

**Using Bayesian IRT for Multi-Cohort Repeated Measure Design to Estimate Individual Latent Change Scores**

**Supplemental Material**

**Table A1.**

*ADNI-Language items and their recoded values*

	<b>Recoded Language Score</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>Raw scores</b>	Category Fluency-Animal	0-8	9-11	12-14	15-17	18-20	21-23	24-27	28-41
	Category Fluency-Vegetable	0-5	6-8	9-10	11-12	13-14	15-16	17-19	20-31
	Boston Naming (Total)	0-14	15-17	18-20	21-22	23-24	25-26	27-28	29-30
	ADAS-Cog Following Commands	1-5	0						
	ADAS-Cog Object Naming	2-5	1	0					
	ADAS-Cog Ideational Practice	1-5	0						
	Letter F Fluency	0-5	6-8	9-11	12-14	15-17	18-20	21-34	

**Table A2.**

*ADNI-EF items and their recoding*

<b>Original Language Score</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>
<b>WAIS-R Digit Symbol</b>	0-9	10-15	16-19	20-29	30-38	39-46	47-53	54-56	57-61	62-87
<b>Digit Span Backwards</b>	1-2	3	4	5	6	7	8	9	10	11-12
<b>Trails A</b>	118-150	94-117	73-93	53-72	40-52	32-39	27-31	24-26	21-23	3-20
<b>Trails B</b>	261-300	226-260	196-225	137-195	96-136	73-95	60-72	54-59	49-53	5-48

## Mplus Code

### Code for ADNI-EF

TITLE: ADNI EF concurrent calibration

DATA: FILE = "EFADNI12.lgrm.cor.concurrent.dat";

VARIABLE: NAMES = rid y1 y2 y3 y4 y5 y6 y7 y8 y9 y10 y11 y12 y13 y14 y15 y16 y17 y18 Phase;

MISSING=.;

CATEGORICAL ARE y1-y18;

IDVARIABLE = rid;

CLASSES=c(2);

KNOWNCLASS=c(Phase=1-2);

ANALYSIS:

TYPE=MIXTURE;

ESTIMATOR = BAYES;

CHAINS=1;

FBITER = 200000;

POINT=MEAN;

MODEL:

%OVERALL%

th1\_1 by y1-y9\* (1\_1-1\_9);

th1\_2 by y10-y18\* (1\_1-1\_9);

th1\_3 by y5@1 y6@1 y7@1 y8@1 y9@1;

th1\_4 by y14@1 y15@1 y16@1 y17@1 y18@1;

th2\_1 by y1@1 y10@1;

th2\_2 by y2@1 y11@1;

th2\_3 by y3@1 y12@1;

th2\_4 by y4@1 y13@1;

th2\_5 by y5@1 y14@1;

th2\_6 by y6@1 y15@1;

th2\_7 by y7@1 y16@1;

th2\_8 by y8@1 y17@1;

th2\_9 by y9@1 y18@1;

[y1\$1 y10\$1] (t1);

[y1\$2 y10\$2] (t2);

[y1\$3 y10\$3] (t3);

[y1\$4 y10\$4] (t4);

[y1\$5 y10\$5] (t5);

[y1\$6 y10\$6] (t6);

[y1\$7 y10\$7] (t7);

[y1\$8 y10\$8] (t8);

[y1\$9 y10\$9] (t9);

[y2\$1 y11\$1] (t10);

[y2\$2 y11\$2] (t11);

[y2\$3 y11\$3] (t12);

[y2\$4 y11\$4] (t13);

[y2\$5 y11\$5] (t14);

[y2\$6 y11\$6] (t15);

[y2\$7 y11\$7] (t16);

