

Laboratory for Interactions (including Rosnow & Rosenthal)

1. In the last lab, you looked at the following data set:

We're looking at the effect of sex (M/F) and reward (Low, Med, High) on the performance of rats in a maze. The DV is number of trials to no errors in completing the maze. The data are seen below, with the group means in the last row.

M/Low	M/Med	M/High	F/Low	F/Med	F/High
7	6	4	4	3	3
8	7	5	5	3	3
6	8	3	3	2	4
8	7	4	3	3	4
7	6	5	4	4	3
7.2	6.8	4.2	3.8	3.0	3.4

Here are these data analyzed using SPSS:

Tests of Between-Subjects Effects

Dependent Variable: TRNOERR

Source	Sum of Squares	df	Mean Square	F	Sig.	Noncent. Parameter	Observed Power
Corrected Model	81.467	5	16.293	27.156	.000	135.778	1.000
Intercept	672.133	1	672.133	1120.222	.000	1120.222	1.000
SEX	53.333	1	53.333	88.889	.000	88.889	1.000
REWARD	14.867	2	7.433	12.389	.000	24.778	.991
SEX * REWARD	13.267	2	6.633	11.056	.000	22.111	.983
Error	14.400	24	.600				
Total	768.000	30					
Corrected Total	95.867	29					

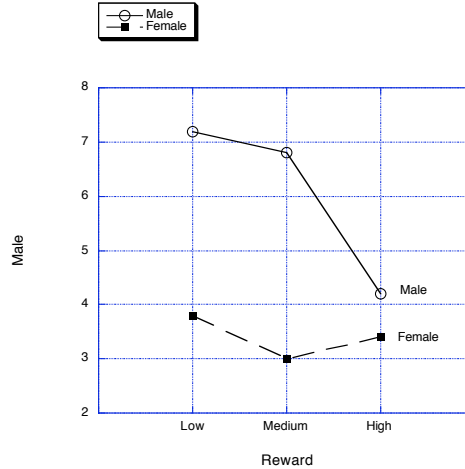
a. Computed using alpha = .05

b. R Squared = .850 (Adjusted R Squared = .818)

Descriptive Statistics

Dependent Variable: TRNOERR

SEX	REWARD	Mean	Std. Deviation	N
Female	High	3.40	.548	5
	Low	3.80	.837	5
	Medium	3.00	.707	5
	Total	3.40	.737	15
Male	High	4.20	.837	5
	Low	7.20	.837	5
	Medium	6.80	.837	5
	Total	6.07	1.580	15
Total	High	3.80	.789	10
	Low	5.50	1.958	10
	Medium	4.90	2.132	10
	Total	4.73	1.818	30



Rosnow and Rosenthal argue that it's important to view an interaction in its pure form, unaffected by the main effects. To give you practical experience with removing the main effects to get an "unbiased" view of the interaction, let's work with this data set. First, compute the marginal means (and the Grand Mean, which you can place in the lower right corner).

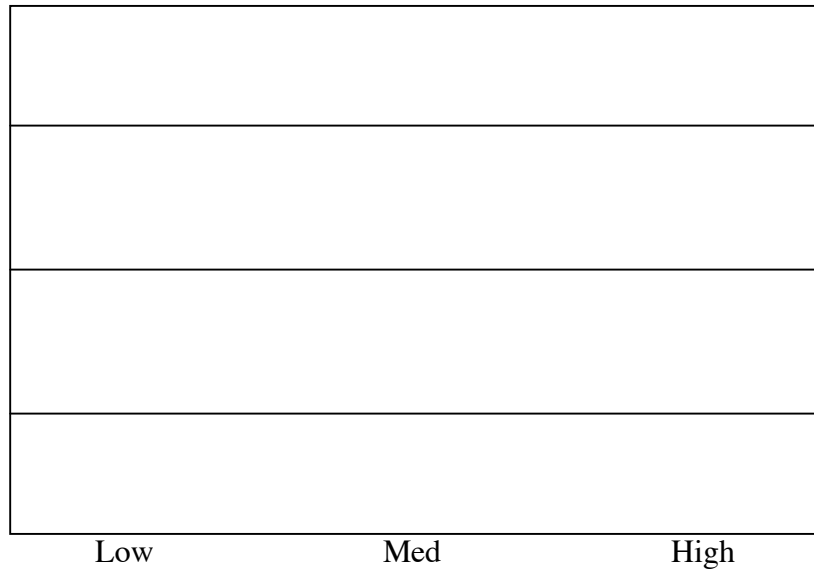
	Low	Medium	High	Marginal
Male	7.2	6.8	4.2	
Female	3.8	3.0	3.4	
Marginal				

Next, use the values that you've computed to determine the interaction terms:

- The Row effect is the Row mean (marginal) for the Group mean minus the Grand Mean.
- The Column effect is the Column mean (marginal) for the Group mean minus the Grand Mean.
- The Interaction effect is the Group mean minus the sum of the (Row effect + Col effect + Grand mean).

