

Group Member Names: \_\_\_\_\_

*Instructions:* Each student will work in a group of three. Each group member will contribute to this activity, but will each also hold a unique role. One member should be the “Manager” and make sure that the group stays on task, finishes on time, and that all members of the group are being heard and participating in the activity. The second member should be the “Recorder” and write down the answers on the worksheet to be submitted to the professor. The third member will be the “Reporter” and should be prepared to share the groups’ responses with the members of another group upon completion of the exercise to check for accuracy.

### Experimental Workshop: Factorial Designs

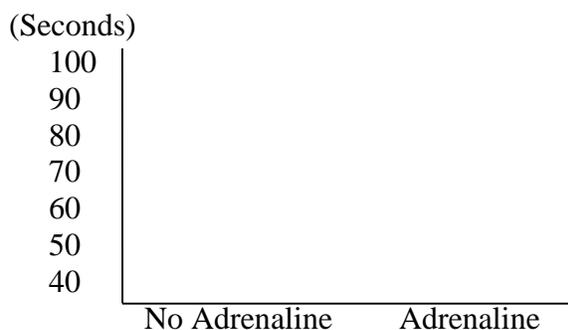
*Background:* 60 participants are given either a shot of adrenaline or an inert shot. Then, people from each group participate in either an easy obstacle course or a more challenging obstacle course. They are timed to see how many seconds it takes them to complete the courses. The resulting data are in the table below:

	Course Difficulty		Row Average (Mean)
	Easy	Hard	
No Adrenaline	50	90	_____
Adrenaline	80	60	_____
Column Average (Mean)	_____	_____	

1. Fill in the column and row average values.

The three variables in this study include **course difficulty**, **drug administration**, and **course time**. Both course difficulty and drug administration are **independent variables** and course time is the **dependent variable**. Each independent variable has two levels (there were two groups), thus, this is a 2x2 factorial design.

2. Graph the four original data points (not the averages; use a dotted line to connect the “easy” scores and a solid line to connect the “hard” scores).



3. Look at the chart and graph. Without paying attention to the scores for those who have and have not had an adrenaline shot, would you say that there were differences in how quickly the participants completed the easy and hard obstacle course? Describe what you see.
4. Look at the chart and graph. Without paying attention to the scores for the easy versus hard obstacle course, would you say that there were differences in the scores for those who had and did not have an adrenaline shot? Describe what you see.

**Information:**

In factorial designs, we are both interested in main effects and interactions. A **main effect** is when one of the independent variables single-handedly influences the dependent variable – irrespective of the influence of other independent variables. Without using inferential statistics, we can estimate a main effect by using the row or column averages. If the averages are different (by more than a couple of seconds), there is a main effect. If they are not different, there is not a main effect of that variable.

5. Based on the information above and your answer to question 3, would you say that there is a main effect of “course difficulty”? Why? Explain what this finding means in sentence format.
6. Based on the information above and your answer to question 4, would you say that there is a main effect of drug administration? Why? Explain what this finding means in sentence format.

**Information:**

In factorial design, we are also interested in how the two independent variables interact with each other. This means that the effect of one of the independent variables is dependent on the other independent variable. In other words, whether one independent variable increases or decreases the scores depends on what is happening with the second variable. One way to tell if there is an interaction is if the lines of the graphed results are not parallel.

7. Using the graph above, do you think there is an interaction? Why?
8. Using the chart and the graph above, describe the interaction between these two variables. In other words, how does one independent variable depend on the other?

**Information:**

Now that you have a better understanding of factorial research designs and how to write about research results from these studies, let us **apply** your new knowledge to additional research scenarios. Imagine a researcher conducts an experiment investigating the effects of 10-weeks of cognitive-behavioral therapy (complete or incomplete) and the effects of taking a moderate dosage of anti-depressant medication (taken or not taken) on participants’ depressive symptoms.

9. Given the above research scenario, identify the three variables involved and describe hypothesized results for: a) a main effect of variable 1; b) a main effect of variable 2; and c) an interaction between the two variables.

Independent Variable 1:

Independent Variable 2:

Dependent Variable:

a)

b)

c)

10. Come up with another research question example that makes use of a factorial design. List each variable and provide your hypotheses for: a) a main effect of variable 1; b) a main effect of variable 2; and c) an interaction between the two variables.

Independent Variable 1:

Independent Variable 2:

Dependent Variable:

a)

b)

c)

*Instructions:* Through reviewing the questions above, discuss as a group both what you have learned and what is still unclear about the following terms and concepts: factorial design, main effects, and interactions.

Next, discuss as a group what the process was like to: a) use the chart/graph to help understand the results; b) simultaneously consider main effects and interactions with regard to the data; and c) generate written explanations of the results you determined through your analysis of the data.

