Laboratory Exercise for Three-Factor Designs that Include Repeated Factors

1. [Howell] Assume that a tiny "click" on your clock radio always slightly precedes your loud and intrusive alarm going off. Over time that click (psychologists would call it a "CS") could come to elicit the responses normally produced by the alarm (the "US"). Moreover, it is possible that simply presenting the click might lead to suppression of an ongoing behavior, even if that click is not accompanied by the alarm. In a laboratory investigation of how the click affects (suppresses) ongoing behavior, Bouton and Swartzentruber (1985) investigated the degree to which a tone, which had previously been paired with shock, would suppress the rate of an ongoing bar-pressing response in rats. Suppression was measured by taking the ratio of the number of bar presses during a 1-minute test period following the tone to the total number of bar presses during both a baseline period and the test period. For all groups, behavior was assessed in two Phases—Shock phase (shock accompanied the tone) and a No-shock phase (shock did not accompany the tone) repeated over a series of four Cycles of the experiment.

During Phase I, Group A-B was placed in Box A. After a 1-minute baseline interval, during which the animal bar-pressed for food, a tone was presented for 1 minute and was followed by a mild shock. The degree of suppression of the bar-pressing response when the tone was present (a normal fear response) was recorded. The animal was then placed in Box B for Phase II of the cycle, where, after 1 minute of baseline bar-pressing, only the tone stimulus was presented. Because the tone was previously paired with shock, it should suppress bar-pressing behavior to some extent. Over a series of A-B cycles, however, the rat should learn that shock is never administered in Phase II and that Box B is therefore a "safe" box. Thus, for later cycles there should be less suppression on the no-shock trials.

Group L-A-B was treated in the same way as Group A-B except that these animals previously had had experience with a situation in which a light, rather than a tone, had been paired with shock. Because of this previous experience, the researchers expected the animals to perform slightly better (less suppression during Phase II) than did the other group, especially on the first cycle or two.

Group A-A was also treated in the same way as Group A-B except that both Phases were carried out in the same box—Box A. Because there were no differences in the test boxes to serve as cues (i.e., animals had no way to distinguish the no-shock from the shock phases), this group would be expected to show the most suppression during the No-shock phases.

How would you characterize this design?

The data are seen below, though they were converted to proportions in the data file (Suppression.sav). Analyze the results as completely as you can.

Group	Cycle 1		Cycle 2		Cycle 3		Cycle 4	
	Phase I	Phase II	Phase I	Phase II	Phase I	Phase II	Phase I	Phase II
A-B	1	28	22	48	22	50	14	48
	21	21	16	40	15	39	11	56
	15	17	13	35	22	45	1	43
	30	34	55	54	37	57	57	68
	11	23	12	33	10	50	8	53
	16	11	18	34	11	40	5	40
	7	26	29	40	25	50	14	56
	0	22	23	45	18	38	15	50
A-A	1	6	16	8	9	14	11	33
	37	59	28	36	34	32	26	37
	18	43	38	50	39	15	29	18
	1	2	9	8	6	5	5	15
	44	25	28	42	47	46	33	35
	15	14	22	32	16	23	32	26
	0	3	7	17	6	9	10	15
	26	15	31	32	28	22	16	15
L-A-B	33	43	40	52	39	52	38	48
	4	35	9	42	4	46	23	51
	32	39	38	47	24	44	16	40
	17	34	21	41	27	50	13	40
	44	52	37	48	33	53	33	43
	12	16	9	39	9	59	13	45
	18	42	3	62	45	49	60	57
	13	29	14	44	9	50	15	48

Generate an ANOVA source table (and means table). You should see a significant three-way interaction, so that's where you need to focus your attention.

