Standardized Coefficients in Multilevel DSEM
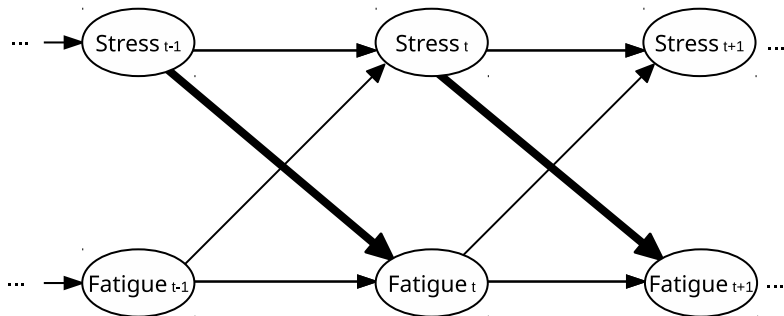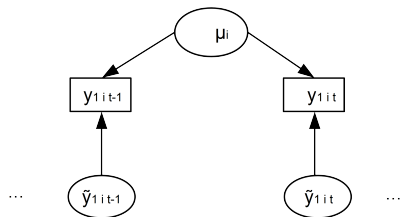
N.K. Schuurman

Utrecht University

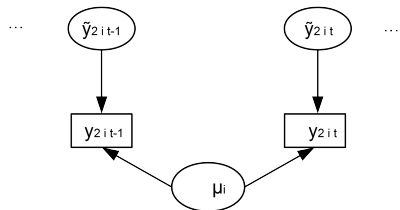July 2017

Why multilevel VAR modeling?

- ▶ Psychological processes take place at a within-subject level
- ▶ How do psychological variables affect themselves, and each other over time?
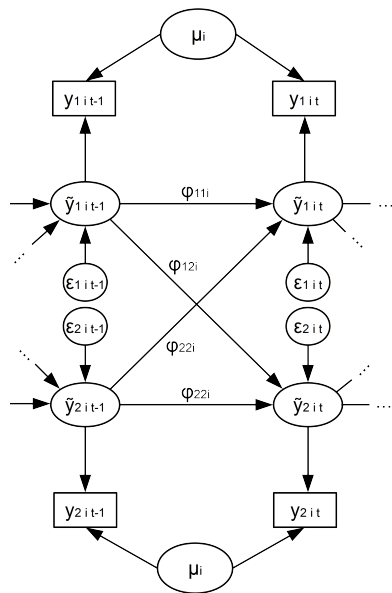- ▶ Special interest in reciprocality/bidirectionality/causal dominance of variables

Bivariate n=1 autoregressive model

$$y_{it} = \mu_i + \tilde{y}_{it}$$

Bivariate n=1 autoregressive model

$$y_{it} = \mu_i + \tilde{y}_{it}$$
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$$\epsilon_{it} \sim MvN\left(0, \Omega\right)$$

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Bivariate multilevel autoregressive model
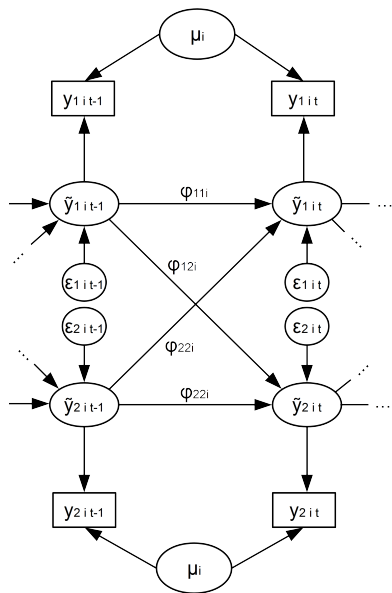

