Moderation

A continuation of the alternative medical example for partial correlation applied to a test of a moderation hypothesis requiring a hierarchical regression

The variables DEPRESSION and ANXIETY (state-trait) pattern are again used. In addition, another variable is introduced. The 80 adults have been keeping an anxiety diary for two years and the new variable we are going to introduce is number of days during that period that no feelings of anxiety are recorded. The first few rows of (fabricated) data appear in Table 6.2 (the full dataset, med.moderation.sav, can be found on the book website). The data are used on this occasion to illustrate an analysis designed to test that the relationship between ANXIETY (state-trait) pattern and DEPRESSION is moderated by number of anxiety-free days. So, we have three continuous variables; a predictor variable, an outcome variable and a hypothesized moderator variable, and our goal is to test the interaction between the IV (ANXIETY) and the proposed moderator (ANXFREEDAYS).

Table 6.2
The first few rows of (fabricated) data on depression, anxiety and anxiety free days for 80 adults. (The full dataset can be found as med.moderation.sav on the website)

depression	anxiety	anxfreedays
2.06	-.15	351
3.65	-1.38	290
2.06	-.35	333
1.24	-.50	324
2.29	-.85	343
1.24	-.55	319

Moderation: the application of the regression approach

The interaction can be tested by creating an interaction term (ANXIETY*ANXFREEDAYS) and entering it after entry of ANXIETY and ANXFREEDAYS. Then, if addition of the new ANXIETY*ANXFREEDAYS variable results in a significant increase in R^2, it can be claimed that a moderating effect of ANXFREEDAYS on the relationship between ANXIETY and ANXFREEDAYS has been confirmed. Of course, generating a new variable by multiplying together two existing variables risks creating a multicollinearity problem. That is, either ANXIETY or ANXFREEDAYS, or both, will be highly correlated with ANXIETY*ANXFREEDAYS, which will seriously affect the estimation of the regression coefficients for the main effects. In addition, any effect of ANXIETY or ANXFREEDAYS will be tested at a value of zero for the other variable. For example, the effect of ANXIETY on DEPRESSION would be tested for the rather extreme circumstance in which participants had no anxiety free days at all.

Moderation using regression: centring and standardising

These two problems can be avoided by converting ANXIETY and ANXFREEDAYS to *Z* scores, that have mean zero and standard deviation one. To obtain a set of data with the same spread but with zero mean we need to subtract the mean from each of our values. This process is called centring If the resulting data are divided by the standard deviation to obtain (raw score – mean)/*sd*, these values have mean zero and standard deviation one. This process is called standardising. The result is that the effect of the transformed variable, ZANXIETY on DEPRESSION, for example, would be tested in relation to participants with an average number of anxiety free days, which seems considerably more reasonable. This procedure has the additional advantage of reducing the problem of multicollinearity by reducing the size of any high correlation

of the IV or the moderator variable with the new interaction variable. The two standardized variables are then multiplied together to create the interaction variable.

Moderation: requesting the analysis in SPSS

Open the file, med.moderation.sav in SPSS and create the two new *Z* score variables (the predictor and the moderator) by selecting **Analyze**, then **Descriptive Statistics**, then **Descriptives**. Move ANXIETY and ANXFREEDAYS into the Variable(s) and click on **Save standardized values as variables** and then on **OK**. Check that the two new variables (automatically named as ZANXIETY and ZANXFREEDAYS) have been added to the datasheet. Next, create an interaction term by selecting **Transform**, then **Compute**. Enter a name (e.g., ANXDAYS) in the **Target Variable** box and ZANXIETY*ZANXFREEDAYS in the **Numeric Expression** box, and click **OK** and check that the interaction variable (ANXDAYS) has been added to the datasheet.

Now we are ready for the moderator analysis. Select **Analyze**, then **Regression**, then **Linear** to get a dialog box like SPSS Dialog Box 4.1. Move DEPRESSION into the **Dependent** box and ANXIETY and ANXFREEDAYS into the **Independent(s)** box. Then click on **Next**, just as when doing a hierarchical regression described in Chapter 4. When **Block 2 of 2** appears, enter ANXDAYS in the **Independent Variable(s)** box and click **Continue**. Click the **Statistics** button and select **R Squared Change**, then **OK**.

Moderation analysis: understanding the output

We focus on the Model Summary shown in SPSS Output 6.5. Under Change Statistics, we see that *R* Square Change is 0.045 when the interaction variable is added (model 2) to the predictor and moderator variables. This change is significant, $F(1,76) = 4.65$, $p = 0.034$. The significant interaction tells us that our presumed moderator

(ANXFREEDAYS) does indeed moderate the effects of the predictor (ANXIETY) on the outcome variable (DEPRESSION).

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.461[a]	.213	.192	.70488	.213	10.396	2	77	.000
2	.508[b]	.258	.229	.68875	.045	4.649	1	76	.034

