



Multilevel Mediation

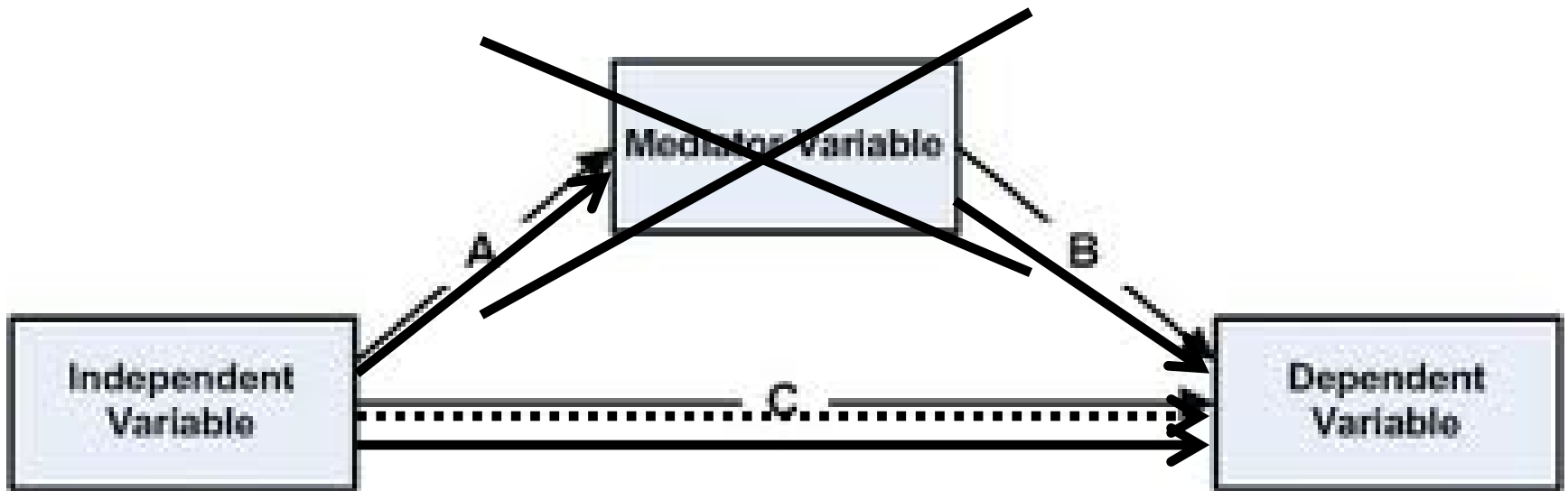
Jeremy Yorgason
SFL Methods Lunch
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Thanks

- Vaughn Call
 - Lance Erickson
 - Joe Olson
 - Wes Godfrey
 - Katie Gustafson
-
- Funding: Veterans Rural Health Resource Center (Western Region), VA SLC

Traditional Mediation

- Baron, R.M., & Kenny, D.A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, 51, 1173-1182.



Why Multilevel Mediation?

- When data violate the assumption of “independence of observations”
 - Clustered data
 - Repeated measures
- The nesting needs to be taken into account
- When researchers want to consider mediation at different levels (e.g., within-person mediation vs. between-person mediation, unconfounded)

Multilevel Variables

- Within Person = Person's score at a given time point minus their mean across all waves. This gives you a value that represents the difference from one's average at a given time point
 - Person or group mean centered
- Between Person = Person's average across all time points
 - Sample or grand mean centered

Multi-levels of Mediation: X – M - Y

- Level 1 outcomes:

- 1-1-1

- 1-2-1

- 2-1-1

- 2-2-1

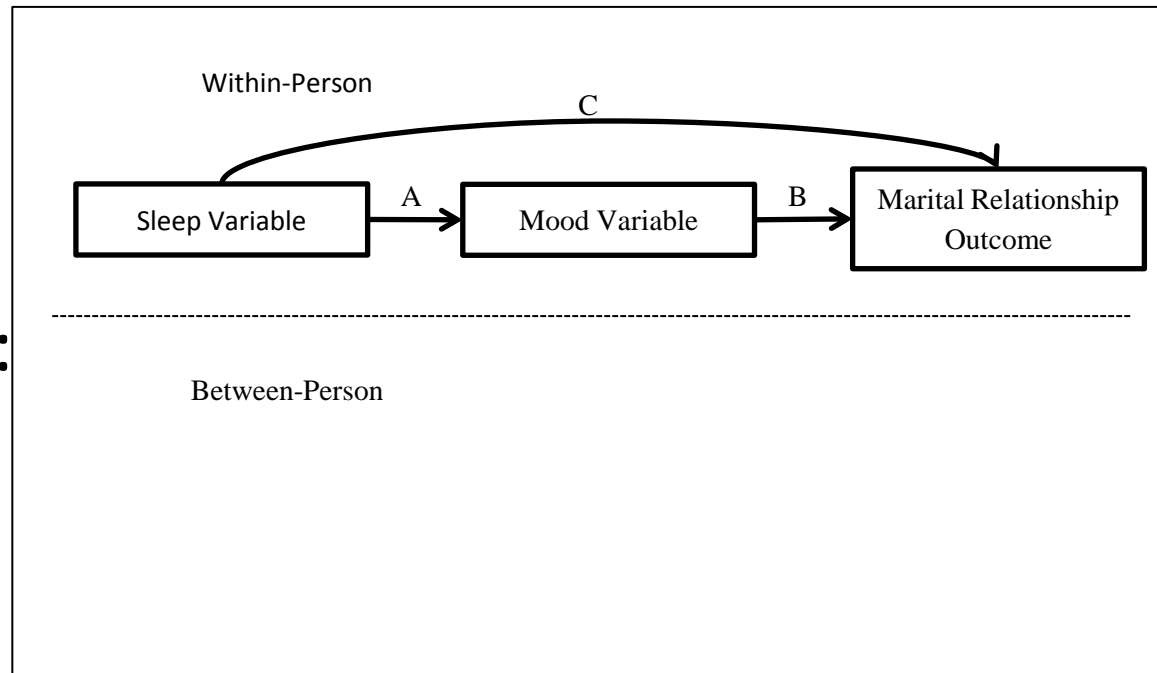
- Level 2 outcomes:

- 2-2-2

- 1-2-2

- 1-1-2

- 2-1-2



Multi-levels of Mediation: X – M - Y

- Level 1 outcomes:

- 1-1-1

- **1-2-1**

- 2-1-1

- 2-2-1

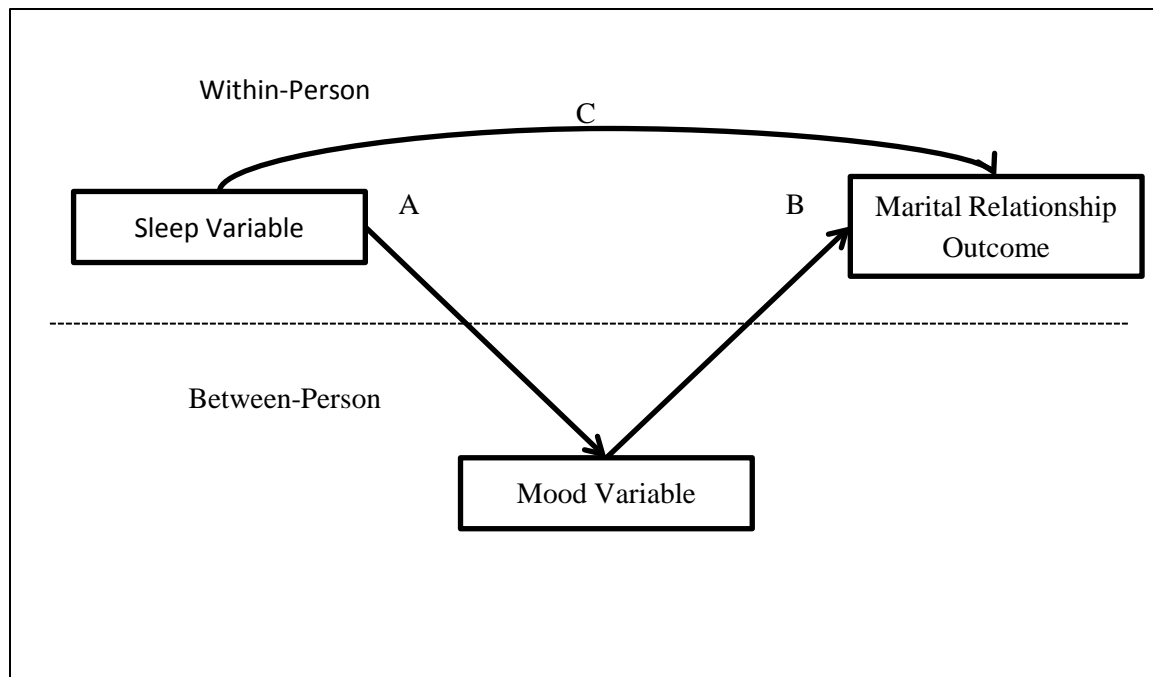
- Level 2 outcomes:

- 2-2-2

- 1-2-2

- 1-1-2

- 2-1-2



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- 2-2-1

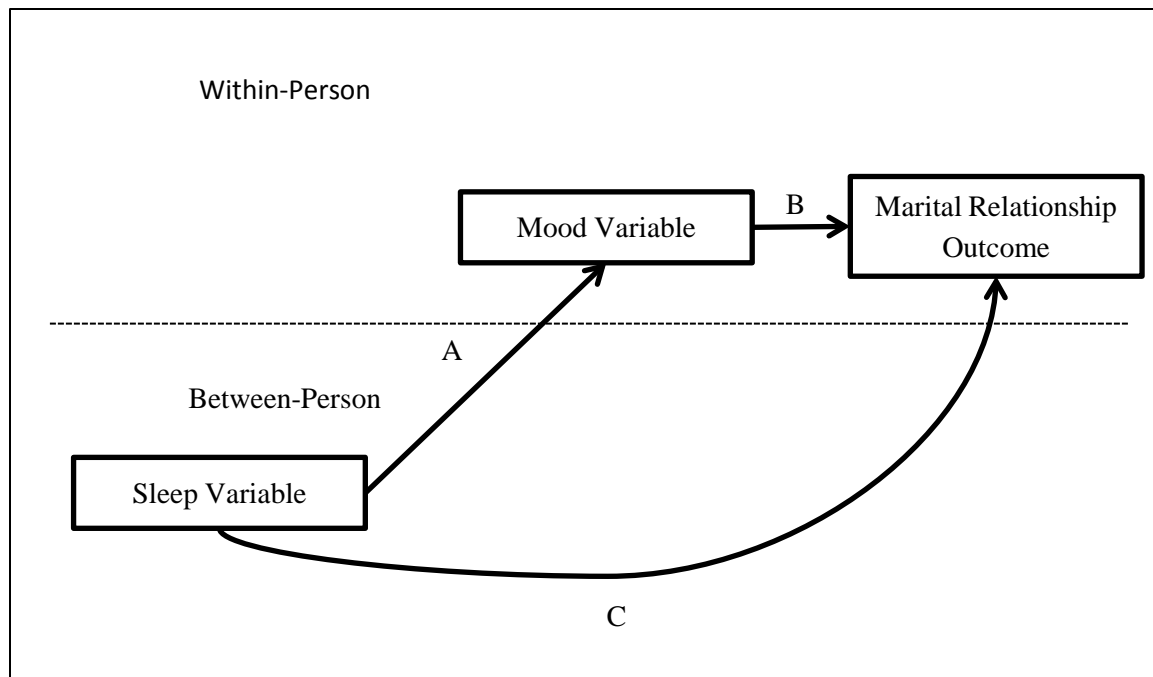
- Level 2 outcomes:

- 2-2-2

- 1-2-2

- 1-1-2

- 2-1-2



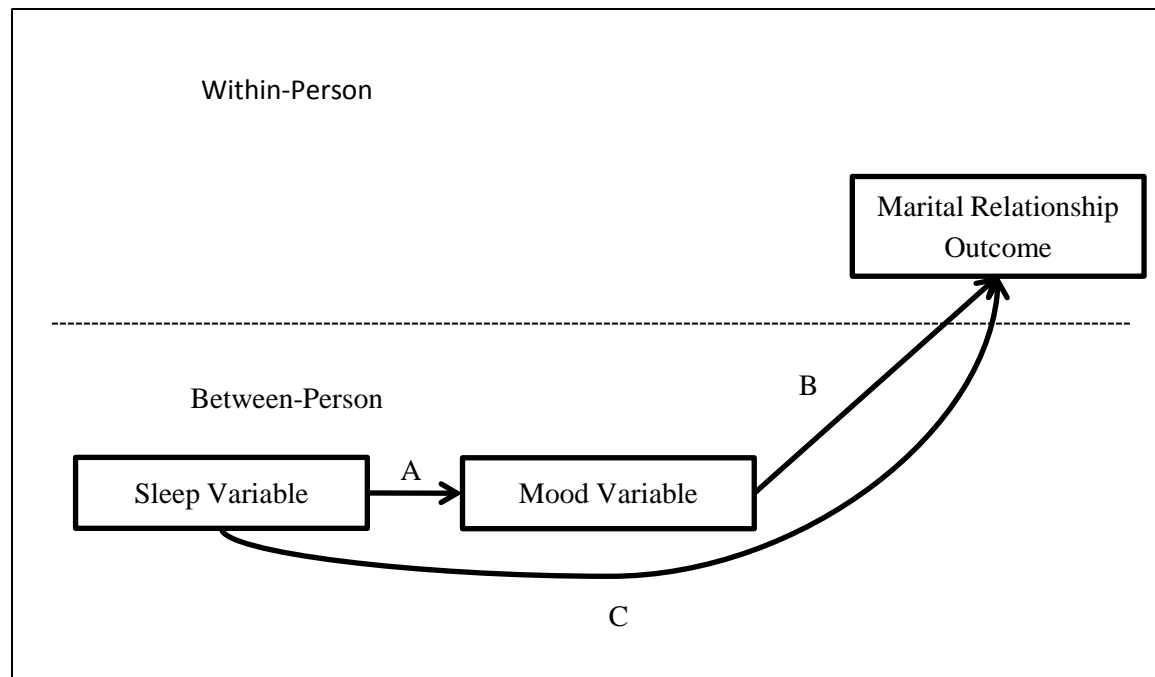
Multi-levels of Mediation: X – M – Y

- Level 1 outcomes:

- 1-1-1
- 1-2-1
- 2-1-1
- 2-2-1

- Level 2 outcomes:

- 2-2-2
- 1-2-2
- 1-1-2
- 2-1-2



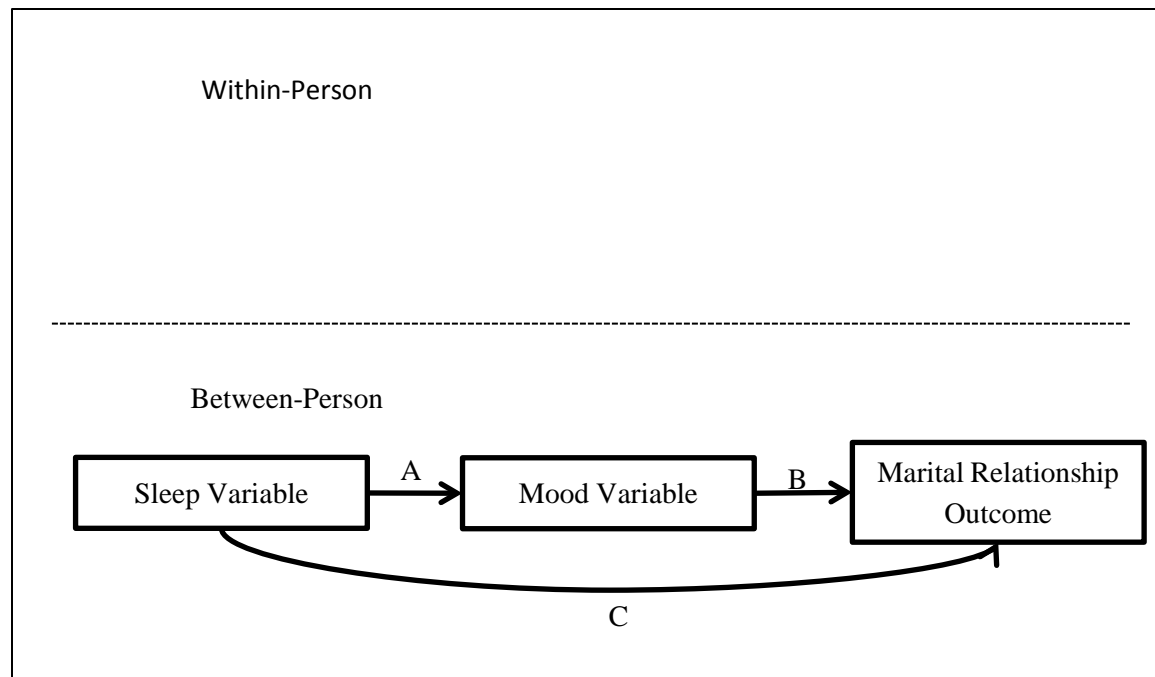
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- Level 1 outcomes:

- 1-1-1
- 1-2-1
- 2-1-1
- 2-2-1

- Level 2 outcomes:

- 2-2-2
- 1-2-2
- 1-1-2
- 2-1-2



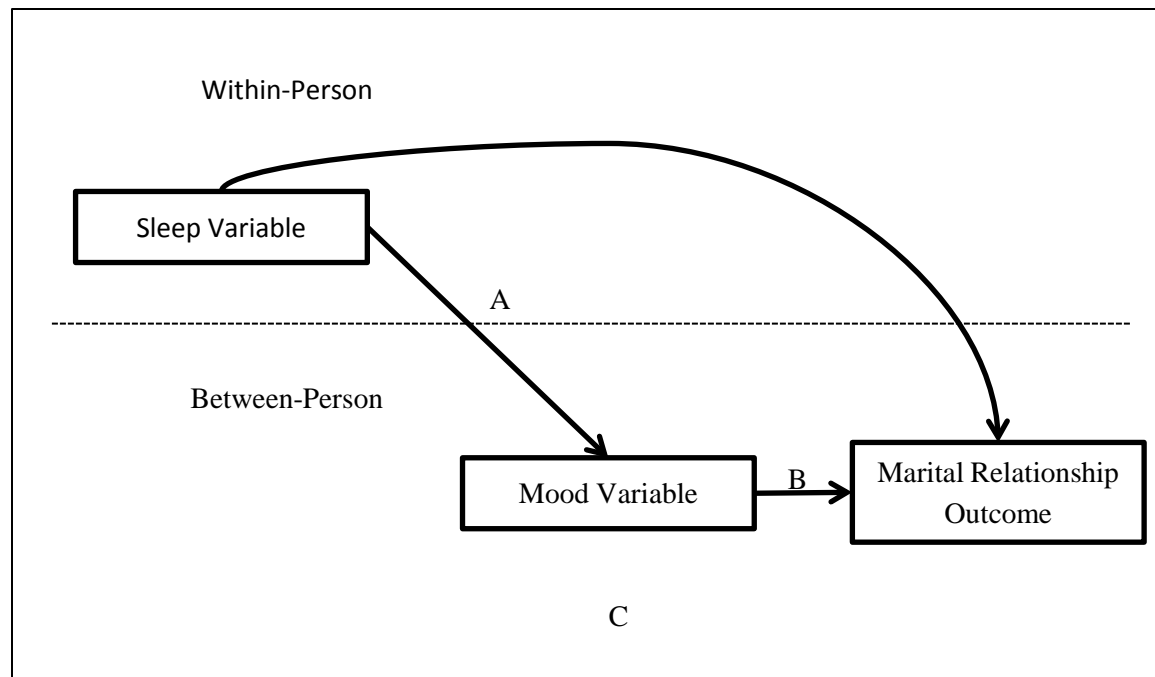
Multi-levels of Mediation: X – M - Y

- Level 1 outcomes:

- 1-1-1
- 1-2-1
- 2-1-1
- 2-2-1

- Level 2 outcomes:

- 2-2-2
- 1-2-2
- 1-1-2
- 2-1-2



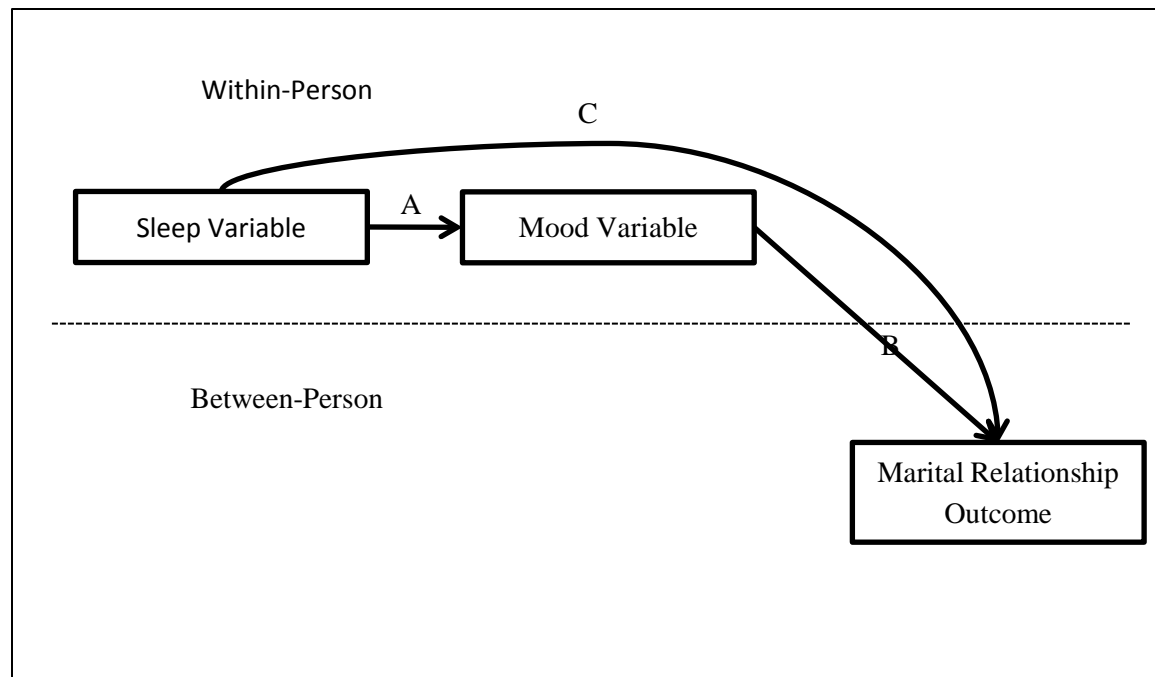
Multi-levels of Mediation: X – M – Y

- Level 1 outcomes:

- 1-1-1
- 1-2-1
- 2-1-1
- 2-2-1

- Level 2 outcomes:

- 2-2-2
- 1-2-2
- 1-1-2
- 2-1-2



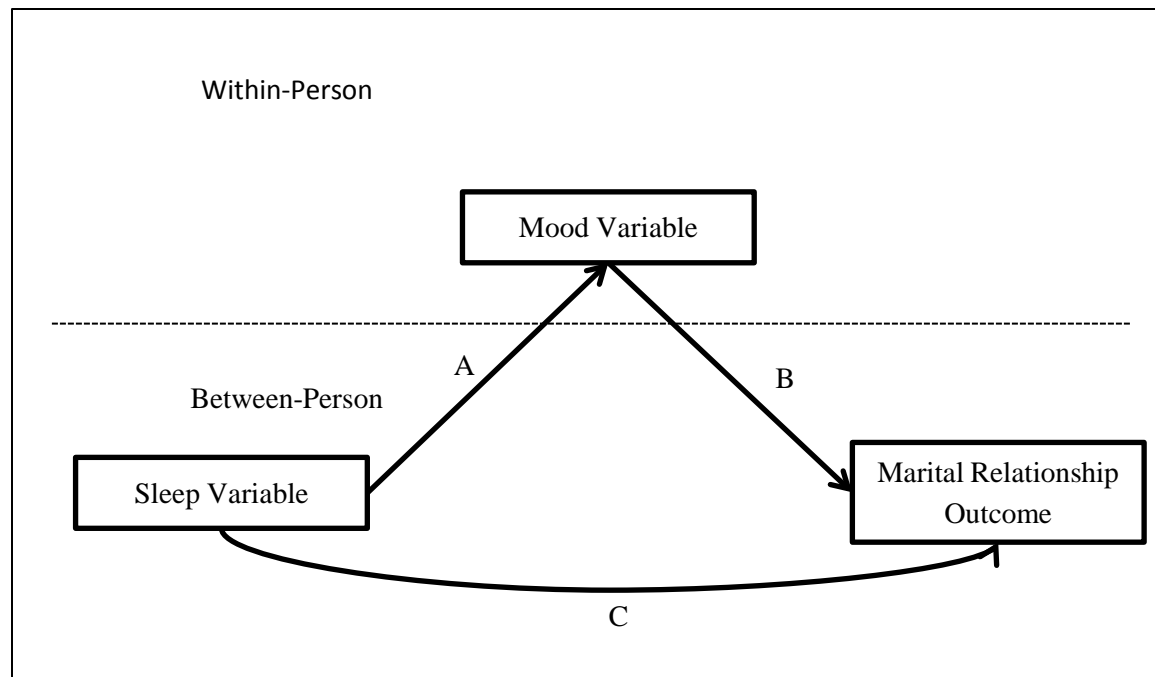
Multi-levels of Mediation: X – M - Y

- Level 1 outcomes:

- 1-1-1
- 1-2-1
- 2-1-1
- 2-2-1

- Level 2 outcomes:

- 2-2-2
- 1-2-2
- 1-1-2
- 2-1-2



Multilevel Mediation:

Current Example

- Level 1 outcomes:

- 1-1-1

- 1-2-1

- 2-1-1

- 2-2-1

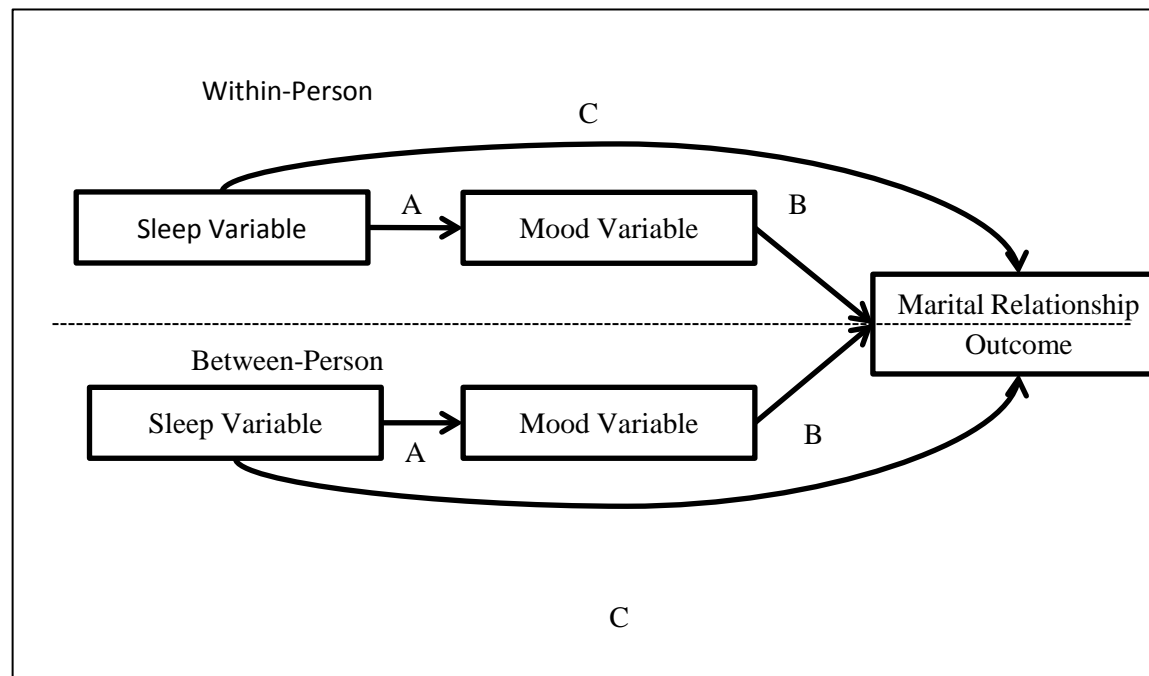
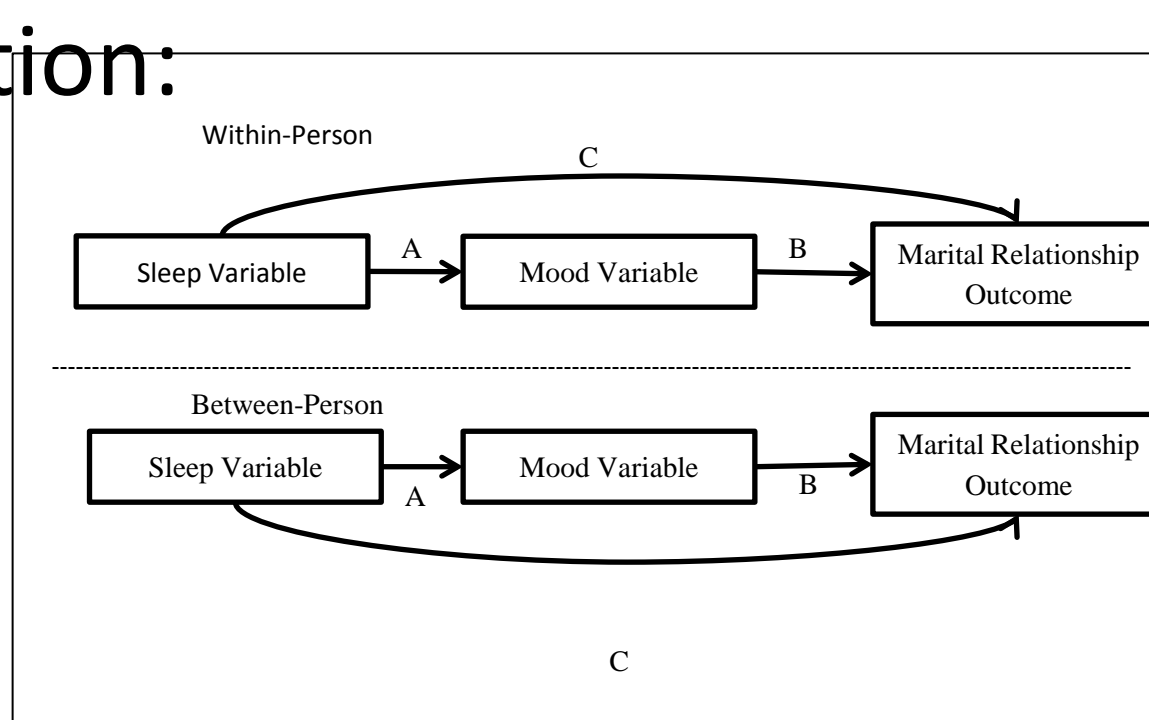
- Level 2 outcomes:

- 2-2-2

- 1-2-2

- 1-1-2

- 2-1-2



Multilevel Mediation: Estimation

- Bauer technique – for SAS Proc Mixed
 - Double stack your data and create dummy variables to select each “stack” of data
 - In one of the stacks you specify that “Z” equals the outcome “Y”
 - In the other stack you specify that “Z” equals the outcome “M”
 - This approach essentially tricks the computer into estimating path A and path B simultaneously
 - May be best if you have a small sample size (e.g., $N < 100$?)

