Mediation Effect with inclusion of LatentVariable

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Contents

```
# library(xlsx)
library(OpenMx)
```

```
## To take full advantage of multiple cores, use:
##   mxOption(NULL, 'Number of Threads', parallel::detectCores()) #now
##   Sys.setenv(OMP_NUM_THREADS=parallel::detectCores()) #before library(OpenMx)
```

```
library(metaSEM)
```

```
## "SLSQP" is set as the default optimizer in OpenMx.
```

```
## mxOption(NULL, "Gradient algorithm") is set at "central".
```

```
## mxOption(NULL, "Optimality tolerance") is set at "6.3e-14".
```

```
## mxOption(NULL, "Gradient iterations") is set at "2".
```

```
# setwd("d:/Data/")

data<-readFullMat("bone.txt")
# head(data)
n<-c(508,527,201,400,247,325,1644,640,252,842,638)
head(n)
```

```
## [1] 508 527 201 400 247 325
```

```
## Mike: Add the variable names to the data
data <- lapply(data, function(x) {
  dimnames(x) <- list(c("A","C","ES","E","O","IBT","SE"),
                      c("A","C","ES","E","O","IBT","SE"))
  x})
head(data)
```

```
## $`1`
##        A    C   ES    E    O  IBT   SE
## A   1.00 0.43 0.17 0.37 0.21 0.33 0.04
## C   0.43 1.00 0.28 0.66 0.25 0.35 0.14
## ES  0.17 0.28 1.00 0.37 0.37 0.45 0.16
## E   0.37 0.66 0.37 1.00 0.34 0.46 0.19
## O   0.21 0.25 0.37 0.34 1.00 0.39 0.28
## IBT 0.33 0.35 0.45 0.46 0.39 1.00 0.32
## SE  0.04 0.14 0.16 0.19 0.28 0.32 1.00
##
## $`2`
##        A     C    ES     E     O   IBT   SE
## A   1.00  0.21  0.07  0.12  0.20  0.10 0.22
## C   0.21  1.00  0.23  0.02  0.36 -0.12 0.23
## ES  0.07  0.23  1.00 -0.25  0.08  0.12 0.01
```

```
## E   0.12  0.02 -0.25  1.00  0.13 -0.05 0.05
## O   0.20  0.36  0.08  0.13  1.00 -0.07 0.28
## IBT 0.10 -0.12  0.12 -0.05 -0.07  1.00 0.16
## SE  0.22  0.23  0.01  0.05  0.28  0.16 1.00
##
## $`3`
##         A     C    ES     E     O   IBT    SE
## A    1.00  0.09  0.19  0.07  0.00 -0.08 -0.10
## C    0.09  1.00  0.14  0.14  0.12 -0.20 -0.25
## ES   0.19  0.14  1.00  0.21 -0.09 -0.17 -0.24
## E    0.07  0.14  0.21  1.00  0.11  0.03 -0.12
## O    0.00  0.12 -0.09  0.11  1.00 -0.11 -0.04
## IBT -0.08 -0.20 -0.17  0.03 -0.11  1.00  0.37
## SE  -0.10 -0.25 -0.24 -0.12 -0.04  0.37  1.00
##
## $`4`
##         A    C    ES    E    O   IBT SE
## A    1.00 0.06 -0.01 0.02 0.02  0.00 NA
## C    0.06 1.00  0.00 0.10 0.04  0.01 NA
## ES  -0.01 0.00  1.00 0.00 0.00 -0.03 NA
## E    0.02 0.10  0.00 1.00 0.10  0.02 NA
## O    0.02 0.04  0.00 0.10 1.00  0.01 NA
## IBT  0.00 0.01 -0.03 0.02 0.01  1.00 NA
## SE     NA   NA    NA   NA   NA    NA  1
##
## $`5`
##          A      C     ES      E      O   IBT     SE
## A    1.000  0.440  0.450  0.310  0.190 -0.04 -0.033
## C    0.440  1.000  0.370  0.320  0.300 -0.13  0.150
## ES   0.450  0.370  1.000  0.380  0.280 -0.14 -0.100
## E    0.310  0.320  0.380  1.000  0.370 -0.03  0.108
## O    0.190  0.300  0.280  0.370  1.000 -0.06  0.017
## IBT -0.040 -0.130 -0.140 -0.030 -0.060  1.00  0.520
## SE  -0.033  0.015 -0.102  0.108  0.017  0.52  1.000
##
## $`6`
##         A     C    ES     E     O   IBT SE
## A    1.00 -0.50  0.37  0.47  0.61  0.65 NA
## C   -0.50  1.00 -0.69 -0.73 -0.59 -0.77 NA
## ES   0.37 -0.69  1.00  0.53  0.47  0.60 NA
## E    0.47 -0.73  0.53  1.00  0.63  0.63 NA
## O    0.61 -0.59  0.47  0.63  1.00  0.68 NA
## IBT  0.65 -0.77  0.60  0.63  0.68  1.00 NA
## SE     NA    NA    NA    NA    NA    NA  1
```

```
##Stages1
Random<-tssem1(data,n, method = "REM", RE.type = "Diag")
summary(Random)
```

```
##
## Call:
## meta(y = ES, v = acovR, RE.constraints = Diag(paste0(RE.startvalues,
##     "*Tau2_", 1:no.es, "_", 1:no.es)), RE.lbound = RE.lbound,
##     I2 = I2, model.name = model.name, suppressWarnings = TRUE,
##     silent = silent, run = run)
```

