Chapter 16: Multivariate analysis of variance (MANOVA)

Labcoat Leni's Real Research

A lot of hot air

Problem

Marzillier, S. L., & Davey, G. C. L. (2005). *Cognition and Emotion*, *19*, 729–750.

Have you ever wondered what researchers do in their spare time? Well, some of them spend it tracking down the sounds of people burping and farting! Anxious people are, typically, easily disgusted. Throughout this book I have talked about how you cannot infer causality from relationships between variables. This has been a bit of a conundrum for anxiety researchers: does anxiety cause feelings of digust or does a low threshold for being disgusted cause anxiety? Two colleagues of mine at Sussex addressed this in an unusual study in which they induced feelings of anxiety, disgust, or a neutral mood. They looked at the effect of these induced moods on feelings of anxiety, sadness, happiness, anger, disgust and contempt. To induce these moods, they used three different types of manipulation: vignettes (e.g., 'You're swimming in a dark lake and something brushes your leg' for anxiety, and 'You go into a public toilet and find it has not been flushed. The bowl of the toilet is full of diarrhoea' for disgust), music (e.g., some scary music for anxiety, and a tape of burps, farts and vomitting for disgust), videos (e.g., a clip from *Silence of the Lambs* for anxiety and a scene from *Pink Flamingos* in which Divine eats dog faeces) and memory (remembering events from the past that had made the person anxious, disgusted or neutral).

Different people underwent anxiety, disgust and neutral mood inductions. Within these groups, the induction was done using either vignettes and music, videos, or memory recall and music for different people. The outcome variables were the change (from before to after the induction) in six moods: anxiety, sadness, happiness, anger, disgust and contempt. The data are in the file **Marzillier and Davey (2005).sav**. Draw an error bar graph of the changes in moods in the different conditions, then conduct a 3 (Mood: anxiety, disgust, neutral) × 3 (Induction: vignettes + music, videos, memory recall + music) MANOVA on these data. Whatever you do, don't imagine what their fart tape sounded like while you do the analysis!

Solution

To do the graph we have to access the chart builder and select a clustered bar chart (Figure 1). First, let's set mood induction type as the *x*-axis by selecting it and dragging it to the X-Axis? drop zone.
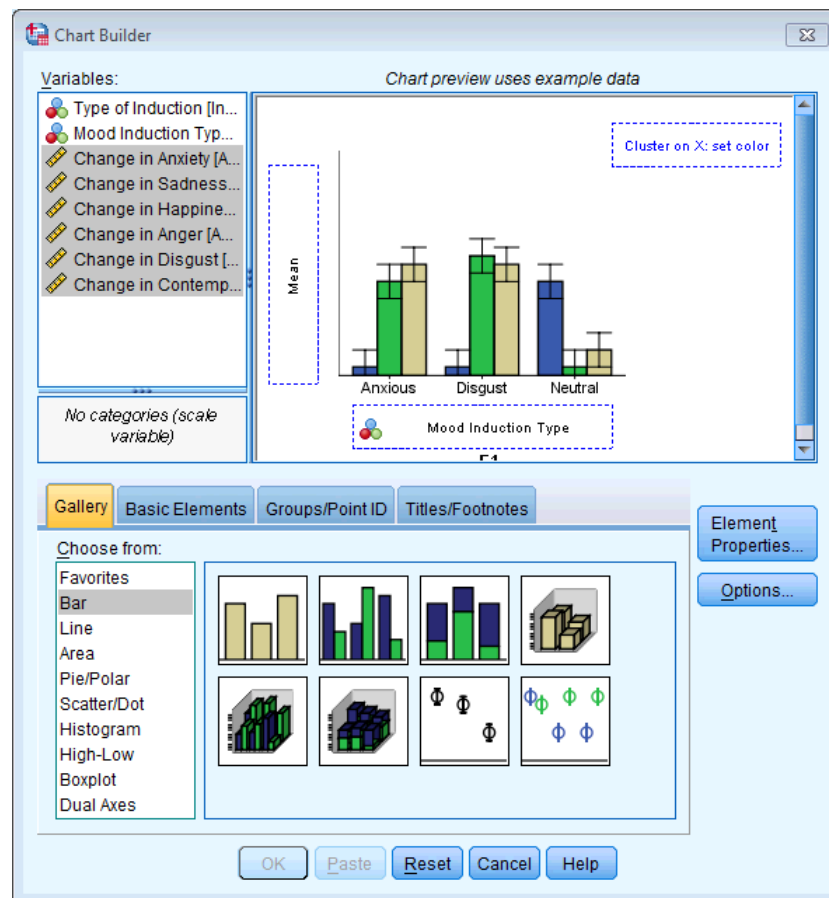

