Modeling growth in dyads at the group level

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The Study of Change

The study of change is important for the understanding of many phenomena.

The analysis of change in dyads calls for specific techniques because

- there are two types of nonindependence
  - within dyads: members are often nonindependent.
  - autocorrelation within each member.
- standard methods for multilevel data are not appropriate because group size is only two.

Fitting a Three-Level Model?

In dyadic longitudinal data there are three levels:

occasions nested in *members* nested in *dyads*

So, it seems obvious that such data can be analyzed formulating a three-level model.

Fitting a Three-Level Model?

The idea of fitting a three-level model is to abandon because with dyads there are just two observations (member A and member B) at the middle level (Kenny & Kashy, 2011).

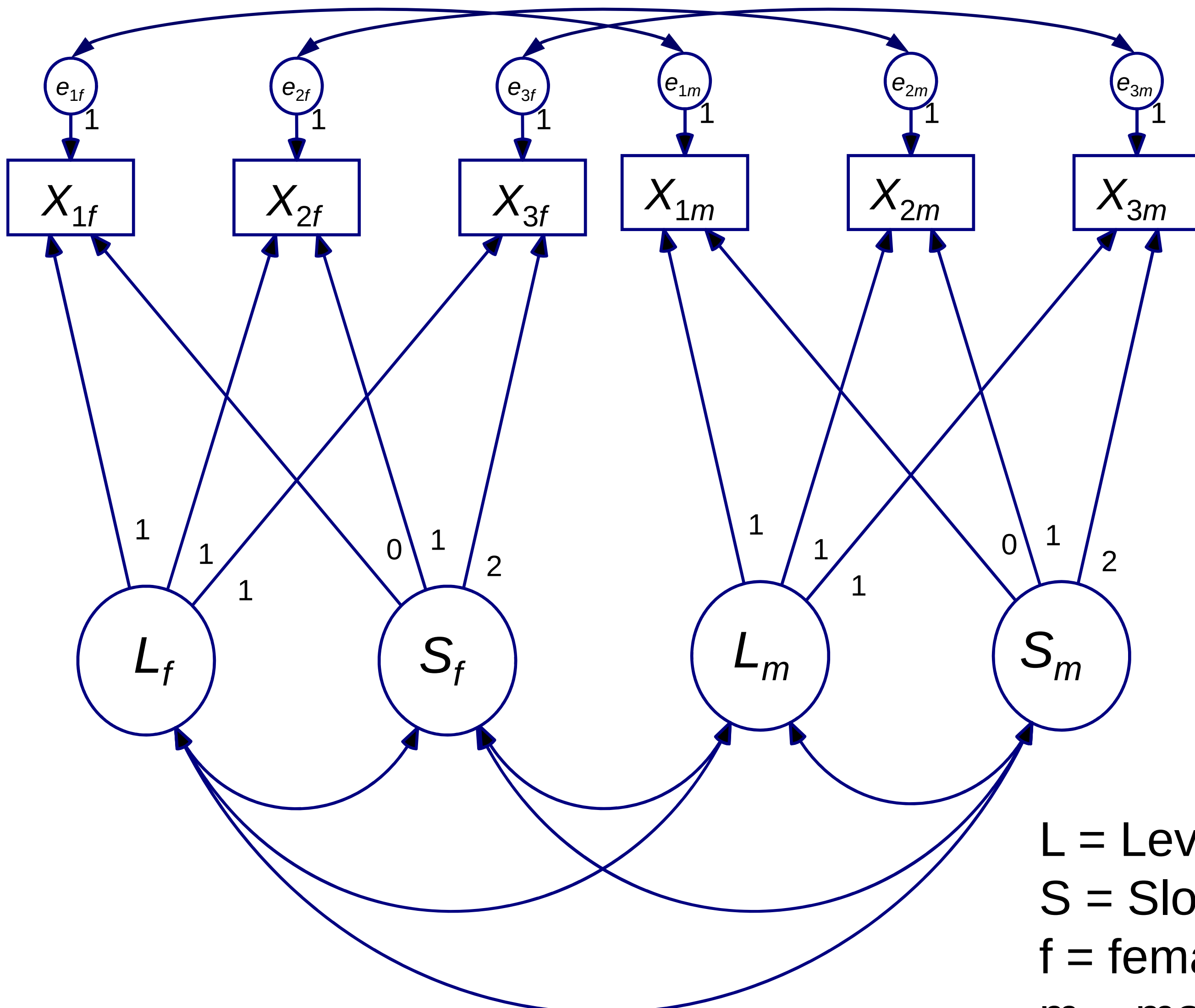
Or in the words of Laurenceau and Bolger (2005, p. 96):
"This is rarely, if ever, a good idea."