```
##
## 95% confidence intervals: z statistic approximation
## Coefficients:
##                Estimate   Std.Error      lbound      ubound z value
## Intercept1   0.13593935  0.07524722 -0.01154250  0.28342120  1.8066
## Intercept2   0.12973246  0.05406785  0.02376143  0.23570349  2.3994
## Intercept3   0.20271212  0.04877373  0.10711737  0.29830686  4.1562
## Intercept4   0.23019225  0.04392171  0.14410727  0.31627723  5.2410
## Intercept5   0.11651383  0.05900511  0.00086594  0.23216171  1.9746
## Intercept6   0.10939525  0.06201779 -0.01215738  0.23094787  1.7639
## Intercept7   0.08231191  0.08895708 -0.09204077  0.25666458  0.9253
## Intercept8   0.07946869  0.09549134 -0.10769090  0.26662828  0.8322
## Intercept9   0.08687406  0.07288679 -0.05598142  0.22972954  1.1919
## Intercept10 -0.17589425  0.08631859 -0.34507557 -0.00671293 -2.0377
## Intercept11  0.06368249  0.08131692 -0.09569575  0.22306072  0.7831
## Intercept12  0.16910800  0.07199299  0.02800434  0.31021166  2.3490
## Intercept13  0.09968303  0.05631641 -0.01069510  0.21006116  1.7701
## Intercept14 -0.02060218  0.08206428 -0.18144522  0.14024085 -0.2510
## Intercept15  0.03004997  0.09983076 -0.16561472  0.22571466  0.3010
## Intercept16  0.27164867  0.04705545  0.17942168  0.36387567  5.7729
## Intercept17  0.14085617  0.05769529  0.02777548  0.25393686  2.4414
## Intercept18  0.13623417  0.06961503 -0.00020878  0.27267712  1.9570
## Intercept19  0.12645600  0.06652527 -0.00393112  0.25684313  1.9009
## Intercept20  0.18043606  0.04754206  0.08725534  0.27361678  3.7953
## Intercept21  0.23942288  0.07400621  0.09437337  0.38447239  3.2352
## Tau2_1_1     0.05997289  0.02666071  0.00771885  0.11222693  2.2495
## Tau2_2_2     0.02976185  0.01370911  0.00289249  0.05663120  2.1710
## Tau2_3_3     0.02402062  0.01125583  0.00195960  0.04608165  2.1341
## Tau2_4_4     0.01910472  0.00928436  0.00090771  0.03730174  2.0577
## Tau2_5_5     0.03590525  0.01654219  0.00348316  0.06832735  2.1705
## Tau2_6_6     0.02049243  0.01313492 -0.00525155  0.04623640  1.5601
## Tau2_7_7     0.08468682  0.03717123  0.01183255  0.15754109  2.2783
## Tau2_8_8     0.09789835  0.04284998  0.01391394  0.18188277  2.2847
## Tau2_9_9     0.05603854  0.02506502  0.00691200  0.10516507  2.2357
## Tau2_10_10   0.07964303  0.03490981  0.01122106  0.14806500  2.2814
## Tau2_11_11   0.03709746  0.02287494 -0.00773660  0.08193152  1.6218
## Tau2_12_12   0.05469654  0.02418339  0.00729797  0.10209510  2.2617
