$$\begin{array}{lll} \mathbf{y}_{ii} &= \alpha_{i} + \beta_{ii} \mathrm{agc}_{i} + \delta_{ii} \mathrm{TVC}_{ii} + \mathcal{E}_{ii} & \mathrm{MODEL:} \\ \alpha_{i} &= \mu_{\alpha} + \gamma_{01} \mathrm{TIC}_{i} + \mathcal{E}_{ai} & ! \mathrm{Grows BY} \\ \beta_{ii} &= \mu_{\beta i} + \gamma_{11} \mathrm{TIC}_{i} + \mathcal{E}_{\beta ii} & \mathrm{Int} & \mathrm{by y8@1 y9@1} \\ \mathbf{y}_{i} &= \Lambda \mathbf{q}_{i} + \Delta \mathbf{z}_{ii} + \mathbf{z}_{i} & \mathrm{Int} & \mathrm{by y8@0 y9@1} \\ \mathbf{y}_{i0} &= \mathbf{q}_{i} + \mathbf{1} \mathbf{w}_{i} + \mathbf{z}_{i} & \mathrm{Int} & \mathrm{by y8@0 y9@1} \\ \mathbf{y}_{i0} &= \begin{pmatrix} \mathcal{S}_{i8} \\ 1 & 1 \\ 1 & 2 \\ 1 & 3 \end{pmatrix} \begin{pmatrix} \delta_{i8} \\ \delta_{i9} \\ \delta_{i1} \end{pmatrix} + \begin{pmatrix} \delta_{i8} \\ \delta_{i9} \\ \delta_{i1} \\ \delta_{i1} \end{pmatrix} \begin{pmatrix} \mathcal{E}_{iN} \\ \delta_{i9} \\ \delta_{i1} \\ \delta_{i1} \end{pmatrix} \begin{pmatrix} \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \delta_{i0} \\ \delta_{i1} \\ \delta_{i1} \end{pmatrix} + \begin{pmatrix} \mathcal{E}_{iN} \\ \mathcal{E}_{i0} \\ \delta_{i0} \\ \delta_{i1} \\ \delta_{i1} \end{pmatrix} \begin{pmatrix} \mathcal{E}_{iN} \\ \mathcal{E}_{i0} \\ \delta_{i1} \\ \delta_{i1} \end{pmatrix} \begin{pmatrix} \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \delta_{i0} \\ \delta_{i1} \\ \delta_{i1} \end{pmatrix} \begin{pmatrix} \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \delta_{i0} \\ \delta_{i1} \\ \delta_{i1} \end{pmatrix} \begin{pmatrix} \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \delta_{i0} \\ \delta_{i1} \end{pmatrix} \begin{pmatrix} \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \delta_{i0} \\ \delta_{i1} \end{pmatrix} \begin{pmatrix} \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \delta_{i0} \\ \delta_{i0} \end{pmatrix} \begin{pmatrix} \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \end{pmatrix} \begin{pmatrix} \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \end{pmatrix} \begin{pmatrix} \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \end{pmatrix} \begin{pmatrix} \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \end{pmatrix} \begin{pmatrix} \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \end{pmatrix} \begin{pmatrix} \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \end{pmatrix} \begin{pmatrix} \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \end{pmatrix} \begin{pmatrix} \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \end{pmatrix} \begin{pmatrix} \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \end{pmatrix} \begin{pmatrix} \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \\ \mathcal{E}_{iN} \end{pmatrix} \begin{pmatrix} \mathcal{E}_{iN} \\ \mathcal{E}_{iN}$$

$$\begin{array}{lll} \mathbf{y}_{ii} &= \alpha_{i} + \beta_{ii} \mathrm{agc}_{i} + \delta_{2} \, \mathrm{TVC}_{ii} + \mathcal{E}_{ii} \\ \alpha_{i} &= \mu_{\alpha} + \gamma_{01} \mathrm{TIC}_{i} + \mathcal{C}_{ai} \\ \beta_{ii} &= \mu_{\beta_{i}} + \gamma_{11} \mathrm{TIC}_{i} + \mathcal{C}_{\beta_{ii}} \\ \mathbf{y}_{i} &= \Lambda \mathbf{q}_{i} + \Delta \mathbf{z}_{ii} + \mathbf{e}_{i} \\ \mathbf{y}_{i0} &= \mathbf{q}_{i} + \mathbf{q}_{i} + \mathbf{q}_{i} + \mathbf{q}_{i} \\ \mathbf{y}_{i0} &= \begin{pmatrix} \delta_{i} \\ 1 & 1 \\ 1 & 2 \\ 1 & 3 \end{pmatrix} \begin{pmatrix} \delta_{i} \\ \delta_{i} \\ \delta_{i} \\ \delta_{i} \\ \delta_{i} \end{pmatrix} + \begin{pmatrix} \delta_{i} \\ \delta_{i} \\$$

$$\begin{array}{lll} \mathbf{y}_{ii} &= \alpha_{i} + \beta_{ii} \operatorname{age}_{i} + \varepsilon_{ii} \\ \alpha_{i} &= \mu_{\alpha} + \gamma_{01} \operatorname{TIC}_{i} + \zeta_{ai} \\ \beta_{ii} &= \mu_{\beta_{i}} + \gamma_{11} \operatorname{TIC}_{i} + \zeta_{\beta ii} \\ \mathbf{y}_{i} &= \Lambda \mathbf{\eta}_{i} + \mathbf{\epsilon}_{i} \\ \mathbf{y}_{ij} &= \Lambda \mathbf{\eta}_{i} + \mathbf{\epsilon}_{i} \\ \mathbf{y}_{i0} &= \begin{pmatrix} 1 & 0 \\ 1 & 1 \\ 1 & 2 \\ 1 & 3 \end{pmatrix} \alpha_{i} + \begin{pmatrix} \varepsilon_{i8} \\ \varepsilon_{i0} \\ \varepsilon_{i11} \end{pmatrix} & \text{line by } y \otimes 0 \quad y \otimes 0 \\ \mathbf{y} \otimes 0 & y \otimes 0 & y \otimes 0 \\ \mathbf{y} \otimes 0 & y \otimes 0 & y \otimes 0 \\ \mathbf{y} \otimes 0 & y \otimes 0 & y \otimes 0 \\ \mathbf{y} \otimes 0 & y \otimes 0 & y \otimes 0 \\ \mathbf{y} \otimes 0 & y \otimes 0 & y \otimes 0 \\ \mathbf{y} \otimes 0 & y \otimes 0 & y \otimes 0 \\ \mathbf{y} \otimes 0 & y \otimes 0 & y \otimes 0 \\ \mathbf{y} \otimes 0 & y \otimes 0 & y \otimes 0 \\ \mathbf{y} \otimes 0 & y \otimes 0 & y \otimes 0 \\ \mathbf{y} \otimes 0 & y \otimes 0 & y \otimes 0 \\ \mathbf{y} \otimes 0 & y \otimes 0 & y \otimes 0 \\ \mathbf{y} \otimes 0 & y \otimes 0 & y \otimes 0 \\ \mathbf{y} \otimes 0 & y \otimes 0 & y \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 \\ \mathbf{y} \otimes 0 & \mathbf{y} \otimes 0 & \mathbf{y} \otimes$$

