

Multiple Regression: Mediation and Conditional Process Analysis

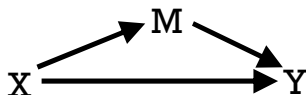
PSY 5102: Advanced Statistics for
Psychological and Behavioral Research 2

Goals

- Introduce the idea of mediation
 - Assumptions
 - Additional variables
- Introduce the idea of conditional process analysis
 - Various forms of this analysis

What is Mediation?

- Mediation is a hypothesized causal chain in which one variable (X) affects a second variable (M) which, in turn, affects a third variable (Y)



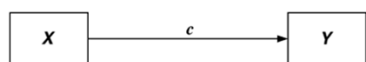
- M “mediates” the relationship between X and Y
- Mediation implies a **causal hypothesis** whereby an independent variable **causes** a mediator which, in turn, **causes** a dependent variable

Interest in Mediation

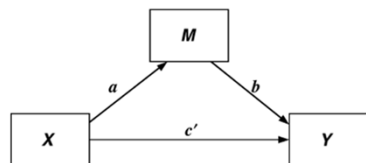
- ◉ Dramatic increase in mentions of “mediation” or “mediator” in psychology abstracts during the past few decades
- ◉ Why such interest in mediation?
 - Desire to understand the mechanisms or processes underlying behavior
 - Theoretical concerns
 - Find more proximal endpoints
 - Attempt to understand why an intervention did not work
 - Missing links
 - Compensatory processes

The Mediation Model

Panel A



Panel B



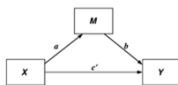
The Four Paths

- ◉ $X \rightarrow Y$: Path c
- ◉ $X \rightarrow M$: Path a
- ◉ $M \rightarrow Y$ (controlling for X): Path b
- ◉ $X \rightarrow Y$ (controlling for M): Path c'

Panel A



Panel B



The Four Paths

Path c ($X \rightarrow Y$) is the **total effect** of X on Y

Panel A

Panel B

The Four Paths

Path c' ($X \rightarrow Y$) is the **direct effect** of X on Y controlling for M

Panel A

Panel B

The Four Paths

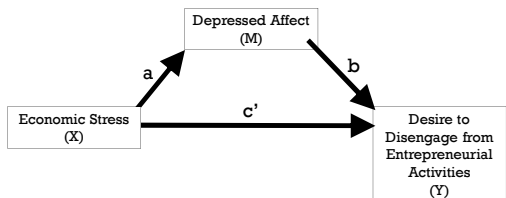
The product of Path a ($X \rightarrow M$) and Path b ($M \rightarrow Y$) is the **indirect effect** of X on Y through M (i.e., $a*b$)

Panel A

Panel B

Example

- Pollack et al. (2012) proposed that economic stress (X) leads to a desire to disengage from entrepreneurial activities (Y) as a result of depressed affect (M)

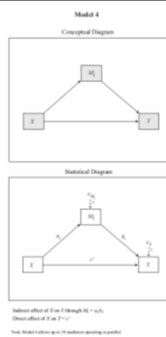


Examining Mediation Using Process

- PROCESS is a computational tool for path analysis-based moderation, mediation, and conditional process analysis (which is a combination of moderation and mediation)
- PROCESS can be downloaded from www.afhayes.com (it is free) and it can be used in conjunction with SPSS

Models from PROCESS

- PROCESS is capable of running a wide variety of analyses (there are nearly 80 models in the current version of PROCESS)
- Model 4: Simple mediation



Models from PROCESS

Model 6
(2 mediators)

Conceptual Diagram

Statistical Diagram

Indirect effect of X on Y through M1 only = a_1b_1
 Indirect effect of X on Y through M1 and M2 in serial = $a_1b_1b_2$
 Indirect effect of X on Y through M2 and M1 in serial = $a_2b_2b_1$
 Direct effect of X on Y = c_1
 See Model 4 diagram for mediator naming to avoid

Models from PROCESS

Model 6
(3 mediators)

Conceptual Diagram

Statistical Diagram

Indirect effect of X on Y through M1 only = a_1b_1
 Indirect effect of X on Y through M1 and M2 in serial = $a_1b_1b_2$
 Indirect effect of X on Y through M1, M2, and M3 in serial = $a_1b_1b_2b_3$
 Indirect effect of X on Y through M2 and M1 in serial = $a_2b_2b_1$
 Indirect effect of X on Y through M3 and M1 in serial = $a_3b_3b_1$
 Indirect effect of X on Y through M2, M3, and M1 in serial = $a_2b_2b_3b_1$
 Direct effect of X on Y = c_1

Models from PROCESS

Model 6
(4 mediators)

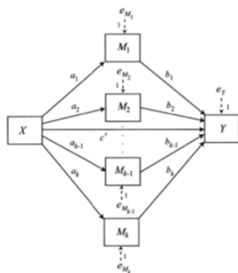
Conceptual Diagram

Statistical Diagram

Indirect effect of X on Y through M1 only = a_1b_1
 Indirect effect of X on Y through M1 and M2 in serial = $a_1b_1b_2$
 Indirect effect of X on Y through M1, M2, and M3 in serial = $a_1b_1b_2b_3$
 Indirect effect of X on Y through M1, M2, M3, and M4 in serial = $a_1b_1b_2b_3b_4$
 Indirect effect of X on Y through M2 and M1 in serial = $a_2b_2b_1$
 Indirect effect of X on Y through M3 and M1 in serial = $a_3b_3b_1$
 Indirect effect of X on Y through M4 and M1 in serial = $a_4b_4b_1$
 Indirect effect of X on Y through M2, M3, and M1 in serial = $a_2b_2b_3b_1$
 Indirect effect of X on Y through M3, M4, and M1 in serial = $a_3b_3b_4b_1$
 Indirect effect of X on Y through M2, M4, and M1 in serial = $a_2b_2b_4b_1$
 Indirect effect of X on Y through M3, M4, and M2 in serial = $a_3b_3b_4b_2$
 Direct effect of X on Y = c_1

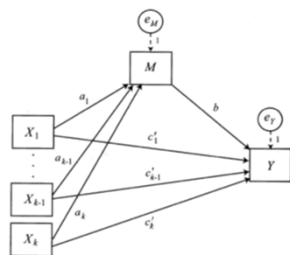
Models from PROCESS

- It is possible to run models involving multiple parallel mediators in PROCESS



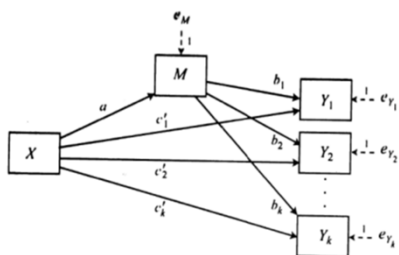
Models from PROCESS

- It is possible to run models involving multiple predictor (X) variables in PROCESS



Models from PROCESS

- It is possible to run models involving multiple outcome (Y) variables in PROCESS



Models from PROCESS

- It is possible to run models that include one or more control (C) variables in PROCESS

```

    graph LR
      X --> M
      X --> Y
      C --> M
      C --> Y
      M --> Y
    
```

Example

- We will start with a relatively simple example
- Model 4: Simple mediation
- Example: economic stress (X) leads to a desire to disengage from entrepreneurial activities (Y) as a result of depressed affect (M)

```

    graph LR
      X --> M
      X --> Y
      M --> Y
    
```

process vars=stress affect withdraw/y=withdraw/x=stress/m=affect/total=1/boot=10000/normal=1/model=4

Example

- We will start with a relatively simple example
- Model 4: Simple mediation
- Example: economic stress (X) leads to a desire to disengage from entrepreneurial activities (Y) as a result of depressed affect (M)

This part of the syntax activates PROCESS

```

    graph LR
      X --> M
      X --> Y
      M --> Y
    
```

process vars=stress affect withdraw/y=withdraw/x=stress/m=affect/total=1/boot=10000/normal=1/model=4

Example

- We will start with a relatively simple example
- Model 4: Simple mediation
- Example: economic stress (X) leads to a desire to disengage from entrepreneurial activities (Y) as a result of depressed affect (M)