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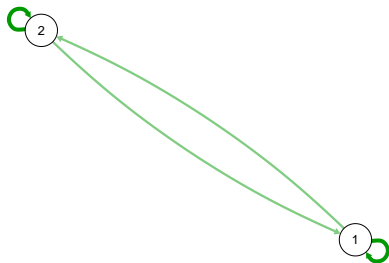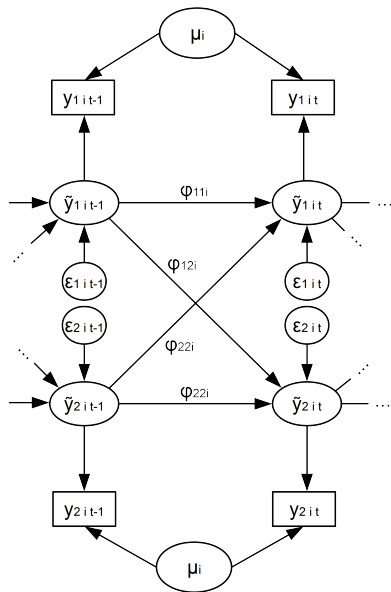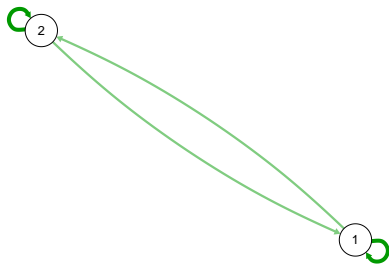$$\epsilon_{it} \sim MvN(0, \Omega)$$
$$\mu_i, \Phi_i \sim MvN(\gamma, \Psi)$$

Why standardized coefficients

Interpretation unstandardized coefficients

How many measurement units the dependent variable increases, when the predictor variable increases one measurement unit.

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Standardized coefficient: How many standard deviations the dependent variable increases, when the predictor variable increases one standard deviation.

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- ▶ Unstandardized coefficients are sensitive to the measurement unit

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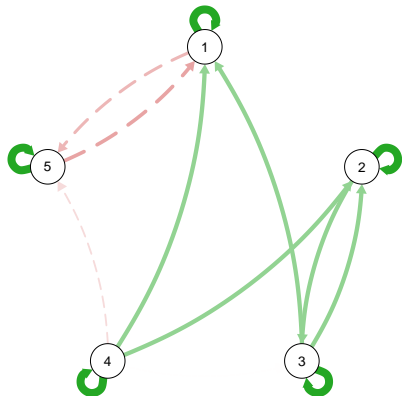
Why standardized coefficients

Unstandardized coefficients are sensitive to the measurement unit
(variable 1 multiplied by 2)
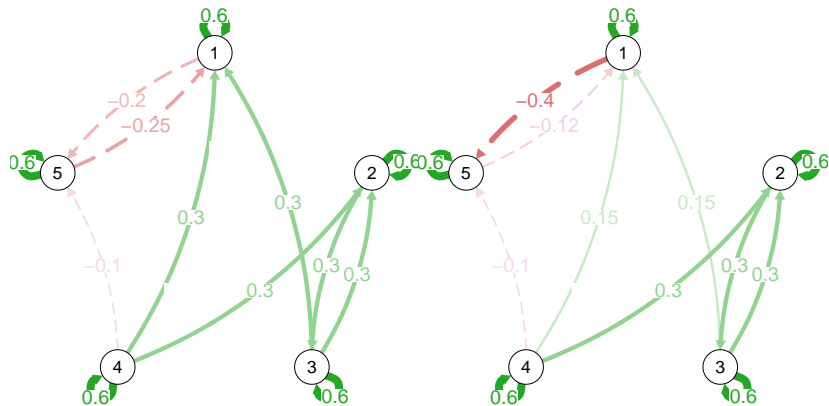
N=1 Standardization
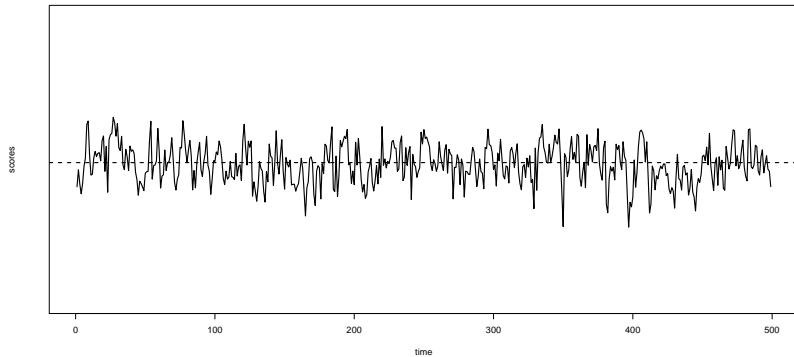
$$\beta = b \frac{\sigma_x}{\sigma_y} \qquad \text{or } \phi_{12}^* = \phi_{12} \frac{\sigma_{y2}}{\sigma_{y1}}$$