Multilevel SEM: Mediation

- Preacher, Zhang, & Zyphur (2010)
- <http://www.quantpsy.org/medn.htm>

- Bolger and Leurenceau (2013)
- <http://www.amazon.com/Intensive-Longitudinal-Methods-Introduction-Methodology/dp/146250678X>

TITLE: 1-1-1 mediation (unconflated MLM)
DATA: FILE IS mydata.dat; ! text file containing raw data in long format
VARIABLE: NAMES ARE id x m y xmean mmean ymean;
USEVARIABLES ARE id x m y xmean mmean;
CENTERING IS GROUPMEAN(x m); ! group-mean center x and m
CLUSTER IS id; ! Level-2 grouping identifier
WITHIN ARE x m; ! identify variables with only Within variance;
! variables that are not claimed as "BETWEEN ARE" or "WITHIN ARE" can have
! both Within and Between variance
BETWEEN ARE xmean mmean; ! identify variables with only Between variance
ANALYSIS: TYPE IS TWOLEVEL RANDOM;
MODEL: ! model specification follows
%WITHIN% ! Model for Within effects follows
m ON x(**aw**); ! regress m on x, call the slope "aw"
y ON m(**bw**); ! regress y on m, call the slope "bw"
y ON x; ! regress y on x
[m@0]; ! m was group-mean centered, so fix its mean to zero
%BETWEEN% ! Model for Between effects follows
mmean y; ! estimate Level-2 (residual) variances for mmean and y
mmean ON xmean (**ab**); ! regress mmean on xmean, call the slope "ab"
y ON mmean (**bb**); ! regress y on mmean, call the slope "bb"
y ON xmean; ! regress y on xmean
MODEL CONSTRAINT: ! section for computing indirect effects
NEW(indb indw); ! name the indirect effects
indw=aw*bw; ! compute the Within indirect effect
indb=ab*bb; ! compute the Between indirect effect
OUTPUT: TECH1 TECH8 CINTERVAL; ! request parameter specifications, starting values, optimization history, and confidence intervals

Mplus Syntax for 1-1-1 MLSEM for Mediation

http://www.quantpsy.org/pubs/syntax_appendix_081311.pdf

A Daily Diary Example

- Life and Family Legacies Daily Experiences Study
 - 6,729 high school seniors in 1966
 - Follow-up surveys completed in 1980, 2010
 - Daily Diary – random stratified sample of married respondents to the 2010 survey
 - N=1928 eligible
 - 559 randomly contacted to be recruited

A Daily Diary Example Across 14 days

Sample: N=191 couples

Ages: ranged from 60 to 64 (M=62.43)

Education: M = 3 years of college

Income: M = \$88,800/year

Marital Status: 58% in 1st marriage

Ethnicity: 98% Caucasian

Veteran Status: 65% of males were Vets

47% lived in Rural areas

Measures

X - Sleep

- Hours of sleep the previous night
- Sleep quality
- Restedness

M - Positive and Negative Mood (Thomas & Deiner, 1990)

- 9 items

Y – Positive and Negative Marital Events

- Count variable indicating the positive and negative marital events endorsed each day of the survey

Y - Satisfaction with Daily Marital Interactions

- Responses ranged from very unsatisfied (coded as 0) to very satisfied (coded as 6)

Mplus Input

```
Usevariables = id_f w_rest_f b_rest_f  
w_NMoodf b_NMoodf NMarE_f;  
  
Between = b_rest_f b_NMoodf;  
Within = w_rest_f w_NMoodf;  
Cluster = id_f;  
useobservations are id_f < 185 or id_f > 185;
```

```
Analysis: Type = twolevel random;
```

```
Model:
```

```
%Within%  
w_rest_f w_NMoodf NMarE_f;  
w_NMoodf on w_rest_f (aw);  
NMarE_f on w_NMoodf (bw);  
NMarE_f on w_rest_f (cw);
```

```
%Between%
```

```
b_rest_f b_NMoodf NMarE_f;  
b_NMoodf on b_rest_f (ab);  
NMarE_f on b_NMoodf (bb);  
NMarE_f on b_rest_f (cb);
```

```
Model Constraint:
```

```
New(indb indw);  
indb=ab*bb;  
indw=aw*bw;
```

```
Output: Sampstat Tech1 Tech8  
Cinterval;
```

Mplus Truncated Output

INPUT READING TERMINATED NORMALLY

Number of groups 1
 Number of observations 2598
 Number of dependent variables 3
 Number of independent variables 2
 Number of continuous latent variables 0

SUMMARY OF DATA

Number of clusters 191
 Average cluster size 13.602

ESTIMATED SAMPLE STATISTICS FOR WITHIN

Means					
	B_NMOODF	B_REST_F	W_NMOODF	NMARE_F	W_REST_F
1	0.000	0.000	1.296	0.000	0.610

ESTIMATED SAMPLE STATISTICS FOR BETWEEN

Means					
	B_NMOODF	B_REST_F	W_NMOODF	NMARE_F	W_REST_F
1	0.022	0.014	0.000	0.269	0.000

THE MODEL ESTIMATION TERMINATED NORMALLY

MODEL FIT INFORMATION

Number of Free Parameters 17
 Chi-Square Test of Model Fit
 Value 0.000*
 Degrees of Freedom 0
 P-Value 1.0000
 Scaling Correction Factor 1.0000
 for MLR

RMSEA (Root Mean Square Error Of Approximation)

Estimate 0.000

CFI/TLI

CFI 1.000
 TLI 1.000

SRMR (Standardized Root Mean Square Residual)

Value for Within 0.000
 Value for Between 0.000

MODEL RESULTS

	Estimate	S.E.	Two-Tailed Est./S.E.	P-Value
Within Level				
NMARE_F ON				
W_REST_F	-0.002	0.001	-1.689	0.091
W_NMOODF	0.003	0.001	2.525	0.012