$$\begin{array}{lll} \mathbf{y}_{ii} &= \alpha_{i} + \beta_{ii} \operatorname{age}_{i} + \varepsilon_{ii} \\ \alpha_{i} &= \mu_{\alpha} + \gamma_{01} \operatorname{TIC}_{i} + \zeta_{\alpha i} \\ \beta_{ii} &= \mu_{\beta i} + \zeta_{\beta ii} \\ \mathbf{y}_{i} &= \Lambda \mathbf{\eta}_{i} + \mathbf{\epsilon}_{i} \\ \mathbf{y}_{ij} &= \mathbf{\eta}_{\eta} + \mathbf{r} \mathbf{w}_{i} + \zeta_{i} \\ \mathbf{y}_{i0} &= \begin{pmatrix} 1 & 0 \\ 1 & 1 \\ 1 & 2 \\ 1 & 3 \end{pmatrix} \alpha_{i} + \begin{pmatrix} \varepsilon_{i8} \\ \varepsilon_{i0} \\ \varepsilon_{i10} \\ \varepsilon_{i11} \end{pmatrix} & \text{Int by y8@1 y9@1 } \\ y10@2 y11@3; \\ \vdots & \text{Regressed ON} \\ \text{Int on TiC;} \\ & \text{Add TiC of intercept} \\ & \text{Add TiC of intercept} \\ & \text{Add TiC of intercept} \\ & \text{Make residual variances} \neq \\ & \alpha_{i} \\ \beta_{ij} &= \begin{pmatrix} \mu_{\alpha} \\ \mu_{\beta i} \end{pmatrix} + \begin{pmatrix} \gamma_{01} \\ \gamma_{01} \\ \varepsilon_{i0} \\ \varepsilon_{i0} \end{pmatrix} \begin{pmatrix} \operatorname{TiC}_{i} \end{pmatrix} + \begin{pmatrix} \zeta_{\alpha i} \\ \zeta_{\beta i} \\ \varepsilon_{\beta i} \\ \varepsilon_{\beta i0} \end{pmatrix} & \text{Int on TiC;} \\ & \text{Make slope random} \\ & \text{Intercepts} \\ [y8-y11@0]; \\ [int]; \\ [int]; \\ [int]; \\ [int]; \\ [y8-y11@0]; \\ [int]; \\ [int]; \\ [y8-y11] \approx 1; \\ y_{ij} &= \mu_{\alpha} + \mu_{\beta i} \operatorname{age}_{c_{i}} + \varepsilon_{ii} \\ y_{ij} &= \mu_{\alpha} + \mu_{\beta i} \operatorname{age}_{c_{i}} + \varepsilon_{ii} \\ & + \zeta_{\beta i} \operatorname{age}_{c_{i}} \\ & \text{Intercept} \\ & \text{Intercept} \\ & \text{Null} \\ & \text{Null} \\ & \text{Null} \\ & \text{Add unique TVC for each time} \\ & \text{Add same TVC for all times} \\ & \text{Add TiC of slope} \\ & \text{Add TiC of intercept} \\ & \text{Make Tic of intercept} \\ & \text{Make residual variances} \neq \\ & \text{Have intercept & slope covary} \\ & \text{Make slope random} \\ & \text{Make intercept random} \\ & \text{Add fixed slope} \\ & \text{Add fixed intercept} \\ & \text{$$

```
y_{ii} = \alpha_i + \beta_{1i} age_t + \varepsilon_{ii}
                                                                                                         MODEL:
                                                                                                                                                                                       Add unique TVC for each time
                                                                                                         ! Grows BY
\alpha_i = \mu_{\alpha} + \zeta_{\alpha i}
                                                                                                                         by y8@1 y9@1
\beta_{1i} = \mu_{\beta 1} + \zeta_{\beta 1i}
                                                                                                         Int
                                                                                                                                                                                       Add same TVC for all times
                                                                                                                             y10@1 y11@1;
 \mathbf{y}_i = \mathbf{\Lambda} \mathbf{\eta}_i + \mathbf{\varepsilon}_i
                                                                                                         linear by y8@0 y9@1
 \mathbf{\eta}_i = \mathbf{\mu}_{\eta} + \mathbf{\zeta}_i
                                                                                                                                                                                       Add TIC of slope
                                                                                                                             y10@2 y11@3;
          \begin{pmatrix} y_{i8} \\ y_{i9} \\ y_{i10} \\ y_{crit} \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 1 & 1 \\ 1 & 2 \\ 1 & 3 \end{pmatrix} \begin{pmatrix} \alpha_i \\ \beta_{1i} \end{pmatrix} + \begin{pmatrix} \varepsilon_{i8} \\ \varepsilon_{i9} \\ \varepsilon_{i10} \\ \varepsilon \end{pmatrix} 
                                                                                                         ! Regressed ON
                                                                                                                                                                                       Add TIC of intercept
                                                                                                                                                                                       Make residual variances ≠
           \begin{pmatrix} \alpha_i \\ \beta_{1i} \end{pmatrix} = \begin{pmatrix} \mu_{\alpha} \\ \mu_{\beta 1} \end{pmatrix} + \begin{pmatrix} \zeta_{\alpha i} \\ \zeta_{\beta 1i} \end{pmatrix} 
                                                                                                                                                                                       Have intercept & slope covary