Effect	M/Low	M/Med	M/High	F/Low	F/Med	F/High
Group mean	7.2	6.8	4.2	3.8	3.0	3.4
Row effect						
Col effect						
Grand mean						
Sum of R,C,G						
Interaction						

The residual (interaction) means have had all the main effects removed. Plot the residuals below to get a sense of the “true” interaction in these data.



How would your interpretation of the interaction seen above differ from your interpretation of the interaction on the “raw” data? What would your post hoc tests tell you? Which interpretation makes more sense to you?

I’ve placed the residual data in the data file, so you can actually compute an ANOVA on the residual values. Do so now. There is some rounding slop, so one main effect does not come out to zero exactly, but you can see that the interaction effect is unaffected and that the main effects are zero and near zero.

As you may recall, you computed two simple effects for the interaction analysis.

Simple Effect	SS_{Effect}	MS_{Effect}	MS_{Error}	F
Reward for Male	26.533	13.267	.6	22.11
Reward for Female	1.6	0.800	.6	1.33
Sum of SS				

As K&W point out, in the presence of an interaction the simple effects will differ (as they do here). But, as they also point out, the simple effects tap into both the interaction effect and the main effect. You can see how that’s true by comparing the sum of the SS for the two simple effects with the sum of the SS_{Reward} and $SS_{Interaction}$ from the original source table.

SS_{Reward}	$SS_{Interaction}$	Sum

Given that the simple effects reflect a contribution of the main effect as well as the interaction, you need another approach to explaining the interaction that does not involve the main effect. K&W show how you could compute interaction contrasts (a set of 2x2 comparisons). Let's approach the interpretation of this interaction using interaction contrasts. You'll need to tell SPSS what you want to compare, but compute the three interaction contrasts below, then compute the F for each comparison.

Contrast	$SS_{Contrast}$	$df_{Contrast}$	$MS_{Contrast}$	MS_{Error}	F
M/Lo-Med vs F/Lo-Med					
M/Lo-Hi vs F/Lo-Hi					
M/Med-Hi vs F/Med-Hi					
Sum of SS					

These contrasts cannot be orthogonal, because there are only $(a-1)(b-1) = 2$ orthogonal contrasts. However, if these contrasts were orthogonal, their sum would equal $SS_{Interaction}$. Sum the three contrast SS and you should find that their sum is greater than $SS_{Interaction}$.

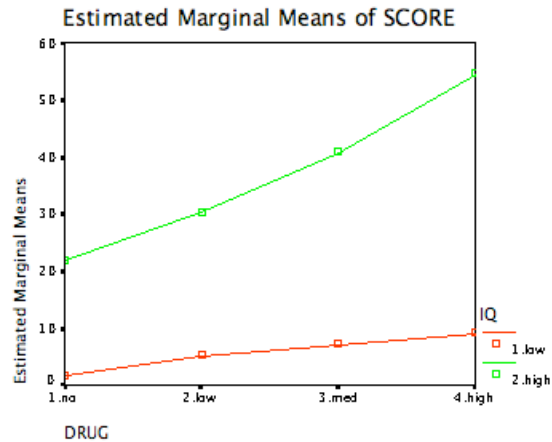
Of course, you still need to determine if the F -ratios are significant. Considering these contrasts as post hoc tests, you might compare them to a Tukey or Fisher-Hayter critical F value. Now, use these interaction contrasts to craft an interpretation of the significant interaction found in this study. How is your interpretation informed by the simple effects analyses? How is your interpretation informed by the interaction contrasts?

2. Here's another problem. Assume that you have people with Low IQ (80-90) and people with High IQ (110-120). You're interested in the effect of a new drug that you will administer in one of 3 levels (Low, Medium, High) as well as a control condition that receives a placebo (No Drug). The DV is the number of problems solved in an hour. Analyze the results as completely as you can. Obviously, you would need to interpret the significant interaction. The interaction contrasts will be very helpful in interpreting the interaction. (The data are in a file called IQ.Drug.sav.)