This part of the syntax is the list of the variables that will be included in this analysis

`process vars=estress affect withdraw/y=withdraw/x=estress/m=effect/total=1/boot=10000/normal=1/model=4`

Example

- We will start with a relatively simple example
- Model 4: Simple mediation
- Example: economic stress (X) leads to a desire to disengage from entrepreneurial activities (Y) as a result of depressed affect (M)

This part of the syntax identifies the outcome variable (Y)

`process vars=estress affect withdraw/y=withdraw/x=estress/m=effect/total=1/boot=10000/normal=1/model=4`

Example

- We will start with a relatively simple example
- Model 4: Simple mediation
- Example: economic stress (X) leads to a desire to disengage from entrepreneurial activities (Y) as a result of depressed affect (M)

This part of the syntax identifies the predictor variable (X)

`process vars=estress affect withdraw/y=withdraw/x=estress/m=effect/total=1/boot=10000/normal=1/model=4`

Example

- We will start with a relatively simple example
- Model 4: Simple mediation
- Example: economic stress (X) leads to a desire to disengage from entrepreneurial activities (Y) as a result of depressed affect (M)

This part of the syntax identifies the mediator variable (M)

```

process vars=estress affect withdraw/y=withdraw/x=estress/m=affect/total=1/boot=10000/normal=1/model=4
    
```

Example

- We will start with a relatively simple example
- Model 4: Simple mediation
- Example: economic stress (X) leads to a desire to disengage from entrepreneurial activities (Y) as a result of depressed affect (M)

This part of the syntax requests that PROCESS generate the total effect of X on Y

```

process vars=estress affect withdraw/y=withdraw/x=estress/m=affect/total=1/boot=10000/normal=1/model=4
    
```

Example

- We will start with a relatively simple example
- Model 4: Simple mediation
- Example: economic stress (X) leads to a desire to disengage from entrepreneurial activities (Y) as a result of depressed affect (M)

This part of the syntax requests that PROCESS generate 10,000 bootstrap samples

```

process vars=estress affect withdraw/y=withdraw/x=estress/m=affect/total=1/boot=10000/normal=1/model=4
    
```

Example

- We will start with a relatively simple example
- Model 4: Simple mediation
- Example: economic stress (X) leads to a desire to disengage from entrepreneurial activities (Y) as a result of depressed affect (M)

This part of the syntax requests that PROCESS generate the normal theory-based Sobel test for the indirect effect

```

process vars=estress affect withdraw/y=withdraw/x=estress/m=affect/total=1/boot=1000/normal=1/model=4
    
```

Example

- We will start with a relatively simple example
- Model 4: Simple mediation
- Example: economic stress (X) leads to a desire to disengage from entrepreneurial activities (Y) as a result of depressed affect (M)

This part of the syntax tells PROCESS to run Model 4

```

process vars=estress affect withdraw/y=withdraw/x=estress/m=affect/total=1/boot=1000/normal=1/model=4
    
```

Example: Output from PROCESS

```

Model 1
1 = ESTRESS
2 = WITHDRAW
3 = AFFECT
4 = DEPENDIT

Sample size:
200

Outcome: DEPENDIT

Model Summary
R      F(1,197)    SS      MS      P      CI
0.3603  0.1100   31.8088  0.0002  200.0000  0.0000

Model
coeff   on      P      SS(1)  SS(2)
constant  0.7038  0.1473  0.2777  0.0000  0.3570  0.0004
DEPENDIT  0.1712  0.0036  0.0000  0.0000  0.0000  0.0000

Outcome: WITHDRAW

Model Summary
R      F(1,197)    SS      MS      P      CI
0.4247  0.1369   28.4346  0.0002  200.0000  0.0000

Model
coeff   on      P      SS(1)  SS(2)
constant  0.6971  0.0000  0.0000  0.0000  0.0000  0.0000
DEPENDIT  0.2426  0.0031  0.0007  0.0000  0.0000  0.0000
DEPENDIT  -0.2748  0.0024  0.0007  0.0007  -0.0000  0.0000

Outcome: ESTRESS

Model Summary
R      F(1,197)    SS      MS      P      CI
0.3563  0.0941   1.0718  0.0000  200.0000  0.3615

Model
coeff   on      P      SS(1)  SS(2)
constant  0.6614  0.0000  0.0000  0.0000  0.0000  0.0000
DEPENDIT  0.2563  0.0042  0.0003  0.0013  -0.0000  0.0009

===== TOTAL EFFECT MODEL =====
Outcome: DEPENDIT

Model Summary
R      F(1,197)    SS      MS      P      CI
0.3603  0.1100   31.8088  0.0002  200.0000  0.0000

Model
coeff   on      P      SS(1)  SS(2)
DEPENDIT  0.1712  0.0036  0.0000  0.0000  0.0000  0.0000

Outcome: WITHDRAW

Model Summary
R      F(1,197)    SS      MS      P      CI
0.4247  0.1369   28.4346  0.0002  200.0000  0.0000

Model
coeff   on      P      SS(1)  SS(2)
DEPENDIT  0.2426  0.0031  0.0007  0.0000  0.0000  0.0000
DEPENDIT  -0.2748  0.0024  0.0007  0.0007  -0.0000  0.0000

Outcome: ESTRESS

Model Summary
R      F(1,197)    SS      MS      P      CI
0.3563  0.0941   1.0718  0.0000  200.0000  0.3615

Model
coeff   on      P      SS(1)  SS(2)
DEPENDIT  0.2563  0.0042  0.0003  0.0013  -0.0000  0.0009

Normal theory test for indirect effect
R      F(1,197)    SS      MS      P      CI
0.1330  0.0076  0.0000  0.0000  0.0000  0.0000

===== ANALYSIS NOTES AND WARNINGS =====
Number of bootstrap samples for bias corrected bootstrap confidence intervals:
10000000
Level of confidence for all confidence intervals is set to:
95.0000
    
```

**Example:
Output from PROCESS**

This tells you which model was used

```

Model 1
  1 = Outcome
  2 = Mediator
  3 = Predictor

Sample size: 200

-----
Outcome: MEDIATE
Model Summary
  R      F(1, 198)    p      CI
  0.3401  0.1124    0.2898    1.0000    200.0000    0.3605

Coeff      SE      p      LLCI      ULCI
Constant  0.7494  0.1433  0.0000  0.3570  1.0824
MEDIATE   0.1702  0.0276  0.0000  0.0999  0.2405

Outcome: WITHDRAWAL
Model Summary
  R      F(1, 198)    p      CI
  0.4247  0.1824    0.1666    1.0000    200.0000    0.3605

Coeff      SE      p      LLCI      ULCI
Constant  0.4671  0.0887  0.0000  0.2885  0.6457
MEDIATE   0.1465  0.0216  0.0000  0.0987  0.2003
MEDIATE2  -0.0748  0.0204  0.0000  -0.1187  -0.0309

-----
TOTAL EFFECTS MODEL
Outcome: WITHDRAWAL
Model Summary
  R      F(1, 198)    p      CI
  0.3561  0.1261    0.2618    1.0000    200.0000    0.3605

Coeff      SE      p      LLCI      ULCI
Constant  0.5612  0.0987  0.0000  0.3625  0.7600
MEDIATE   0.1465  0.0216  0.0000  0.0987  0.2003
MEDIATE2  -0.0748  0.0204  0.0000  -0.1187  -0.0309

-----
TOTAL, DIRECT AND INDIRECT EFFECTS
Direct effect of X on Y
Effect      SE      p      LLCI      ULCI
MEDIATE    0.1465  0.0216  0.0000  0.0987  0.2003

Indirect effect of X on Y
Effect      SE      p      LLCI      ULCI
MEDIATE2  -0.0748  0.0204  0.0000  -0.1187  -0.0309

-----
INDIRECT EFFECTS MODEL
Outcome: WITHDRAWAL
Model Summary
  R      F(1, 198)    p      CI
  0.3561  0.1261    0.2618    1.0000    200.0000    0.3605

Coeff      SE      p      LLCI      ULCI
Constant  0.5612  0.0987  0.0000  0.3625  0.7600
MEDIATE   0.1465  0.0216  0.0000  0.0987  0.2003
MEDIATE2  -0.0748  0.0204  0.0000  -0.1187  -0.0309

-----
ANALYSIS NOTES AND WARNINGS
Number of bootstrap samples for bias corrected bootstrap confidence intervals: 5000
Level of confidence for all confidence intervals is output: 95.0000
    
```