          \begin{vmatrix} \zeta_{\alpha i} \\ \zeta_{\beta 1 i} \end{vmatrix} \sim N \begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \psi_{\alpha \alpha} \\ \psi_{\alpha \beta 1} & \psi_{\beta 1 \beta 1} \end{pmatrix} 
                                                                                                                                                                                       Make slope random
                                                                                                         ! Correlated WITH
                                                                                                         int with linear;
                                                                                                         ! Intercepts
                                                                                                                                                                                       Make intercept random
                                                                                                         [y8-y11@0];
                                                                                                         [int];
                                                                                                                                                                                       Add fixed slope
                                                                                                         [linear];
\mathbf{y}_{i} = \mathbf{\Lambda} \mathbf{\mu}_{\eta} + \mathbf{\Lambda} \mathbf{\zeta}_{i} + \mathbf{\varepsilon}_{i}
                                                                                                         ! Residual Variances
                                                                                                                                                                                      Add fixed intercept
\mathbf{y}_{it} = \mu_{\alpha} + \mu_{\beta 1} \text{age}_{t} + \boldsymbol{\varepsilon}_{it}
                                                                                                         y8-y11;
                                                                                                         int;
                                                                                                                                                                                       Null
                        +\zeta_{\beta 1i}age<sub>t</sub>
                                                                                                         linear;
```

```
y_{ii} = \alpha_i + \beta_{1i} age_t + \varepsilon_{ii}
                                                                                                                       MODEL:
                                                                                                                                                                                                                Add unique TVC for each time
                                                                                                                       ! Grows BY
\alpha_i = \mu_\alpha + \zeta_{ai}
                                                                                                                                         by y8@1 y9@1
\beta_{1i} = \mu_{\beta 1} + \zeta_{\beta 1i}
                                                                                                                       Int
                                                                                                                                                                                                                Add same TVC for all times
                                                                                                                                              y10@1 y11@1;
 \mathbf{y}_i = \mathbf{\Lambda} \mathbf{\eta}_i + \mathbf{\varepsilon}_i
                                                                                                                       linear by y8@0 y9@1

\eta_i = \mu_{\eta} + \zeta_i

                                                                                                                                                                                                                Add TIC of slope
                                                                                                                                              y10@2 y11@3;
          \begin{pmatrix} y_{i8} \\ y_{i9} \\ y_{i10} \\ y_{i1} \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 1 & 1 \\ 1 & 2 \\ 1 & 3 \end{pmatrix} \begin{pmatrix} \alpha_i \\ \beta_{1i} \end{pmatrix} + \begin{pmatrix} \varepsilon_{i8} \\ \varepsilon_{i9} \\ \varepsilon_{i10} \\ \varepsilon_{i1} \end{pmatrix} 
                                                                                                                       ! Regressed ON
                                                                                                                                                                                                                Add TIC of intercept
