Chapter 12: GLM 1: Comparing several independent means

Labcoat Leni's Real Research

Scraping the barrel?

Problem

Gallup, G. G. J., et al. (2003). *Evolution and Human Behavior*, *24*, 277–289.

Evolution has endowed us with many beautiful things (cats, dolphins, the Great Barrier Reef, etc.) all selected to fit their ecological niche. Given evolution's seemingly limitless capacity to produce beauty, it's something of a wonder how it managed to produce such a monstrostity as the human penis. One theory is that the penis evolved into the shape that it is because of sperm competition. Specifically, the human penis has an unusually large glans (the 'bell-end', as it's affectionately known) compared to other primates, and this may have evolved so that the penis can displace seminal fluid from other males by 'scooping it out' during intercourse. To put this idea to the test, Gordon Gallup and his colleagues came up with an ingenious study (Gallup et al., 2003). Armed with various female masturbatory devices from Hollywood Exotic Novelties, an artificial vagina from California Exotic Novelties, and some water and cornstarch to make fake sperm, they loaded the artificial vagina with 2.6 ml of fake sperm and inserted one of three female sex toys into it before withdrawing it. Over several trials, three different female sex toys were used: a control phallus that had no coronal ridge (i.e., no bell-end), a phallus with a minimal coronal ridge (small bell-end) and a phallus with a coronal ridge.

They measured sperm displacement as a percentage using the following equation (included here because it is more interesting than all of the other equations in this book):

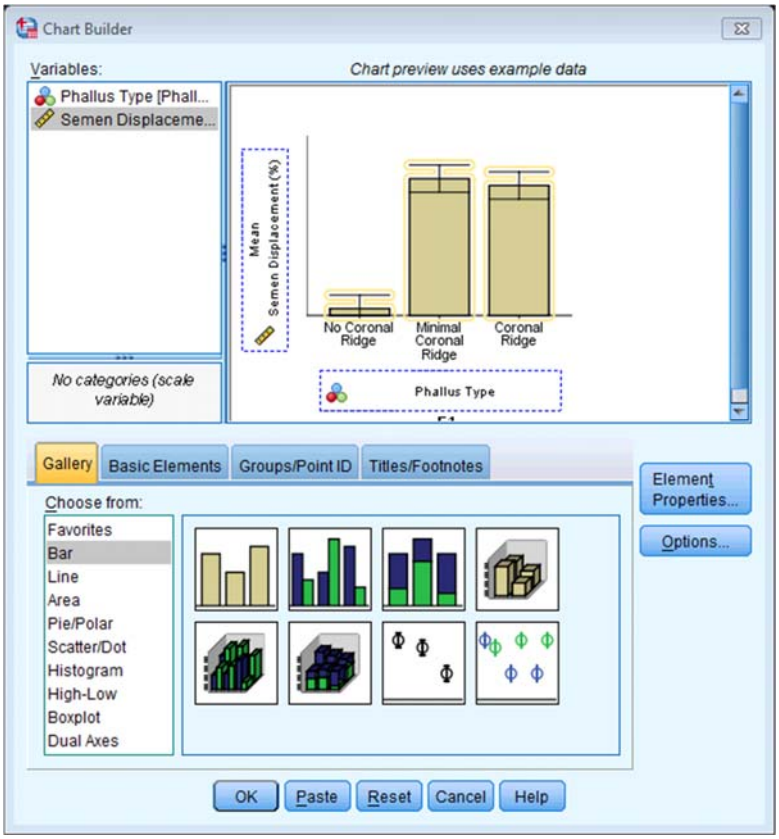
$$\frac{\text{Weight of vagina with semen} - \text{weight of vagina following insertion and removal of phallus}}{\text{Weight of vagina with semen} - \text{weight of empty vagina}} \times 100$$

As such, 100% means that all of the sperm was displaced by the phallus, and 0% means that none of the sperm was displaced. If the human penis evolved as a sperm displacement device then Gallup et al. predicted: (1) that having a bell-end would displace more sperm

