Below, the SAS code for all the analyses included in Chapter 7 is listed. For the analysis of static interaction models and asymmetric dynamic models, the data set "aggression_dich" is needed. It contains the following variables: (1) a column of binary responses `y`, (2) a column of person identification labeled `person`, (3) a column of Gender coding, named as `male` (`male`=1 for males and `male`=0 for females) or `gender` (`gender`=-1 for females and `gender`=1 for males), (4) 24 columns for 24 indicator variables named from `x1` to `x24`, (5) a variable `x25` which equals 1 for the items actually cursing or scolding and 0 otherwise, (6) 12 dynamic predictors labeled `wd1` to `wd12` which equal 1 for a do-item if the corresponding want-item equals 1, (7) 12 dynamic predictors labeled `dw1` to `dw12` which equal 1 for a want-item if the corresponding do-item equals 1. In the code below, it is assumed that items 1 to 12 are want-items and that items 13-24 are do-items. The order within want- and do-items is as follows: curse in situation 1, scold in situation 1, shout in situation 1, curse in situation 2, etc.

For the analysis of symmetric local dependency models, the data set "ccdm" is needed. This data set is based on the responses of 316 persons to 12 pairs of want and do items. The data set contains the following variables: (1) a column of polytomous responses `y` which may take four values (`y`=1 if want=0 and do=0, `y`=2 if want=0 and do=1, `y`=3 if want=1 and do=0, `y`=4 if want=1 and do=1), (2) a column of person identification labeled `person`, (3) 12 columns for 12 indicator variables named from `x1` to `x12`, (4) 12 predictor variables labeled `cb1_1` to `cb1_12` to code for the main effect of want, (5) 12 predictor variables labeled `cb2_1` to `cb2_12` to code for the main effect of do, (6) 12 predictor variables labeled `cd_1` to `cd_12` to code for the interaction between want and do items, (7) a predictor labeled `disc` which codes for the weight of the latent trait. In particular, the predictors `disc`, `cb1`, `cb2` and `cd` are defined as in Table 1.

1 SAS code static interaction models

1.1 Rasch model, no DIF

```
PROC NLMIXED data=verbalag_dich method=gauss noad technique=newrap qpoints=20;
PARMS b1-b24=0 mu1=0 sd0=0.5 sd1=0.5;
beta=b1*x1+b2*x2+b3*x3+b4*x4+b5*x5+b6*x6+b7*x7+b8*x8+b9*x9+b10*x10
+b11*x11+b12*x12+b13*x13+b14*x14+b15*x15+b16*x16+b17*x17+b18*x18
+b19*x19+b20*x20+b21*x21+b22*x22+b23*x23+b24*x24;
ex=exp(theta-beta);
p=ex/(1+ex);
MODEL y ~ binary(p);
RANDOM theta ~ normal(mu1*male,(1-male)*(sd0**2)+male*(sd1**2)) subject=person;
ESTIMATE 'sd0**2' sd0**2;
ESTIMATE 'sd1**2' sd1**2;
RUN;
```

Table 1: coding scheme for the CCDM

want	do	y	disc	cb1	cb2	d
0	0	1	0	0	0	0
0	1	2	1	0	-1	0
1	0	3	1	-1	0	0
1	1	4	2	-1	-1	-1

1.2 2PL, no DIF

```
PROC NLMIXED data=verbalag_dich method=gauss noad technique=newrap qpoints=20;
PARMS a1-a24=1 b1-b24=0 mu1=0 sd1=0.5;
beta=b1*x1+b2*x2+b3*x3+b4*x4+b5*x5+b6*x6+b7*x7+b8*x8+b9*x9+b10*x10
+b11*x11+b12*x12+b13*x13+b14*x14+b15*x15+b16*x16+b17*x17+b18*x18
+b19*x19+b20*x20+b21*x21+b22*x22+b23*x23+b24*x24;
alfa=a1*x1+a2*x2+a3*x3+a4*x4+a5*x5+a6*x6+a7*x7+a8*x8+a9*x9+a10*x10
+a11*x11+a12*x12+a13*x13+a14*x14+a15*x15+a16*x16+a17*x17+a18*x18
+a19*x19+a20*x20+a21*x21+a22*x22+a23*x23+a24*x24;
ex=exp(alfa*theta-beta);
p=ex/(1+ex);
MODEL y ~ binary(p);
RANDOM theta ~ normal(male*mu1,male*(sd1**2)) subject=person;
ESTIMATE 'sd1**2' sd1**2;
RUN;
```

