366
## 174   E ~1          2     2       -0.019 0.104  -0.186  0.853   -0.224    0.185
## 175   N ~1          2     2       -0.049 0.111  -0.444  0.657   -0.266    0.168
## 176   O ~1          2     2       -0.458 0.166  -2.764  0.006   -0.783   -0.133
```