## Tau2_13_13   0.03249426  0.01492618  0.00323948  0.06174904  2.1770
## Tau2_14_14   0.07165524  0.03156821  0.00978269  0.13352778  2.2699
## Tau2_15_15   0.05721421  0.03417326 -0.00976416  0.12419258  1.6742
## Tau2_16_16   0.02236107  0.01046020  0.00185946  0.04286268  2.1377
## Tau2_17_17   0.03424404  0.01570648  0.00345990  0.06502818  2.1802
## Tau2_18_18   0.02652449  0.01651106 -0.00583660  0.05888557  1.6065
## Tau2_19_19   0.04629543  0.02092883  0.00527567  0.08731519  2.2120
## Tau2_20_20   0.01091845  0.00821484 -0.00518234  0.02701925  1.3291
## Tau2_21_21   0.03026985  0.01903277 -0.00703369  0.06757339  1.5904
##              Pr(>|z|)
## Intercept1  0.0708294 .
## Intercept2  0.0164202 *
## Intercept3  3.236e-05 ***
## Intercept4  1.597e-07 ***
## Intercept5  0.0483091 *
## Intercept6  0.0777432 .
## Intercept7  0.3548103
```

```
## Intercept8  0.4052913
## Intercept9  0.2332989
## Intercept10 0.0415766 *
## Intercept11 0.4335452
## Intercept12 0.0188264 *
## Intercept13 0.0767183 .
## Intercept14 0.8017760
## Intercept15 0.7634075
## Intercept16 7.790e-09 ***
## Intercept17 0.0146312 *
## Intercept18 0.0503516 .
## Intercept19 0.0573188 .
## Intercept20 0.0001475 ***
## Intercept21 0.0012157 **
## Tau2_1_1    0.0244816 *
## Tau2_2_2    0.0299346 *
## Tau2_3_3    0.0328379 *
## Tau2_4_4    0.0396159 *
## Tau2_5_5    0.0299670 *
## Tau2_6_6    0.1187248
## Tau2_7_7    0.0227093 *
## Tau2_8_8    0.0223318 *
## Tau2_9_9    0.0253697 *
## Tau2_10_10  0.0225252 *
## Tau2_11_11  0.1048566
## Tau2_12_12  0.0237135 *
## Tau2_13_13  0.0294808 *
## Tau2_14_14  0.0232164 *
## Tau2_15_15  0.0940836 .
## Tau2_16_16  0.0325387 *
## Tau2_17_17  0.0292390 *
## Tau2_18_18  0.1081712
## Tau2_19_19  0.0269639 *
## Tau2_20_20  0.1838107
## Tau2_21_21  0.1117430
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Q statistic on the homogeneity of effect sizes: 3652.746
## Degrees of freedom of the Q statistic: 180
## P value of the Q statistic: 0
##
## Heterogeneity indices (based on the estimated Tau2):
##                               Estimate
## Intercept1: I2 (Q statistic)    0.9717
## Intercept2: I2 (Q statistic)    0.9426
## Intercept3: I2 (Q statistic)    0.9363
## Intercept4: I2 (Q statistic)    0.9220
## Intercept5: I2 (Q statistic)    0.9518
## Intercept6: I2 (Q statistic)    0.9179
## Intercept7: I2 (Q statistic)    0.9795
## Intercept8: I2 (Q statistic)    0.9818
## Intercept9: I2 (Q statistic)    0.9686
## Intercept10: I2 (Q statistic)   0.9786
```