Figure 1

Next, select all of the dependent variables (click on change in anxiety, then hold *Shift* down and click on change in contempt and all six should become highlighted). Then drag these into the *y*-axis drop zone (Figure 2). This will have the effect that different moods will be displayed by different-coloured bars. Remember to select ☑ Display error bars in the Element Properties... dialog box and also change the statistic drop-down menu from *Count* to *Mean* and click on Apply.
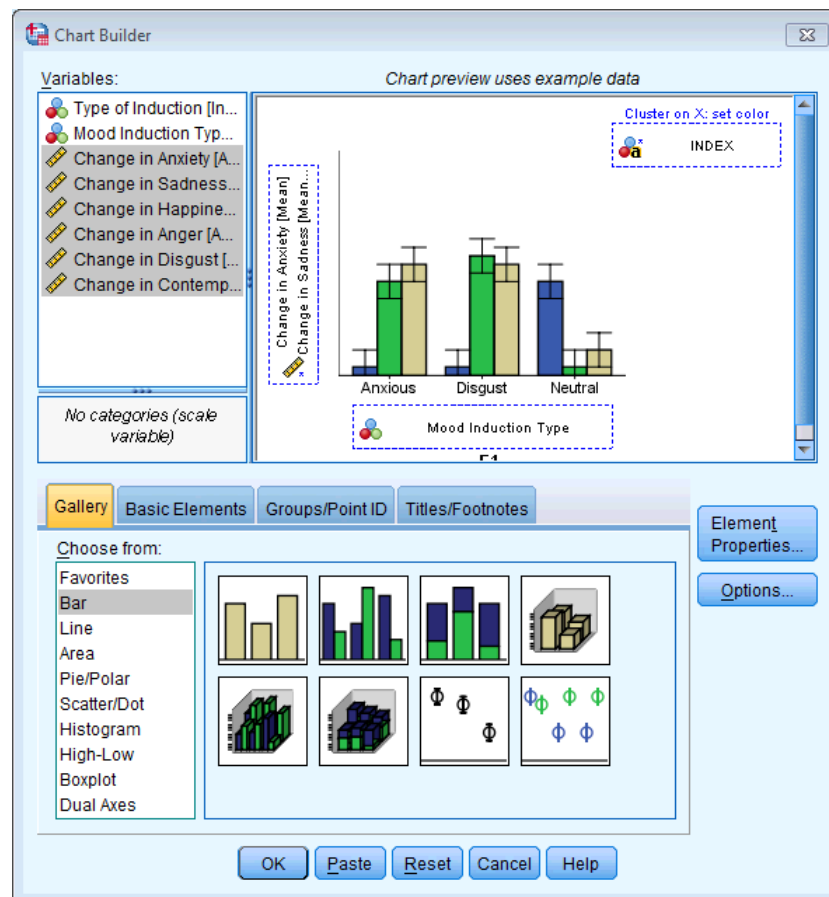
Figure 2

