Distinguishing between Confounds, Mediators, and Moderators

confound vs. mediator – An internal validity confound and mediator have the same mathematical relationships to the independent and dependent variables. Both are third variables that explain the relationship between the independent and dependent variables, that is, the shared variance between the independent variable and the confound/mediator is associated with the dependent variable. We choose the label confound or mediator based on our conceptualization of the causal process that relates the independent to the dependent variable. We label this third variable a confound if it is extrinsic to the causal process, and we label it a mediator if it is intrinsic to the causal process.

confound vs. moderator – A moderator is a variable that moderates the relationship between the independent and dependent variables. That is, the direction or magnitude of the relationship between the independent and dependent variables depends on the moderator variable. Mathematically, a moderator effect is a statistical interaction effect (i.e., regression lines with different slopes). An internal validity confound has nothing to do with an interaction effect, and can exist when there is no interaction effect at all. In fact, different sloping regression lines would preclude including a confound as a covariate because the homogeneity of regression assumption would be violated. In contrast, there can be no moderation effect without an interaction effect.

Homework

Identify one specific plausible threat to internal validity? Describe the confound clearly and completely, including the direction of the effect

Between-Subjects Correlational Study:

1. Primary Hypothesis: IV causes DV, regardless of CONFOUND.
2. However, an observed correlation between IV and DV may not support the hypothesis because the observed IV-DV correlation may not reflect a true correlation. Such a spurious correlation could be due to the confound of _____.
3. Alternative Causal Hypothesis: It is possible that CONFOUND causes DV and is associated with (possibly caused by) the IV, such that participants with high levels of CONFOUND, also have high levels of IV and DV, which results in IV being correlation with DV.
4. Participants with higher levels of IV may be the participants with higher levels of CONFOUND.
5. Higher levels of CONFOUND is associated with higher levels of DV.
6. Therefore, contrary to the investigators' hypothesis, the statistical association between IV and DV could be entirely due to CONFOUND rather than IV. Thus, if all participants in our study had the same level of CONFOUND no correlation would be observed between IV and DV.

Static Group Comparison Study:

1. Primary Hypothesis: IV causes DV, regardless of CONFOUND.
2. However, an observed difference between IV groups in DV may not support the hypothesis because the observed group difference may not reflect a true difference. Such a spurious difference could be due to the confound of _____.
3. Alternative Causal Hypothesis: It is possible that CONFOUND causes DV and for some reason occurs more in one of the IV groups, which explains why one of the groups has more DV.
4. Group 1 may have higher levels of CONFOUND.
5. Higher levels of CONFOUND is associated with higher levels of DV.
6. Therefore, contrary to the investigators' hypothesis, the observed difference between IV groups in DV could be entirely due to CONFOUND rather than other characteristics of the groups. Thus, if all participants in our study had the same level of CONFOUND no correlation would be observed difference IV and DV.

Randomized Experiment:

