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!!!!All changes and additions in this model as compared to the baseline model are marked in
!!!!**boldface** font
!!!!

TITLE: Prediction Model

DATA: FILE IS your_name.dat;

VARIABLE: NAMES ARE

!Long List of all variable names;

USEVARIABLES ARE

gender

Y11 Y12 Y13 Y14 !!!First item parcel across four waves

Y21 Y22 Y23 Y24; !!!Second item parcel across four waves

MISSING IS ALL (-9999); !!!Specifying ISCED and AGE as auxiliary variables for missing
!!value estimations

Grouping IS cohort1 (5=Y2001 4=Y2000 3=Y1999);

!5 = born in 1999 = 10 years@T1

!4 = born in 2000 = 9 years@T1

!3 = born in 2001 = 8 years@T1

MODEL:

!In this three group model, we specified a group specific model for each cohort [this can be
!done more elegantly by using Mplus' defaults, but for instructional purposes we have chosen this
!modeling]

!Model for the youngest cohort

Model for the youngest cohort #####
#####Y 2001#####
#####

IN8 by Y11@1 !This would have been done by default, but to make sure that this works
!across groups, we explicitly set this loading@1
Y21* (121) !*= Estimate loading, but restrict it to be equal for all parameters with
Y12@1 !the same label (121 → see table 1 lambda21)
Y22* (121) !This is done for two reasons 1) we need the same metric across
Y13@1 !Measurement occasions - see description of TIC models 2) the measurement
Y23* (121) !models have to be the same across groups
Y14@1
Y24* (121);

IN8_9 by Y12@1
Y22* (121)
Y13@1
Y23* (121)
Y14@1
Y24* (121);

IN9_10 by Y13@1
Y23* (121)
Y14@1
Y24* (121);

IN10_11 by Y14@1
Y24* (121);

!IN8 = internalizing problem behaviors representing level @ age 8
!IN8_9 = change in internalizing problem behaviors between ages 8 and 9
!IN9_10 = change in internalizing problem behaviors between ages 9 and 10
!IN10_11 = change in internalizing problem behaviors between ages 10 and 11

!Manifest Mean Model

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[Y11@0];      !In order to identify the mean model the first manifest intercept has to be
              !restricted to be zero, because we want to estimate group specific latent means.
[Y21*];      !For the same reason as the factor loadings, the manifest intercepts
[Y12@0];      !have to be restricted to be equal across time and cohorts; same
[Y22*](i21);  !label(i21)
[Y13@0];
[Y23*](i21);
[Y14@0];
[Y24*](i21);
!Latent Means (Alpha)

[IN8*] (A_IN8); !Estimate latent mean and label it
[IN8_9*] (A_IN89);
[IN9_10*] (A_IN910); !This mean will be found in cohort 2 as well, therefore the label has to be
                    !the same in the second cohort in order to restrict those means to be equal
                    !across cohorts.
[IN10_11*](A_IN1011); !This mean will be found in cohort 2 & 3 as well, therefore the label has to
                    !be the same in the second and third cohort in order to restrict those means
                    !to be equal across cohorts.

!Latent Variance (PSI)

IN8* (P_IN8); !Estimate latent variance and label it
IN8_9* (P_IN89);
IN9_10* (P_IN910); !This variance will be found in cohort 2 as well, therefore the label has to
                  !be the same in the second cohort in order to restrict those variances to be
                  !equal across cohorts.
IN10_11* (P_IN1011); !This variance will be found in cohort 2 & 3 as well, therefore the label
                  !has to be the same in the second and third cohort in order to restrict
                  !those variances to be equal across cohorts.

!Latent Intercorrelations (PSI)

IN8 with IN8_9 IN9_10 IN10_11;
IN8_9 with IN9_10 IN10_11;
IN9_10 with IN10_11 (PSI_1); !This covariance will be found in cohort 2 as well, therefore the
                            !label has to be the same in the second cohort in order to
                            !restrict those covariances to be equal across cohorts

!Correlated uniquenesses to account for measurement variance over time, due to the same item
!parcels. They are set equal (same labels) to keep the metric measurement models invariant
!across cohorts.

Y11 with Y12 (u1);
Y11 with Y13 (u2);
Y11 with Y14 (u3);
Y12 with Y13 (u4);
Y12 with Y14 (u5);
Y13 with Y14 (u6);

Y21 with Y22 (u7);
Y21 with Y23 (u8);
Y21 with Y24 (u9);
Y22 with Y23 (u10);
Y22 with Y24 (u11);
Y23 with Y24 (u12);

!The uniquenesses (the diagonal in the error covariance matrix of the manifest variables - theta
!Epsilon) are restricted to be equal (same labels) across cohorts to secure invariant
!measurements.