**Example:
Output from PROCESS**

This tells you which variables were included in the analysis

```

Model 1
  1 = Outcome
  2 = Mediator
  3 = Predictor

Sample size: 200

-----
Outcome: MEDIATE
Model Summary
  R      F(1, 198)    p      CI
  0.3401  0.1124    0.2898    1.0000    200.0000    0.3605

Coeff      SE      p      LLCI      ULCI
Constant  0.7494  0.1433  0.0000  0.3570  1.0824
MEDIATE   0.1702  0.0276  0.0000  0.0999  0.2405

Outcome: WITHDRAWAL
Model Summary
  R      F(1, 198)    p      CI
  0.4247  0.1824    0.1666    1.0000    200.0000    0.3605

Coeff      SE      p      LLCI      ULCI
Constant  0.4671  0.0887  0.0000  0.2885  0.6457
MEDIATE   0.1465  0.0216  0.0000  0.0987  0.2003
MEDIATE2  -0.0748  0.0204  0.0000  -0.1187  -0.0309

-----
TOTAL EFFECTS MODEL
Outcome: WITHDRAWAL
Model Summary
  R      F(1, 198)    p      CI
  0.3561  0.1261    0.2618    1.0000    200.0000    0.3605

Coeff      SE      p      LLCI      ULCI
Constant  0.5612  0.0987  0.0000  0.3625  0.7600
MEDIATE   0.1465  0.0216  0.0000  0.0987  0.2003
MEDIATE2  -0.0748  0.0204  0.0000  -0.1187  -0.0309

-----
TOTAL, DIRECT AND INDIRECT EFFECTS
Direct effect of X on Y
Effect      SE      p      LLCI      ULCI
MEDIATE    0.1465  0.0216  0.0000  0.0987  0.2003

Indirect effect of X on Y
Effect      SE      p      LLCI      ULCI
MEDIATE2  -0.0748  0.0204  0.0000  -0.1187  -0.0309

-----
INDIRECT EFFECTS MODEL
Outcome: WITHDRAWAL
Model Summary
  R      F(1, 198)    p      CI
  0.3561  0.1261    0.2618    1.0000    200.0000    0.3605

Coeff      SE      p      LLCI      ULCI
Constant  0.5612  0.0987  0.0000  0.3625  0.7600
MEDIATE   0.1465  0.0216  0.0000  0.0987  0.2003
MEDIATE2  -0.0748  0.0204  0.0000  -0.1187  -0.0309

-----
ANALYSIS NOTES AND WARNINGS
Number of bootstrap samples for bias corrected bootstrap confidence intervals: 5000
Level of confidence for all confidence intervals is output: 95.0000
    
```

**Example:
Output from PROCESS**

This tells you the sample size

```

Model 1
  1 = Outcome
  2 = Mediator
  3 = Predictor

Sample size: 200

-----
Outcome: MEDIATE
Model Summary
  R      F(1, 198)    p      CI
  0.3401  0.1124    0.2898    1.0000    200.0000    0.3605

Coeff      SE      p      LLCI      ULCI
Constant  0.7494  0.1433  0.0000  0.3570  1.0824
MEDIATE   0.1702  0.0276  0.0000  0.0999  0.2405

Outcome: WITHDRAWAL
Model Summary
  R      F(1, 198)    p      CI
  0.4247  0.1824    0.1666    1.0000    200.0000    0.3605

Coeff      SE      p      LLCI      ULCI
Constant  0.4671  0.0887  0.0000  0.2885  0.6457
MEDIATE   0.1465  0.0216  0.0000  0.0987  0.2003
MEDIATE2  -0.0748  0.0204  0.0000  -0.1187  -0.0309

-----
TOTAL EFFECTS MODEL
Outcome: WITHDRAWAL
Model Summary
  R      F(1, 198)    p      CI
  0.3561  0.1261    0.2618    1.0000    200.0000    0.3605

Coeff      SE      p      LLCI      ULCI
Constant  0.5612  0.0987  0.0000  0.3625  0.7600
MEDIATE   0.1465  0.0216  0.0000  0.0987  0.2003
MEDIATE2  -0.0748  0.0204  0.0000  -0.1187  -0.0309

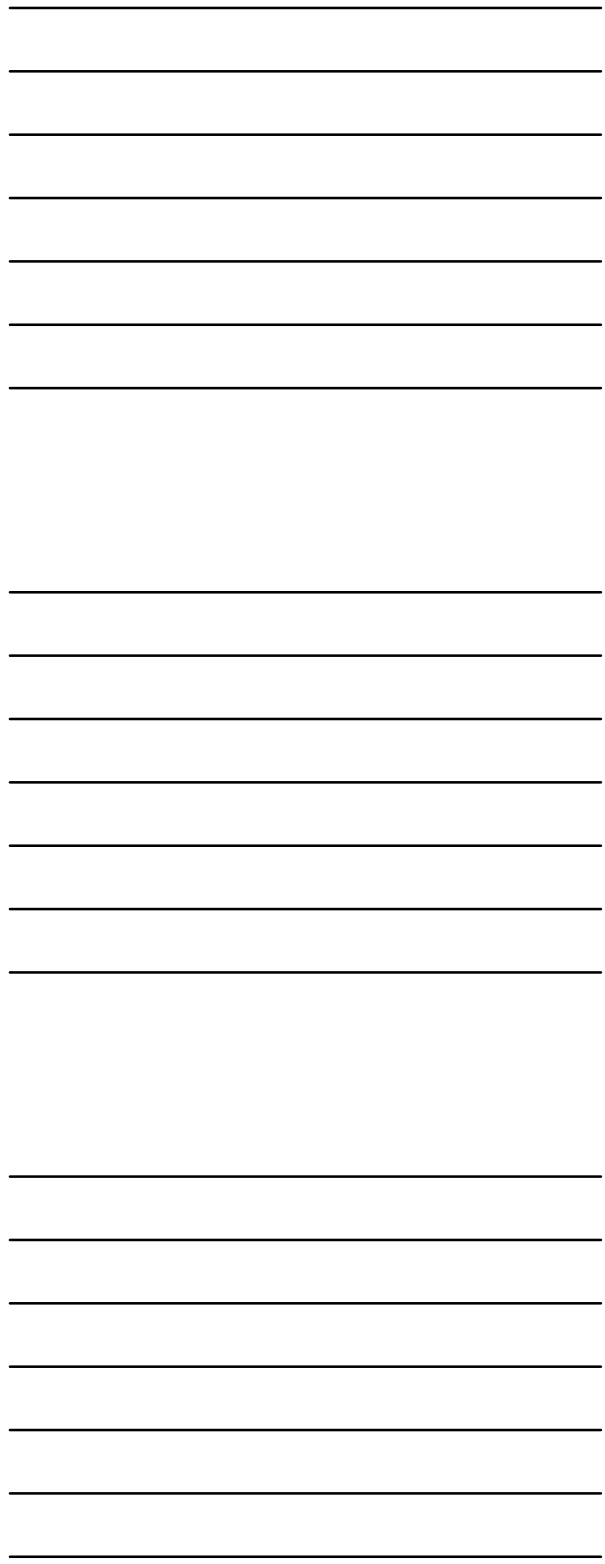
-----
TOTAL, DIRECT AND INDIRECT EFFECTS
Direct effect of X on Y
Effect      SE      p      LLCI      ULCI
MEDIATE    0.1465  0.0216  0.0000  0.0987  0.2003

Indirect effect of X on Y
Effect      SE      p      LLCI      ULCI
MEDIATE2  -0.0748  0.0204  0.0000  -0.1187  -0.0309

-----
INDIRECT EFFECTS MODEL
Outcome: WITHDRAWAL
Model Summary
  R      F(1, 198)    p      CI
  0.3561  0.1261    0.2618    1.0000    200.0000    0.3605

Coeff      SE      p      LLCI      ULCI
Constant  0.5612  0.0987  0.0000  0.3625  0.7600
MEDIATE   0.1465  0.0216  0.0000  0.0987  0.2003
MEDIATE2  -0.0748  0.0204  0.0000  -0.1187  -0.0309

-----
ANALYSIS NOTES AND WARNINGS
Number of bootstrap samples for bias corrected bootstrap confidence intervals: 5000
Level of confidence for all confidence intervals is output: 95.0000
    
```



Example: Output from PROCESS

This tells you about Path a (X → M).