1.3 Rasch model, uniform DIF all items

```
PROC NLMIXED data=verbalag_dich method=gauss noad technique=newrap qpoints=20;
PARMS b1-b24=0 d1-d23=0 sd0=0.5 sd1=0.5 mu1=0;
beta=b1*x1+b2*x2+b3*x3+b4*x4+b5*x5+b6*x6+b7*x7+b8*x8+b9*x9+b10*x10
+b11*x11+b12*x12+b13*x13+b14*x14+b15*x15+b16*x16+b17*x17+b18*x18
+b19*x19+b20*x20+b21*x21+b22*x22+b23*x23+b24*x24;
delta=d1*x1+d2*x2+d3*x3+d4*x4+d5*x5+d6*x6+d7*x7+d8*x8+d9*x9+d10*x10
+d11*x11+d12*x12+d13*x13+d14*x14+d15*x15+d16*x16+d17*x17+d18*x18
+d19*x19+d20*x20+d21*x21+d22*x22+d23*x23;
ex=exp(theta-beta-delta*male);
p=ex/(1+ex);
MODEL y ~ binary(p);
RANDOM theta ~ normal(male*mu1,(1-male)*(sd0**2)+male*(sd1**2)) subject=person;
ESTIMATE 'sd0**2' sd0**2;
ESTIMATE 'sd1**2' sd1**2;
RUN;
```

1.4 2PL, non-uniform DIF all items

```
PROC NLMIXED data=verbalag_dich method=gauss noad technique=newrap qpoints=20;
PARMS a1-a24=1 b1-b24=0 e1-e23=1 d1-d23=0 mu1=0 sd1=0.5;
beta=b1*x1+b2*x2+b3*x3+b4*x4+b5*x5+b6*x6+b7*x7+b8*x8+b9*x9+b10*x10
+b11*x11+b12*x12+b13*x13+b14*x14+b15*x15+b16*x16+b17*x17+b18*x18
+b19*x19+b20*x20+b21*x21+b22*x22+b23*x23+b24*x24;
alfa=a1*x1+a2*x2+a3*x3+a4*x4+a5*x5+a6*x6+a7*x7+a8*x8+a9*x9+a10*x10
+a11*x11+a12*x12+a13*x13+a14*x14+a15*x15+a16*x16+a17*x17+a18*x18
+a19*x19+a20*x20+a21*x21+a22*x22+a23*x23+a24*x24;
delta=d1*x1+d2*x2+d3*x3+d4*x4+d5*x5+d6*x6+d7*x7+d8*x8+d9*x9+d10*x10
+d11*x11+d12*x12+d13*x13+d14*x14+d15*x15+d16*x16+d17*x17+d18*x18
+d19*x19+d20*x20+d21*x21+d22*x22+d23*x23;
epsilon=e1*x1+e2*x2+e3*x3+e4*x4+e5*x5+e6*x6+e7*x7+e8*x8+e9*x9+e10*x10
+e11*x11+e12*x12+e13*x13+e14*x14+e15*x15+e16*x16+e17*x17+e18*x18
```

```
+e19*x19+e20*x20+e21*x21+e22*x22+e23*x23;
ex=exp((alfa+epsilon*male)*theta-beta-delta*male);
p=ex/(1+ex);
MODEL y ~ binary(p);
RANDOM theta ~ normal(male*mu1,male*(sd1**2)) subject=person;
ESTIMATE 'sd1**2' sd1**2;
RUN;
```

1.5 Rasch model, uniform DIF do-items

```
PROC NLMIXED data=verbalag_dich method=gauss noad technique=newrap qpoints=20;
PARMS b1-b24=0 d13-d24=0 sd0=0.5 sd1=0.5 mu1=0;
beta=b1*x1+b2*x2+b3*x3+b4*x4+b5*x5+b6*x6+b7*x7+b8*x8+b9*x9+b10*x10
+b11*x11+b12*x12+b13*x13+b14*x14+b15*x15+b16*x16+b17*x17+b18*x18
+b19*x19+b20*x20+b21*x21+b22*x22+b23*x23+b24*x24;
delta=d13*x13+d14*x14+d15*x15+d16*x16+d17*x17+d18*x18
+d19*x19+d20*x20+d21*x21+d22*x22+d23*x23;
ex=exp(theta-beta-delta*male);
p=ex/(1+ex);
MODEL y ~ binary(p);
RANDOM theta ~ normal(male*mu1,(1-male)*(sd0**2)+male*(sd1**2)) subject=person;
ESTIMATE 'sd0**2' sd0**2;
ESTIMATE 'sd1**2' sd1**2;
RUN;
```