We have another variable, the type of induction, and we can display this too. First, click on the *Groups*/*Point ID* tab and then select *Rows panel variable*. When this is selected a new drop zone appears (called panel), and you can drag the type of induction into that zone. The finished dialog box will look like Figure 3. Click on [OK] to produce the graph.
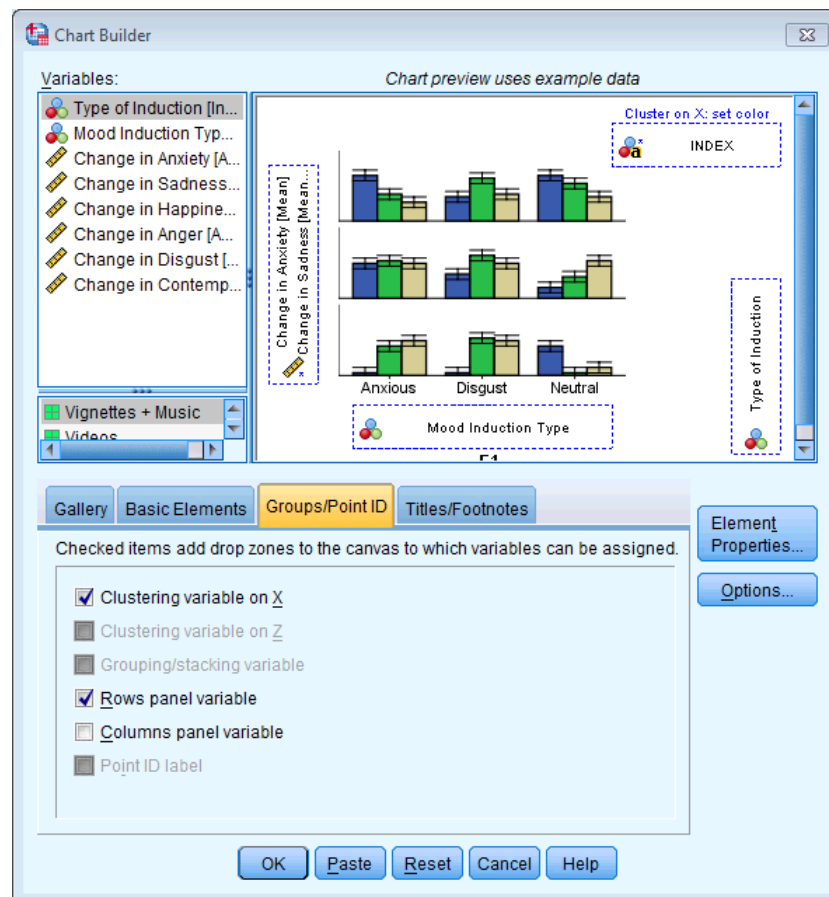
Figure 3