```
## Intercept11: I2 (Q statistic)   0.9527
## Intercept12: I2 (Q statistic)   0.9690
## Intercept13: I2 (Q statistic)   0.9469
## Intercept14: I2 (Q statistic)   0.9751
## Intercept15: I2 (Q statistic)   0.9687
## Intercept16: I2 (Q statistic)   0.9362
## Intercept17: I2 (Q statistic)   0.9499
## Intercept18: I2 (Q statistic)   0.9356
## Intercept19: I2 (Q statistic)   0.9624
## Intercept20: I2 (Q statistic)   0.8573
## Intercept21: I2 (Q statistic)   0.9430
##
## Number of studies (or clusters): 11
## Number of observed statistics: 201
## Number of estimated parameters: 42
## Degrees of freedom: 159
## -2 log likelihood: -52.50656
## OpenMx status1: 0 ("0" or "1": The optimization is considered fine.
## Other values may indicate problems.)
```

```
vec2symMat(coef(Random,select = "fixed"), diag = FALSE)
```

```
##           [,1]        [,2]        [,3]       [,4]       [,5]        [,6]
## [1,] 1.0000000  0.13593935  0.12973246 0.20271212 0.23019225  0.11651383
## [2,] 0.1359394  1.00000000  0.08231191 0.07946869 0.08687406 -0.17589425
## [3,] 0.1297325  0.08231191  1.00000000 0.16910800 0.09968303 -0.02060218
## [4,] 0.2027121  0.07946869  0.16910800 1.00000000 0.27164867  0.14085617
## [5,] 0.2301922  0.08687406  0.09968303 0.27164867 1.00000000  0.12645600
## [6,] 0.1165138 -0.17589425 -0.02060218 0.14085617 0.12645600  1.00000000
## [7,] 0.1093952  0.06368249  0.03004997 0.13623417 0.18043606  0.23942288
##            [,7]
## [1,] 0.10939525
## [2,] 0.06368249
## [3,] 0.03004997
## [4,] 0.13623417
## [5,] 0.18043606
## [6,] 0.23942288
## [7,] 1.00000000
```

```
##Stage two

##Loading g
f<-c("0.2*g_A", "0.2*g_C","0.2*g_ES","0.2*g_E","0.2*g_O","0.2*g_IBT","0.2*g_SE")
F<-matrix(f,ncol = 1,nrow = 7)
F
```

```
##      [,1]
## [1,] "0.2*g_A"
## [2,] "0.2*g_C"
## [3,] "0.2*g_ES"
## [4,] "0.2*g_E"
## [5,] "0.2*g_O"
## [6,] "0.2*g_IBT"
## [7,] "0.2*g_SE"
```

```
##Creat A
A1<-matrix(c(rep(0,47),"0.2*SE_IBT","0"),ncol = 7,nrow = 7)
A1
```

```
##      [,1] [,2] [,3] [,4] [,5] [,6] [,7]
## [1,] "0"  "0"  "0"  "0"  "0"  "0"  "0"
## [2,] "0"  "0"  "0"  "0"  "0"  "0"  "0"
## [3,] "0"  "0"  "0"  "0"  "0"  "0"  "0"
## [4,] "0"  "0"  "0"  "0"  "0"  "0"  "0"
## [5,] "0"  "0"  "0"  "0"  "0"  "0"  "0"
## [6,] "0"  "0"  "0"  "0"  "0"  "0"  "0.2*SE_IBT"
## [7,] "0"  "0"  "0"  "0"  "0"  "0"  "0"
```

```
A<-rbind(cbind(A1, F), matrix (0, ncol=8, nrow=1))
A
```

```
##      [,1] [,2] [,3] [,4] [,5] [,6] [,7]         [,8]
## [1,] "0"  "0"  "0"  "0"  "0"  "0"  "0"          "0.2*g_A"
## [2,] "0"  "0"  "0"  "0"  "0"  "0"  "0"          "0.2*g_C"
## [3,] "0"  "0"  "0"  "0"  "0"  "0"  "0"          "0.2*g_ES"
## [4,] "0"  "0"  "0"  "0"  "0"  "0"  "0"          "0.2*g_E"
## [5,] "0"  "0"  "0"  "0"  "0"  "0"  "0"          "0.2*g_O"
## [6,] "0"  "0"  "0"  "0"  "0"  "0"  "0.2*SE_IBT" "0.2*g_IBT"
## [7,] "0"  "0"  "0"  "0"  "0"  "0"  "0"          "0.2*g_SE"
## [8,] "0"  "0"  "0"  "0"  "0"  "0"  "0"          "0"
```

```
dimnames(A)<-list(c("A","C","ES","E","O","IBT","SE","g"), c("A","C","ES","E","O","IBT","SE","g"))
A
```

```
##     A   C   ES  E   O   IBT SE          g
## A   "0" "0" "0" "0" "0" "0" "0"         "0.2*g_A"
## C   "0" "0" "0" "0" "0" "0" "0"         "0.2*g_C"
## ES  "0" "0" "0" "0" "0" "0" "0"         "0.2*g_ES"
## E   "0" "0" "0" "0" "0" "0" "0"         "0.2*g_E"
## O   "0" "0" "0" "0" "0" "0" "0"         "0.2*g_O"
## IBT "0" "0" "0" "0" "0" "0" "0.2*SE_IBT" "0.2*g_IBT"
## SE  "0" "0" "0" "0" "0" "0" "0"         "0.2*g_SE"
## g   "0" "0" "0" "0" "0" "0" "0"         "0"
```

```
##Cov among Latent Variables
phi<-matrix(c("1"),nrow = 1,ncol = 1)
##Erro variance