Model	B	SE	beta	CI	LL	UL	p
Model Summary	R	0.746					0.000
	Adjusted R	0.729					0.000
	F	33.868					288.000
	df	1, 288					0.000
	Prob > F						0.000
	Tolerance	0.749					0.000
	VIF	1.335					0.242
	Collinearity	0.172					0.000



Example: Output from PROCESS

R² for AFFECT (M) represents the amount of variance in AFFECT (M) that is explained by ESTRESS (X). To express this value as a percentage, you should multiply this value by 100.

Model	B	SE	beta	CI	LL	UL	p
Model Summary	R	0.746					0.000
	Adjusted R	0.729					0.000
	F	33.868					288.000
	df	1, 288					0.000
	Prob > F						0.000
	Tolerance	0.749					0.000
	VIF	1.335					0.242
	Collinearity	0.172					0.000



Example: Output from PROCESS

Constant is the Y-intercept for this model.

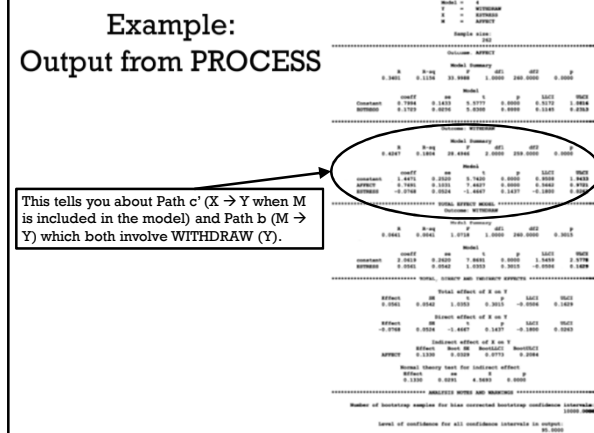
The row for ESTRESS represents the association between ESTRESS (X) and AFFECT (M). The coefficient is .1729 with a t-value of 5.8308 and a p-value of 0.0000 which means that ESTRESS (X) has a significant positive association with AFFECT (M).

Model	B	SE	beta	CI	LL	UL	p
Model Summary	R	0.746					0.000
	Adjusted R	0.729					0.000
	F	33.868					288.000
	df	1, 288					0.000
	Prob > F						0.000
	Tolerance	0.749					0.000
	VIF	1.335					0.242
	Collinearity	0.172					0.000



**Example:
Output from PROCESS**

This tells you about Path c' ($X \rightarrow Y$ when M is included in the model) and Path b ($M \rightarrow Y$) which both involve WITHDRAW (Y).



```

Model = 3
  X = ESTRESS
  M = WITHDRAW
  Y = AFFECT
  Sample Size = 250

-----
Outcome: AFFECT
-----
Model Summary
-----
R              F              df              p              CI
0.3401    0.1129    33.8988    1.0000    298.0000    0.0000

Coefficients:
-----
Model              F              p              LLCI              ULCI
Constant    0.7938    0.1433    0.2377    0.0000    0.3570    1.0894
ESTRESS    0.1702    0.4976    0.4806    0.0000    0.1189    0.2309

Outcome: WITHDRAW
-----
Model Summary
-----
R              F              df              p              CI
0.4247    0.1424    33.8988    1.0000    298.0000    0.0000

Coefficients:
-----
Model              F              p              LLCI              ULCI
Constant    0.7434    0.1433    0.2377    0.0000    0.3570    1.0894
ESTRESS    0.2426    0.2331    0.4807    0.0000    0.1480    0.3392
WITHDRAW   -0.2748    0.0024    1.4687    0.1637    -0.1899    0.0383

-----
TOTAL EFFECT MODEL
-----
Outcome: WITHDRAW
-----
Model Summary
-----
R              F              df              p              CI
0.3561    0.1041    1.0714    1.0000    298.0000    0.3615

Coefficients:
-----
Model              F              p              LLCI              ULCI
Constant    0.8662    0.0000    0.0000    0.0000    0.8460    0.8778
WITHDRAW   -0.0561    0.2562    1.0000    0.3615    -0.0559    0.1499

-----
TOTAL, DIRECT AND INDIRECT EFFECTS
-----
Direct effect of X on Y
-----
Estimate    SE              LLCI              ULCI
WITHDRAW    0.2426    0.0024    0.2377    0.2475

Indirect effect of X on Y
-----
Estimate    SE              LLCI              ULCI
WITHDRAW    -0.2748    0.0024    -0.2867    -0.1830

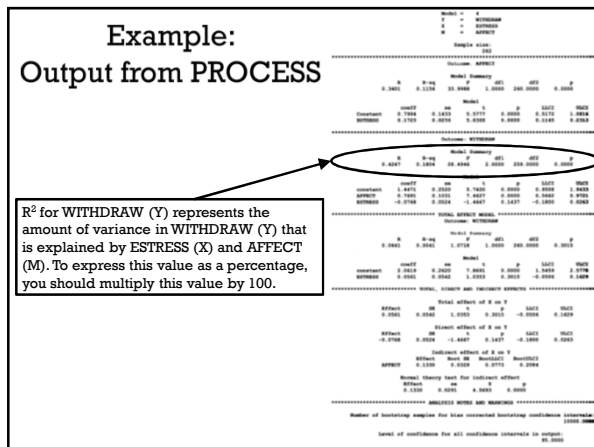
Indirect effect of X on Y
-----
Estimate    SE              LLCI              ULCI
WITHDRAW    0.1129    0.0024    0.1081    0.1175

Model Fit: GFI = 0.9999, RMSEA = 0.0000, CFI = 1.0000
Model chi-square test for indirect effect
-----
Estimate    SE              LLCI              ULCI
WITHDRAW    0.1129    0.0024    0.1081    0.1175

-----
ANALYSIS NOTES AND WARNINGS
-----
Number of bootstrap samples for bias corrected bootstrap confidence intervals: 10000
Level of confidence for all confidence intervals is: 95.0000
  