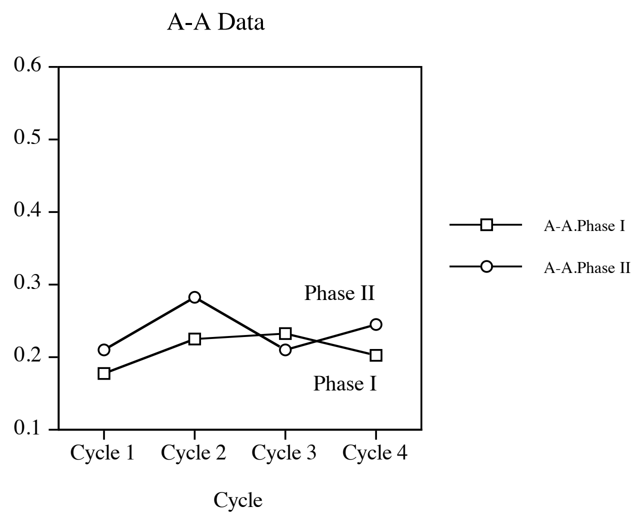
What would be your best estimate of ω^2 for the interaction? What estimate would SPSS provide for effect size using partial η^2?

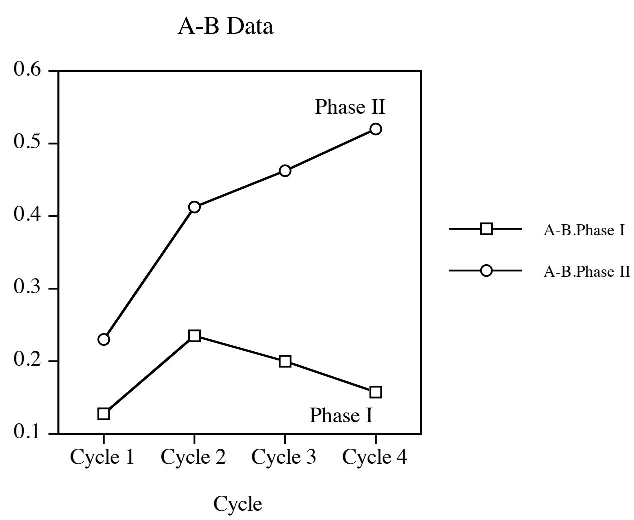
$$\hat{\omega}^2 = \frac{\hat{\sigma}^2_{AxBxC}}{\hat{\sigma}^2_{AxBxC} + \hat{\sigma}^2_{Error}}$$

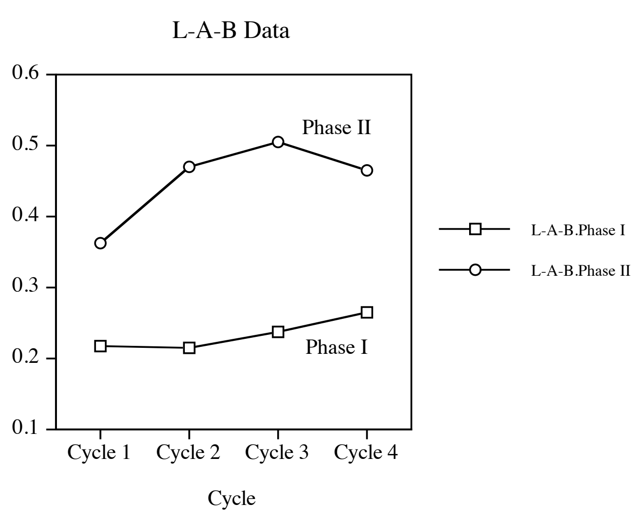
$$\hat{\sigma}^2_{AxBxC} = \frac{df_{AxBxC}\left(MS_{AxBxC} - MS_{Error}\right)}{(a)(b)(c)(n)}$$

$$\hat{\sigma}^2_{Error} = MS_{Error}$$

The first step, I think, would be to construct graphs to help understand the interaction. I did that for you in Cricket Graph. (I could have fit it all on 2 graphs if I'd done Phase I vs. Phase II, but I think that the comparisons across the three groups made more sense. To make the comparisons "fair," I had Cricket Graph make the y-axes identical (0.1 to 0.6).







Given the three-way interaction, of course, you know that at least two of the three interactions above have to be different. Thus, that's your task. Explain the source of the three-way interaction.