The two-level approach of Raudenbush et al. (1995)

Level 1:
$$Y_{ti} = \pi_{f0i}(\text{female}_{ti}) + \pi_{f1i}(\text{female}_{ti}\text{*time}_{ti}) + \pi_{m0i}(\text{male}_{ti}) + \pi_{m1i}(\text{male}_{ti}\text{*time}_{ti})$$

Level 2:
$$\pi_{f0i} = \beta_{f00} + r_{f00i}$$
$$\pi_{f1i} = \beta_{f10} + r_{f10i}$$
$$\pi_{m0i} = \beta_{m00} + r_{m00i}$$
$$\pi_{m1i} = \beta_{m10} + r_{m10i}$$

The two-level approach of Raudenbush et al. (1995)



L = Level (Intercept)
S = Slope
f = female
m = male

Hallmark of the Raudenbush et al. (1995) model

Change is modeled separately for each type of dyad member.

That is, for spouses, there is

- a level for husbands and a level for wives
- a slope for husbands and a slope for wives

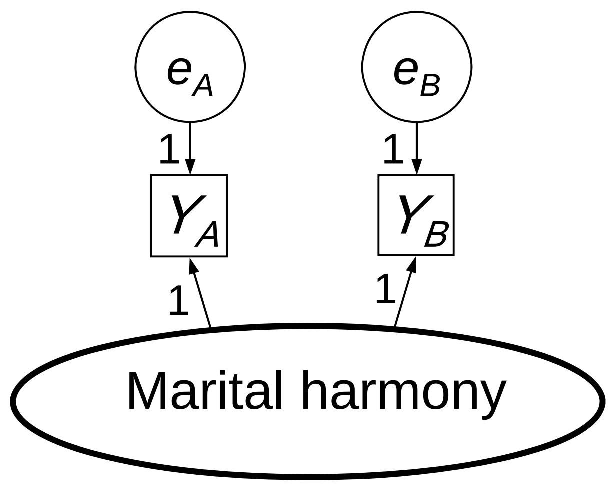
The Common Fate Growth Model (CFGM)

An alternative model is the Common Fate Growth Model.

The CFGM enables the analysis of change at the level of the dyads (groups).

The Common Fate Growth Model (CFGM)

The CFGM is an extension of the Common Fate Model.



The Common Fate Model is perhaps the oldest model to analyze dyadic data

The Common Fate Growth Model (CFGM)

The CFGM can be used when the focal variable measured in both members represents

- a shared variable
  e.g., housing quality in couples
- a dyad-common construct
  e.g., relationship harmony, relationship tension