```

**Example:
Output from PROCESS**

R² for WITHDRAW (Y) represents the amount of variance in WITHDRAW (Y) that is explained by ESTRESS (X) and AFFECT (M). To express this value as a percentage, you should multiply this value by 100.



```

Model = 3
  X = ESTRESS
  M = WITHDRAW
  Y = AFFECT
  Sample Size = 250

-----
Outcome: AFFECT
-----
Model Summary
-----
R              F              df              p              CI
0.3401    0.1129    33.8988    1.0000    298.0000    0.0000

Coefficients:
-----
Model              F              p              LLCI              ULCI
Constant    0.7938    0.1433    0.2377    0.0000    0.3570    1.0894
ESTRESS    0.1702    0.4976    0.4806    0.0000    0.1189    0.2309

Outcome: WITHDRAW
-----
Model Summary
-----
R              F              df              p              CI
0.4247    0.1424    33.8988    1.0000    298.0000    0.0000

Coefficients:
-----
Model              F              p              LLCI              ULCI
Constant    0.7434    0.1433    0.2377    0.0000    0.3570    1.0894
ESTRESS    0.2426    0.2331    0.4807    0.0000    0.1480    0.3392
WITHDRAW   -0.2748    0.0024    1.4687    0.1637    -0.1899    0.0383

-----
TOTAL EFFECT MODEL
-----
Outcome: WITHDRAW
-----
Model Summary
-----
R              F              df              p              CI
0.3561    0.1041    1.0714    1.0000    298.0000    0.3615

Coefficients:
-----
Model              F              p              LLCI              ULCI
Constant    0.8662    0.0000    0.0000    0.0000    0.8460    0.8778
WITHDRAW   -0.0561    0.2562    1.0000    0.3615    -0.0559    0.1499

-----
TOTAL, DIRECT AND INDIRECT EFFECTS
-----
Direct effect of X on Y
-----
Estimate    SE              LLCI              ULCI
WITHDRAW    0.2426    0.0024    0.2377    0.2475

Indirect effect of X on Y
-----
Estimate    SE              LLCI              ULCI
WITHDRAW    -0.2748    0.0024    -0.2867    -0.1830

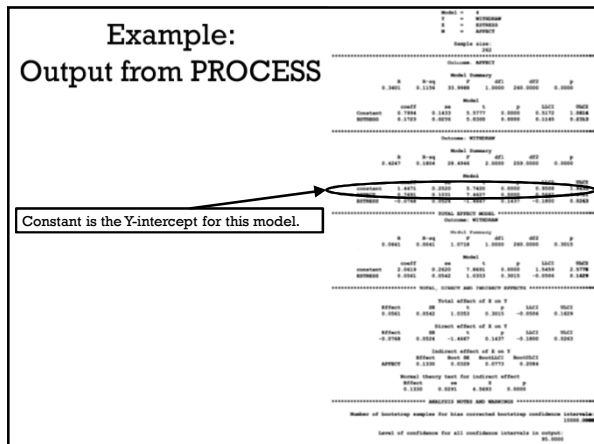
Indirect effect of X on Y
-----
Estimate    SE              LLCI              ULCI
WITHDRAW    0.1129    0.0024    0.1081    0.1175

Model Fit: GFI = 0.9999, RMSEA = 0.0000, CFI = 1.0000
Model chi-square test for indirect effect
-----
Estimate    SE              LLCI              ULCI
WITHDRAW    0.1129    0.0024    0.1081    0.1175

-----
ANALYSIS NOTES AND WARNINGS
-----
Number of bootstrap samples for bias corrected bootstrap confidence intervals: 10000
Level of confidence for all confidence intervals is: 95.0000
  
```

**Example:
Output from PROCESS**

Constant is the Y-intercept for this model.



```

Model = 3
  X = ESTRESS
  M = WITHDRAW
  Y = AFFECT
  Sample Size = 250

-----
Outcome: AFFECT
-----
Model Summary
-----
R              F              df              p              CI
0.3401    0.1129    33.8988    1.0000    298.0000    0.0000

Coefficients:
-----
Model              F              p              LLCI              ULCI
Constant    0.7938    0.1433    0.2377    0.0000    0.3570    1.0894
ESTRESS    0.1702    0.4976    0.4806    0.0000    0.1189    0.2309

Outcome: WITHDRAW
-----
Model Summary
-----
R              F              df              p              CI
0.4247    0.1424    33.8988    1.0000    298.0000    0.0000

Coefficients:
-----
Model              F              p              LLCI              ULCI
Constant    0.7434    0.1433    0.2377    0.0000    0.3570    1.0894
ESTRESS    0.2426    0.2331    0.4807    0.0000    0.1480    0.3392
WITHDRAW   -0.2748    0.0024    1.4687    0.1637    -0.1899    0.0383

-----
TOTAL EFFECT MODEL
-----
Outcome: WITHDRAW
-----
Model Summary
-----
R              F              df              p              CI
0.3561    0.1041    1.0714    1.0000    298.0000    0.3615

Coefficients:
-----
Model              F              p              LLCI              ULCI
Constant    0.8662    0.0000    0.0000    0.0000    0.8460    0.8778
WITHDRAW   -0.0561    0.2562    1.0000    0.3615    -0.0559    0.1499

-----
TOTAL, DIRECT AND INDIRECT EFFECTS
-----
Direct effect of X on Y
-----
Estimate    SE              LLCI              ULCI
WITHDRAW    0.2426    0.0024    0.2377    0.2475

Indirect effect of X on Y
-----
Estimate    SE              LLCI              ULCI
WITHDRAW    -0.2748    0.0024    -0.2867    -0.1830

Indirect effect of X on Y
-----
Estimate    SE              LLCI              ULCI
WITHDRAW    0.1129    0.0024    0.1081    0.1175

Model Fit: GFI = 0.9999, RMSEA = 0.0000, CFI = 1.0000
Model chi-square test for indirect effect
-----
Estimate    SE              LLCI              ULCI
WITHDRAW    0.1129    0.0024    0.1081    0.1175

-----
ANALYSIS NOTES AND WARNINGS
-----
Number of bootstrap samples for bias corrected bootstrap confidence intervals: 10000
Level of confidence for all confidence intervals is: 95.0000
  
```

Example: Output from PROCESS

The row for AFFECT represents the association between AFFECT (M) and WITHDRAW (Y). The coefficient is .7691 with a t-value of 7.4627 and a p-value of 0.0000 which means that AFFECT (M) has a significant positive association with WITHDRAW (Y).

```

Model 1
1 = WITHDRAW
2 = ESTRESS
3 = AFFECT
Sample Size = 200

Outcome: AFFECT
Model Summary
R      F(1, 198)    SS      MS      P
0.3601  0.1129  33.8988  33.8988  0.0000

Coefficients
Model 1
          B      SE      P      LLCI     ULCI
Constant  0.7924  0.1433  0.0000  0.5050  1.0798
AFFECT    0.7691  0.1029  0.0000  0.5633  0.9749
WITHDRAW  0.1702  0.0276  0.0000  0.1150  0.2254

Outcome: WITHDRAW
Model Summary
R      F(2, 196)    SS      MS      P
0.4247  0.1824  28.4246  14.2123  0.0000

Coefficients
Model 1
          B      SE      P      LLCI     ULCI
Constant  0.2212  0.0802  0.0000  0.0608  0.3816
AFFECT    0.7691  0.1029  0.0000  0.5633  0.9749
WITHDRAW  0.2212  0.0802  0.0000  0.0608  0.3816

Outcome: ESTRESS
Model Summary
R      F(2, 196)    SS      MS      P
0.2861  0.0541  1.0714  0.5357  0.3615

Coefficients
Model 1
          B      SE      P      LLCI     ULCI
Constant  0.0612  0.0207  0.0000  0.0198  0.1026
AFFECT    0.2861  0.0207  0.0000  0.2447  0.3275
WITHDRAW  0.2861  0.0207  0.0000  0.2447  0.3275

Total, Direct and Indirect Effects
Direct effect of X on Y
AFFECT    0.7691  0.1029  0.0000  0.5633  0.9749
WITHDRAW  0.1702  0.0276  0.0000  0.1150  0.2254
Indirect effect of X on Y
AFFECT    0.1337  0.0208  0.0000  0.0921  0.1754
Model Change Test for Indirect Effect
Z(1) = 1.3337  0.0000  0.0000
Number of bootstrap samples for bias corrected bootstrap confidence intervals = 5000
Level of confidence for all confidence intervals is output = 95.0000
    
```