1.6 Rasch model, DFF actually scolding or cursing

```
PROC NLMIXED data=verbalag_dich method=gauss noad technique=newrap qpoints=20;
PARMS b1-b24=0 delta=0 mu1=0 sd0=0.5 sd1=0.5;
beta=b1*x1+b2*x2+b3*x3+b4*x4+b5*x5+b6*x6+b7*x7+b8*x8+b9*x9+b10*x10
+b11*x11+b12*x12+b13*x13+b14*x14+b15*x15+b16*x16+b17*x17+b18*x18
+b19*x19+b20*x20+b21*x21+b22*x22+b23*x23+b24*x24;
ex=exp(theta-beta-delta*x25*male);
p=ex/(1+ex);
MODEL y ~ binary(p);
RANDOM theta ~ normal(male*mu1,(1-male)*(sd0**2)+male*(sd1**2)) subject=person;
ESTIMATE 'sd0**2' sd0**2;
ESTIMATE 'sd1**2' sd1**2;
RUN;
```

1.7 Rasch model, RW-DFF for actually scolding or cursing using dummy coding for Gender

```
PROC NLMIXED data=verbalag_dich method=gauss noad technique=newrap qpoints=20;
PARMS b1-b24=0 muth1=0 muga1=0 sdth0=0.5 sdth1=0.5 sdga1=0.5 cothga1=0.5;
beta=b1*x1+b2*x2+b3*x3+b4*x4+b5*x5+b6*x6+b7*x7+b8*x8+b9*x9+b10*x10
+b11*x11+b12*x12+b13*x13+b14*x14+b15*x15+b16*x16+b17*x17+b18*x18
+b19*x19+b20*x20+b21*x21+b22*x22+b23*x23+b24*x24;
```

```
ex=exp(theta-beta-gamma*x25*gender);
p=ex/(1+ex);
MODEL y ~ binary(p);
RANDOM theta gamma ~ normal([male*muth1,male*muga1], [(1-male)*(sdth0**2)+male*(sdth1**2),
male*cothga1, male*(sdga1**2)]) subject=person;
ESTIMATE 'sdth0**2' sdth0**2;
ESTIMATE 'sdth1**2' sdth1**2;
ESTIMATE 'sdga1**2' sdga1**2;
RUN;
```

1.8 Rasch model, RW-DFF for actually scolding or cursing using contrast coding for Gender

```
PROC NLMIXED data=verbalag_dich method=gauss noad technique=newrap qpoints=20;
PARMS b1-b24=0 muth1=0 muga1=0 sdth0=0.5 sdth1=0.5 sdga0=0.5 sdga1=0.5 cothga0=0 cothga1=0.5;
beta=b1*x1+b2*x2+b3*x3+b4*x4+b5*x5+b6*x6+b7*x7+b8*x8+b9*x9+b10*x10
+b11*x11+b12*x12+b13*x13+b14*x14+b15*x15+b16*x16+b17*x17+b18*x18
+b19*x19+b20*x20+b21*x21+b22*x22+b23*x23+b24*x24;
ex=exp(theta-beta-gamma*x25*gender);
p=ex/(1+ex);
MODEL y ~ binary(p);
RANDOM theta gamma ~ normal([male*muth1,male*muga1], [(1-male)*(sdth0**2)+male*(sdth1**2),
(1-male)*cothga0+male*cothga1, (1-male)*(sdga0**2)+male*(sdga1**2)]) subject=person;
ESTIMATE 'sdth0**2' sdth0**2;
ESTIMATE 'sdth1**2' sdth1**2;
ESTIMATE 'sdga0**2' sdga0**2;
ESTIMATE 'sdga1**2' sdga1**2;
RUN;
```

2 SAS code dynamic interaction models

2.1 Rasch model

```
PROC NLMIXED data=verbalag_dich method=gauss noad technique=newrap qpoints=20;
PARMS b1-b24=0 sd=0.5;
beta=b1*x1+b2*x2+b3*x3+b4*x4+b5*x5+b6*x6+b7*x7+b8*x8+b9*x9+b10*x10
+b11*x11+b12*x12+b13*x13+b14*x14+b15*x15+b16*x16+b17*x17+b18*x18
+b19*x19+b20*x20+b21*x21+b22*x22+b23*x23+b24*x24;
ex=exp(theta-beta);
p=ex/(1+ex);
MODEL y ~ binary(p);
RANDOM theta ~ normal(0,sd**2) subject=person;
ESTIMATE 'sd**2' sd**2;
RUN;
```

