Chapter 10: Moderation, mediation and more regression

Labcoat Leni's Real Research

I heard that Jane has a boil and kissed a tramp

Problem

Massar, K.., et al. (2012). *Personality and Individual Differences*, *52,* 106–109.

Everyone likes a good gossip from time to time, but apparently it has an evolutionary function. One school of thought is that gossip is used a way to derogate sexual competitors – especially by questioning their appearance and sexual behaviour. For example, if you've got your eyes on a guy, but he has his eyes on Jane, then a good strategy is to spread gossip that Jane has a massive pus-oozing boil on her stomach and that she kissed a smelly vagrant called Aqualung. Apparently men rate gossiped-about women as less attractive, and they are more influenced by the gossip if it came from a woman with a high mate value (i.e., attractive and sexually desirable). Karlijn Massar and her colleagues hypothesized that if this theory is true then (1) younger women will gossip more because there is more mate competition at younger ages; and (2) this relationship will be mediated by the mate value of the person (because for those with high mate value gossiping for the purpose of sexual competition will be more effective). Eighty-three women aged from 20 to 50 (**Age**) completed questionnaire measures of their tendency to gossip (**Gossip**) and their sexual desirability (**Mate_Value**). Test Massar et al.'s mediation model using Baron and Kenny's method (as they did) but also using *PROCESS* to estimate the indirect effect (**Massar et al.(2011).sav**).

Solution using Baron and Kenny's method

Baron and Kenny suggested that mediation is tested through three regression models:

1. A regression predicting the outcome (**Gossip**) from the predictor variable (**Age**).

2. A regression predicting the mediator (**Mate_Value**) from the predictor variable (**Age**).

3. A regression predicting the outcome (**Gossip**) from both the predictor variable (**Age**) and the mediator (**Mate_Value**).

These models test the four conditions of mediation: (1) the predictor variable (**Age**) must significantly predict the outcome variable (**Gossip**) in model 1; (2) the predictor variable (**Age**) must significantly predict the mediator (**Mate_Value**) in model 2; (3) the mediator (**Mate_Value**) must significantly predict the outcome (**Gossip**) variable in model 3; and (4) the predictor variable (**Age**) must predict the outcome variable (**Gossip**) less strongly in model 3 than in model 1.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.143	1	6.143	6.727	.011[b]
	Residual	73.060	80	.913		
	Total	79.203	81			

a. Dependent Variable: Tendency to Gossip (1-16)

b. Predictors: (Constant), Age

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.898	.282		10.265	.000
	Age	-.022	.009	-.279	-2.594	.011

a. Dependent Variable: Tendency to Gossip (1-16)

Output 1: Predicting Gossip from Age

Output indicates that the first condition of mediation was met, in that participant age was a significant predictor of the tendency to gossip, $t(80) = -2.59$, $p < .05$.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.491	1	8.491	13.452	.000[b]
	Residual	49.863	79	.631		
	Total	58.354	80			

a. Dependent Variable: Mate Value

b. Predictors: (Constant), Age

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.798	.237		16.056	.000
	Age	-.027	.007	-.381	-3.668	.000

a. Dependent Variable: Mate Value

Output 2: Predicting Mate_Value from Age

Looking at Output 2, we can see that the second condition of mediation was also met, in that participant age was a significant predictor of mate value, $t(79) = -3.67$, $p < .001$.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	16.849	2	8.425	10.547	.000[b]
	Residual	62.306	78	.799		
	Total	79.155	80			

a. Dependent Variable: Tendency to Gossip (1-16)

b. Predictors: (Constant), Mate Value, Age

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.196	.549		2.177	.032
	Age	-.011	.009	-.139	-1.275	.206
	Mate Value	.455	.127	.390	3.592	.001

a. Dependent Variable: Tendency to Gossip (1-16)

Output 3: Predicting Gossip from Age and Mate_Value

Looking at Output , we can see that the third condition of mediation has been met, in that mate value significantly predicted the tendency to gossip while controlling for participant age, $t(78) = 3.5$, $p < .01$. Finally, the fourth condition of mediation has also been met, in that the standardized regression coefficient between participant age and tendency to gossip decreased substantially when controlling for mate value, $t(78) = -1.28$, *ns*. Therefore, we can conclude that the author's prediction is supported, and the relationship between participant age and tendency to gossip is mediated by mate value.

