Mediation Analyses with Dyadic Data

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Overview

- When to use dyadic data mediation analyses
- Two SEM approaches with example data
  - Actor-Partner Interdependence Mediation Model (APIMeM)
  - Common Fate Model (CFM)
- Advantages and disadvantages
- Additional tips and resources

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When to Use Dyadic Data Mediation Analyses

- Social scientists frequently encounter dyadic data
  - Ex: Couples, siblings, roommates, coworkers
- Traditional mediation analyses assume independent observations
  - Individuals within dyad likely covary on their measures
- Mediation analyses that account for dependency are needed
  - SEM allows for modeling dependent data
    - Bootstrapping indirect effects (IEs) easily implemented
- Two popular SEM models to analyze mediation dyadic data:
  - Actor-Partner Interdependence Mediation Model (APIMeM; Ledermann, Macho, & Kenny, 2011)
  - Common Fate Model (CFM; Ledermann & Macho, 2009)
Using SEM to Examine Mediation in Dyads

Note. Data should be structured by dyad for both analyses

- Each row represents the dyad and contains both individuals’ scores

Example: Heterosexual Couple Data

<table>
<thead>
<tr>
<th>ID</th>
<th>Dyad</th>
<th>Gender</th>
<th>X</th>
<th>M</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>101</td>
<td>1</td>
<td>M</td>
<td>4.0</td>
<td>6.0</td>
<td>5.0</td>
</tr>
<tr>
<td>102</td>
<td>1</td>
<td>F</td>
<td>3.0</td>
<td>4.0</td>
<td>3.0</td>
</tr>
<tr>
<td>103</td>
<td>2</td>
<td>M</td>
<td>1.0</td>
<td>3.0</td>
<td>2.0</td>
</tr>
<tr>
<td>104</td>
<td>2</td>
<td>F</td>
<td>2.0</td>
<td>3.0</td>
<td>2.0</td>
</tr>
</tbody>
</table>

- Dyad structured data

<table>
<thead>
<tr>
<th>Dyad</th>
<th>maleX</th>
<th>maleM</th>
<th>maleY</th>
<th>femaleX</th>
<th>femaleM</th>
<th>femaleY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.0</td>
<td>6.0</td>
<td>5.0</td>
<td>3.0</td>
<td>4.0</td>
<td>3.0</td>
</tr>
<tr>
<td>2</td>
<td>1.0</td>
<td>3.0</td>
<td>2.0</td>
<td>2.0</td>
<td>3.0</td>
<td>2.0</td>
</tr>
</tbody>
</table>
Distinguishable vs. Indistinguishable Dyads

- Both models also require determining the type of dyad you are examining

- Distinguishable dyads: Membership in the dyad differs on a variable of interest
  - Ex: husbands & wives, parent & child

- Indistinguishable dyads: No distinct membership in the dyad
  - Ex: same sex twins, roommates

- The remainder of this talk will focus on distinguishable dyads
  - APIMeM and CFM accommodate both types of dyads
  - Indistinguishable dyad models require additional model constraints
Actor-Partner Interdependence Mediation Model (APIM; see Kenny, Kashy & Cook, 2006)

- Allows research to examine *actor* and *partner* effects
  - Actor effects: intraindividual effects
  - Partner effects: interindividual effect

Actor-Partner Interdependence Mediation Model (Ledermann, Macho, Kenny, 2011)

- Actor effects: Each Individual’s indirect effect (IE) of $X \rightarrow M \rightarrow Y$
- Partner effect: One individual’s $X$ or $M$, effect the other's $M$ or $Y$
$N_{couples} = 95$ Heterosexual couples in romantic relationships ($N = 190$)

- Dating at least 1 month ($M = 16.74$, $SD = 14.87$)
- Age ($M = 19.91$ $SD = 2.22$)

Does perceived reasoning ability ($X$) lead to relationship commitment ($Y$), as a result of relationship satisfaction ($M$)?

- $X =$ perceived reasoning ability of significant other (1-9 Likert scale, $\alpha = .72$)
- $M =$ relationship satisfaction (0-5 Likert scale, $\alpha = .94$)
- $Y =$ relationship commitment (0-8 Likert scale, $\alpha = .95$)
**Note.** 8 different IEs are possible!
Both Actor-Actor IEs are significant
- Men Actor IE: bootstrapped 95% CI [0.17, 0.75]
- Women Actor IE: bootstrapped 95% CI [0.07, 0.42]
- These Actor-Actor IEs not significantly different $\chi^2(2) = 3.47, p = .18$

Note. Covariances between X, M, & Y removed from figure for simplicity. Grey dashed lines indicate $p > .05$

No significant Actor-Partner, Partner-Actor, or Partner-Partner IEs
Common Fate Model (CFM)

- API MeM examines data at the individual level
- Common Fate Model (CFM) examines effects at the dyad level
  - Ex: relational harmony, shared life experiences
  - Ex: Questions worded with “We” or “our” (Ledermann & Kenny, 2012)
- CFM uses both members of the dyad scores as indicators of a single latent variable
  - Communalities among items should be high for proper estimation and model fit
Note. Correlated residuals among each individual’s items

\[ a \times b = \text{indirect effect} \]
**APIMeM: Advantages and Disadvantages**

- **Advantages**
  - Indirect effects for both individuals can be tested and compared
  - Allows researcher to test indistinguishability
  - Impose equality constraints to examine if $a$, $b$, and IEs are same for each dyad member

- **Disadvantages**
  - More complex model with many possible indirect effects
  - Tests for each IE should be theoretically supported

- **Note.** Model fit indices (e.g. $CFI$, $TLI$) may need to be recalculated
  - Distinguishable dyads: the software default null model is appropriate
  - Indistinguishable dyads: an alternative null model is needed (see Ledermann et al., 2011)
CFM: Advantages and Disadvantages

- **Advantages**
  - Allows for dyad-level variable to serve as X, M, or Y
  - Parsimonious: less IEs to test than APIMeM

- **Disadvantages**
  - Requires moderate correlations among indicators of each construct
  - Indistinguishable dyad models require an alternative null model for fit indices
  - May miss individual differences
Use a software package that allows labeling estimated parameters and examining specific indirect effects

- *lavaan* package in R (Rossel, 2012). It’s free and very powerful!
- Mplus (Muthén & Muthén, 2012)
- AMOS requires using phantom variables to “trick” the software to estimate specific IE

Alternatives to APIMeM and CFM?

- Multilevel structural equation modeling (MSEM)
Thank You!

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For slides and code please visit http://stephendshort.wix.com/psyc
References


