

APPENDIX 22.1: R CODE FOR THE EXAMPLE DATA SETS

Note: The following code yields the reported findings in R version 3.3.1 on Windows, but results may slightly vary across different versions of R and different platforms.

In the following code, the model components correspond to the following elements of the model formulas in the text.

```
l3n = number of groups
l2n = number of individuals in each group
l1n = number of measurement time points in each
      individual
gamma000 =  $\gamma_{000}$ 
vu00 = variance of  $u_{00j}$  or  $v_{00}$ 
vu01 = variance of  $u_{01j}$  or  $v_{11}$ 
vu0001 = covariance of  $u_{00j}$  and  $u_{01j}$  or  $v_{11}$ 
vr0 = variance of  $r_{0ij}$  or  $\tau_{11}$ 
delta =  $\delta_1$ 
gendat <- function(l3n,l2n,l1n,gamma000,pi01,
  vu00,vu01,vu0100,vr0,ve,delta){
  dat=expand.grid(time = 0:(l1n-1),
    person = 1:l2n,group = 1:l3n)
  u <- MASS::mvrnorm(l3n, c(0,0),
    matrix(c(vu00,vu0100,vu0100,vu01), 2),
    empirical=T)
  r<-rep(rnorm(l2n*l3n,0,sd=sqrt(vr0)),each=l1n)
  e<-rnorm(l1n*l2n*l3n,0,sd=sqrt(ve*exp(2*delta*d
    at$time)))
  dat$y<-gamma000+pi01*dat$time+u[,1]
    [dat[,3]]+u[,2][dat[,3]]*dat$time+r+e
  return(dat)
}

set.seed(123456)
dataset1<-gendat(l3n=5,l2n=30,l1n=5,gamma000=5,
  pi01=0.05, vu00=0.1,vu01=0,vu0100=0,vr0=0.3,
  ve=2,delta=-0.60)

set.seed(765432)
dataset2<-gendat(l3n=5,l2n=30,l1n=5,gamma000=5
  ,pi01=0.05, vu00=0.1,vu01=0.1,
  vu0100=0,vr0=0.3,ve=2,delta=0)

sherifdat=expand.grid(person = 1:3,time = 0:2,
  group = 1:8)
sherifdat$y<-c(4.0,2.7,2.0,3.8,2.6,2.1,2.0,2.4,2.3,1.3,
  1.5,1.1,2.0,1.6,1.5,1.8,1.5,1.4,2.9,1.9,1.9,2.9,2.1,
```

```
2.0,1.9,1.7,1.9,3.5,3.4,3.6,4.7,3.8,4.6,4.4,4.4,4.6,
4.3,4.3,3.6,4.1,4.0,3.9,4.0,3.9,3.5,4.5,4.0,4.0,1.9,
1.8,1.6,1.4,1.6,1.5,2.5,2.5,2.2,2.2,1.6,1.8,1.9,1.8,
1.8,3.1,2.6,1.5,5.8,5.2,5.2,4.4,4.4,4.4)
sherifdat$condition<-rep(c(1,0),each=36)
```

APPENDIX 22.2: R CODE FOR RUNNING THE ANALYSES

```
library(nlme)

twolevel<-lme(y ~ time, random = list(group=
  pdLogChol(~time)),data=dataset1,
  control=lmeControl(opt="optim",maxIter=
    3000,msMaxIter=3000))
twolevelCEM<-update(twolevel,weights=
  varExp(form = ~ time))
summary(twolevelCEM)
anova(twolevel,twolevelCEM)

threelevel<-lme(y ~ time, random = list(group=
  pdLogChol( time),person=pdIdent( 1)),
  data=dataset1,control=lmeControl(opt=
    "optim",maxIter=3000, msMaxIter=3000))
threelevelCEM<-update(threelevel,weights=
  varExp(form = ~ time))
summary(threelevelCEM)
anova(threelevel,threelevelCEM)
threelevelCEMic<-update(threelevelCEM,
  weights=varComb(varExp(form =
    ~ time|group),varIdent(form=~1|group)))
summary(threelevelCEMic)

threelevelCEMwithPRED1<-lme(y
  ~ time*condition, random =
  list(group=pdLogChol(~time),
  person=pdIdent(~1)),data=sherifdat,control=
  lmeControl(opt="optim",maxIter=3000,
  msMaxIter=3000),
  weights=varComb(varExp(form = ~ time),
  varExp(form = ~ condition)))
threelevelCEMwithPRED2<-update
  (threelevelCEMwithPRED1,
  weights=varComb(varExp(form = ~ time),
  varExp(form = ~ condition),
  varExp(form = ~ time*condition)))
summary(threelevelCEMwithPRED2)
anova(threelevelCEMwithPRED1,
  threelevelCEMwithPRED2)
```