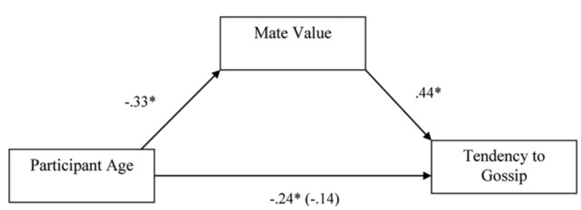

Diagram of a mediation model from Massar et al. (2011)

Solution using *PROCESS*

```
**************************************************************************
Model = 4
    Y = Gossip
    X = Age
    M = Mate_Val

Sample size
         81

**************************************************************************
Outcome: Mate_Val

Model Summary
          R       R-sq          F        df1        df2          p
      .3815      .1455    13.4522     1.0000    79.0000      .0004

Model
              coeff         se          t          p
constant     3.7981      .2366    16.0558      .0000
Age          -.0266      .0073    -3.6677      .0004
```

Output 4

Looking at Output , we can see that age significantly predicts mate value, *b* = −0.03, *t* = −3.67, *p* = .000. The R^2 value tells us that age explains 14.6% of the variance in mate value, and the fact that the *b* is negative tells us that the relationship is negative also: as age increases, mate value declines (and vice versa).

```
**************************************************************************
Outcome: Gossip

Model Summary
          R       R-sq          F        df1        df2          p
      .4614      .2129    10.5468     2.0000    78.0000      .0001

Model
              coeff         se          t          p
constant     1.1963      .5495     2.1771      .0325
Mate_Val      .4546      .1266     3.5921      .0006
Age          -.0113      .0088    -1.2753      .2060
```

Output 5

Output shows the results of the regression of tendency to gossip predicted from both age and mate value. We can see that while age does not significantly predict tendency to gossip with mate value in the model, $b = -0.01$, $t = -1.28$, $p = .21$, mate value does significantly predict tendency to gossip, $b = 0.45$, $t = 3.59$, $p < .01$. The R^2 value tells us that the model explains 21.3% of the variance in tendency to gossip. The negative *b* for age tells us that as age increases, tendency to gossip declines (and vice versa), but the positive *b* for mate value indicates that as mate value increases, tendency to gossip increases also. These relationships are in the predicted direction.

```
************************* TOTAL EFFECT MODEL ***************************
Outcome: Gossip

Model Summary
          R       R-sq          F        df1        df2          p
      .2875      .0827     7.1180     1.0000    79.0000      .0093

Model
              coeff         se          t          p
constant     2.9230      .2855    10.2397      .0000
Age          -.0234      .0088    -2.6680      .0093
```