2.2 Want-Do model with situation-behavior-specific dynamic effects

```
PROC NLMIXED data=verbalag_dich method=gauss noad technique=newrap qpoints=20;
PARMS b1-b24=0 d1-d12=0 sd=0.5;
beta=b1*x1+b2*x2+b3*x3+b4*x4+b5*x5+b6*x6+b7*x7+b8*x8+b9*x9+b10*x10
+b11*x11+b12*x12+b13*x13+b14*x14+b15*x15+b16*x16+b17*x17+b18*x18
+b19*x19+b20*x20+b21*x21+b22*x22+b23*x23+b24*x24;
delta=d1*wd1+d2*wd2+d3*wd3+d4*wd4+d5*wd5+d6*wd6
+d7*wd7+d8*wd8+d9*wd9+d10*wd10+d11*wd11+d12*wd12;
ex=exp(theta-beta-delta);
p=ex/(1+ex);
MODEL y ~ binary(p);
RANDOM theta ~ normal(0,sd**2) subject=person;
ESTIMATE 'sd**2' sd**2;
RUN;
```

2.3 Want-Do model with behavior-specific dynamic effects

```
PROC NLMIXED data=verbalag_dich method=gauss noad technique=newrap qpoints=20;
PARMS b1-b24=0 d1-d3=0 sd=0.5;
beta=b1*x1+b2*x2+b3*x3+b4*x4+b5*x5+b6*x6+b7*x7+b8*x8+b9*x9+b10*x10
+b11*x11+b12*x12+b13*x13+b14*x14+b15*x15+b16*x16+b17*x17+b18*x18
+b19*x19+b20*x20+b21*x21+b22*x22+b23*x23+b24*x24;
delta=d1*(wd1+wd4+wd7+wd10)+d2*(wd2+wd5+wd8+wd11)+d3*(wd3+wd6+wd9+wd12);
ex=exp(theta-beta-delta);
p=ex/(1+ex);
MODEL y ~ binary(p);
RANDOM theta ~ normal(0,sd**2) subject=person;
ESTIMATE 'sd**2' sd**2;
RUN;
```

2.4 Want-Do model with situation-specific dynamic effects

```
PROC NLMIXED data=verbalag_dich method=gauss noad technique=newrap qpoints=20;
PARMS b1-b24=0 d1-d4=0 sd=0.5;
beta=b1*x1+b2*x2+b3*x3+b4*x4+b5*x5+b6*x6+b7*x7+b8*x8+b9*x9+b10*x10
+b11*x11+b12*x12+b13*x13+b14*x14+b15*x15+b16*x16+b17*x17+b18*x18
+b19*x19+b20*x20+b21*x21+b22*x22+b23*x23+b24*x24;
delta=d1*(wd1+wd2+wd3)+d2*(wd4+wd5+wd6)+d3*(wd7+wd8+wd9)+d4*(wd10+wd11+wd12);
ex=exp(theta-beta-delta);
p=ex/(1+ex);
MODEL y ~ binary(p);
RANDOM theta ~ normal(0,sd**2) subject=person;
ESTIMATE 'sd**2' sd**2;
RUN;
```

2.5 Want-Do model with non-specific dynamic effect

```
PROC NLMIXED data=verbalag_dich method=gauss noad technique=newrap qpoints=20;
PARMS b1-b24=0 d=0 sd=0.5;
beta=b1*x1+b2*x2+b3*x3+b4*x4+b5*x5+b6*x6+b7*x7+b8*x8+b9*x9+b10*x10
+b11*x11+b12*x12+b13*x13+b14*x14+b15*x15+b16*x16+b17*x17+b18*x18
+b19*x19+b20*x20+b21*x21+b22*x22+b23*x23+b24*x24;
delta=d*(wd1+wd2+wd3+wd4+wd5+wd6+wd7+wd8+wd9+wd10+wd11+wd12);
ex=exp(theta-beta-delta);
p=ex/(1+ex);
MODEL y ~ binary(p);
RANDOM theta ~ normal(0,sd**2) subject=person;
ESTIMATE 'sd**2' sd**2;
RUN;
```