[y2\$8 y11\$8] (t17);  
[y2\$9 y11\$9] (t18);  
[y3\$1 y12\$1] (t19);  
[y3\$2 y12\$2] (t20);  
[y3\$3 y12\$3] (t21);  
[y3\$4 y12\$4] (t22);  
[y3\$5 y12\$5] (t23);  
[y3\$6 y12\$6] (t24);  
[y3\$7 y12\$7] (t25);  
[y3\$8 y12\$8] (t26);  
[y3\$9 y12\$9] (t27);  
[y4\$1 y13\$1] (t28);  
[y4\$2 y13\$2] (t29);  
[y4\$3 y13\$3] (t30);  
[y4\$4 y13\$4] (t31);  
[y4\$5 y13\$5] (t32);  
[y4\$6 y13\$6] (t33);  
[y4\$7 y13\$7] (t34);  
[y4\$8 y13\$8] (t35);  
[y4\$9 y13\$9] (t36);  
[y5\$1 y14\$1] (t37);  
[y6\$1 y15\$1] (t38);  
[y7\$1 y16\$1] (t39);  
[y8\$1 y17\$1] (t40);  
[y9\$1 y18\$1] (t41);

th1\_1 WITH th1\_3-th1\_4@0;  
th1\_2 WITH th1\_3-th1\_4@0;  
th1\_1 WITH th2\_1-th2\_9@0;  
th1\_2 WITH th2\_1-th2\_9@0;  
th1\_3 WITH th2\_1-th2\_9@0;  
th1\_4 WITH th2\_1-th2\_9@0;  
th2\_1 WITH th2\_2-th2\_9@0;  
th2\_2 WITH th2\_3-th2\_9@0;  
th2\_3 WITH th2\_4-th2\_9@0;  
th2\_4 WITH th2\_5-th2\_9@0;  
th2\_5 WITH th2\_6-th2\_9@0;  
th2\_6 WITH th2\_7-th2\_9@0;  
th2\_7 WITH th2\_8-th2\_9@0;  
th2\_8 WITH th2\_9@0;

%c#1%  
[th1\_1@0];  
th1\_1@1;  
[th1\_2\*0];  
th1\_2\*1;  
[th1\_3@0];  
th1\_3\*1;  
[th1\_4@0];  
th1\_4\*1;

```
[th2_1-th2_9@0];
th2_1-th2_9*1;
th1_1 WITH th1_2;
th1_3 WITH th1_4;
```

```
%c#2%
[th1_1*0];
th1_1*1;
[th1_2*0];
th1_2*1;
[th1_3@0];
th1_3*1;
[th1_4@0];
th1_4*1;
[th2_1-th2_9@0];
th2_1-th2_9*1;
th1_1 WITH th1_2;
th1_3 WITH th1_4;
```

OUTPUT:  
TECH1, TECH2, TECH8, TECH10;STANDARDIZED;  
SAVEDATA:  
FILE is EFADNI12traitconcurrent.txt;  
SAVE is fscores (100);  
PLOT:  
TYPE=PLOT3

## Stage II code for ADNI-language

```
TITLE: ADNI Language Stage II Estimation
DATA: FILE = "mplus.ADNI2.mcmc.lgrm210119NI.dat";
VARIABLE: NAMES = rid y1 y2 y3 y4 y5 y6 y7 y8 y9 y10 y11 y12 y13 y14 y15 y16 y17 y18 y19 y20
          y21 y22;
          MISSING=.;
          CATEGORICAL ARE y1-y22;
          IDVARIABLE = rid;
ANALYSIS:
          TYPE=GENERAL;
          ESTIMATOR = BAYES;
          CHAINS=1;
          FBITER = 100000;
          POINT=MEAN;
MODEL:
          th1_1 by y1-y11* (l_1-l_11);
          th1_2 by y12-y22* (l_1-l_11);
          th2_1 by y1* y12 (n1);
          th2_2 by y2* y12 (n2);
          th2_3 by y3* y14 (n3);
          th2_4 by y4* y15 (n4);
          th2_5 by y5* y16 (n5);
          th2_6 by y6* y17 (n6);
```