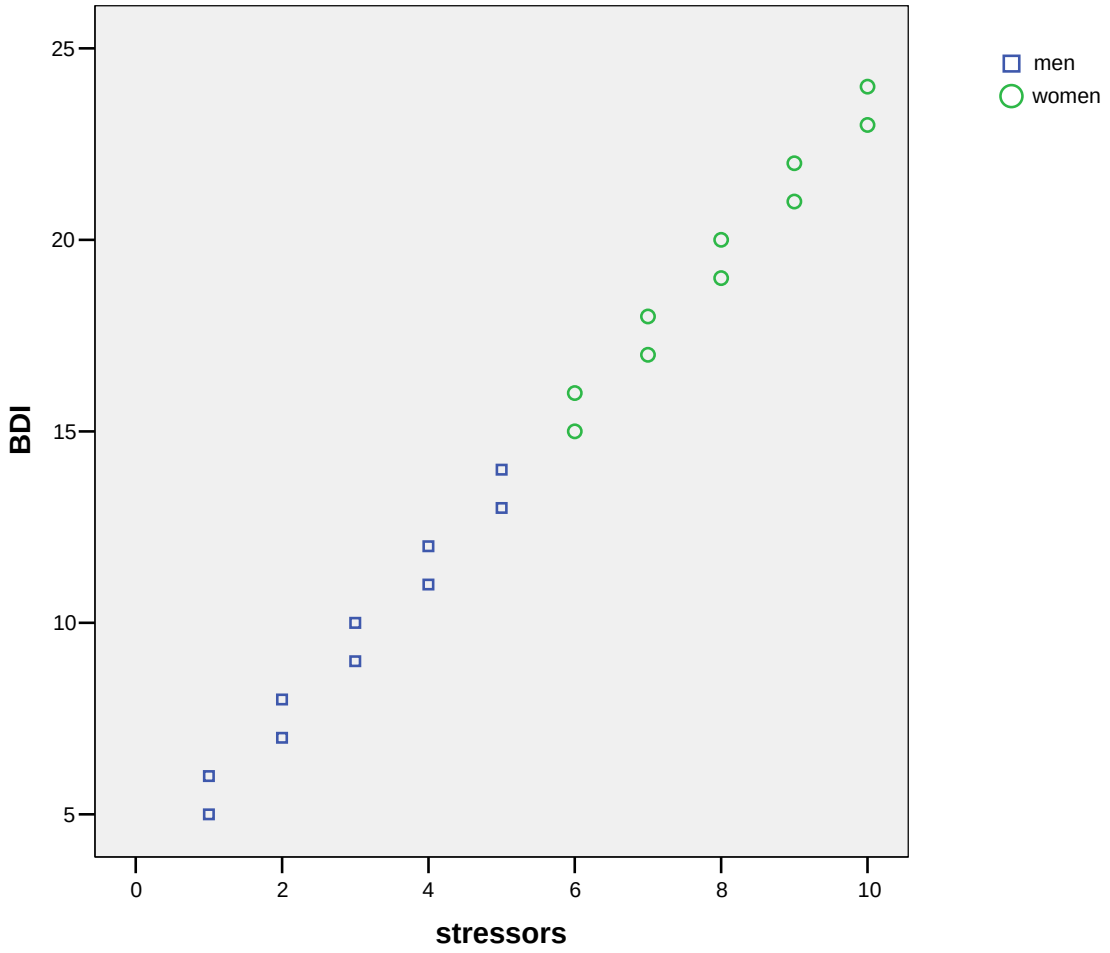
1. Primary Hypothesis: IV causes DV, regardless of CONFOUND.
2. However, an observed difference between IV groups in DV may not support the hypothesis because the observed group difference may not reflect a true difference. Such a spurious difference could be due to the confound of _____.
3. Alternative Causal Hypothesis: It is possible that CONFOUND causes DV and due to random chance (despite randomization) occurs more in one of the IV groups, which explains why one of the groups has more DV.
4. Group 1 may have higher levels of CONFOUND.
5. Higher levels of CONFOUND is associated with higher levels of DV.
6. Therefore, contrary to the investigators' hypothesis, the observed difference between IV groups in DV could be entirely due to CONFOUND rather than other characteristics of the groups. Thus, if all participants in our study had the same level of CONFOUND no correlation would be observed difference IV and DV.

Example 1

Hypothesis 1: Women are more depressed than men (because they are more emotionally reactive and sensitive than men).
Confound = stressful events
Alternative explanation: Women may be more depressed simply because they experience more stressful events than men.

Hypothesis 2: Women are more depressed than men because they experience more stressful events than men.
Mediator = stressful events

Men		Women	
BDI	stressors	BDI	stressors
5	1	15	6
6	1	16	6
7	2	17	7
8	2	18	7
9	3	19	8
10	3	20	8
11	4	21	9
12	4	22	9
13	5	23	10
14	5	24	10



In this depression example, women clearly are more depressed than men.

Gender is not a moderator of the relationship between stressors and depression (BDI scores) because no Gender X Stressor interaction effect is visible on the graph (the regression lines for men and women are parallel.

ANOVA (no covariates)

```
UNIANOVA
  bdi  BY gender
  /METHOD = SSTYPE(3)
  /INTERCEPT = INCLUDE
  /CRITERIA = ALPHA(.05)
  /DESIGN = gender .
```

Dependent Variable: BDI

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
gender	500.0	1	500.000	54.545	.000
Error	165.0	18	9.167		

There is a gender difference when no covariate is included

The SPSS output below clearly supports Hypothesis 2 and does not support Hypothesis 1.

Hypothesis 1 is <u>not</u> confirmed. Women could be more depressed simply because they experience more stressful events than men. Stressors is a serious confound. If women and men had equal stressors then they would probably be equally depressed.

Hypothesis 2 <u>is</u> confirmed. Women seem to be more depressed than men <u>because</u> they experience more stressful events than men. Stressors is a full mediator. Women only get more depressed than men when they have more stressors.