Y11 (TE1);
Y21 (TE2);
Y12 (TE3);
Y22 (TE4);
Y13 (TE5);

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Y23 (TE6);
Y14 (TE7);
Y24 (TE8);

!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!Phantom Variables!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!

!The number and names of the latent variables have to be the same across groups in a multi-group
!model. But, in this group/cohort there is no latent intercept regarding age 9 or 10 as well as
!no latent changes between age 11 and 12 as well as between age 12 and 13, because there is no
!data in this cohort. Therefore, phantom variables are necessary.

!Specify them by any manifest variable of your choice, but restrict the loading to be zero

IN9 by Y11@0;
IN10 by Y11@0;
IN11_12 by Y13@0;
IN12_13 by Y14@0;

!Restrict the latent means to be zero.

[IN9@0];
[IN10@0];
[IN11_12@0];
[IN12_13@0];

!Restrict the latent variances to be zero.

IN9@0;
IN10@0;
IN12_13@0;
IN11_12@0;

!Restrict all latent covariances to be zero.

IN8 IN8_9 IN9_10 IN10_11 with IN9@0;
IN8 IN8_9 IN9_10 IN10_11 with IN10@0;
IN8 IN8_9 IN9_10 IN10_11 with IN12_13@0;
IN8 IN8_9 IN9_10 IN10_11 with IN11_12@0;
IN9 with IN10@0 IN12_13@0 IN11_12@0;
IN10 with IN12_13@0 IN11_12@0;
IN12_13 with IN11_12@0;

!REGRESSION on gender

IN8 on gender;
IN8_9 on gender;
IN9_10 on gender (beta1); !This beta will be found in cohort 2 as well, therefore the label has
!to be the same in the second cohort in order to restrict the beta to
!be equal across cohorts.
IN10_11 on gender (beta2); !This beta will be found in cohort 2 & 3 as well, therefore the label
!has to be the same in the second cohort in order to restrict the
!beta to be equal across cohorts.

!Phantom variables regressed on gender

IN9 IN10 IN12_13 IN11_12 on gender@0; !betas fixed to zero

Model for the middle cohort #####
#####Y 2000#####
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MODEL Y2000:

IN9 by Y11@1 !Use the same item parcels - now they have a different meaning (age)
!since the kids are from another birth cohort
Y21* (I21) !Note that the label is the same as in cohort 1 - restricted to be the

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                !same
                Y12@1
                Y22* (121)
                Y13@1
                Y23* (121)
                Y14@1
                Y24* (121);

IN9_10 by      Y12@1
              Y22*(121)
              Y13@1
              Y23*(121)
              Y14@1
              Y24*(121) ;

IN10_11 by    Y13@1
              Y23*(121)
              Y14@1
              Y24*(121);

IN11_12 by    Y14@1
              Y24*(121);

!IN9 = internalizing problem behaviors representing level @ age 9
!IN9_10 = change in internalizing problem behaviors between ages 9 and 10
!IN10_11 = change in internalizing problem behaviors between ages 10 and 11
!IN11_12 = change in internalizing problem behaviors between ages 11 and 12

! Manifest Mean Model
[Y11@0];
[Y21*] (i21); !Note that the label is the same as in cohort 1 - restricted to be the same
[Y12@0];
[Y22*] (i21);
[Y13@0] ;
[Y23*] (i21);
[Y14@0] ;
[Y24*] (i21);

!Latent Means (Alpha)

[IN9*]      (A_IN9);
[IN9_10*]   (A_IN910); !Same mean as in cohort 1 - therefore same label - therefore restricted to
                !be the same.
[IN10_11*] (A_IN1011);!Same mean as in cohort 1 & 3- therefore same label - therefore restricted
                !to be the same.
[IN11_12*] (A_IN1112);!Same mean as in cohort 3 - therefore same label - therefore restricted to
                !be the same.