2.6 Do-Want model with situation-behavior-specific dynamic effects

```
PROC NLMIXED data=verbalag_dich method=gauss noad technique=newrap qpoints=20;
PARMS b1-b24=0 d1-d12=0 sd=0.5;
beta=b1*x1+b2*x2+b3*x3+b4*x4+b5*x5+b6*x6+b7*x7+b8*x8+b9*x9+b10*x10
+b11*x11+b12*x12+b13*x13+b14*x14+b15*x15+b16*x16+b17*x17+b18*x18
+b19*x19+b20*x20+b21*x21+b22*x22+b23*x23+b24*x24;
delta=d1*dw1+d2*dw2+d3*dw3+d4*dw4+d5*dw5+d6*dw6
+d7*dw7+d8*dw8+d9*dw9+d10*dw10+d11*dw11+d12*dw12;
ex=exp(theta-beta-delta);
p=ex/(1+ex);
MODEL y ~ binary(p);
RANDOM theta ~ normal(0,sd**2) subject=person;
ESTIMATE 'sd**2' sd**2;
RUN;
```

2.7 Do-Want model with behavior-specific dynamic effects

```
PROC NLMIXED data=verbalag_dich method=gauss noad technique=newrap qpoints=20;
PARMS b1-b24=0 d1-d3=0 sd=0.5;
beta=b1*x1+b2*x2+b3*x3+b4*x4+b5*x5+b6*x6+b7*x7+b8*x8+b9*x9+b10*x10
+b11*x11+b12*x12+b13*x13+b14*x14+b15*x15+b16*x16+b17*x17+b18*x18
+b19*x19+b20*x20+b21*x21+b22*x22+b23*x23+b24*x24;
delta=d1*(dw1+dw4+dw7+dw10)+d2*(dw2+dw5+dw8+dw11)+d3*(dw3+dw6+dw9+dw12);
ex=exp(theta-beta-delta);
p=ex/(1+ex);
MODEL y ~ binary(p);
RANDOM theta ~ normal(0,sd**2) subject=person;
ESTIMATE 'sd**2' sd**2;
RUN;
```

2.8 Do-Want model with situation-specific dynamic effects

```
PROC NLMIXED data=verbalag_dich method=gauss noad technique=newrap qpoints=20;
PARMS b1-b24=0 d1-d4=0 sd=0.5;
beta=b1*x1+b2*x2+b3*x3+b4*x4+b5*x5+b6*x6+b7*x7+b8*x8+b9*x9+b10*x10
+b11*x11+b12*x12+b13*x13+b14*x14+b15*x15+b16*x16+b17*x17+b18*x18
+b19*x19+b20*x20+b21*x21+b22*x22+b23*x23+b24*x24;
delta=d1*(dw1+dw2+dw3)+d2*(dw4+dw5+dw6)+d3*(dw7+dw8+dw9)+d4*(dw10+dw11+dw12);
ex=exp(theta-beta-delta);
p=ex/(1+ex);
MODEL y ~ binary(p);
RANDOM theta ~ normal(0,sd**2) subject=person;
ESTIMATE 'sd**2' sd**2;
RUN;
```

2.9 Do-Want model with non-specific dynamic effect

```
PROC NLMIXED data=verbalag_dich method=gauss noad technique=newrap qpoints=20;
PARMS b1-b24=0 d=0 sd=0.5;
beta=b1*x1+b2*x2+b3*x3+b4*x4+b5*x5+b6*x6+b7*x7+b8*x8+b9*x9+b10*x10
+b11*x11+b12*x12+b13*x13+b14*x14+b15*x15+b16*x16+b17*x17+b18*x18
+b19*x19+b20*x20+b21*x21+b22*x22+b23*x23+b24*x24;
delta=d*(dw1+dw2+dw3+dw4+dw5+dw6+dw7+dw8+dw9+dw10+dw11+dw12);
ex=exp(theta-beta-delta);
p=ex/(1+ex);
MODEL y ~ binary(p);
RANDOM theta ~ normal(0,sd**2) subject=person;
ESTIMATE 'sd**2' sd**2;
RUN;
```