ANCOVA (with level of stressors as a covariate)

```
UNIANOVA
  bdi  BY gender  WITH stressor
  /METHOD = SSTYPE(3)
  /INTERCEPT = INCLUDE
  /CRITERIA = ALPHA(.05)
  /DESIGN = stressor gender .
```

Dependent Variable: BDI

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
stressor	160.0	1	160.000	544.0	.000
gender	0.0	1	.000	.0	1.000
Error	5.0	17	.294		

There is <u>no</u> gender difference when stressor covariate is included, so stressors is a confound/mediator

ANOVA Test of Moderation (Gender X Stressor interaction effect)

```
UNIANOVA
  bdi  BY gender stressor
```

```
  /METHOD = SSTYPE(3)
  /INTERCEPT = INCLUDE
  /CRITERIA = ALPHA(.05)
  /DESIGN = gender stressor gender* stressor.
```

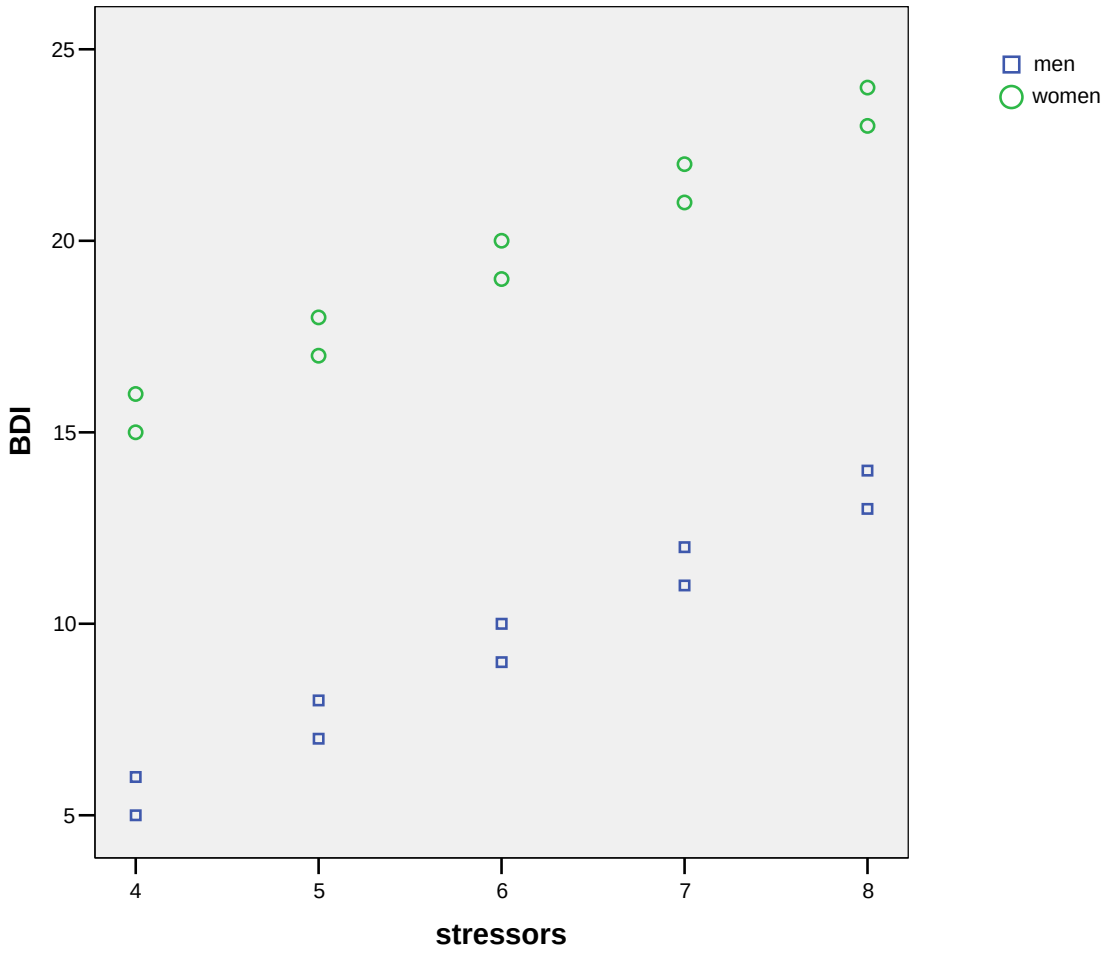
Dependent Variable: BDI

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
gender	.000	0	.	.	.
stressor	160.000	8	20.000	40.000	.000
gender * stressor	.000	0	.	.	
Error	5.000	10	.500		

There is no gender Gender X Stressor interaction effect, and thus, no moderation effect

Example 2
Same hypothesis as for Example 1.