Hallmarks of the CFGM

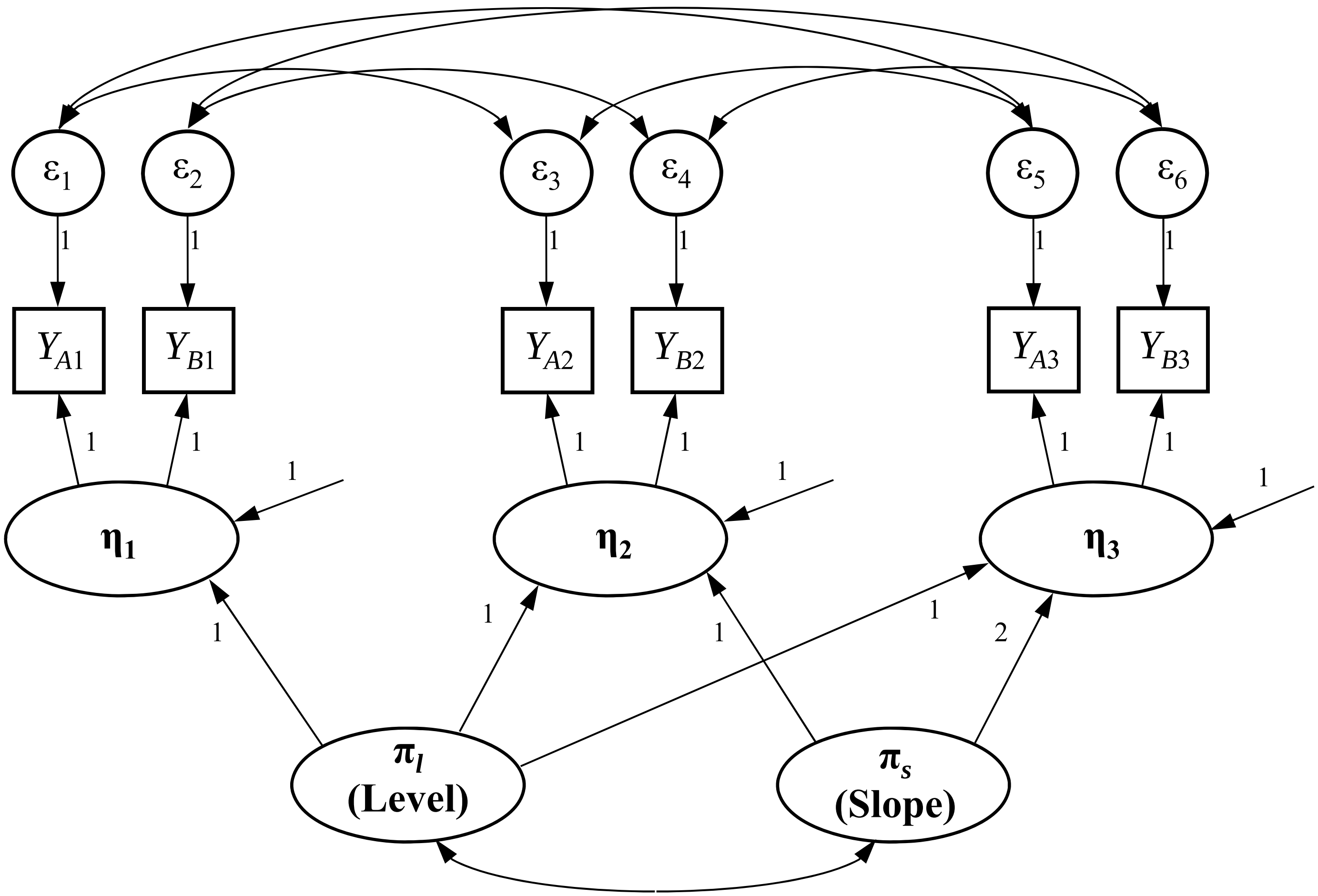
Change is modeled at the group (relationship) level.

⇒ Modeling a linear trend, there is one level and one slope factor.

⇒ The structural part of the CFGM is simpler than that of the Raudenbush et al. model.

This makes the model particularly attractive for the study of complex mechanisms and designs, such as mediation and latent class analysis.

The Common Fate Growth Model



Testing Strategy

Estimating dyad-level means

1. Fit a strong factorial invariance measurement model.
2. If the strong factorial invariance holds, test for strict factorial invariance.

Testing Strategy

Estimating growth at the dyadic

1. Fit a different CFGM implying strong invariance:
   - A level-only model
   - A linear trajectory model

   With more than three measurement points
   - add a quadratic or a cubic component
   - add a second level component for a piecewise
2. Test whether strict factorial invariance holds using the most appropriate model.

Testing Strategy

Distinguishable members

Sometimes dyad members are theoretically distinguishable (e.g., heterosexual couples).

If so we test whether members can be treated as indistinguishable using the most appropriate model.

Indistinguishable members (e.g., same-sex twins)

Both SEM and multilevel SEM can be used.

Illustrative Example

Data

482 couples of the Longitudinal Study of Generation (Bengtson, 2009)