!Latent Variance (PSI)

IN9*      (P_IN9);
IN9_10*   (P_IN910); !Same variance as in cohort 1 - therefore same label - therefore restricted
                !to be the same
IN10_11* (P_IN1011);!Same variance as in cohort 1 & 3 - therefore same label - therefore
                !restricted to be the same
IN11_12* (P_IN1112);!Same variance as in cohort 3 - therefore same label - therefore restricted
                !to be the same

!Latent Intercorrelations (PSI)

IN9 with IN9_10 IN10_11 IN11_12;
IN9_10 with IN11_12;
IN9_10 with IN10_11 (PSI_1); !Same covariance as in cohort 1 - therefore same label - therefore
                !restricted to be the same
IN10_11 with IN11_12 (PSI_2);!Same covariance as in cohort 3 - therefore same label - therefore
                !restricted to be the same

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!Correlated uniquenesses to account for measurement variance over time, due to the same item
!parcels. They are set equal (same labels) to keep the metric measurement models invariant
!across cohorts

Y11 with Y12 (u1);
Y11 with Y13 (u2);
Y11 with Y14 (u3);
Y12 with Y13 (u4);
Y12 with Y14 (u5);
Y13 with Y14 (u6);

Y21 with Y22 (u7);
Y21 with Y23 (u8);
Y21 with Y24 (u9);
Y22 with Y23 (u10);
Y22 with Y24 (u11);
Y23 with Y24 (u12);

!The uniquenesses (the diagonal in the error covariance matrix of the manifest variables - theta
!Epsilon) are restricted to be equal (same labels) across cohorts to assure invariant
!measurements.

Y11 (TE1);
Y21 (TE2);
Y12 (TE3);
Y22 (TE4);
Y13 (TE5);
Y23 (TE6);
Y14 (TE7);
Y24 (TE8);

!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!Phantom Variables!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!

!The number and names of the latent variables have to be the same across groups in a multi-group
!model. But, in this group/cohort there is no latent intercept regarding age 8 or 10 as well as
!no latent changes between age 8 and 9 as well as between age 12 and 13, because there is not
!data in this cohort. Therefore, phantom variables are necessary.

!Specify them by any manifest variable of your choice, but restrict the loading to be zero.

IN8 by Y11@0;
IN10 by Y11@0;
IN8_9 by Y12@0;
IN12_13 by Y14@0;

!Restrict the latent means to be zero
[IN8@0];
[IN10@0];
[IN8_9@0];
[IN12_13@0];

!Restrict the latent variances to be zero
IN8@0;
IN10@0;
IN8_9@0;
IN12_13@0;

!Restrict all latent covariances to be zero
IN9 IN9_10 IN10_11 IN11_12 with IN8@0;
IN9 IN9_10 IN10_11 IN11_12 with IN10@0;
IN9 IN9_10 IN10_11 IN11_12 with IN8_9@0;
IN9 IN9_10 IN10_11 IN11_12 with IN12_13@0;
IN8 with IN10@0 IN8_9@0 IN12_13@0;
IN10 with IN8_9@0 IN12_13@0;
IN8_9 with IN12_13@0;

!REGRESSION on gender

IN9 on gender;
IN9_10 on gender (beta1); !This beta will be found in cohort 1 as well, therefore the label has
!to be the same in the second cohort in order to restrict the beta to
!be equal across cohorts.
IN10_11 on gender (beta2); !This beta will be found in cohort 1 & 3 as well, therefore the label
!has to be the same in the second cohort in order to restrict the
!beta to be equal across cohorts.
IN11_12 on gender (beta3); !This beta will be found in cohort 3 as well, therefore the label has
!to be the same in the second cohort in order to restrict the beta to
!be equal across cohorts.

!Phantom variables regressed on gender

IN8 IN10 IN8_9 IN12_13 on gender@0; !betas fixed to zero

Model for the oldest cohort #####
Y 1999#####
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MODEL Y1999:

IN10 by Y11@1 !Use the same item parcels - now they have a different meaning (age)
!since the kids are from another birth cohort

Y21* (121) !Note that the label is the same as in cohort 1 and 2 - restricted to be
!the same

Y12@1
Y22* (121)
Y13@1
Y23* (121)
Y14@1
Y24* (121);

IN10_11 by Y12@1
Y22*(121)
Y13@1
Y23*(121)
Y14@1
Y24*(121);

IN11_12 by Y13@1
Y23*(121)
Y14@1
Y24*(121);

IN12_13 by Y14@1
Y24*(121);

!IN10 = internalizing problem behaviors representing level @ age 10
!IN10_11 = change in internalizing problem behaviors between ages 10 and 11
!IN11_12 = change in internalizing problem behaviors between ages 11 and 12
!IN12_13 = change in internalizing problem behaviors between ages 12 and 13

!Manifest Mean Model

[Y11@0] ;
[Y21*] (i21); !Note that the label is the same as in cohort 1 and 2 - restricted to be the same
[Y12@0] ;
[Y22*] (i21);
[Y13@0] ;
[Y23*] (i21);
[Y14@0];
[Y24*] (i21);

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!Latent Means (Alpha)