Men		Women	
BDI	stressors	BDI	stressors
5	4	15	4
6	4	16	4
7	5	17	5
8	5	18	5
9	6	19	6
10	6	20	6
11	7	21	7
12	7	22	7
13	8	23	8
14	8	24	8



In this depression example, women clearly are more depressed than men.

Gender is not a moderator of the relationship between stressors and depression (BDI scores) because no Gender X Stressor interaction effect is visible on the graph (the regression lines for men and women are parallel.
The SPSS output below supports Hypothesis 1 and does not support Hypothesis 2.

Hypothesis 1 is supported. There is no evidence that women are more depressed simply because they experience more stressful events than men. Stressors is not a confound.

Hypothesis 2 is not supported. Women seem to be more depressed than men because they experience more stressful events than men. Stressors is not a mediator.

ANOVA (no covariates)

```
UNIANOVA
  bdi  BY gender
  /METHOD = SSTYPE(3)
  /INTERCEPT = INCLUDE
  /CRITERIA = ALPHA(.05)
  /DESIGN = gender .
```

Dependent Variable: BDI

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
gender	500.0	1	500.000	54.545	.000
Error	165.0	18	9.167		

There is a gender difference when no covariate is included

ANCOVA (with level of stressors as a covariate)

```
UNIANOVA
  bdi  BY gender  WITH stressor
  /METHOD = SSTYPE(3)
  /INTERCEPT = INCLUDE
  /CRITERIA = ALPHA(.05)
  /DESIGN = stressor gender .
```

Dependent Variable: BDI

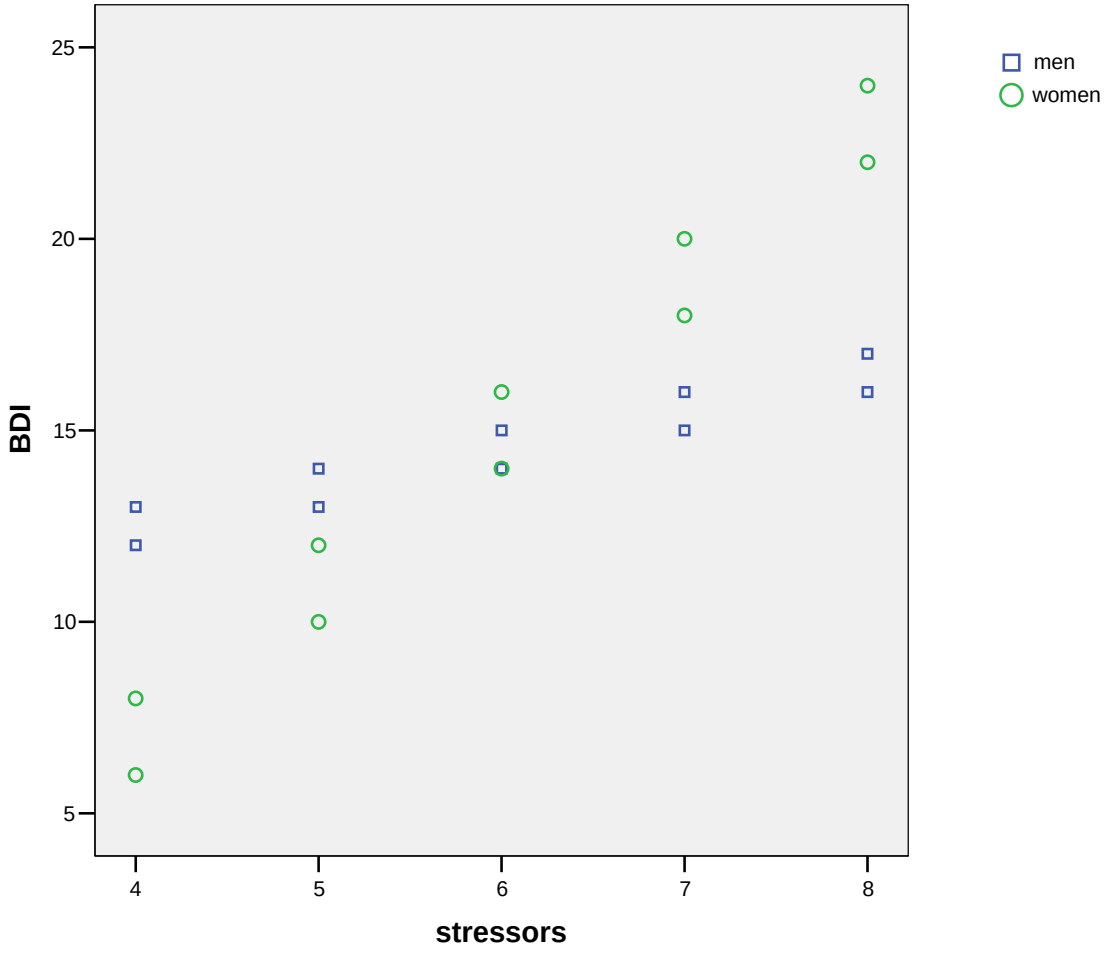
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
stressor	160.0	1	160.000	544.0	.000
gender	500.0	1	500.000	1700.0	.000
Error	5.0	17	.294		