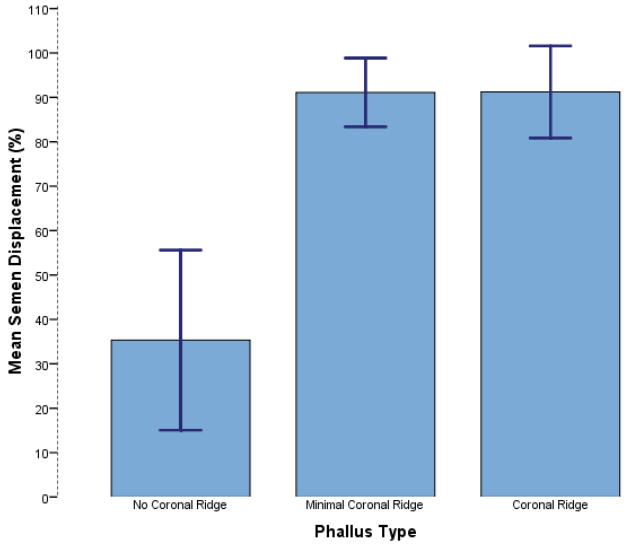
than not; and (2) the phallus with the larger coronal ridge would displace more sperm than the phallus with the minimal coronal ridge. The conditions are ordered (no ridge, minimal ridge, normal ridge) so we might also predict a linear trend. The data can be found in the file **Gallup et al.sav**. Draw an error bar graph of the means of the three conditions. Conduct a one-way ANOVA with planned comparisons to test the two hypotheses above. What did Gallup et al. find?

Solution

OK, let's do the graph first. There are two variables in the data editor: **Phallus** (the independent variable that has three levels: no ridge, minimal ridge and normal ridge) and **Displacement** (the dependent variable, the percentage of sperm displaced). The graph should therefore plot **Phallus** on the *x*-axis and **Displacement** on the *y*-axis. The completed dialog box should look like this:

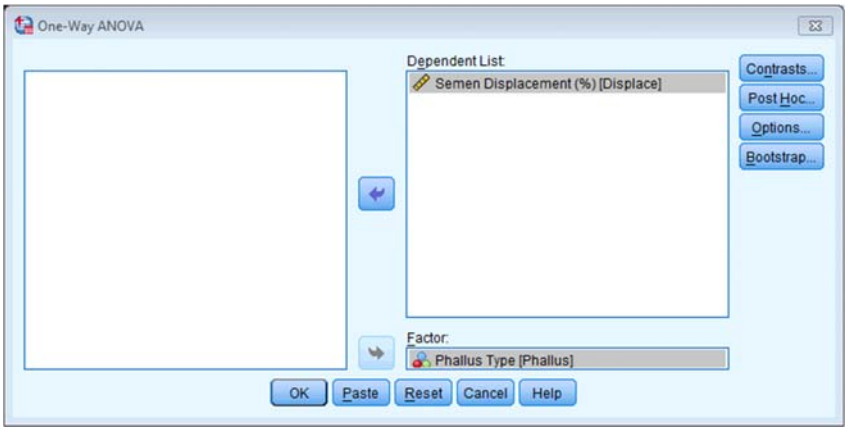


The final graph looks like this (I have edited mine, you can edit yours too to get some practice):



It shows that having a coronal ridge results in more sperm displacement than not having one. The size of ridge made very little difference.

For the ANOVA the dialog box should look like this:



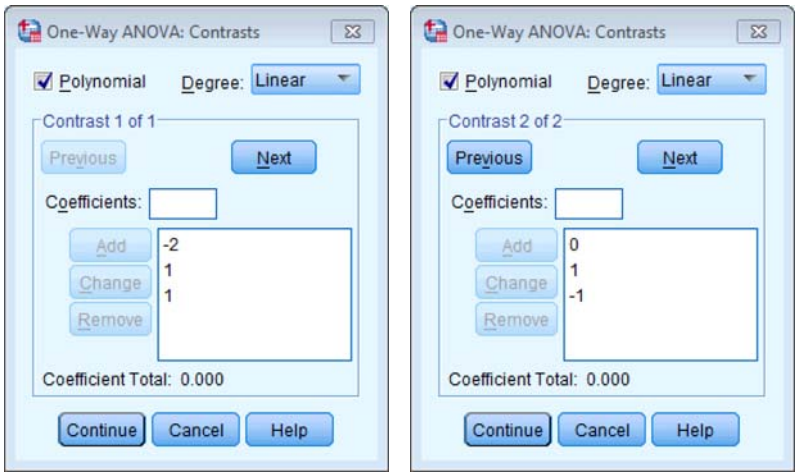
To test our hypotheses we need to enter the following codes for the contrasts:

	Group		
	No Ridge (Control)	**Minimal Ridge**	**Coronal Ridge**
Contrast 1	−2	1	**1**
Contrast 2	**0**	**−1**	**1**