[IN10*] (A_IN10);
[IN10_11*] (A_IN1011); !Same mean as in cohort 1 & 2- therefore same label - therefore restricted
!to be the same
[IN11_12*] (A_IN1112); !Same mean as in cohort 2 - therefore same label - therefore restricted to
!be the same
[IN12_13*] (A_IN1213);

!Latent Variance (PSI)

IN10* (P_IN10);
IN10_11* (P_IN1011); !Same variance as in cohort 1 & 2 - therefore same label - therefore
!restricted to be the same
IN11_12* (P_IN1112); !Same variance as in cohort 2 - therefore same label - therefore restricted
!to be the same
IN12_13* (P_IN1213);

!Latent intercorrelations (PSI)
IN10 with IN10_11 IN11_12 IN12_13 ;
IN10_11 with IN12_13 ;
IN11_12 with IN12_13 ;
IN10_11 with IN11_12 (PSI_2); !Same covariance as in cohort 2 - therefore same label - therefore
!restricted to be the same

!Correlated uniquenesses to account for measurement variance over time, due to the same item
!parcels. They are set equal (same labels) to keep the metric measurement models invariant
!across cohorts

Y11 with Y12 (u1);
Y11 with Y13 (u2);
Y11 with Y14 (u3);
Y12 with Y13 (u4);
Y12 with Y14 (u5);
Y13 with Y14 (u6);

Y21 with Y22 (u7);
Y21 with Y23 (u8);
Y21 with Y24 (u9);
Y22 with Y23 (u10);
Y22 with Y24 (u11);
Y23 with Y24 (u12);

!The uniquenesses (the diagonal in the error covariance matrix of the manifest variables - theta
!Epsilon) are restricted to be equal (same labels) across cohorts to assure invariant
!measurements:

Y11 (TE1);
Y21 (TE2);
Y12 (TE3);
Y22 (TE4);
Y13 (TE5);
Y23 (TE6);
Y14 (TE7);
Y24 (TE8);

!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!Phantom Variables!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!

!The number and names of the latent variables have to be the same across groups in a multi-group
!model. But, in this group/cohort there is no latent intercept regarding age 8 or 9 as well as

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!no latent changes between age 8 and 9 as well as between age 9 and 10, because there is not
!data in this cohort. Therefore, phantom variables are necessary.

!Specify them by any manifest variable of your choice, but restrict the loading to be zero

IN8 by Y11@0;
IN9 by Y11@0;
IN8_9 by Y12@0;
IN9_10 by Y12@0;

!Restrict the latent means to be zero.
[IN8@0];
[IN9@0];
[IN8_9@0];
[IN9_10@0];

!Restrict the latent variances to be zero.
IN8@0;
IN9@0;
IN8_9@0;
IN9_10@0;

!Restrict all latent covariances to be zero.

IN10 IN10_11 IN11_12 IN12_13 with IN8@0;
IN10 IN10_11 IN11_12 IN12_13 with IN9@0;
IN10 IN10_11 IN11_12 IN12_13 with IN8_9@0;
IN10 IN10_11 IN11_12 IN12_13 with IN9_10@0;
IN8 with IN9@0 IN8_9@0 IN9_10@0;
IN9 with IN8_9@0 IN9_10@0;
IN8_9 with IN9_10@0;

!REGRESSION on gender

IN10 on gender;
IN10_11 on gender (beta2); **!This beta will be found in cohort 1 & 2 as well, therefore the label
!has to be the same in the second cohort in order to restrict the
!beta to be equal across cohorts.**
IN11_12 on gender (beta3); **!This beta will be found in cohort 2 as well, therefore the label has
!to be the same in the second cohort in order to restrict the beta to
!be equal across cohorts.**
IN12_13 on gender;

!Phantom variables regressed on gender.
IN8 IN9 IN8_9 IN9_10 on gender@0; **!betas fixed to zero**

!The final constraint should link the latent means of the cohort-specific intercept variables
!with the respective change variables in the other cohorts.

Model constraints:
A_IN9 = A_IN8 + A_IN89; **!The intercept of age nine (cohort 2) is restricted to be the same as
!the intercept of grade 8 (cohort 1) plus the change between age 8 and
!age 9 (cohort 1)**
A_IN10 = A_IN9 + A_IN910; **!The intercept of age 10 (cohort 3) is restricted to be the same as the
!intercept of age grade 9 (cohort 2) plus the change between age 9 and
!age 10 (cohort 2). Since in the preceding constraint the intercept of
!age nine (cohort 2) was linked to the first cohort, all three cohorts
!are now interlinked.**

OUTPUT: STANDARDIZED TECH1 TECH4; **!TECH1 is important to check if all restriction in the model
!were actually in place**

