

# Step 2: TWOLEVEL Modeling of PA, NA, and Tired

## Model 3: Random Residual Covariance

### New in Version 8.9

- How much do the residual covariances between different variables vary across individuals? What are their predictors?
  - Bivariate (or multivariate) outcome, random means, random residual variances and covariance:

$$y_{it} = \alpha_{yi} + \varepsilon_{yit}, \quad (4)$$

$$z_{it} = \alpha_{zi} + \varepsilon_{zit}, \quad (5)$$

where the residuals have individually-varying variances,  $\varepsilon_{yit} \sim N(0, \sigma_{yi}^2)$  and  $\varepsilon_{zit} \sim N(0, \sigma_{zi}^2)$ , as well as

individually-varying covariance  $\rho_i \sqrt{\sigma_{yi}^2} \sqrt{\sigma_{zi}^2}$  where  $\rho_i$  is the

correlation (Fisher z-transform of  $\rho_i \sim N(\mu_r, \sigma_r^2)$ ); see

Asparouhov & Muthén (2010). Bayesian analysis using Mplus:

Technical implementation. [http:](http://www.statmodel.com/download/Bayes3.pdf)

[//www.statmodel.com/download/Bayes3.pdf](http://www.statmodel.com/download/Bayes3.pdf))