Multilevel Standardization

$$\beta = b\frac{\sigma_x}{\sigma_y} \qquad \text{or } \phi_{12}^* = \phi_{12}\frac{\sigma_{y2}}{\sigma_{y1}}$$
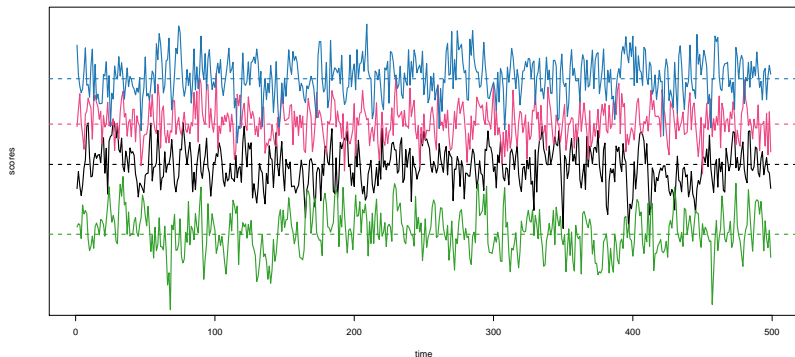
Different variances in the multilevel model: within-person, between-person, grand

Different Standardization, Different Results
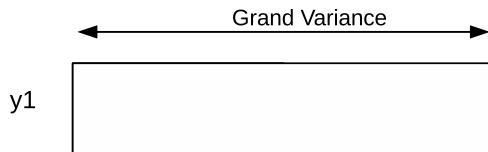
Different Standardization, Different Results

Different Standardization, Different Results

Grand Variance

y1

y2

Grand: $\varphi^*_{12} = \varphi^*_{21}$

Given equal unstandardized coefficients

Different Standardization, Different Results

y1 — Average Within Variance

y2 — Average Within Variance
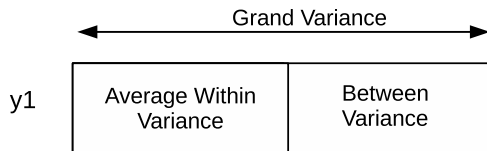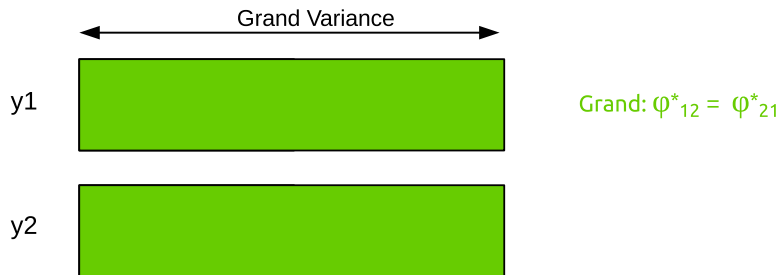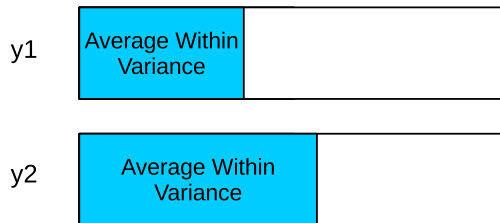
Grand: $\varphi^{*}_{12} = \varphi^{*}_{21}$