The completed graph will look like Figure 4. This shows that the neutral mood induction (regardless of the way in which it was induced) didn't really affect mood too much (the changes are all quite small). For the disgust mood induction, disgust always increased quite a lot (the yellow bars) regardless of how disgust was induced. Similarly, the anxiety induction raised anxiety (predominantly). Happiness decreased for both anxiety and disgust mood inductions.
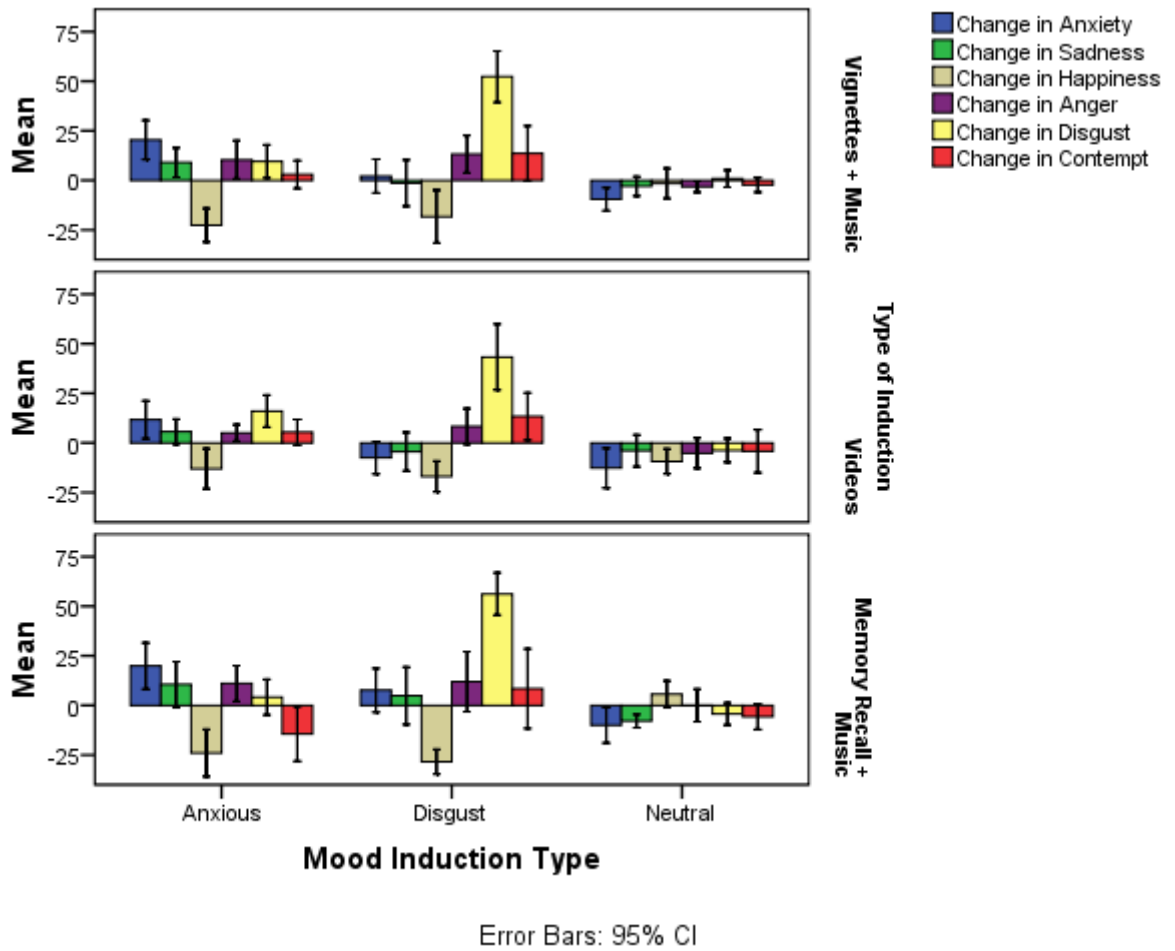
Figure 4

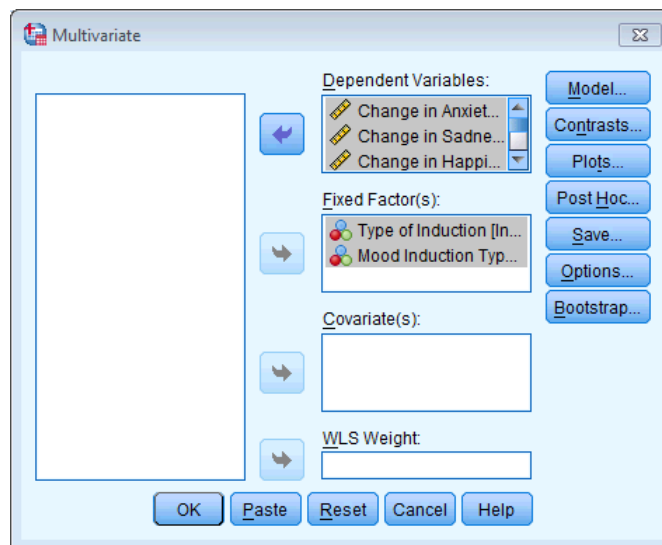To run the MANOVA, the main dialog box should look like Figure 5.

Figure 5

You can set whatever options you like based on the chapter. The main multivariate statistics are shown in Output 1. A main effect of mood was found $F(12, 334) = 21.91$, $p < .001$, showing that the changes for some mood inductions were bigger than for others overall (looking at the graph, this finding probably reflects that the disgust mood induction had the greatest effect overall – mainly because it produced such huge changes in disgust).