                                                                                                                                                                                                                Make residual variances ≠
            \begin{pmatrix} \alpha_i \\ \beta_{1i} \end{pmatrix} = \begin{pmatrix} \mu_{\alpha} \\ \mu_{\beta 1} \end{pmatrix} + \begin{pmatrix} \zeta_{\alpha i} \\ \zeta_{\beta 1i} \end{pmatrix} 
                                                                                                                                                                                                                Have intercept & slope covary
           \begin{vmatrix} \zeta_{\alpha i} \\ \zeta_{\beta 1 i} \end{vmatrix} \sim N \begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \psi_{\alpha \alpha} \\ \psi_{\alpha \beta 1} \end{pmatrix} \psi_{\beta 1 \beta 1} 
                                                                                                                                                                                                                Make slope random
                                                                                                                       ! Correlated WITH
                                                                                                                       int with linear;
          \begin{bmatrix} \boldsymbol{\varepsilon}_{i8} \\ \boldsymbol{\varepsilon}_{i9} \\ \boldsymbol{\varepsilon}_{i10} \\ \boldsymbol{\varepsilon}_{i11} \end{bmatrix} \sim N \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \boldsymbol{\theta}_{\varepsilon} \\ \boldsymbol{\theta}_{\varepsilon} \\ \boldsymbol{\theta}_{\varepsilon} \\ \boldsymbol{\theta}_{\varepsilon} \end{pmatrix}
                                                                                                                    ! Intercepts
                                                                                                                                                                                                                Make intercept random
                                                                                                                     [y8-y11@0];
                                                                                                                       [int];
                                                                                                                                                                                                               Add fixed slope
                                                                                                                       [linear];
\mathbf{y}_{i} = \mathbf{\Lambda} \mathbf{\mu}_{\eta} + \mathbf{\Lambda} \mathbf{\zeta}_{i} + \mathbf{\varepsilon}_{i}
                                                                                                                       ! Residual Variances
                                                                                                                                                                                                               Add fixed intercept
\mathbf{y}_{it} = \mu_{\alpha} + \mu_{\beta 1} \text{age}_{t} + \boldsymbol{\varepsilon}_{it}
                                                                                                                       y8-y11(epsilon);
                                                                                                                       int;
                                                                                                                                                                                                                Null
                            +\zeta_{\beta 1i}age<sub>t</sub>
                                                                                                                       linear;
```

```
MODEL:
 y_{it} = \alpha_i + \beta_{1i} age_t + \varepsilon_{it}
                                                                                                                                                                                            Add unique TVC for each time
                                                                                                            ! Grows BY
\alpha_i = \mu_{\alpha} + \zeta_{ai}
                                                                                                                            by y8@1 y9@1
\beta_{1i} = \mu_{\beta 1} + \zeta_{\beta 1i}
                                                                                                            Int
                                                                                                                                                                                            Add same TVC for all times