Within: $\varphi^{*}_{12} > \varphi^{*}_{21}$

Given equal unstandardized coefficients

Different Standardization, Different Results

y1 | Between Variance

y2 | Between Variance

Grand: $\varphi^*_{12} = \varphi^*_{21}$

Within: $\varphi^*_{12} > \varphi^*_{21}$

Between: $\varphi^*_{12} < \varphi^*_{21}$

Given equal unstandardized coefficients

Multilevel Standardization

Within-person, between-person or grand?

- ▶ Always standardize on the level on which the predictor explains variance.

Multilevel Standardization

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- ▶ Always standardize on the level on which the predictor explains variance.
- ▶ The cross-lagged coefficients are about within person effects, and explain within-unit variance.

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Multilevel Standardization

Within-person, between-person or grand?

- ▶ Always standardize on the level on which the predictor explains variance.
- ▶ The cross-lagged coefficients are about within person effects, and explain within-unit variance.
- ▶ Different individuals have different parameters, take this into account in the standardization!
- ▶ **So: Standardize each person's coefficients, using within person standardization.**

Multilevel Standardization

What about the fixed effects (group effects)?

- ▶ fixed effects are the expectation of the person-specific effects across persons
- ▶ standardized fixed effects should be the expectation of the within-person standardized person-specific effects

Multilevel Standardization

What about the fixed effects (group effects)?

- ▶ fixed effects are the expectation of the person-specific effects across persons
- ▶ standardized fixed effects should be the expectation of the within-person standardized person-specific effects
- ▶ Expectation tricky to formally derive/calculate
- ▶ So we calculate the average person-specific coefficient in our sample
- ▶ As a result, credible intervals for standardized 'fixed effect' will be a bit too small

Standardization in Mplus

```
output: standardized (cluster);
```

Standardization in Mplus

```
STANDARDIZED MODEL RESULTS


STDYX Standardization

                          Posterior  One-Tailed        95% C.I.
                 Estimate    S.D.      P-Value    Lower 2.5%  Upper 2.5%  Significance

Within-Level Standardized Estimates Averaged Over Clusters

 PHI12 | Y1 ON
    Y2&1            0.007     0.013      0.289      -0.018      0.034

 PHI11 | Y1 ON
    Y1&1            0.485     0.013      0.000       0.459      0.512          *

 PHI21 | Y2 ON
    Y1&1           -0.015     0.013      0.126      -0.039      0.011

 PHI22 | Y2 ON
    Y2&1            0.493     0.013      0.000       0.467      0.519          *

 Y1      WITH
    Y2             -0.021     0.015      0.082      -0.050      0.009
```

Standardization in Mplus

```
WITHIN-LEVEL STANDARDIZED MODEL RESULTS FOR CLUSTER 3


STDYX Standardization

                                  Posterior   One-Tailed         95% C.I.
                       Estimate      S.D.       P-Value     Lower 2.5%  Upper 2.5%  Significance
 PHI12 | Y1 ON
    Y2&1                  0.006      0.063        0.460        -0.121      0.131

 PHI11 | Y1 ON
    Y1&1                  0.555      0.084        0.000         0.397      0.728         *

 PHI21 | Y2 ON
    Y1&1                 -0.036      0.082        0.326        -0.206      0.117

 PHI22 | Y2 ON
    Y2&1                  0.418      0.085        0.000         0.249      0.579         *
```

That's it

Thank you for your time and attention!

▶ Bulteel, K., Tuerlinckx, F., Brose, A., & Ceulemans, E. (2016). Using raw VAR regression coefficients to build networks can be misleading. *Multivariate behavioral research*.

▶ Schuurman, N.K., Ferrer, E., de Boer-Sonnenschein, M., & Hamaker, E.L. (2016). How to compare cross-lagged coefficients in multilevel autoregressive models. *Psychological Methods.*