Example: Output from PROCESS

The row for ESTRESS represents the association between ESTRESS (X) and WITHDRAW (Y). The coefficient is -0.0768 with a t-value of -1.4667 and a p-value of 0.1437 which means that ESTRESS (X) does not have a significant association with WITHDRAW (Y) when AFFECT (M) is included in the model.

```

Model 1
1 = WITHDRAW
2 = ESTRESS
3 = AFFECT
Sample Size = 200

Outcome: AFFECT
Model Summary
R      F(1, 198)    SS      MS      P
0.3601  0.1129  33.8988  33.8988  0.0000

Coefficients
Model 1
          B      SE      P      LLCI     ULCI
Constant  0.7924  0.1433  0.0000  0.5050  1.0798
AFFECT    0.7691  0.1029  0.0000  0.5633  0.9749
WITHDRAW  0.1702  0.0276  0.0000  0.1150  0.2254

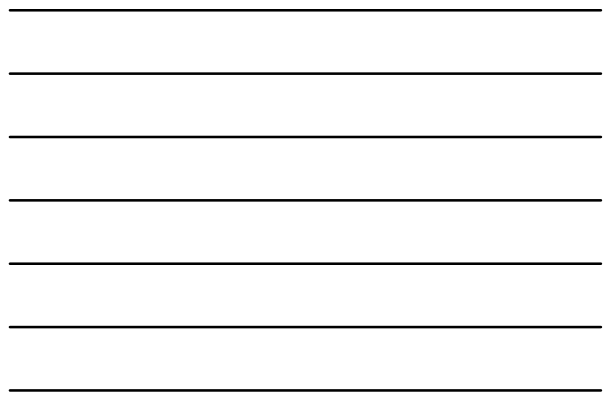
Outcome: WITHDRAW
Model Summary
R      F(2, 196)    SS      MS      P
0.4247  0.1824  28.4246  14.2123  0.0000

Coefficients
Model 1
          B      SE      P      LLCI     ULCI
Constant  0.2212  0.0802  0.0000  0.0608  0.3816
AFFECT    0.7691  0.1029  0.0000  0.5633  0.9749
WITHDRAW  0.2212  0.0802  0.0000  0.0608  0.3816

Outcome: ESTRESS
Model Summary
R      F(2, 196)    SS      MS      P
0.2861  0.0541  1.0714  0.5357  0.3615

Coefficients
Model 1
          B      SE      P      LLCI     ULCI
Constant  0.0612  0.0207  0.0000  0.0198  0.1026
AFFECT    0.2861  0.0207  0.0000  0.2447  0.3275
WITHDRAW  0.2861  0.0207  0.0000  0.2447  0.3275

Total, Direct and Indirect Effects
Direct effect of X on Y
AFFECT    0.7691  0.1029  0.0000  0.5633  0.9749
WITHDRAW  0.1702  0.0276  0.0000  0.1150  0.2254
Indirect effect of X on Y
AFFECT    0.1337  0.0208  0.0000  0.0921  0.1754
Model Change Test for Indirect Effect
Z(1) = 1.3337  0.0000  0.0000
Number of bootstrap samples for bias corrected bootstrap confidence intervals = 5000
Level of confidence for all confidence intervals is output = 95.0000
    
```



Example: Output from PROCESS

This tells you about Path c (X → Y when M is not included in the model).

```

Model 1
1 = WITHDRAW
2 = ESTRESS
3 = AFFECT
Sample Size = 200

Outcome: AFFECT
Model Summary
R      F(1, 198)    SS      MS      P
0.3601  0.1129  33.8988  33.8988  0.0000

Coefficients
Model 1
          B      SE      P      LLCI     ULCI
Constant  0.7924  0.1433  0.0000  0.5050  1.0798
AFFECT    0.7691  0.1029  0.0000  0.5633  0.9749
WITHDRAW  0.1702  0.0276  0.0000  0.1150  0.2254

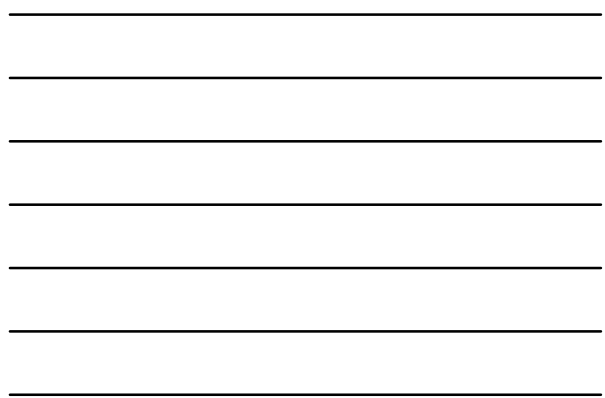
Outcome: WITHDRAW
Model Summary
R      F(2, 196)    SS      MS      P
0.4247  0.1824  28.4246  14.2123  0.0000

Coefficients
Model 1
          B      SE      P      LLCI     ULCI
Constant  0.2212  0.0802  0.0000  0.0608  0.3816
AFFECT    0.7691  0.1029  0.0000  0.5633  0.9749
WITHDRAW  0.2212  0.0802  0.0000  0.0608  0.3816

Outcome: ESTRESS
Model Summary
R      F(2, 196)    SS      MS      P
0.2861  0.0541  1.0714  0.5357  0.3615

Coefficients
Model 1
          B      SE      P      LLCI     ULCI
Constant  0.0612  0.0207  0.0000  0.0198  0.1026
AFFECT    0.2861  0.0207  0.0000  0.2447  0.3275
WITHDRAW  0.2861  0.0207  0.0000  0.2447  0.3275

Total, Direct and Indirect Effects
Direct effect of X on Y
AFFECT    0.7691  0.1029  0.0000  0.5633  0.9749
WITHDRAW  0.1702  0.0276  0.0000  0.1150  0.2254
Indirect effect of X on Y
AFFECT    0.1337  0.0208  0.0000  0.0921  0.1754
Model Change Test for Indirect Effect
Z(1) = 1.3337  0.0000  0.0000
Number of bootstrap samples for bias corrected bootstrap confidence intervals = 5000
Level of confidence for all confidence intervals is output = 95.0000
    
```



Example: Output from PROCESS

R^2 for the TOTAL EFFECT MODEL represents the amount of variance in WITHDRAW (Y) that is explained by ESTRESS (X) when AFFECT (M) is not included in the model. To express this value as a percentage, you should multiply this value by 100.

```

Model 1
  Y = WITHDRAW
  X = ESTRESS
  M = AFFECT
  Sample size = 200

-----
Outcome: AFFECT

Model Summary
  R      F(1, 198)    SS Regression    MS Regression    F          Sig.
1     0.176    33.898     1.033    1.033    200.000    0.000

Coefficients
  Constant    0.749    0.143    0.277    0.000    0.317    0.000
  ESTRESS     0.172    0.076    0.000    0.000    0.000    0.100

Outcome: WITHDRAW

Model Summary
  R      F(2, 196)    SS Regression    MS Regression    F          Sig.
1     0.427    128.426     2.000    1.000    200.000    0.000

Coefficients
  Constant    0.461    0.080    0.162    0.000    0.000    0.940
  AFFECT      0.740    0.215    7.487    0.000    0.340    0.000
  ESTRESS    -0.274    0.024    0.467    0.000    0.147    0.100

-----
Outcome: WITHDRAW

TOTAL EFFECT MODEL
Model Summary
  R      F(1, 198)    SS Regression    MS Regression    F          Sig.
1     0.061    1.074     1.000    1.000    200.000    0.302

Coefficients
  Constant    0.661    0.080    0.162    0.000    0.000    0.940
  ESTRESS     0.061    0.001    1.033    0.001    0.302    0.100

-----
Outcome: WITHDRAW

Model Summary
  R      F(2, 196)    SS Regression    MS Regression    F          Sig.
1     0.061    1.074     1.000    1.000    200.000    0.302

Coefficients
  Constant    0.661    0.080    0.162    0.000    0.000    0.940
  AFFECT      0.740    0.215    7.487    0.000    0.340    0.000
  ESTRESS    -0.274    0.024    0.467    0.000    0.147    0.100

-----
Outcome: WITHDRAW

TOTAL, DIRECT AND INDIRECT EFFECTS
Direct effect of X on Y
  Effect    B      SE      Z      Sig.
ESTRESS    0.061    0.019    3.015    0.000

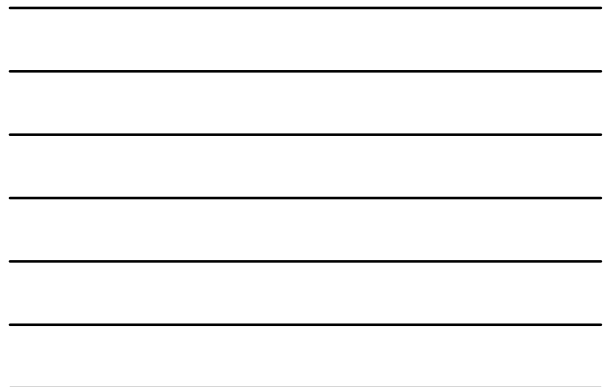
Indirect effect of X on Y
  Effect    B      SE      Z      Sig.
ESTRESS    -0.274    0.024    -11.467    0.000

Indirect effect of X on Y
  Effect    B      SE      Z      Sig.
AFFECT     0.215    0.019    11.051    0.000

Model Change Test for Indirect Effect
  Effect    B      SE      Z      Sig.
AFFECT     0.215    0.019    11.051    0.000

Model Change Test for Indirect Effect
  Effect    B      SE      Z      Sig.
ESTRESS    -0.274    0.024    -11.467    0.000

-----
ANALYSIS NOTES AND WARNINGS
Number of bootstrap samples for bias corrected bootstrap confidence intervals: 5000
Level of confidence for all confidence intervals is: 95.00%
    
```