2.10 CCDM model with situation-behavior-specific interactions

```
PROC NLMIXED data=test noad technique=newrap method=gauss qpoints=20;
PARMS b1_1-b1_12=0 b2_1-b2_12=0 d1-d12=0 sd=.5;
num1=disc*th+b1_1*cb1_1+b2_1*cb2_1+d1*cd_1;
denom1=1+exp(th-b1_1)+exp(th-b2_1)+exp(2*th-b1_1-b2_1-d1);
num2=disc*th+b1_2*cb1_2+b2_2*cb2_2+d2*cd_2;
denom2=1+exp(th-b1_2)+exp(th-b2_2)+exp(2*th-b1_2-b2_2-d2);
num3=disc*th+b1_3*cb1_3+b2_3*cb2_3+d3*cd_3;
denom3=1+exp(th-b1_3)+exp(th-b2_3)+exp(2*th-b1_3-b2_3-d3);
num4=disc*th+b1_4*cb1_4+b2_4*cb2_4+d4*cd_4;
denom4=1+exp(th-b1_4)+exp(th-b2_4)+exp(2*th-b1_4-b2_4-d4);
num5=disc*th+b1_5*cb1_5+b2_5*cb2_5+d5*cd_5;
denom5=1+exp(th-b1_5)+exp(th-b2_5)+exp(2*th-b1_5-b2_5-d5);
num6=disc*th+b1_6*cb1_6+b2_6*cb2_6+d6*cd_6;
denom6=1+exp(th-b1_6)+exp(th-b2_6)+exp(2*th-b1_6-b2_6-d6);
num7=disc*th+b1_7*cb1_7+b2_7*cb2_7+d7*cd_7;
denom7=1+exp(th-b1_7)+exp(th-b2_7)+exp(2*th-b1_7-b2_7-d7);
num8=disc*th+b1_8*cb1_8+b2_8*cb2_8+d8*cd_8;
denom8=1+exp(th-b1_8)+exp(th-b2_8)+exp(2*th-b1_8-b2_8-d8);
```

```
num9=disc*th+b1_9*cb1_9+b2_9*cb2_9+d9*cd_9;
denom9=1+exp(th-b1_9)+exp(th-b2_9)+exp(2*th-b1_9-b2_9-d9);
num10=disc*th+b1_10*cb1_10+b2_10*cb2_10+d10*cd_10;
denom10=1+exp(th-b1_10)+exp(th-b2_10)+exp(2*th-b1_10-b2_10-d10);
num11=disc*th+b1_11*cb1_11+b2_11*cb2_11+d11*cd_11;
denom11=1+exp(th-b1_11)+exp(th-b2_11)+exp(2*th-b1_11-b2_11-d11);
num12=disc*th+b1_12*cb1_12+b2_12*cb2_12+d12*cd_12;
denom12=1+exp(th-b1_12)+exp(th-b2_12)+exp(2*th-b1_12-b2_12-d12);
ll= x1*(num1-log(denom1))
+x2*(num2-log(denom2))
+x3*(num3-log(denom3))
+x4*(num4-log(denom4))
+x5*(num5-log(denom5))
+x6*(num6-log(denom6))
+x7*(num7-log(denom7))
+x8*(num8-log(denom8))
+x9*(num9-log(denom9))
+x10*(num10-log(denom10))
+x11*(num11-log(denom11))
+x12*(num12-log(denom12));
model y general(ll);
random th normal(0,sd**2) subject=person;
run;
```