There was no significant main effect of the type of mood induction $F(12, 334) = 1.12$, $p > .05$, showing that whether videos, memory, tapes, etc., were used did not affect the changes in mood. Also, the type of mood × type of induction interaction, $F(24, 676) = 1.22$, $p > .05$, showed that the type of induction did not influence the main effect of mood. In other words, the fact that the disgust induction seemed to have the biggest effect on mood (overall) was not influenced by how disgust was induced.

Multivariate Tests^c

Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	.568	36.311^a	6.000	166.000	.000
	Wilks' Lambda	.432	36.311^a	6.000	166.000	.000
	Hotelling's Trace	1.312	36.311^a	6.000	166.000	.000
	Roy's Largest Root	1.312	36.311^a	6.000	166.000	.000
Induction	Pillai's Trace	.078	1.123	12.000	334.000	.340
	Wilks' Lambda	.923	1.127^a	12.000	332.000	.337
	Hotelling's Trace	.082	1.131	12.000	330.000	.334
	Roy's Largest Root	.069	1.933^b	6.000	167.000	.078
Mood	Pillai's Trace	.881	21.910	12.000	334.000	.000
	Wilks' Lambda	.291	23.593^a	12.000	332.000	.000
	Hotelling's Trace	1.842	25.321	12.000	330.000	.000
	Roy's Largest Root	1.427	39.726^b	6.000	167.000	.000
Induction * Mood	Pillai's Trace	.166	1.221	24.000	676.000	.215
	Wilks' Lambda	.841	1.230	24.000	580.315	.208
	Hotelling's Trace	.180	1.237	24.000	658.000	.201
	Roy's Largest Root	.110	3.110^b	6.000	169.000	.006

a. Exact statistic

b. The statistic is an upper bound on F that yields a lower bound on the significance level.

c. Design: Intercept + Induction + Mood + Induction * Mood

Output 1

The univariate effects for type of mood (which was the only significant multivariate effect) show (Output 2) that the effect of the type of mood induction was significant for all six moods (in other words, for all six moods there were significant differences across the anxiety, disgust and neutral conditions). Figure 6 is a graph that collapses across the way that mood was induced (video, music, etc.) because this effect was not significant (you can create this by going back to the chart builder and deselecting *Rows panel variable*). We should do more tests, but just looking at the graph shows that changes in anxiety (blue bars) are higher over the three mood conditions (they go up after the anxiety induction, stay the same for the disgust induction, and go down for the neutral induction). Similarly, for disgust, the change is biggest after the disgust induction, it increases a little after the anxiety induction and doesn't really change after the neutral (yellow bars). Finally, for happiness, this goes down after both anxiety and disgust inductions, but doesn't change for neutral.