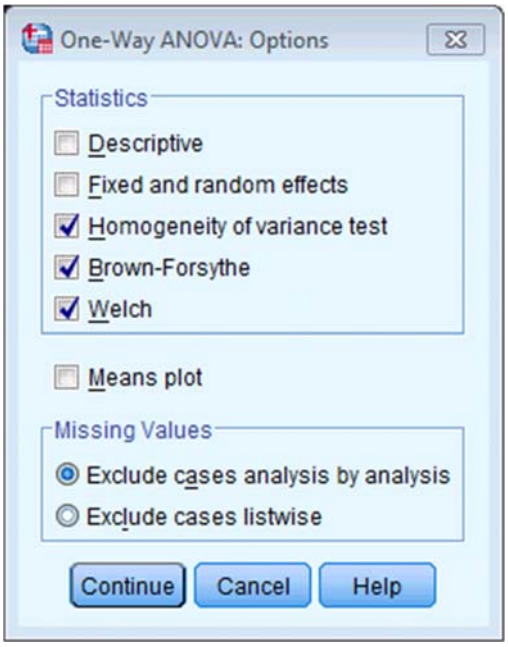
Contrast 1 tests hypothesis 1: that having a bell-end will displace more sperm than not. To test this we compare the two conditions with a ridge against the control condition (no ridge). So we compare chunk 1 (no ridge) to chunk 2 (minimal ridge, coronal ridge). The numbers assigned to the groups are the number of groups in the opposite chunk, and then we randomly assigned one chunk to be a negative value (the codes 2, −1, −1 would work fine as well).

Contrast 2 tests hypothesis 2: the phallus with the larger coronal ridge will displace more sperm than the phallus with the minimal coronal ridge. First we get rid of the control phallus by assigning a code of 0; next we compare chunk 1 (minimal ridge) to chunk 2 (coronal ridge). The numbers assigned to the groups are the number of groups in the opposite chunk, and then we randomly assigned one chunk to be a negative value (the codes 0, 1, −1 would work fine as well).

We enter these codes into SPSS as below:



We should also ask for homogeneity tests and corrections:



Test of Homogeneity of Variances

Semen Displacement (%)

Levene Statistic	df1	df2	Sig.
1.122	2	12	.358

Output 1

Output ~~Output 1~~ tells us that Levene's test is not significant, $F(2, 12) = 1.12$, $p > .05$, so we can assume that variances are equal.

ANOVA

Semen Displacement (%)

			Sum of Squares	df	Mean Square	F	Sig.
Between Groups	(Combined)		10397.657	2	5198.829	41.559	.000
	Linear Term	Contrast	7814.086	1	7814.086	62.466	.000
		Deviation	2583.572	1	2583.572	20.653	.001
Within Groups			1501.128	12	125.094		
Total			11898.785	14			

Output 2

Output ~~Output 2~~ is the output of the main ANOVA and tells us that there was a significant effect of the type of phallus, $F(2, 12) = 41.56$, $p < .001$. (This is exactly the same result as reported in the paper on page 280.) There is also a significant linear trend, $F(1, 12) = 62.47$, $p >$

.001, indicating that more sperm was displaced as the ridge increased (however, note from the graph that this effect reflects the increase in displacement as we go from no ridge to having a ridge; there is no extra increase from 'minimal ridge' to 'coronal ridge').

Contrast Coefficients

Contrast	Phallus Type		
	No Coronal Ridge	Minimal Coronal Ridge	Coronal Ridge
1	-2	1	1
2	0	1	-1

Output 3

Output ~~Output 3~~ tells us that we entered our weights correctly.☺

Contrast Tests

		Contrast	Value of Contrast	Std. Error	t	df	Sig. (2-tailed)
Semen Displacement (%)	Assume equal variances	1	111.7012	12.25205	9.117	12	.000
		2	-.1136	7.07373	-.016	12	.987
	Does not assume equal variances	1	111.7012	15.33284	7.285	4.828	.001
		2	-.1136	4.65938	-.024	7.399	.981

Output 4

Looking at Output ~~Output 4~~, we can see that contrast 1 tells us that hypothesis 1 is supported: having some kind of ridge led to greater sperm displacement than not having a ridge, $t(12) = 9.12$, $p < .001$. Contrast 2 shows that hypothesis 2 is not supported: the amount of sperm displaced by the normal coronal ridge was not significantly different from the amount displaced by a minimal coronal ridge, $t(12) = -0.02$, $p = .99$.