The gender difference remains when the stressor covariate is included, so it is neither a confound nor a mediator

Example 3

Hypothesis: Women are more emotionally reactive and sensitive than men and therefore more likely to be affected by stressful events. When women and men have comparable increases in stressful events women have larger increases in depression.

Men		Women	
BDI	stressors	BDI	stressors
12	4	6	4
13	4	8	4
13	5	10	5
14	5	12	5
14	6	14	6
15	6	16	6
15	7	18	7
16	7	20	7
16	8	22	8
17	8	24	8



The SPSS output below supports the hypothesis that women get more depressed than men when facing increasing stressful events. Overall, women are not more depressed, just more reactive to stressors.

ANOVA (no covariates)

```
UNIANOVA
  bdi  BY gender
  /METHOD = SSTYPE(3)
  /INTERCEPT = INCLUDE
  /CRITERIA = ALPHA(.05)
  /DESIGN = gender .
```

Dependent Variable: BDI

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
gender	1.250	1	1.250	.064	.803
Error	352.500	18	19.583		

Because there is no gender difference in mean BDI scores, stressors cannot be a confound.

ANOVA Test of Moderation (Gender X Stressor interaction effect)

```
UNIANOVA
  bdi  BY gender stressor
  /METHOD = SSTYPE(3)
  /INTERCEPT = INCLUDE
  /CRITERIA = ALPHA(.05)
  /DESIGN = gender stressor gender* stressor.
```

Dependent Variable: BDI

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
gender	1.25	1	1.250	1.0	.341
stressor	250.00	4	62.500	50.0	.000
gender * stressor	90.00	4	22.500	18.0	.000
Error	12.50	10	1.250		

There is a gender Gender X Stressor interaction effect, and thus, a moderation effect

```
temp.
SELECT IF gender=0.
REGRESSION
  /DEPENDENT bdi
  /METHOD=ENTER stressor  .
```

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	8.500	.771		11.031	.000
	STRESSOR	1.000	.125	.943	8.000	.000

a. Dependent Variable: BDI

For men, a 1-point increase in stressors is associated with a 1- point increase in BDI depression score.

```
temp.
SELECT IF gender=1.
REGRESSION
  /DEPENDENT bdi
  /METHOD=ENTER stressor  .
```

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-9.000	1.541		-5.840	.000
	STRESSOR	4.000	.250	.985	16.000	.000

a. Dependent Variable: BDI

For women, a 1-point increase in stressors is associated with a 4- point increase in BDI depression score.

Thorough Confound Description

1. Women score higher than men on the BDI due to higher levels of reactivity in women.
2. However, the difference between men and women may be due to the confound of the number/severity of stressors experienced.
3. Women experience more stressful events than men.
4. More stressful events are related to higher BDI scores.
5. Therefore, the gender difference in BDI scores may be due entirely to differences in the number/severity of stressors experienced. Women may experience more depression than men simply because they have more stressful events than men. Thus, if even if all the women and men in our study had the same number and severity of stressors, men and women would show no difference in BDI scores.

Thorough Moderator Description

1. Gender moderates the relationship between stressors and BDI scores
2. Overall, higher levels of stressors is strongly correlated with higher BDI scores, with a correlation of r = .84.
3. But, the effect is different for various the two genders (the two levels of the moderator).
4. For women, higher levels of stressors is more associated with higher BDI scores (a 1-point increase in stressors is associated with a 4- point increase in the BDI depression score).
5. For men, higher levels of stressors is associated with higher BDI scores to a lesser degree than for women (a 1-point increase in stressors is associated with a 1- point increase in BDI depression score).