Example: Output from PROCESS

Constant is the Y-intercept for this model.

```

Model 1
  Y = WITHDRAW
  X = ESTRESS
  M = AFFECT
  Sample size = 200

-----
Outcome: AFFECT

Model Summary
  R      F(1, 198)    SS Regression    MS Regression    F          Sig.
1     0.176    33.898     1.033    1.033    200.000    0.000

Coefficients
  Constant    0.749    0.143    0.277    0.000    0.317    0.000
  ESTRESS     0.172    0.076    0.000    0.000    0.000    0.100

Outcome: WITHDRAW

Model Summary
  R      F(2, 196)    SS Regression    MS Regression    F          Sig.
1     0.427    128.426     2.000    1.000    200.000    0.000

Coefficients
  Constant    0.461    0.080    0.162    0.000    0.000    0.940
  AFFECT      0.740    0.215    7.487    0.000    0.340    0.000
  ESTRESS    -0.274    0.024    0.467    0.000    0.147    0.100

-----
Outcome: WITHDRAW

TOTAL EFFECT MODEL
Model Summary
  R      F(1, 198)    SS Regression    MS Regression    F          Sig.
1     0.061    1.074     1.000    1.000    200.000    0.302

Coefficients
  Constant    0.661    0.080    0.162    0.000    0.000    0.940
  ESTRESS     0.061    0.001    1.033    0.001    0.302    0.100

-----
Outcome: WITHDRAW

Model Summary
  R      F(2, 196)    SS Regression    MS Regression    F          Sig.
1     0.061    1.074     1.000    1.000    200.000    0.302

Coefficients
  Constant    0.661    0.080    0.162    0.000    0.000    0.940
  AFFECT      0.740    0.215    7.487    0.000    0.340    0.000
  ESTRESS    -0.274    0.024    0.467    0.000    0.147    0.100

-----
Outcome: WITHDRAW

TOTAL, DIRECT AND INDIRECT EFFECTS
Direct effect of X on Y
  Effect    B      SE      Z      Sig.
ESTRESS    0.061    0.019    3.015    0.000

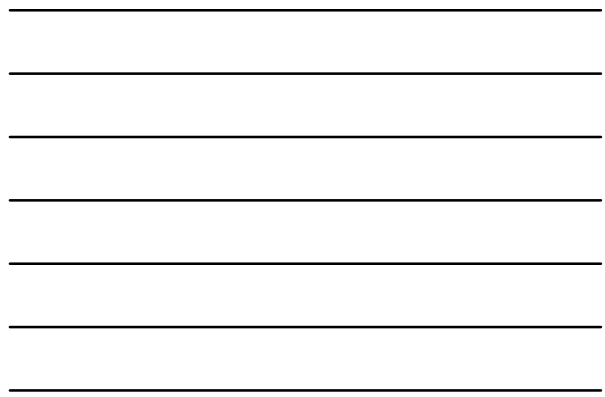
Indirect effect of X on Y
  Effect    B      SE      Z      Sig.
ESTRESS    -0.274    0.024    -11.467    0.000

Indirect effect of X on Y
  Effect    B      SE      Z      Sig.
AFFECT     0.215    0.019    11.051    0.000

Model Change Test for Indirect Effect
  Effect    B      SE      Z      Sig.
AFFECT     0.215    0.019    11.051    0.000

Model Change Test for Indirect Effect
  Effect    B      SE      Z      Sig.
ESTRESS    -0.274    0.024    -11.467    0.000

-----
ANALYSIS NOTES AND WARNINGS
Number of bootstrap samples for bias corrected bootstrap confidence intervals: 5000
Level of confidence for all confidence intervals is: 95.00%
    
```



Example: Output from PROCESS

The row for ESTRESS represents the association between ESTRESS (X) and WITHDRAW (Y). The coefficient is 0.0561 with a t-value of 1.0353 and a p-value of 0.3015 which means that ESTRESS (X) does not have a significant association with WITHDRAW (Y) even when AFFECT (M) is NOT included in the model.

```

Model 1
  Y = WITHDRAW
  X = ESTRESS
  M = AFFECT
  Sample size = 200

-----
Outcome: AFFECT

Model Summary
  R      F(1, 198)    SS Regression    MS Regression    F          Sig.
1     0.176    33.898     1.033    1.033    200.000    0.000

Coefficients
  Constant    0.749    0.143    0.277    0.000    0.317    0.000
  ESTRESS     0.172    0.076    0.000    0.000    0.000    0.100

Outcome: WITHDRAW

Model Summary
  R      F(2, 196)    SS Regression    MS Regression    F          Sig.
1     0.427    128.426     2.000    1.000    200.000    0.000

Coefficients
  Constant    0.461    0.080    0.162    0.000    0.000    0.940
  AFFECT      0.740    0.215    7.487    0.000    0.340    0.000
  ESTRESS    -0.274    0.024    0.467    0.000    0.147    0.100

-----
Outcome: WITHDRAW

TOTAL EFFECT MODEL
Model Summary
  R      F(1, 198)    SS Regression    MS Regression    F          Sig.
1     0.061    1.074     1.000    1.000    200.000    0.302

Coefficients
  Constant    0.661    0.080    0.162    0.000    0.000    0.940
  ESTRESS     0.061    0.001    1.033    0.001    0.302    0.100

-----
Outcome: WITHDRAW

Model Summary
  R      F(2, 196)    SS Regression    MS Regression    F          Sig.
1     0.061    1.074     1.000    1.000    200.000    0.302

Coefficients
  Constant    0.661    0.080    0.162    0.000    0.000    0.940
  AFFECT      0.740    0.215    7.487    0.000    0.340    0.000
  ESTRESS    -0.274    0.024    0.467    0.000    0.147    0.100

-----
Outcome: WITHDRAW

TOTAL, DIRECT AND INDIRECT EFFECTS
Direct effect of X on Y
  Effect    B      SE      Z      Sig.
ESTRESS    0.061    0.019    3.015    0.000

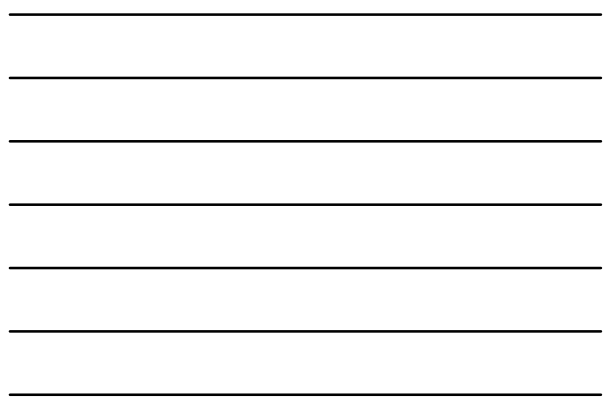
Indirect effect of X on Y
  Effect    B      SE      Z      Sig.
ESTRESS    -0.274    0.024    -11.467    0.000

Indirect effect of X on Y
  Effect    B      SE      Z      Sig.
AFFECT     0.215    0.019    11.051    0.000

Model Change Test for Indirect Effect
  Effect    B      SE      Z      Sig.
AFFECT     0.215    0.019    11.051    0.000

Model Change Test for Indirect Effect
  Effect    B      SE      Z      Sig.
ESTRESS    -0.274    0.024    -11.467    0.000

-----
ANALYSIS NOTES AND WARNINGS
Number of bootstrap samples for bias corrected bootstrap confidence intervals: 5000
Level of confidence for all confidence intervals is: 95.00%
    
```



Bootstrap Confidence Interval

- ◎ PROCESS uses a bootstrapping approach to estimate the confidence interval for the indirect effect
- ◎ Steps for constructing the bootstrap confidence interval
 1. Take a random sample of n cases from the original sample (sampled with replacement) where n is the size of the original sample. This is called a bootstrap sample.
 2. Estimate the indirect effect ($a*b$) in this bootstrap sample.
 3. Repeat Steps 1 and 2 a total of k times (k is usually a large number such as 10,000) saving the value of $a*b$ for each bootstrap sample.
 4. Sort the k indirect effects ($a*b$) from each bootstrap sample from low to high.
 5. Find the lower bound and upper bound of the 95% confidence interval.
 6. If the 95% confidence interval does not contain 0, then the indirect effect is significant (i.e., mediation is supported).