th2\_7 by y7\* y18 (n7);  
 th2\_8 by y8\* y19 (n8);  
 th2\_9 by y9\* y20 (n9);  
 th2\_10 by y10\* y21 (n10);  
 th2\_11 by y11\* y22 (n11);  
 [th1\_1\*0];  
 th1\_1\*1;  
 [th1\_2\*0];  
 th1\_2\*1.1;  
 [th2\_1-th2\_11@0];  
 th2\_1-th2\_11@1;  
 [y1\$1 y12\$1] (t3);  
 [y1\$2 y12\$2] (t4);  
 [y1\$3 y12\$3] (t5);  
 [y1\$4 y12\$4] (t6);  
 [y1\$5 y12\$5] (t7);  
 [y1\$6 y12\$6] (t8);  
 [y1\$7 y12\$7] (t9);  
 [y2\$1 y13\$1] (t10);  
 [y2\$2 y13\$2] (t11);  
 [y2\$3 y13\$3] (t12);  
 [y2\$4 y13\$4] (t13);  
 [y2\$5 y13\$5] (t14);  
 [y2\$6 y13\$6] (t15);  
 [y2\$7 y13\$7] (t16);  
 [y3\$1 y14\$1] (t17);  
 [y4\$1 y15\$1] (t18);  
 [y5\$1 y16\$1] (t19);  
 [y6\$1 y17\$1] (t20);  
 [y6\$2 y17\$2] (t21);  
 [y7\$1 y18\$1] (t31);  
 [y8\$1 y19\$1] (t22);  
 [y9\$1 y20\$1] (t23);  
 [y10\$1 y21\$1] (t24);  
 [y11\$1 y22\$1] (t25);  
 [y11\$2 y22\$2] (t26);  
 [y11\$3 y22\$3] (t27);  
 [y11\$4 y22\$4] (t28);  
 [y11\$5 y22\$5] (t29);  
 [y11\$6 y22\$6] (t30);  
 th1\_1 WITH th1\_2;  
 th1\_1 WITH th2\_1-th2\_11@0;  
 th1\_2 WITH th2\_1-th2\_11@0;  
 th2\_1 WITH th2\_2-th2\_11@0;  
 th2\_2 WITH th2\_3-th2\_11@0;  
 th2\_3 WITH th2\_4-th2\_11@0;  
 th2\_4 WITH th2\_5-th2\_11@0;  
 th2\_5 WITH th2\_6-th2\_11@0;  
 th2\_6 WITH th2\_7-th2\_11@0;  
 th2\_7 WITH th2\_8-th2\_11@0;  
 th2\_8 WITH th2\_9-th2\_11@0;

th2\_9 WITH th2\_10-th2\_11@0;  
th2\_10 WITH th2\_11@0;

MODEL PRIOR:

l\_1~N(1.576,0.011449);  
l\_2~N(2.232,0.034596);  
l\_3~N(0.444,0.006724);  
l\_4~N(0.174,0.002704);  
l\_5~N(0.5,0.004225);  
l\_6~N(1.346,0.0169);  
l\_7~N(0.81,0.011025);  
n1~N(-0.844,0.005776);  
n2~N(1.981,0.015129);  
n3~N(1.185,0.021316);  
n4~N(0.016,0.188356);  
n5~N(0.744,0.0144);  
n6~N(1.146,0.017161);  
n7~N(1.124,0.022801);  
t3~N(-2.920,0.013689);  
t4~N(-1.669,0.007569);  
t5~N(-0.478,0.005776);  
t6~N(0.586,0.006084);  
t7~N(1.653,0.008836);  
t8~N(2.66,0.014161);  
t9~N(3.97,0.030276);  
t10~N(-6.07,0.077284);  
t11~N(-4.865,0.050625);  
t12~N(-3.664,0.0324);  
t13~N(-2.635,0.021904);  
t14~N(-1.528,0.015876);  
t15~N(-0.268,0.014161);  
t16~N(1.602,0.020164);  
t17~N(-1.562,0.016641);  
t18~N(-1.463,0.01);  
t19~N(-1.248,0.007744);  
t20~N(-3.997,0.066564);  
t21~N(-1.564,0.015876);  
t31~N(-1.836,0.023716);

OUTPUT:

TECH1, TECH2, TECH8, TECH10;STANDARDIZED;

SAVEDATA:

FILE is traitlong2mcmc200119NI.txt;

SAVE is fscores (100);

PLOT:

TYPE=PLOT3