2. One of your homework problems describes a study that compares Adult and Child readers to see if Good and Poor readers (among the Adults and Children) differ in their memory for Settings, Goals, and inferred Dispositions in the texts that they read (10 short stories). Suppose that the summary data had been as seen below (rather than the data found in your homework problem). The DV is the number of each type of information that the participant reports for each of the 10 stories (minimum = 0, maximum = 10).

		Settings	Goals	Dispositions
Children	Poor Readers	5	4	3
		5	3	2
		6	3	2
		4	2	1
		6	3	1
		7	3	2
	Good Readers	8	7	8
		6	7	7
		6	5	7
		7	6	7
		8	7	8
		6	7	8
Adults	Poor Readers	7	5	3
		8	5	3
		7	6	4
		9	7	5
		7	5	4
		8	6	5
	Good Readers	9	8	10
		9	8	8
		8	9	8
		9	9	10
		8	9	9
		9	8	8

Under what circumstances would you be inclined to compute a Brown-Forsythe test on these data?
First, compute an overall ANOVA (and means table) on these data (Reading1.sav)

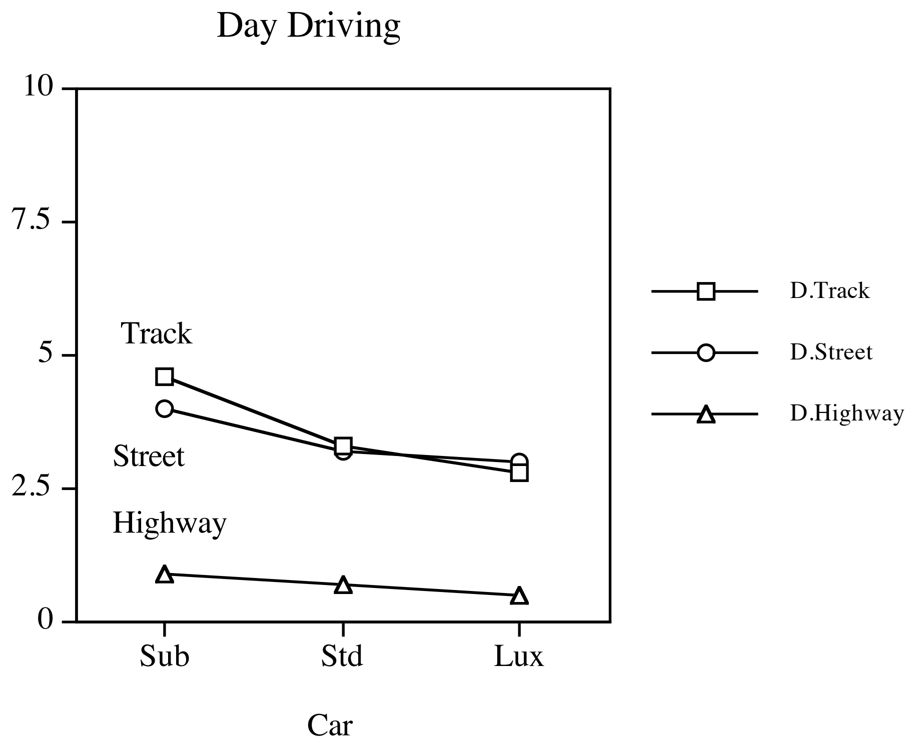
Use SPSS to estimate partial η^2 for the three-way interaction.	
Use SPSS to estimate power for the three-way interaction.	

