Intrapersonal data within a multi-level perspective

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Overview

1. Why individuals should be studied at both the person and the population level
2. Why multi-level regression is well-suited for this task
3. 2-level model of relationship-specific conflict
4. 3-level model of change in relationship-specific conflict
5. Empirical example: First 18 months at university
6. Extensions: Replacing time, adding classroom level
7. Limitations of this approach
8. Summary
Individuals should be studied at both the person and the population level

1. A pure person-oriented approach is of limited utility

*Example*: Diary study of 1 student (20 days)

===> no information about individual's uniqueness
Individuals should be studied at both the person and the population level

2. A pure population-oriented approach is of limited utility

*Example 1* (Epstein, 1983):
angriness – happiness correlation low –
angry – happy correlation strong –

*Example 2* (Cacioppo et al., 1992):
average SCL – average fear expression +
SCL – fear expression within individuals -

==> danger of inferring intraindividual processes from interindividual difference results
Individuals should be studied at both the person and the population level

3. Intra- and interindividucal covariations are only identical in the case of *ergodicity* (Molenaar, 2004) which implies in this case absence of interindividucal differences in intraindividual covariation, i.e., \( N = 1 \) would suffice:

completely unrealistic for psychological data

==> individuals should be studied at *both* the person- and the population level
Multi-level regression is well-suited for this task

In a hierarchical data structure (nested data), lower-level regression coefficients (level and slope) are regressed on predictors at a higher level, and both types of regression coefficients are simultaneously estimated. Leads to smaller SEs than separate estimation by level.

Example:
Waves in a longitudinal study are nested in individuals
The individual growth functions (Level 1) are predicted by constant individual characteristics (gender, personality,...) at Level 2:
inter-individual differences in intraindividual change

This can be generalized to any intraindividual covariations (not only change in time).
Two-level model of relationship-specific conflict

Example:
Relationship-specific conflict ratings are obtained for all major personal relationships reported by each individual (*idiographic data*). Assessed are at least 50 individuals.
To make relationships comparable across individuals, they are grouped into 6 relationship categories: mother, father, sibling, partner, peers, other.
These categories were dummy-coded.
Conflict in each relationship category was then predicted by the Big Five personality traits (*nomothetic analysis*).
**Two-level model of relationship-specific conflict**

HLM notation:

Level-1 Model:
Conflict = B0 + B1*(MOTHER) + B2*(FATHER) + B3*(SIBLING) + B4*(PARTNER) + B5*(PEERS) + e

Level-2 Model:
B0 = G00 + G01(NEUR) + G02(EXTR) + G03(OPEN) + G04(AGREE) + G05(CONSC) + r0
B1 = G10 + G11(NEUR) + G12(EXTR) + G13(OPEN) + G14(AGREE) + G15(CONSC) + r1
...  
B5 = G50 + G51(NEUR) + G52(EXTR) + G53(OPEN) + G54(AGREE) + G55(CONSC) + r5

==> Problem: all effects are relative to Level 1 intercept B0 which represents conflict in "other relationships"
Two-level model of relationship-specific conflict

Potential solution: Model *without intercept*:

Level-1 Model:
Conflict = B0*(OTHER) + B1*(MOTHER) + B2*(FATHER) + B3*(SIBLING) + B4*(PARTNER) + B5*(PEERS) + e

Level-2 Model:
B0 = G00 + G01(NEUR) + G02(EXTR) + G03(OPEN) + G04(AGREE) + G05(CONSC) + r0
B1 = G10 + G11(NEUR) + G12(EXTR) + G13(OPEN) + G14(AGREE) + G15(CONSC) + r1
...
B5 = G50 + G51(NEUR) + G52(EXTR) + G53(OPEN) + G54(AGREE) + G55(CONSC) + r5

==> Now all effects represent conflict in a specific relationship but significance of conflict level is trivial.
Three-level model of relationship-specific conflict

If multiple assessments of conflict are available for each relationship (longitudinal study), the above two-level model can be extended to a three-level model where time points are nested in relationships. Missing time points do not present a problem; time points may be even specific to relationships.
Three-level model of relationship-specific conflict

Level-1 Model
CONFLICT = P0 + P1*(TIME) + e

Level-2 Model
P0 = B00*(OTHER) + B01*(MOTHER) + B02*(FATHER) + B03*(SIBLING) + B04*(PARTNER) + B05*(PEERS) + r0
P1 = B10*(OTHER) + B11*(MOTHER) + B12*(FATHER) + B13*(SIBLING) + B14*(PARTNER) + B15*(PEERS) + r1

Level-3 Model
B00 = G000 + G001(NEUR) + G002(EXTR) + G003(OPEN) + G004(AGREE) + G005(CONSC) + u00
B01 = G010 + G011(NEUR) + G012(EXTR) + G013(OPEN) + G014(AGREE) + G015(CONSC) + u01
...  
B15 = G150 + G151(NEUR) + G152(EXTR) + G153(OPEN) + G154(AGREE) + G155(CONSC) + u15
Example: First 18 months at university

Studied were 163 heterosexual first-year students who reported during the first week at university on their personality, social relationships, and characteristics of each relationship. On average, 63 relationships for each student.