Descriptive Statistics

Dependent Variable: SCORE

IQ	DRUG	Mean	Std. Deviation	N
1.low	1.no	1.8000	.83666	5
	2.low	5.2000	.83666	5
	3.med	7.2000	.83666	5
	4.high	9.2000	.83666	5
	Total	5.8500	2.90689	20
2.high	1.no	22.0000	1.58114	5
	2.low	30.4000	1.14018	5
	3.med	40.8000	3.11448	5
	4.high	54.6000	3.84708	5
	Total	36.9500	12.72575	20
Total	1.no	11.9000	10.71292	10
	2.low	17.8000	13.31499	10
	3.med	24.0000	17.83878	10
	4.high	31.9000	24.07142	10
	Total	21.4000	18.19383	40



Tests of Between-Subjects Effects

Dependent Variable: SCORE

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	12785.200 ^a	7	1826.457	469.828	.000
Intercept	18318.400	1	18318.400	4712.129	.000
IQ	9672.100	1	9672.100	2488.000	.000
DRUG	2202.200	3	734.067	188.827	.000
IQ * DRUG	910.900	3	303.633	78.105	.000
Error	124.400	32	3.888		
Total	31228.000	40			
Corrected Total	12909.600	39			

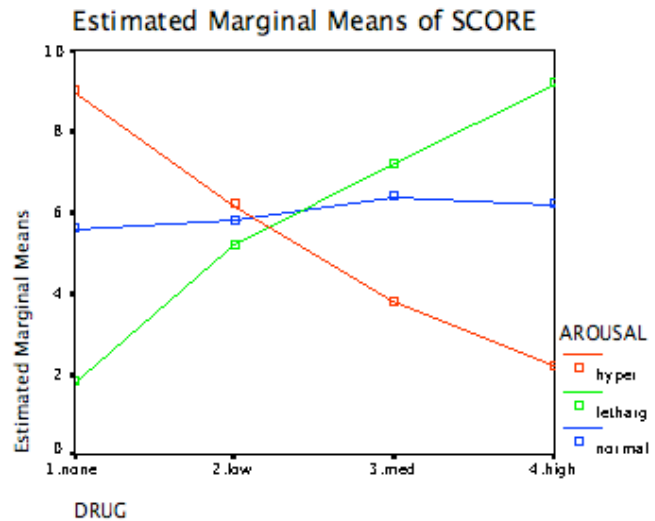
a. R Squared = .990 (Adjusted R Squared = .988)

3. Suppose that you are testing levels of a drug (None, Low, Medium, High) that is intended to affect arousal level. Let's assume that normal arousal level is approximately 5 on a scale of 1-10. You decide to test the drug on Normal people, Hyperactive people, and Lethargic people. Analyze the data below as completely as you can. What recommendation would you make about the drug? (The data file is called Drug.Arousal.sav.)

Descriptive Statistics

Dependent Variable: SCORE

AROUSAL	DRUG	Mean	Std. Deviation	N
hyper	1.none	9.00	.707	5
	2.low	6.20	1.304	5
	3.med	3.80	1.095	5
	4.high	2.20	.837	5
	Total	5.30	2.793	20
letharg	1.none	1.80	.837	5
	2.low	5.20	.837	5
	3.med	7.20	.837	5
	4.high	9.20	.837	5
	Total	5.85	2.907	20
normal	1.none	5.60	1.140	5
	2.low	5.80	.837	5
	3.med	6.40	1.140	5
	4.high	6.20	.837	5
	Total	6.00	.973	20
Total	1.none	5.47	3.159	15
	2.low	5.73	1.033	15
	3.med	5.80	1.781	15
	4.high	5.87	3.067	15
	Total	5.72	2.373	60



Tests of Between-Subjects Effects

Dependent Variable: SCORE

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	288.583 ^a	11	26.235	28.882	.000
Intercept	1960.817	1	1960.817	2158.697	.000
AROUSAL	5.433	2	2.717	2.991	.060
DRUG	1.383	3	.461	.508	.679
AROUSAL * DRUG	281.767	6	46.961	51.700	.000
Error	43.600	48	.908		
Total	2293.000	60			
Corrected Total	332.183	59			

a. R Squared = .869 (Adjusted R Squared = .839)

Interpret this interaction as completely as you can. What recommendation would you make about administration of the drug? Can you see how the interaction contrasts can become complex, given more complicated designs?