Variable

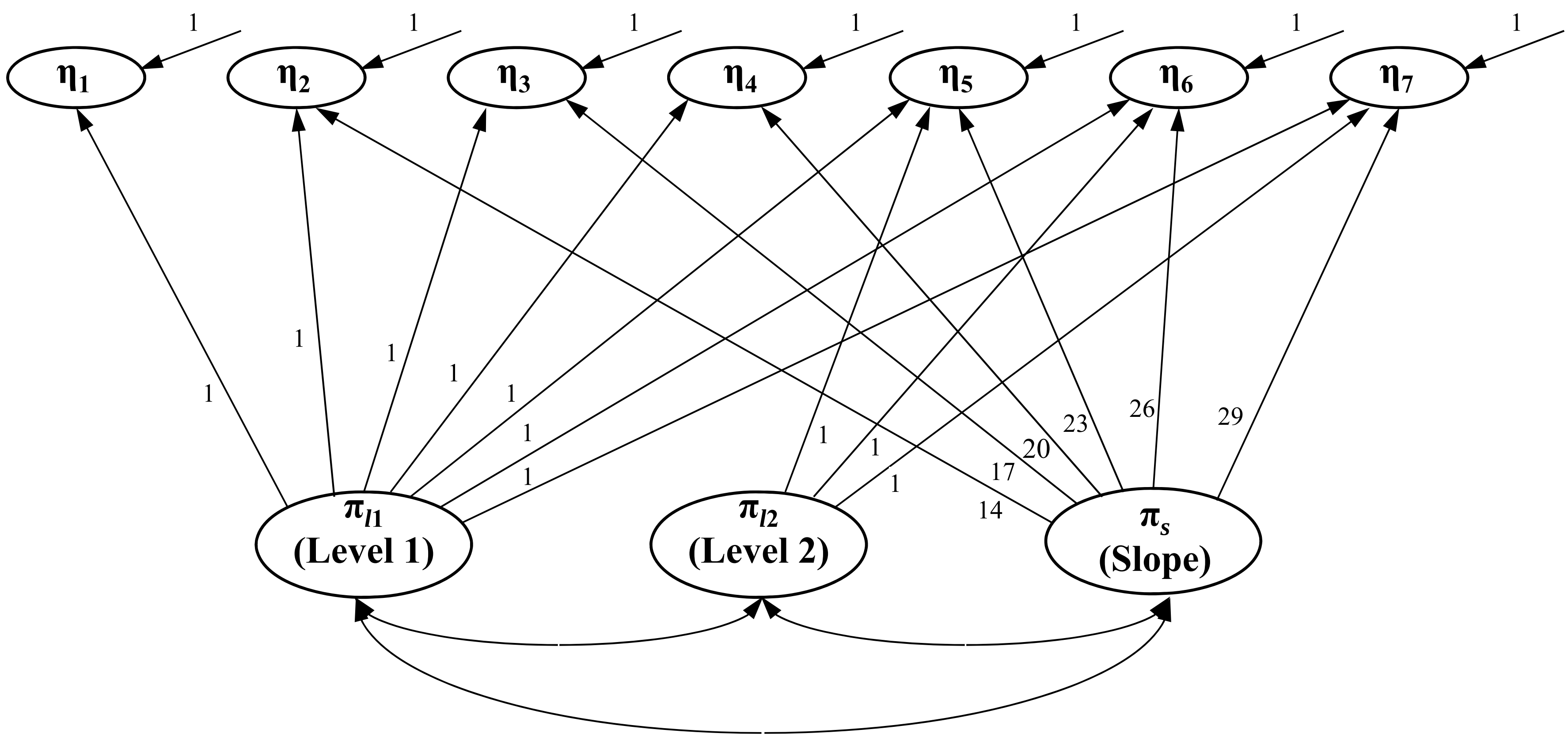
Negative sentiment (range = 5 to 25)