2.11 CCDM model with behavior-specific interactions

```
PROC NLMIXED data=test noad technique=newrap method=gauss qpoints=20;
PARMS b1_1-b1_12=0 b2_1-b2_12=0 d1-d3=0 sd=.5;
num1=disc*th+b1_1*cb1_1+b2_1*cb2_1+d1*cd_1;
denom1=1+exp(th-b1_1)+exp(th-b2_1)+exp(2*th-b1_1-b2_1-d1);
num2=disc*th+b1_2*cb1_2+b2_2*cb2_2+d2*cd_2;
denom2=1+exp(th-b1_2)+exp(th-b2_2)+exp(2*th-b1_2-b2_2-d2);
num3=disc*th+b1_3*cb1_3+b2_3*cb2_3+d3*cd_3;
denom3=1+exp(th-b1_3)+exp(th-b2_3)+exp(2*th-b1_3-b2_3-d3);
num4=disc*th+b1_4*cb1_4+b2_4*cb2_4+d1*cd_4;
denom4=1+exp(th-b1_4)+exp(th-b2_4)+exp(2*th-b1_4-b2_4-d1);
num5=disc*th+b1_5*cb1_5+b2_5*cb2_5+d2*cd_5;
denom5=1+exp(th-b1_5)+exp(th-b2_5)+exp(2*th-b1_5-b2_5-d2);
num6=disc*th+b1_6*cb1_6+b2_6*cb2_6+d3*cd_6;
denom6=1+exp(th-b1_6)+exp(th-b2_6)+exp(2*th-b1_6-b2_6-d3);
num7=disc*th+b1_7*cb1_7+b2_7*cb2_7+d1*cd_7;
denom7=1+exp(th-b1_7)+exp(th-b2_7)+exp(2*th-b1_7-b2_7-d1);
num8=disc*th+b1_8*cb1_8+b2_8*cb2_8+d2*cd_8;
denom8=1+exp(th-b1_8)+exp(th-b2_8)+exp(2*th-b1_8-b2_8-d2);
num9=disc*th+b1_9*cb1_9+b2_9*cb2_9+d3*cd_9;
denom9=1+exp(th-b1_9)+exp(th-b2_9)+exp(2*th-b1_9-b2_9-d3);
num10=disc*th+b1_10*cb1_10+b2_10*cb2_10+d1*cd_10;
denom10=1+exp(th-b1_10)+exp(th-b2_10)+exp(2*th-b1_10-b2_10-d1);
num11=disc*th+b1_11*cb1_11+b2_11*cb2_11+d2*cd_11;
denom11=1+exp(th-b1_11)+exp(th-b2_11)+exp(2*th-b1_11-b2_11-d2);
```

```
num12=disc*th+b1_12*cb1_12+b2_12*cb2_12+d3*cd_12;
denom12=1+exp(th-b1_12)+exp(th-b2_12)+exp(2*th-b1_12-b2_12-d3);
ll= x1*(num1-log(denom1))
+x2*(num2-log(denom2))
+x3*(num3-log(denom3))
+x4*(num4-log(denom4))
+x5*(num5-log(denom5))
+x6*(num6-log(denom6))
+x7*(num7-log(denom7))
+x8*(num8-log(denom8))
+x9*(num9-log(denom9))
+x10*(num10-log(denom10))
+x11*(num11-log(denom11))
+x12*(num12-log(denom12));
model y general(ll);
random th normal(0,sd**2) subject=person;
run;
```

2.12 CCDM model with situation-specific interactions

```
PROC NLMIXED data=test noad technique=newrap method=gauss qpoints=20;
PARMS b1_1-b1_12=0 b2_1-b2_12=0 d1-d4=0 sd=.5;
num1=disc*th+b1_1*cb1_1+b2_1*cb2_1+d1*cd_1;
denom1=1+exp(th-b1_1)+exp(th-b2_1)+exp(2*th-b1_1-b2_1-d1);
num2=disc*th+b1_2*cb1_2+b2_2*cb2_2+d2*cd_2;
denom2=1+exp(th-b1_2)+exp(th-b2_2)+exp(2*th-b1_2-b2_2-d2);
num3=disc*th+b1_3*cb1_3+b2_3*cb2_3+d3*cd_3;
denom3=1+exp(th-b1_3)+exp(th-b2_3)+exp(2*th-b1_3-b2_3-d3);
num4=disc*th+b1_4*cb1_4+b2_4*cb2_4+d4*cd_4;
denom4=1+exp(th-b1_4)+exp(th-b2_4)+exp(2*th-b1_4-b2_4-d4);
num5=disc*th+b1_5*cb1_5+b2_5*cb2_5+d1*cd_5;
denom5=1+exp(th-b1_5)+exp(th-b2_5)+exp(2*th-b1_5-b2_5-d1);
num6=disc*th+b1_6*cb1_6+b2_6*cb2_6+d2*cd_6;
denom6=1+exp(th-b1_6)+exp(th-b2_6)+exp(2*th-b1_6-b2_6-d2);
num7=disc*th+b1_7*cb1_7+b2_7*cb2_7+d3*cd_7;
denom7=1+exp(th-b1_7)+exp(th-b2_7)+exp(2*th-b1_7-b2_7-d3);
num8=disc*th+b1_8*cb1_8+b2_8*cb2_8+d4*cd_8;
denom8=1+exp(th-b1_8)+exp(th-b2_8)+exp(2*th-b1_8-b2_8-d4);
num9=disc*th+b1_9*cb1_9+b2_9*cb2_9+d1*cd_9;
denom9=1+exp(th-b1_9)+exp(th-b2_9)+exp(2*th-b1_9-b2_9-d1);
num10=disc*th+b1_10*cb1_10+b2_10*cb2_10+d2*cd_10;
denom10=1+exp(th-b1_10)+exp(th-b2_10)+exp(2*th-b1_10-b2_10-d2);
num11=disc*th+b1_11*cb1_11+b2_11*cb2_11+d3*cd_11;
denom11=1+exp(th-b1_11)+exp(th-b2_11)+exp(2*th-b1_11-b2_11-d3);
num12=disc*th+b1_12*cb1_12+b2_12*cb2_12+d4*cd_12;
denom12=1+exp(th-b1_12)+exp(th-b2_12)+exp(2*th-b1_12-b2_12-d4);
ll= x1*(num1-log(denom1))
+x2*(num2-log(denom2))
+x3*(num3-log(denom3))
+x4*(num4-log(denom4))
```

```
+x5*(num5-log(denom5))
+x6*(num6-log(denom6))
+x7*(num7-log(denom7))
+x8*(num8-log(denom8))
+x9*(num9-log(denom9))
+x10*(num10-log(denom10))
+x11*(num11-log(denom11))
+x12*(num12-log(denom12));
model y general(ll);
random th normal(0,sd**2) subject=person;
run;
```