W_NMOODF ON				
W_REST_F	0.534	0.119	4.466	0.000

Between Level				
B_NMOODF ON				
B_REST_F	-0.623	0.141	-4.423	0.000

NMARE_F ON				
B_NMOODF	0.063	0.015	4.179	0.000
B_REST_F	0.002	0.020	0.101	0.919

New/Additional Parameters

INDB	-0.039	0.012	-3.316	0.001
INDW	0.002	0.001	2.390	0.017

CONFIDENCE INTERVALS OF MODEL RESULTS

	Lower .5%	Lower 2.5%	Lower 5%	Estimate	Upper 5%	Upper 2.5%	Upper .5%
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Within Level							
NMARE_F ON							
W_REST_F	-0.006	-0.005	-0.004	-0.002	0.000	0.000	0.001
W_NMOODF	0.000	0.001	0.001	0.003	0.005	0.006	0.006

W_NMOODF ON							
W_REST_F	0.226	0.299	0.337	0.534	0.730	0.768	0.841

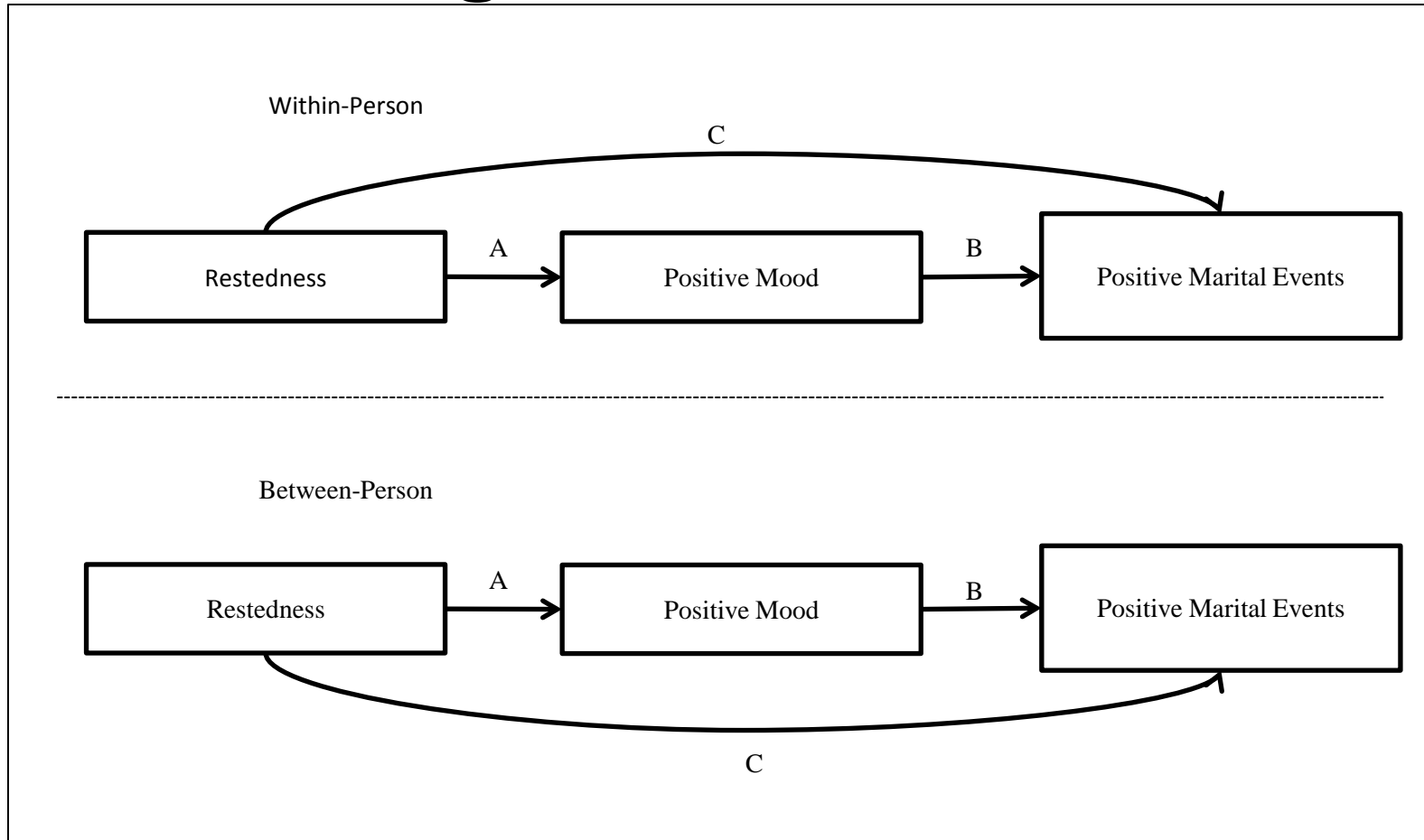
Between Level							
B_NMOODF ON							
B_REST_F	-0.987	-0.900	-0.855	-0.623	-0.392	-0.347	-0.260

NMARE_F ON							
B_NMOODF	0.024	0.034	0.038	0.063	0.088	0.093	0.102
B_REST_F	-0.051	-0.038	-0.032	0.002	0.036	0.042	0.055