**Now, find another group that has completed the workshop and review your answers with them to check for accuracy and clarity of explanation.**

### Answer Key

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### Experimental Workshop: Factorial Designs

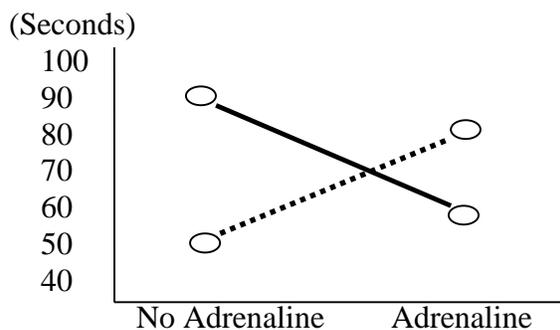
*Background:* 60 participants are given either a shot of adrenaline or an inert shot. Then, people from each group participate in either an easy obstacle course or a more challenging obstacle course. They are timed to see how many seconds it takes them to complete the courses. The resulting data are in the table below:

	Course Difficulty		Row Average (Mean)
	Easy	Hard	
No Adrenaline	50	90	<u>70</u>
Adrenaline	80	60	<u>70</u>
Column Average (Mean)	<u>65</u>	<u>75</u>	

1. Fill in the column and row average values.

The three variables in this study include **course difficulty**, **drug administration**, and **course time**. Both course difficulty and drug administration are **independent variables** and course time is the **dependent variable**. Each independent variable has two levels (there were two groups), thus, this is a 2x2 factorial design.

2. Graph the four original data points (not the averages; use a dotted line to connect the “easy” scores and a solid line to connect the “hard” scores).



3. Look at the chart and graph. Without paying attention to the scores for those who have and have not had an adrenaline shot, would you say that there were differences in how quickly the participants completed the easy and hard obstacle course? Describe what you see.

*It looks like the harder course took a little longer to complete than the easy course because the solid line is in general “higher” on the chart than the dotted line.*

4. Look at the chart and graph. Without paying attention to the scores for the easy versus hard obstacle course, would you say that there were differences in the scores for those who had and did not have an adrenaline shot? Describe what you see.

*They look about the same on average, but there is a bigger range for those without adrenaline.*

**Information:**

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5. Based on the information above and your answer to question 3, would you say that there is a main effect of “course difficulty”? Why? Explain what this finding means in sentence format.

*Yes, the averages are different (65 seconds for the easy course versus 75 seconds for the hard course). This means that the participants completed the easy course faster than the hard course.*

6. Based on the information above and your answer to question 4, would you say that there is a main effect of drug administration? Why? Explain what this finding means in sentence format.

*No, the averages are not different (75 seconds for those with and without adrenaline). This means that taking the adrenaline shot had no main effect on how quickly they completed the course.*

**Information:**

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7. Using the graph above, do you think there is an interaction? Why?

*Yes, there is an interaction. The lines on the graph are not parallel.*

8. Using the chart and the graph above, describe the interaction between these two variables. In other words, how does one independent variable depend on the other?

*When participants are completing a hard course, they do better after taking adrenaline than either the hard course without adrenaline or the easy course with adrenaline. When participants are completing an easy course, they do better without taking adrenaline than either the easy course with adrenaline or the hard course without adrenaline. As such, taking adrenaline is advantageous only if you are completing a difficult course and not if you are completing an easy course.*

**Information:**

Now that you have a better understanding of factorial research designs and how to write about research results from these studies, let us **apply** your new knowledge to additional research scenarios. Imagine a researcher conducts an experiment investigating the effects of 10-weeks of cognitive-behavioral therapy (complete or incomplete) and the effects of taking a moderate dosage of anti-depressant medication (taken or not taken) on participants' depressive symptoms.

9. Given the above research scenario, identify the three variables involved and describe hypothesized results for: a) a main effect of variable 1; b) a main effect of variable 2; and c) an interaction between the two variables.

Independent Variable 1: *Therapy*

Independent Variable 2: *Medication*

Dependent Variable: *Depressive Symptoms*

- a) *Example: Participants who undergo therapy will see an improvement in depressive symptoms*
- b) *Example: Participants who take anti-depressant medication will see an improvement in depressive symptoms*
- c) *Example: Participants who take both undergo therapy and take anti-depressant medication will see a greater improvement in depressive symptom than those who undergo either individual treatment.*

10. Come up with another research question example that makes use of a factorial design. List each variable and provide your hypotheses for: a) a main effect of variable 1; b) a main effect of variable 2; and c) an interaction between the two variables.

Independent Variable 1:

Independent Variable 2:

Dependent Variable:

- a)
- b)
- c)

*Instructions:* Through reviewing the questions above, discuss as a group both what you have learned and what is still unclear about the following terms and concepts: factorial design, main effects, and interactions.

Next, discuss as a group what the process was like to: a) use the chart/graph to help understand the results; b) simultaneously consider main effects and interactions with regard to the data; and c) generate written explanations of the results you determined through your analysis of the data.

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