Previous Approaches to Mediation

- ◎ The most popular approach to mediation in the past was **the causal steps approach** which is also referred to as **the Baron and Kenny approach**
- ◎ Problems with the Baron and Kenny approach...
 1. It does not formally quantify the indirect effect nor does it require an inferential test about the indirect effect.
 2. The ability to claim that M is a mediator depends of rejecting three null hypotheses (Path c , Path a , and Path b) which makes it a relatively low power approach for detecting indirect effects.
 3. The failure to find a significant Path c ($X \rightarrow Y$) is a stopping point (i.e., this approach argues that it is impossible to mediate an association that is not significant) but this logic is flawed. There are many situations in which mediation may occur even when the total effect ($X \rightarrow Y$) appears to be 0. For example, if there are two mediators where the association through one mediator is positive and the association through the other mediator is negative, then it may lead to a situation where the total effect is 0.
 4. This approach does not quantify the indirect effect so it encourages researchers to think about indirect effects in qualitative terms (e.g., no mediation, partial mediation, full mediation).

Conditional Process Analysis

- ◎ Conditional process analysis is used when the analytical goal is to describe and understand the conditional nature of the mechanism (or mechanisms) by which a variable transmits its effect on another
 - This is a blend of **moderation** ("conditional nature") and **mediation** ("the mechanism [or mechanisms] by which a variable transmits its effect on another")
 - This has been referred to by labels such as **moderated mediation** and **mediated moderation**
- ◎ The mechanism linking X to Y can be said to be conditional if the indirect effect of X on Y through M is contingent on a moderator

Models from PROCESS

- PROCESS is capable of running a wide variety of conditional process analyses
- Model 7: Moderator of $X \rightarrow M$

Model 7

Conceptual Diagram

Statistical Diagram

Conditional indirect effect of X on Y through $M = (\beta_1\gamma_1 + \beta_2\gamma_2)$
 Direct effect of X on $Y = \beta_2$

Note: Model 7 allows up to 10 moderation settings to be tested.

Models from PROCESS

- Model 8: Moderator of $X \rightarrow M$ and $X \rightarrow Y$

Model 8

Conceptual Diagram

Statistical Diagram

Conditional indirect effect of X on Y through $M = (\beta_1\gamma_1 + \beta_2\gamma_2)$
 Conditional direct effect of X on $Y = \beta_2 + \beta_3\gamma_2$

Note: Model 8 allows up to 10 moderation settings to be tested.

Models from PROCESS

- Model 9: Two moderators of $X \rightarrow M$

Model 9

Conceptual Diagram

Statistical Diagram

Conditional indirect effect of X on Y through $M = (\beta_1\gamma_1 + \beta_2\gamma_2)$
 Direct effect of X on $Y = \beta_2$

Note: Model 9 allows up to 10 moderation settings to be tested.

Models from PROCESS

Model 10

Conceptual Diagram

Statistical Diagram

Conditional indirect effect of X on Y through M: $\gamma_1 = a_1 a_2 + a_{11} a_2 + a_{12} a_2 + a_{13} a_2 + a_{14} a_2$
 Conditional direct effect of X on Y: $\gamma_2 = a_2 + a_{11} a_2 + a_{12} a_2 + a_{13} a_2 + a_{14} a_2$
*Model 10 allows for threshold scaling to occur

Models from PROCESS

Model 11

Conceptual Diagram

Statistical Diagram

Conditional indirect effect of X on Y through M: $\gamma_1 = a_1 a_2 + a_{11} a_2 + a_{12} a_2 + a_{13} a_2 + a_{14} a_2$
 Direct effect of X on Y: $\gamma_2 = a_2$
*Model 11 allows for threshold scaling to occur

Models from PROCESS

Model 12

Conceptual Diagram

Statistical Diagram

Conditional indirect effect of X on Y through M: $\gamma_1 = a_1 a_2 + a_{11} a_2 + a_{12} a_2 + a_{13} a_2 + a_{14} a_2$
 Conditional direct effect of X on Y: $\gamma_2 = a_2 + a_{21} a_2 + a_{22} a_2 + a_{23} a_2 + a_{24} a_2$
*Model 12 allows for threshold scaling to occur

Models from PROCESS

Model 14: Moderators of $M \rightarrow Y$

Conceptual Diagram

Statistical Diagram

Conditional indirect effect of X on Y through M: $a_1b_1 + a_2b_2$
 Direct effect of X on Y: a_2

*Model 14 allows up to 10 random opening in parallel

Models from PROCESS

Model 17: Two moderators of $M \rightarrow Y$ and $X \rightarrow Y$ that include the three-way interactions ($X * V * Q$)

Conceptual Diagram

Statistical Diagram

Conditional indirect effect of X on Y through M: $a_1b_1 + a_2b_2 + a_3b_3 + a_4b_4 + a_5b_5$
 Conditional direct effect of X on Y: $a_2 + a_3 + a_4 + a_5$

*Model 17 allows up to 10 random opening in parallel

Models from PROCESS

Model 24: Two moderators of $X \rightarrow M$ and $X \rightarrow Y$ and a third moderator of $M \rightarrow Y$

Conceptual Diagram

Statistical Diagram

Conditional indirect effect of X on Y through M: $a_1b_1 + a_2b_2 + a_3b_3 + a_4b_4 + a_5b_5 + a_6b_6 + a_7b_7$
 Conditional direct effect of X on Y: $a_2 + a_3 + a_4 + a_5 + a_6 + a_7$

*Model 24 allows up to 10 random opening in parallel

Models from PROCESS

Model 45: Two moderators of $X \rightarrow M$ and two moderators of $M \rightarrow Y$

Model 45
Conceptual Diagram

Statistical Diagram

Conditional indirect effect of X on Y through M: $\gamma_1\beta_1 + \gamma_2\beta_2 + \gamma_1\beta_1W + \gamma_2\beta_2Z + \gamma_1\beta_1WZ$
 Conditional direct effect of X on Y: $\gamma_1 + \gamma_2 + \gamma_1W + \gamma_2Z + \gamma_1WZ$
 Model fit statistics: $R^2 = .12$, $F(1, 98) = 1.2$, $p = .27$

Models from PROCESS

Model 57: Two moderators of $X \rightarrow M$ and $X \rightarrow Y$ that include the three-way interactions ($X*W*Z$) and two moderators of $M \rightarrow Y$ and $X \rightarrow Y$ that include the three-way interactions ($X*V*Q$)

Model 57
Conceptual Diagram

Statistical Diagram

Conditional indirect effect of X on Y through M: $\gamma_1\beta_1 + \gamma_2\beta_2 + \gamma_1\beta_1W + \gamma_2\beta_2Z + \gamma_1\beta_1WZ$
 Conditional direct effect of X on Y: $\delta_1 + \delta_2 + \delta_1V + \delta_2Q + \delta_1VQ$
 Model fit statistics: $R^2 = .12$, $F(1, 98) = 1.2$, $p = .27$

Models from PROCESS

Model 59: A moderator of $X \rightarrow M$, $M \rightarrow Y$, and $X \rightarrow Y$

Model 59
Conceptual Diagram

Statistical Diagram

Conditional indirect effect of X on Y through M: $\gamma_1\beta_1 + \gamma_1\beta_1W + \gamma_1\beta_1W^2$
 Conditional direct effect of X on Y: $\delta_1 + \delta_1W + \delta_1W^2$
 Model fit statistics: $R^2 = .12$, $F(1, 98) = 1.2$, $p = .27$