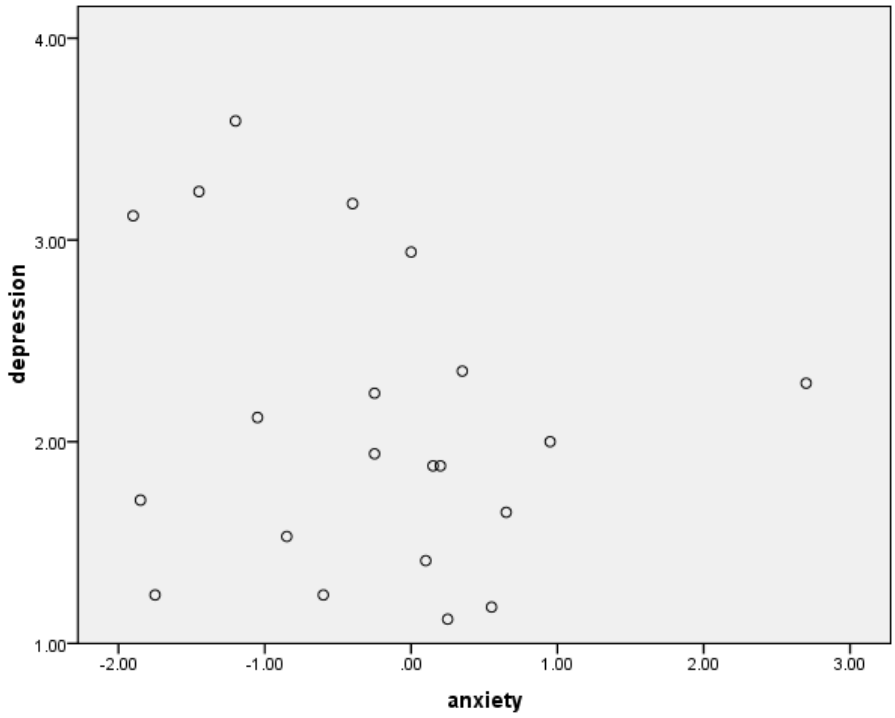
a. Predictors: (Constant), anxfreedays, anxiety

b. Predictors: (Constant), anxfreedays, anxiety, anxdays

SPSS Output 6.5. R Square change when an interaction variable (ANXDAYS) is added to the model

Graphical clarification of the moderation effect

In order to see whether the significant moderator effect is in the predicted direction (the more anxiety free days, the weaker the negative effect of ANXIETY on DEPRESSION) we can look at the cases with the most and least anxiety free days. A boxplot of ANXFREEDAYS shows that the upper quartile is at about 370, and the lower is at about 270. We can use **Data**, then **Select cases** and then click **If condition is satisfied** and the **If** button to select those cases with ANXFREEDAYS > 370. With this selection in place, plot DEPRESSION against ANXIETY and also find the correlation between DEPRESSION and ANXIETY. The results are shown in SPSS Output 6.6. You can see that we have 21 cases here, about a quarter of the full set of 80. These are the ones with the most ANXFREEDAYS and for them, the correlation between DEPRESSION and ANXIETY is -0.21 (p = 0.37), and the graph shows that the relationship between DEPRESSION and ANXIETY is very weak.

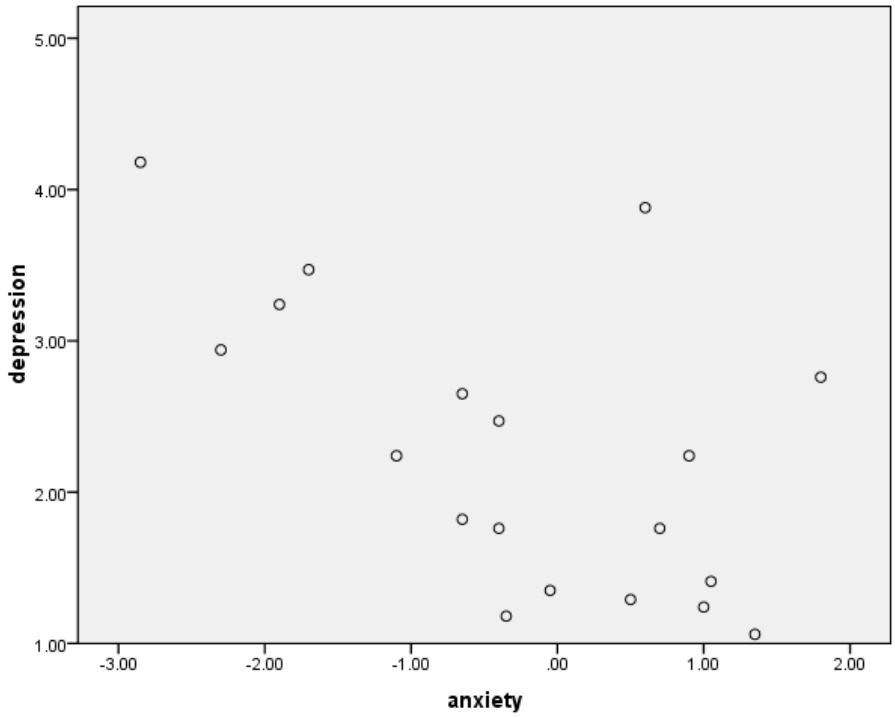


Correlations

		depression	anxiety
depression	Pearson Correlation	1.000	-.206
	Sig. (2-tailed)		.370
	N	21.000	21
anxiety	Pearson Correlation	-.206	1.000
	Sig. (2-tailed)	.370	
	N	21	21.000

SPSS Output 6.6. Plot and correlation for the cases with ANXDAYS > 370

Now go back to **Select cases**, but this time select those with ANXFREEDAYS < 270, and repeat the graph and correlation. We get SPSS Output 6.7, where you can see that we have 19 cases (again about a quarter of the full set), this time those with the fewest ANXFREEDAYS. The graph shows a much stronger relationship and the correlation is -0.58 (p = 0.01).



Correlations

		depression	anxiety
depression	Pearson Correlation	1.000	-.575*
	Sig. (2-tailed)		.010
	N	19.000	19
anxiety	Pearson Correlation	-.575*	1.000
	Sig. (2-tailed)	.010	
	N	19	19.000

*. Correlation is significant at the 0.05 level (2-tailed).

SPSS Output 6.7. Plot and correlation for the cases with ANXDAYS < 270

These brief investigations confirm our expectation that the effect of ANXIETY on DEPRESSION weakens with more anxiety free days. The Sani paper to which we referred earlier illustrates a different approach to investigating the interaction to that adopted here.