2.13 CCDM model with non-specific interactions

```
PROC NLMIXED data=test noad technique=newrap method=gauss qpoints=20;
PARMS b1_1-b1_12=0 b2_1-b2_12=0 d=0 sd=.5;
num1=disc*th+b1_1*cb1_1+b2_1*cb2_1+d*cd_1;
denom1=1+exp(th-b1_1)+exp(th-b2_1)+exp(2*th-b1_1-b2_1-d);
num2=disc*th+b1_2*cb1_2+b2_2*cb2_2+d*cd_2;
denom2=1+exp(th-b1_2)+exp(th-b2_2)+exp(2*th-b1_2-b2_2-d);
num3=disc*th+b1_3*cb1_3+b2_3*cb2_3+d*cd_3;
denom3=1+exp(th-b1_3)+exp(th-b2_3)+exp(2*th-b1_3-b2_3-d);
num4=disc*th+b1_4*cb1_4+b2_4*cb2_4+d*cd_4;
denom4=1+exp(th-b1_4)+exp(th-b2_4)+exp(2*th-b1_4-b2_4-d);
num5=disc*th+b1_5*cb1_5+b2_5*cb2_5+d*cd_5;
denom5=1+exp(th-b1_5)+exp(th-b2_5)+exp(2*th-b1_5-b2_5-d);
num6=disc*th+b1_6*cb1_6+b2_6*cb2_6+d*cd_6;
denom6=1+exp(th-b1_6)+exp(th-b2_6)+exp(2*th-b1_6-b2_6-d);
num7=disc*th+b1_7*cb1_7+b2_7*cb2_7+d*cd_7;
denom7=1+exp(th-b1_7)+exp(th-b2_7)+exp(2*th-b1_7-b2_7-d);
num8=disc*th+b1_8*cb1_8+b2_8*cb2_8+d*cd_8;
denom8=1+exp(th-b1_8)+exp(th-b2_8)+exp(2*th-b1_8-b2_8-d);
num9=disc*th+b1_9*cb1_9+b2_9*cb2_9+d*cd_9;
denom9=1+exp(th-b1_9)+exp(th-b2_9)+exp(2*th-b1_9-b2_9-d);
num10=disc*th+b1_10*cb1_10+b2_10*cb2_10+d*cd_10;
denom10=1+exp(th-b1_10)+exp(th-b2_10)+exp(2*th-b1_10-b2_10-d);
num11=disc*th+b1_11*cb1_11+b2_11*cb2_11+d*cd_11;
denom11=1+exp(th-b1_11)+exp(th-b2_11)+exp(2*th-b1_11-b2_11-d);
num12=disc*th+b1_12*cb1_12+b2_12*cb2_12+d*cd_12;
denom12=1+exp(th-b1_12)+exp(th-b2_12)+exp(2*th-b1_12-b2_12-d);
ll= x1*(num1-log(denom1))
+x2*(num2-log(denom2))
+x3*(num3-log(denom3))
+x4*(num4-log(denom4))
+x5*(num5-log(denom5))
+x6*(num6-log(denom6))
+x7*(num7-log(denom7))
+x8*(num8-log(denom8))
+x9*(num9-log(denom9))
+x10*(num10-log(denom10))
```

```
+x11*(num11-log(denom11))
+x12*(num12-log(denom12));
model y general(ll);
random th normal(0,sd**2) subject=person;
run;
```