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	Change in Anxiety	27241.400ᵃ	8	3405.175	8.380	.000
	Change in Sadness	6923.300ᵇ	8	865.413	2.229	.028
	Change in Happiness	19459.600ᶜ	8	2432.450	6.569	.000
	Change in Anger	7644.511ᵈ	8	955.564	2.589	.011
	Change in Disgust	95721.000ᵉ	8	11965.125	27.571	.000
	Change in Contempt	13984.600ᶠ	8	1748.075	2.882	.005
Intercept	Change in Anxiety	1080.450	1	1080.450	2.659	.105
	Change in Sadness	198.450	1	198.450	.511	.476
	Change in Happiness	36722.450	1	36722.450	99.170	.000
	Change in Anger	5893.889	1	5893.889	15.967	.000
	Change in Disgust	67512.200	1	67512.200	155.565	.000
	Change in Contempt	649.800	1	649.800	1.071	.302
Induction	Change in Anxiety	2578.233	2	1289.117	3.172	.044
	Change in Sadness	374.233	2	187.117	.482	.618
	Change in Happiness	189.100	2	94.550	.255	.775
	Change in Anger	836.411	2	418.206	1.133	.324
	Change in Disgust	216.900	2	108.450	.250	.779
	Change in Contempt	3010.300	2	1505.150	2.481	.087
Mood	Change in Anxiety	23826.033	2	11913.017	29.317	.000
	Change in Sadness	5501.433	2	2750.717	7.084	.001
	Change in Happiness	14193.633	2	7096.817	19.165	.000
	Change in Anger	6676.678	2	3338.339	9.044	.000
	Change in Disgust	92254.233	2	46127.117	106.288	.000
	Change in Contempt	8881.600	2	4440.800	7.321	.001
Induction * Mood	Change in Anxiety	837.133	4	209.283	.515	.725
	Change in Sadness	1047.633	4	261.908	.675	.611
	Change in Happiness	5076.867	4	1269.217	3.428	.010
	Change in Anger	131.422	4	32.856	.089	.986
	Change in Disgust	3249.867	4	812.467	1.872	.117
	Change in Contempt	2092.700	4	523.175	.862	.488
Error	Change in Anxiety	69485.150	171	406.346		
	Change in Sadness	66397.250	171	388.288		
	Change in Happiness	63320.950	171	370.298		
	Change in Anger	63119.600	171	369.120		
	Change in Disgust	74210.800	171	433.981		
	Change in Contempt	103725.600	171	606.582		
Total	Change in Anxiety	97807.000	180			
	Change in Sadness	73519.000	180			
	Change in Happiness	119503.000	180			
	Change in Anger	76658.000	180			
	Change in Disgust	237444.000	180			
	Change in Contempt	118360.000	180			
Corrected Total	Change in Anxiety	96726.550	179			
	Change in Sadness	73320.550	179			
	Change in Happiness	82780.550	179			
	Change in Anger	70764.111	179			
	Change in Disgust	169931.800	179			
	Change in Contempt	117710.200	179			

a. R Squared = .282 (Adjusted R Squared = .248)

b. R Squared = .094 (Adjusted R Squared = .052)

c. R Squared = .235 (Adjusted R Squared = .199)

d. R Squared = .108 (Adjusted R Squared = .066)

e. R Squared = .563 (Adjusted R Squared = .543)

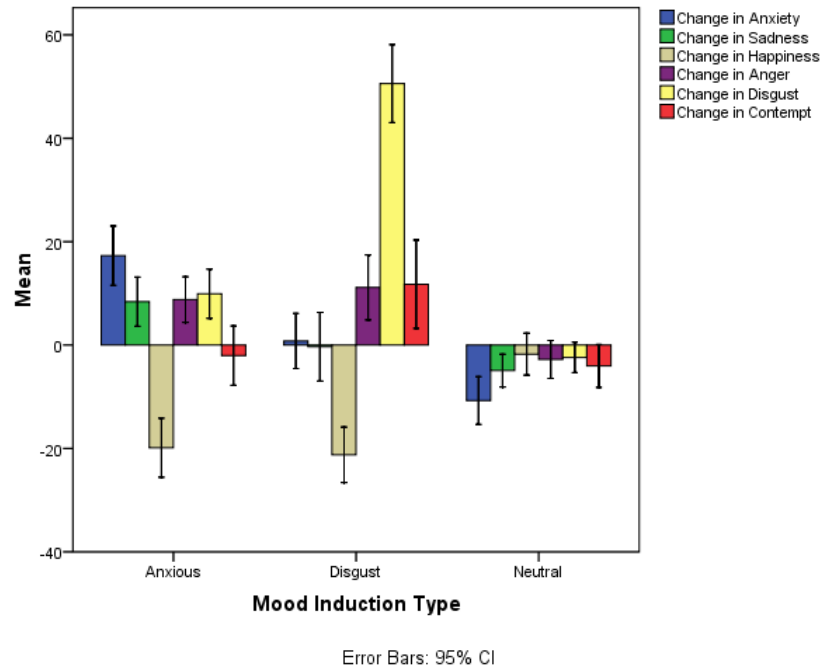f. R Squared = .119 (Adjusted R Squared = .078)

Output 2

Figure 6