The assessments of social relationships were repeated every 3 months over a period of 18 months (7 time points). 3.7 assessments for each relationship.

Data were analyzed with three-level models including intercept at Level 2; the Level 2 intercept represents "other relationships". The Level 1 intercept represents the initial assessment.

Here I show results for interpersonal conflict.
Example: First 18 months at university

Step 1: Variance components at the 3 levels, inform about size of differences:

42% of variance accounted for by relationships, 14% of variance accounted for by interindividual differences. Both $p < .001$.

Explained variance ($Pseudo-R^2$):
Level 1 by linear change: 11%
Level 2 by 7 relationship categories*: 24%
Level 3 by Big Five: 13%
All $p < .001$.

*) Same as before but distinguishing old and new peers
**Example: First 18 months at university**

**Effect of Time at University on Conflict and its Moderation by Relationship Category and Neuroticism, Controlling for the Other Big Five Traits**

<table>
<thead>
<tr>
<th>Effect</th>
<th>Level 1 Intercept P0</th>
<th>Level 1 Slope P1</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>b</td>
<td>SE</td>
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<tr>
<td>Level 2 intercept</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Level 3 intercept</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Neuroticism</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mother</td>
<td>B00</td>
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<tr>
<td>- Level 3 intercept</td>
<td>G000</td>
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<td>- Neuroticism</td>
<td>G001</td>
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<tr>
<td>Father</td>
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<td>- Level 3 intercept</td>
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<td>- Neuroticism</td>
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<td>Sibling</td>
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<td>- Neuroticism</td>
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<td>Old peers</td>
<td>B05</td>
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<td>- Level 3 intercept</td>
<td>G040</td>
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<td>- Neuroticism</td>
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<td>New peers</td>
<td>B06</td>
<td></td>
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<td>- Level 3 intercept</td>
<td>G050</td>
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<tr>
<td>- Neuroticism</td>
<td>G051</td>
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<tr>
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<td>-0.165</td>
</tr>
<tr>
<td>- Neuroticism</td>
<td>G061</td>
<td>-0.144</td>
</tr>
</tbody>
</table>
Example: First 18 months at university

Graphed results for dummy-variable father:

Why both levels?
Why multi-level analysis?
2-level model
3-level model
Illustration
Extensions
Limitations
Summary
Level 1 predictor time can be replaced by
- nonlinear function of time, e.g.
  - quadratic time (accelerated/decelerated growth)
  - exponential functions (decay)
  - contrast in time (modeling effects of events)
- another relationship variable, e.g. emotional closeness, social support, relationship satisfaction:
  covariation of relationship quality over time
Extensions

Application to diary studies on day-to-day changes or event-triggered changes including lagged predictors, e.g.
- does conflict on a day spills over to the next day, and is spill-over related to personality
- does conflict on a day affects relationship satisfaction on the next day, and is this related to personality
- does a visit of the family increase conflict with family members

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Adding classrooms (at least 40) as the highest level if classroom differences in outcomes are significant and classroom characteristics can significantly explain them.

Allows for study of moderation of lower-order effects by classroom differences (cross-level interactions), e.g.
- moderation of ethnic composition of the classroom of conflict with classmates of own versus other ethnicity
- moderation by ethnic composition of the classroom of moderation of conflict with classmates of own versus other ethnicity by perceived discrimination of own ethnicity

Why both levels?
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Limitations

1. Linear model – but allows for modeling nonlinear relations through nonlinear transformations of predictors or dummy-coding of categorical predictors

2. At least 50 units at the highest level (individuals or classrooms) are required but not many assessments at lower levels

3. Modeling time assumes constant, uncorrelated measurement error (equivalent to growth curve model with constant uncorrelated measurement error) although it is possible to model different and/or correlated measurement errors within a multi-level model (HMLM, MPlus)

4. Standard models are based on manifest variables although latent variables can be included also
Summary

1. Individuals should be studied at both the person and the population level
2. Multi-level regression is well-suited for this task
   - flexible tool, allows for multi-level within-person data
   - any intraindividual relations can be studied
   - long-term, day-to-day, event-triggered changes
   - no requirement of many assessments for each individual
   - helps avoiding confusion of levels of analysis
3. Main limitation: at least 50 units at highest level
Thank you for your attention!