                                                                                                                                 y10@1 y11@1;
 \mathbf{y}_i = \mathbf{\Lambda} \mathbf{\eta}_i + \mathbf{\varepsilon}_i
                                                                                                            linear by y8@0 y9@1
 \mathbf{\eta}_i = \mathbf{\mu}_{\eta} + \mathbf{\zeta}_i
                                                                                                                                                                                            Add TIC of slope
                                                                                                                                 y10@2 y11@3;
         \begin{pmatrix} y_{i8} \\ y_{i9} \\ y_{i10} \\ y \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 1 & 1 \\ 1 & 2 \\ 1 & 3 \end{pmatrix} \begin{pmatrix} \alpha_i \\ \beta_{1i} \end{pmatrix} + \begin{pmatrix} \varepsilon_{i8} \\ \varepsilon_{i9} \\ \varepsilon_{i10} \\ \varepsilon_{in10} \end{pmatrix}
                                                                                                            ! Regressed ON
                                                                                                                                                                                            Add TIC of intercept
                                                                                                                                                                                            Make residual variances ≠
           \begin{pmatrix} \alpha_i \\ \beta_{1i} \end{pmatrix} = \begin{pmatrix} \mu_{\alpha} \\ \mu_{\beta 1} \end{pmatrix} + \begin{pmatrix} \zeta_{\alpha i} \\ \zeta_{\beta 1i} \end{pmatrix} 
                                                                                                                                                                                            Have intercept & slope covary
         \begin{bmatrix} \zeta_{\alpha i} \\ \zeta_{\beta 1 i} \end{bmatrix} \sim N \begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \psi_{\alpha \alpha} \\ \psi_{\beta 1 \beta 1} \end{pmatrix}
                                                                                                                                                                                            Make slope random
                                                                                                            ! Correlated WITH
       \begin{bmatrix} \varepsilon_{i8} \\ \varepsilon_{i9} \\ \varepsilon_{i10} \\ 2 \end{bmatrix} \sim N \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}, \qquad \theta_{\varepsilon} \qquad \theta_{\varepsilon} \qquad \theta_{\varepsilon} 
                                                                                                           int with linear@0;
                                                                                                          ! Intercepts
                                                                                                                                                                                            Make intercept random
                                                                                                          [y8-y11@0];
                                                                                                            [int];
                                                                                                                                                                                            Add fixed slope
                                                                                                            [linear];
\mathbf{y}_{i} = \mathbf{\Lambda} \mathbf{\mu}_{\eta} + \mathbf{\Lambda} \mathbf{\zeta}_{i} + \mathbf{\varepsilon}_{i}
                                                                                                            ! Residual Variances
                                                                                                                                                                                           Add fixed intercept
y_{it} = \mu_{\alpha} + \mu_{\beta 1} age_t + \varepsilon_{it}
                                                                                                            y8-y11(epsilon);
                                                                                                            int;
                                                                                                                                                                                            Null
                         +\zeta_{\beta 1i}age<sub>t</sub>
                                                                                                            linear;
```

```
MODEL:
 y_{it} = \alpha_i + \beta_{1i} age_t + \varepsilon_{it}
                                                                                                                                                                                                       Add unique TVC for each time