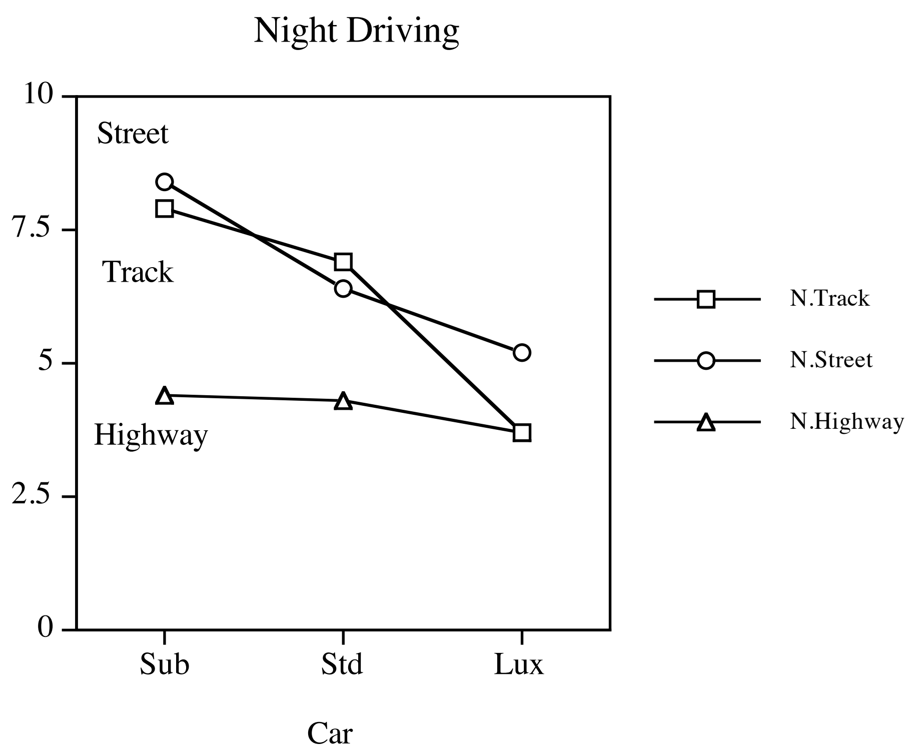
Given the results of the ANOVA, compute the rest of the analyses necessary to completely interpret the results of this study.

3. In the handout for 3-Way analyses, I provided data from Howell about a driving exercise that tested 3 drivers over 3 Courses, 2 Times of Day, and 3 Types of Car. The DV was the number of steering errors. Incomplete counterbalancing would dictate that you should actually run a minimum of 18 participants in the study. Suppose that you did so and obtained the data seen below:

Track						City Streets						Highway					
Night			Day			Night			Day			Night			Day		
Su	St	Lu	Su	St	Lu	Su	St	Lu	Su	St	Lu	Su	St	Lu	Su	St	Lu
10	8	6	5	4	3	9	7	5	4	3	3	7	6	3	2	2	1
9	8	5	4	3	3	10	6	4	4	2	2	4	5	2	2	3	2
8	7	4	4	1	2	7	4	3	3	3	2	3	4	2	1	0	1
5	5	2	5	4	3	8	7	6	5	4	3	5	4	4	1	0	0
7	6	2	5	5	3	7	6	7	3	3	3	4	3	4	1	1	1
8	8	4	5	5	4	9	7	6	3	3	4	3	4	4	2	0	1
9	8	5	4	4	3	8	7	5	3	3	3	5	4	5	0	1	0
6	7	4	3	3	3	9	5	5	4	3	2	4	4	3	1	0	0
7	6	3	4	4	3	10	7	7	5	3	4	4	4	4	1	1	0
8	6	3	5	3	3	9	8	6	4	4	3	5	5	4	1	1	1
5	4	2	4	3	3	7	7	5	5	4	5	6	5	5	0	0	0
9	8	4	5	3	2	8	5	5	6	4	4	4	4	4	0	0	0
10	9	6	6	4	3	9	7	4	5	4	3	3	4	4	2	0	0
8	7	4	5	3	3	8	7	5	4	3	3	5	3	3	1	0	1
9	7	3	4	2	2	9	6	6	4	4	2	4	4	4	1	1	0
7	6	3	5	3	3	7	6	5	3	3	3	5	5	5	1	1	0
8	7	3	4	2	2	8	7	4	4	2	2	4	4	3	0	0	1
9	7	4	5	3	2	9	6	6	3	3	3	5	5	4	0	1	0

To make your life a bit easier, I've graphed the results of the study for you:





Use SPSS to estimate η^2 for the three-way interaction.	
Use SPSS to estimate power for the three-way interaction.	

Analyze and interpret the results of this study as completely as you can (Howell.mod.sav).