Output 6

Output shows the total effect of age on tendency to gossip (outcome). You will get this bit of the output only if you selected *Total effect model*. The total effect is the effect of the predictor on the outcome when the mediator is not present in the model. When mate value is not in the model, age significantly predicts tendency to gossip, $b = -0.02$, $t = -2.67$, $p = .009$. The R^2 value tells us that the model explains 8.27% of the variance in tendency to gossip. Therefore, when mate value is not included in the model, age has a significant negative relationship with infidelity (as shown by the negative *b* value).

```
**************** TOTAL, DIRECT, AND INDIRECT EFFECTS *******************

Total effect of X on Y
     Effect         SE          t          p
     -.0234      .0088    -2.6680      .0093

Direct effect of X on Y
     Effect         SE          t          p
     -.0113      .0088    -1.2753      .2060

Indirect effect of X on Y
             Effect    Boot SE   BootLLCI   BootULCI
Mate_Val     -.0121      .0054     -.0265     -.0042

Partially standardized indirect effect of X on Y
             Effect    Boot SE   BootLLCI   BootULCI
Mate_Val     -.0122      .0050     -.0244     -.0046

Completely standardized indirect effect of X on Y
             Effect    Boot SE   BootLLCI   BootULCI
Mate_Val     -.1489      .0611     -.3051     -.0560

Ratio of indirect to total effect of X on Y
             Effect    Boot SE   BootLLCI   BootULCI
Mate_Val      .5179      .9803      .1707     1.5546

Ratio of indirect to direct effect of X on Y
             Effect    Boot SE   BootLLCI   BootULCI
Mate_Val     1.0744    10.6879    -2.4127    51.3575

R-squared mediation effect size (R-sq_med)
             Effect    Boot SE   BootLLCI   BootULCI
Mate_Val      .0662      .0359      .0111      .1569

Preacher and Kelley (2011) Kappa-squared
             Effect    Boot SE   BootLLCI   BootULCI
Mate_Val      .1458      .0577      .0574      .2913
```

Output 7

Output is the most important part of the output because it displays the results for the indirect effect of age on gossip (i.e., the effect via mate value). First, we're told the effect of age on gossip in isolation (the total effect), and these values replicate the model in Output . Next, we're told the effect of age on gossip when mate value is included as a predictor as well (the direct effect). These values replicate those in Output . The first bit of new information is the *Indirect effect of X on Y*, which in this case is the indirect effect of age on gossip. We're given an estimate of this effect (b = –0.012) as well as a bootstrapped standard error and confidence interval. As we have seen many times before, 95% confidence intervals contain the true value of a parameter in 95% of samples. Therefore, we tend to assume that our sample isn't one of the 5% that does not contain the true value and use them to infer the population value of an effect. In this case, assuming our sample is one of the 95% that 'hits' the true value, we know that the true b-value for the indirect effect falls between –0.027 and –0.004.[1] This range does not include zero (although both values are not much bigger than zero), and

[1] Remember that because of the nature of bootstrapping you will get slightly different values in your output.

remember that *b* = 0 would mean ‘no effect whatsoever’; therefore, the fact that the confidence interval does not contain zero means that there is likely to be a genuine indirect effect. Put another way, mate value is a mediator of the relationship between age and tendency to gossip.

The rest of Output you will see only if you selected *Effect size*; it contains various standardized forms of the indirect effect. In each case they are accompanied by a bootstrapped confidence interval. We discussed these measures of effect size in Section 10.4.3 in the book, and rather than interpret them all I’ll note that for each one you get an estimate along with a confidence interval based on a bootstrapped standard error. As with the unstandardized indirect effect, if the confidence intervals don’t contain zero then we can be confident that the true effect size is different from ‘no effect’. In other words, there is mediation. Focusing on the most useful of these effect sizes, the standardized *b* for the indirect effect, its value is *b* = −.149, 95% BCa CI [−.305, −.056], and similarly, □□ = .146, 95% BCa CI [.057, .291]. □□ is bounded to fall between 0 and 1, so we can interpret this as the indirect effect being about 14.6% of the maximum value that it could have been, which for social science data is a reasonable size.

```
Normal theory tests for indirect effect
     Effect         se          Z          p
     -.0121      .0048    -2.5190      .0118
```

Output 8

The final part of the output (Output) shows the results of the Sobel test. As I have mentioned before, it is better to interpret the bootstrap confidence intervals than formal tests of significance; however, if you selected *Sobel test* this is what you will see. Again, we’re given the size of the indirect effect (*b* = −0.012), the standard error, associated *z*-score (*z* = −2.52) and *p*-value (*p* = .012). The *p*-value is under the not-at-all magic .05 threshold, so we’d conclude that there is a significant indirect effect. In other words, younger women have a higher tendency to gossip than older women, but this elevated tendency can be attributed to their higher mate value.