                                                                                                                  ! Grows BY
\alpha_i = \mu_\alpha + \zeta_{ai}
                                                                                                                                   by y8@1 y9@1
\beta_{1i} = \mu_{\beta 1} +
                                                                                                                  Int
                                                                                                                                                                                                       Add same TVC for all times
                                                                                                                                        y10@1 y11@1;
 \mathbf{y}_i = \mathbf{\Lambda} \mathbf{\eta}_i + \mathbf{\varepsilon}_i
                                                                                                                  linear by y8@0 y9@1

\eta_i = \mu_{\eta} + \zeta_i

                                                                                                                                                                                                       Add TIC of slope
                                                                                                                                        y10@2 y11@3;
         \begin{pmatrix} y_{i8} \\ y_{i9} \\ y_{i10} \\ y_{i1} \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 1 & 1 \\ 1 & 2 \\ 1 & 3 \end{pmatrix} \begin{pmatrix} \alpha_i \\ \beta_{1i} \end{pmatrix} + \begin{pmatrix} \varepsilon_{i8} \\ \varepsilon_{i9} \\ \varepsilon_{i10} \\ \varepsilon_{i1} \end{pmatrix}
                                                                                                                  ! Regressed ON
                                                                                                                                                                                                       Add TIC of intercept
                                                                                                                                                                                                       Make residual variances ≠
           \begin{pmatrix} \alpha_i \\ \beta_{1i} \end{pmatrix} = \begin{pmatrix} \mu_{\alpha} \\ \mu_{\beta 1} \end{pmatrix} + \begin{pmatrix} \zeta_{\alpha i} \\ \end{pmatrix}
                                                                                                                                                                                                       Have intercept & slope covary
          \left| \begin{array}{c} \zeta_{\alpha i} \\ \zeta_{\beta 1 i} \end{array} \right| \sim N \begin{pmatrix} 0 \\ 0 \end{pmatrix}, \left( \begin{array}{c} \psi_{\alpha \alpha} \\ \end{array} \right) 
                                                                                                                                                                                                       Make slope random
                                                                                                                  ! Correlated WITH
       \begin{bmatrix} \boldsymbol{\varepsilon}_{i8} \\ \boldsymbol{\varepsilon}_{i9} \\ \boldsymbol{\varepsilon}_{i10} \\ \hat{\boldsymbol{\varepsilon}} \end{bmatrix} \sim N \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \boldsymbol{\theta}_{\varepsilon} \\ \boldsymbol{\theta}_{\varepsilon} \\ \boldsymbol{\theta}_{\varepsilon} \\ \boldsymbol{\theta}_{\varepsilon} \end{pmatrix}
                                                                                                                  int with linear@0;
                                                                                                                ! Intercepts
                                                                                                                                                                                                       Make intercept random
                                                                                                                [y8-y11@0];
                                                                                                                  [int];
                                                                                                                                                                                                      Add fixed slope
                                                                                                                  [linear];
\mathbf{y}_{i} = \mathbf{\Lambda} \mathbf{\mu}_{\eta} + \mathbf{\Lambda} \mathbf{\zeta}_{i} + \mathbf{\varepsilon}_{i}
                                                                                                                  ! Residual Variances