## Mike: Variance of SE is free.
psi<-Diag(c("0.3*e1","0.3*e2","0.3*e3","0.3*e4","0.3*e5","0.3*e6","0.3*VarSE"))
##Creat S
S<-bdiagMat(list(psi,phi))
dimnames(S)<-list(c("A","C","ES","E","O","IBT","SE","g"), c("A","C","ES","E","O","IBT","SE","g"))
S
```

```
##     A         C         ES        E         O         IBT       SE        g
## A   "0.3*e1" "0"       "0"       "0"       "0"       "0"       "0"       "0"
## C   "0"       "0.3*e2" "0"       "0"       "0"       "0"       "0"       "0"
## ES  "0"       "0"       "0.3*e3" "0"       "0"       "0"       "0"       "0"
## E   "0"       "0"       "0"       "0.3*e4" "0"       "0"       "0"       "0"
## O   "0"       "0"       "0"       "0"       "0.3*e5" "0"       "0"       "0"
## IBT "0"       "0"       "0"       "0"       "0"       "0.3*e6" "0"       "0"
```

```
## SE  "0"      "0"      "0"      "0"      "0"      "0"      "0.3*VarSE" "0"
## g   "0"      "0"      "0"      "0"      "0"      "0"      "0"         "1"
```

```
##Specify F
FM<-create.Fmatrix(c(1,1,1,1,1,1,1,0), as.mxMatrix = FALSE)
dimnames(FM)<-list(c("A","C","ES","E","O","IBT","SE"), c("A","C","ES","E","O","IBT","SE","g"))
FM
```

```
##     A C ES E O IBT SE g
## A   1 0  0 0 0   0  0 0
## C   0 1  0 0 0   0  0 0
## ES  0 0  1 0 0   0  0 0
## E   0 0  0 1 0   0  0 0
## O   0 0  0 0 1   0  0 0
## IBT 0 0  0 0 0   1  0 0
## SE  0 0  0 0 0   0  1 0
```

```
##Stage Two
## Mike: diag.constraints = FALSE is more robust
Random2<-tssem2(Random, Amatrix = A,Smatrix = S,Fmatrix = FM, model.name = "IBTmediator",
                diag.constraints = FALSE, intervals.type = "LB",
                 mx.algebras = list(SE=mxAlgebra(g_SE*SE_IBT,name = "SE")))
summary(Random2)
```

```
##
## Call:
## wls(Cov = pooledS, aCov = aCov, n = tssem1.obj$total.n, Amatrix = Amatrix,
##     Smatrix = Smatrix, Fmatrix = Fmatrix, diag.constraints = diag.constraints,
##     cor.analysis = cor.analysis, intervals.type = intervals.type,
##     mx.algebras = mx.algebras, model.name = model.name, suppressWarnings = suppressWarnings,
##     silent = silent, run = run)
##
## 95% confidence intervals: Likelihood-based statistic
## Coefficients:
##          Estimate Std.Error     lbound     ubound z value Pr(>|z|)
## g_A     0.4307766        NA  0.3137236  0.5614680      NA       NA
## g_C     0.1657789        NA -0.0033302  0.3378157      NA       NA
## g_E     0.5063242        NA  0.3738367  0.6575439      NA       NA
## g_ES    0.2428959        NA  0.1082564  0.3822957      NA       NA
## g_IBT   0.1687854        NA  0.0017643  0.3359550      NA       NA
## SE_IBT  0.1889788        NA  0.0186918  0.3548928      NA       NA
## g_O     0.5379641        NA  0.4083340  0.6782558      NA       NA
## g_SE    0.3007121        NA  0.1685926  0.4403923      NA       NA
##
## mxAlgebras objects (and their 95% likelihood-based CIs):
##              lbound   Estimate    ubound
## SE[1,1] 0.006139233 0.05682821 0.1243842
##
## Goodness-of-fit indices:
##                                                Value
## Sample size                                6224.0000
## Chi-square of target model                    9.8553
## DF of target model                           13.0000
## p value of target model                       0.7057
## Number of constraints imposed on "Smatrix"    0.0000
## DF manually adjusted                          0.0000
```

```
## Chi-square of independence model            139.5712
## DF of independence model                     21.0000
## RMSEA                                         0.0000
## RMSEA lower 95% CI                            0.0000
## RMSEA upper 95% CI                            0.0097
## SRMR                                          0.0557
## TLI                                           1.0428
## CFI                                           1.0000
## AIC                                         -16.1447
## BIC                                        -103.7148
## OpenMx status1: 0 ("0" or "1": The optimization is considered fine.
## Other values indicate problems.)
```

```
## Mike: Plot the output directly
plot(Random2, layout="circle")
```