New/Additional Parameters

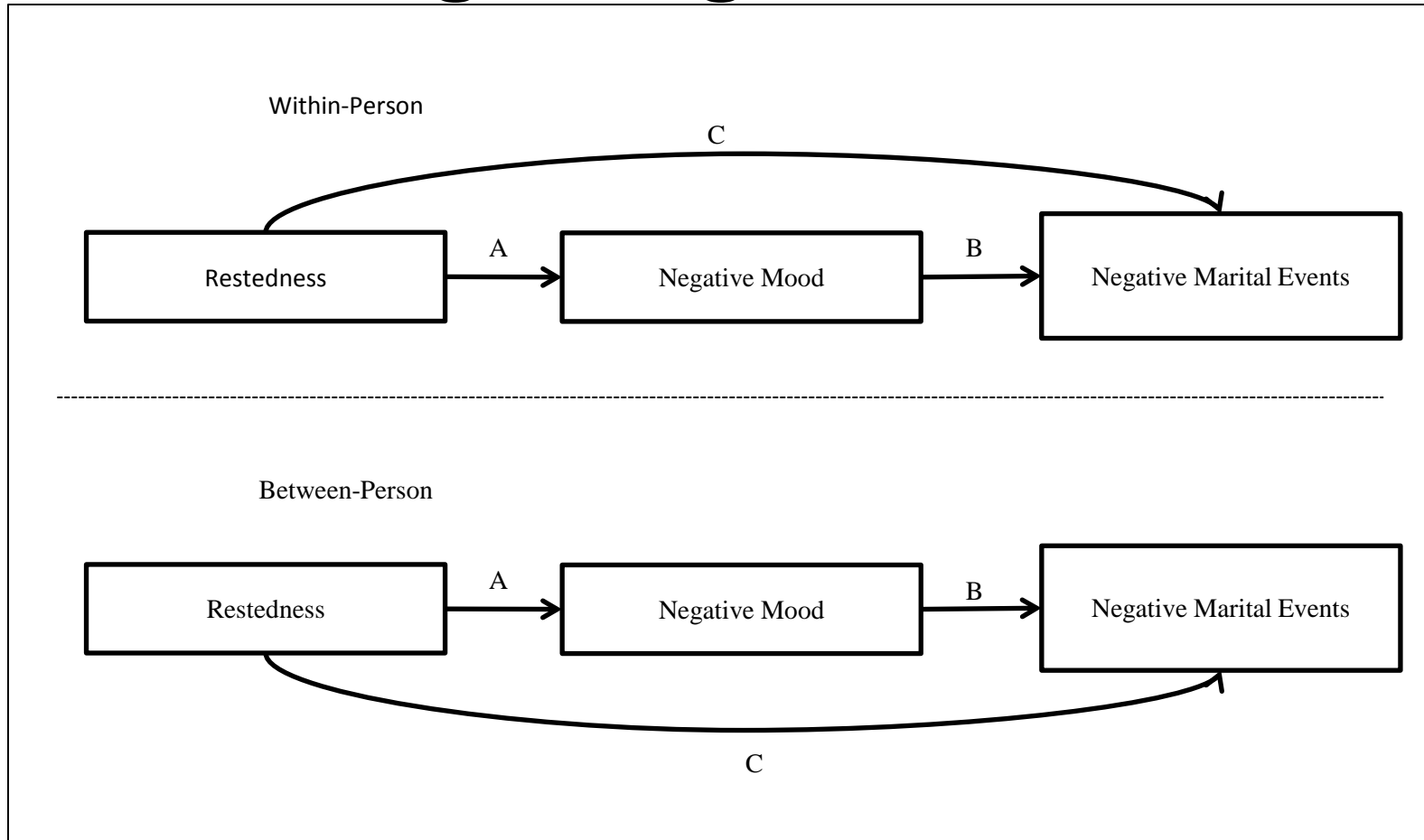
INDB	-0.070	-0.063	-0.059	-0.039	-0.020	-0.016	-0.009
INDW	0.000	0.000	0.001	0.002	0.003	0.003	0.004

Findings: Positive Mood



1. Indirect effect of W/P restedness through W/P Positive Mood on Positive Marital Events: $b = .01$, $z = 2.10$, $p = .036$;
2. Indirect effect of B/P restedness through B/P Positive Mood on Positive Marital Events: $b = .37$, $z = 4.08$, $p = .000$;

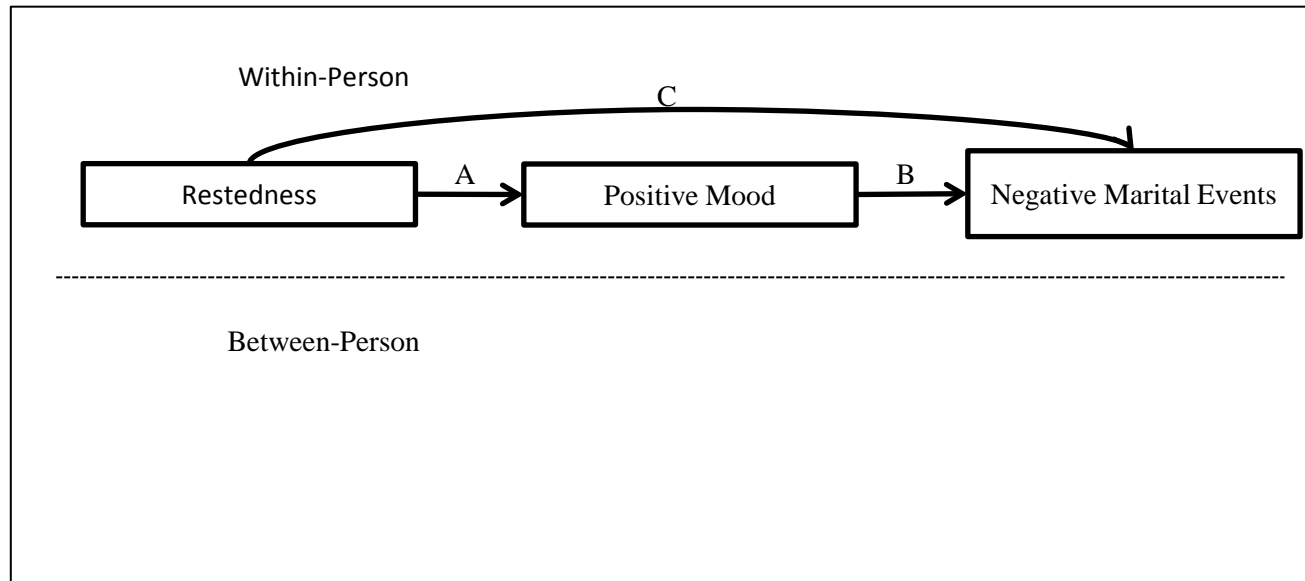
Findings: Negative Mood



1. Indirect effect of W/P restedness through W/P Negative Mood on Negative Marital Events: $b = .002$, $z = 2.39$, $p = .017$;
2. Indirect effect of B/P restedness through B/P Negative Mood on Negative Marital Events: $b = -.04$, $z = -3.32$, $p = .001$;

Findings: Positive Mood

1. Indirect effect of W/P restedness through W/P Positive Mood on Negative Marital Events: $b = -.001$, $z = -2.12$, $p = .034$;



Questions

- What do you think about this approach?
 - Any suggestions?
 - Bootstrapping?
- Questions about MLM Mediation?
 - Neg. indirect effect?
- Example in the literature
 - Moderated mediation
- Gospel applications