                                                                                                                                                                                                      Add fixed intercept
y_{it} = \mu_{\alpha} + \mu_{\beta 1} age_t + \varepsilon_{it}
                                                                                                                  y8-y11(epsilon);
                                                                                                                  int;
                                                                                                                                                                                                       Null
                                                                                                                  linear@0;
```

```
MODEL:
y_{it} = \alpha_i + \beta_{1i} age_t + \varepsilon_{it}
                                                                                                                                               Add unique TVC for each time
                                                                                  ! Grows BY
\alpha_i = \mu_{\alpha}
\beta_{1i} = \mu_{\beta 1}
                                                                                               by y8@1 y9@1
                                                                                  Int
                                                                                                                                               Add same TVC for all times
                                                                                                  y10@1 y11@1;
 \mathbf{y}_i = \mathbf{\Lambda} \mathbf{\eta}_i + \mathbf{\varepsilon}_i
                                                                                  linear by y8@0 y9@1
 \eta_i = \mu_{\eta}
                                                                                                                                               Add TIC of slope
                                                                                                  y10@2 y11@3;
       \begin{pmatrix} y_{i8} \\ y_{i9} \\ y_{i10} \\ y_{i1} \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 1 & 1 \\ 1 & 2 \\ 1 & 3 \end{pmatrix} \begin{pmatrix} \alpha_i \\ \beta_{1i} \end{pmatrix} + \begin{pmatrix} \varepsilon_{i8} \\ \varepsilon_{i9} \\ \varepsilon_{i10} \\ \varepsilon_{21} \end{pmatrix}
                                                                                  ! Regressed ON
                                                                                                                                               Add TIC of intercept
                                                                                                                                               Make residual variances ≠
                                                                                                                                               Have intercept & slope covary
        \left| \begin{array}{c} \zeta_{\alpha i} \\ \zeta_{\beta 1 i} \end{array} \right| \sim N \begin{pmatrix} 0 \\ 0 \end{pmatrix}, 
                                                                                                                                               Make slope random
                                                                                  ! Correlated WITH
                                                                                  int with linear@0;
                                                                                ! Intercepts
                                                                                                                                               Make intercept random
                                                                                [y8-y11@0];
                                                                                  [int];
                                                                                                                                               Add fixed slope
                                                                                  [linear];
\mathbf{y}_{i} = \mathbf{\Lambda} \mathbf{\mu}_{\eta} + \mathbf{\varepsilon}_{i}
                                                                                  ! Residual Variances
                                                                                                                                               Add fixed intercept
y_{it} = \mu_{\alpha} + \mu_{\beta 1} age_t + \mathcal{E}_{it}
                                                                                  y8-y11(epsilon);
                                                                                  int@0;
                                                                                                                                               Null
                                                                                  linear@0;
```