7 measurement occasions

1971, 1985, 1988, 1991, 1994, 1997, and 2000

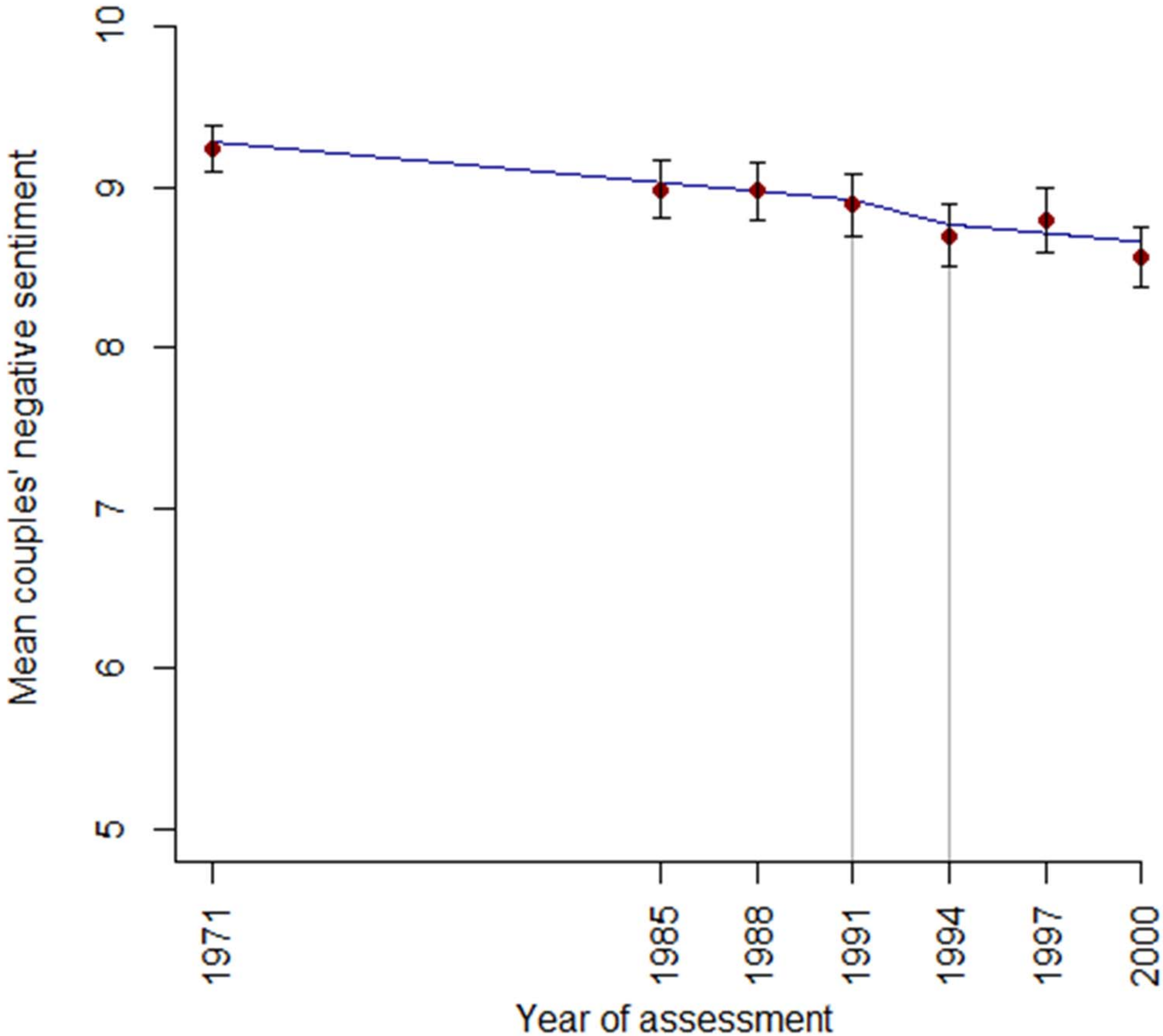
Illustrative Example

Model implying strong factorial invariance



$\chi^2(46) = 58.619$, $p = .114$; RMSEA = .025 (90% CI: <.001, .043)

Illustrative Example



Illustrative Example

Model	χ^2	*df*	*p*
	Distinguishable members		
Measurement model			
Strong invariance	34.307	27	.157
Strict invariance	48.454	39	.143
Strong invariance & indistinguishable	91.514	56	.002
Strict invariance & indistinguishable	100.111	62	.002
Strong invariance CFGM			
Level-only CFGM	97.406	53	<.001
Linear CFGM	67.919	50	.047
Linear CFGM with two level factors	58.619	46	.100
Strict invariance CFGM			
Linear CFGM with two level factors	79.176	58	.034
Strong invariance CFGM & indistinguishable			
Linear CFGM with two level factors	120.200	75	.001

Limitations of the CFGM

1. The CFGM requires the employment of SEM or MSEM.
   ⇒ The number of levels that can be analyzed is limited.
2. The analysis of unbalanced longitudinal data, where the spacing between time points varies across dyads is limited (see Bauer, 2003, for possible strategies).

Conclusion

The Common Fate Growth Model is a synthesis of the Common Fate Model with Growth Curve Modeling.

The Common Fate Growth Model allows

- the analysis of change at the relationship (dyadic) level.
- an appropriate analysis of change in dyads when a three-level model is in a researcher’s mind.

Thank you!

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SEM and MSEM setups: thomasledermann.com/cfgm/

Reference: Ledermann, T., & Macho, S. (2014). Analyzing change at the dyadic level: The common fate growth model. *Journal of Family Psychology, 28, 204-213.*