

## Describing Two-Way Interactions

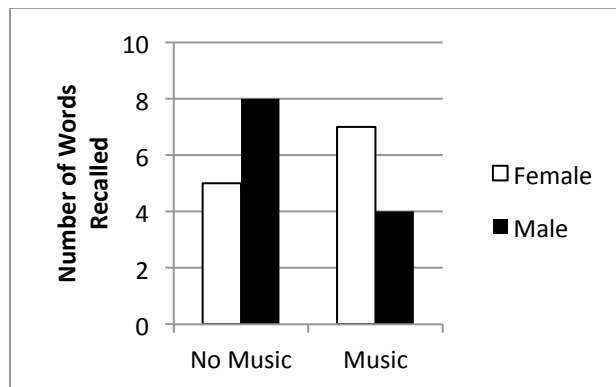
The purpose of this handout is to help you to find the language to describe interactions in writing. All of the examples below involve results with interactions. We assume that you understand the definitions of main effects and interactions and how to evaluate these effects.

This handout focuses on describing 2x2 interactions. A 2x2 interaction can occur when a study has two independent variables (IVs) that each has 2 levels, for a total of 4 conditions. For example, suppose we compare how well men vs. women (IV1, Gender) performed on a memorization task when they studied in an environment with music vs. without music (IV2, Study Environment). The results might show a 2x2 interaction between Gender and Study Environment.

		<b>IV1: Gender</b>	
		<u>Level 1:</u> Female	<u>Level 2:</u> Male
<b>IV2: Study Environment</b>	<u>Level 1:</u> No Music	<i>Condition 1</i> Female, No music	<i>Condition 2</i> Male, No music
	<u>Level 2:</u> Music	<i>Condition 3</i> Female, music	<i>Condition 4</i> Male, music

To say that there is an interaction between the two variables means that the effect of one IV on the dependent variable (DV) depends on the level of the other IV. For example, if we found the results below, we would conclude that there was an interaction between Gender and Study Environment, because the effect of Study Environment on the DV (number of words memorized) is not a simple main effect; it depends on whether the participant was male or female. (For illustrative purposes, assume that any difference between row totals (e.g., 13 vs. 11) is a statistical difference, even though no statistics are used in these examples.)

		<b>DV: Number of Words Recalled</b>		Sum
		<b>IV1: Gender</b>		
		<u>Level 1:</u> Female	<u>Level 2:</u> Male	
<b>IV2: Study Environment</b>	<u>Level 1:</u> No Music	5	8	<i>13</i>
	<u>Level 2:</u> Music	7	4	<i>11</i>
	Sum	<i>12</i>	<i>12</i>	



### Tips for Describing Two-Way Interactions:

1. A 2x2 design may result in zero, one, or two main effects and either no or one interaction. If your results show any main effects, describe these effects before describing any interaction. If you find an interaction, you can state this in several ways; e.g., that:
  - a. One or more main effect is qualified by an interaction.
  - b. One or more main effect exists overall, but the effect of one independent variable depends on (or differs based on) the level of the other independent variable.
  - c. There was a main effect of IV1, no main effect of IV2, and an interaction between IV1 and IV2.

All four descriptions mean the same thing.

#### Example:

- a. *Overall, participants recalled more words in the no music condition than the music condition. However, this main effect was qualified by an interaction with participant gender.*
  - b. *Overall, participants recalled more words in the no music condition than the music condition, but the effect of Study Environment depended on the participant's gender. (Or: ... The effect of Study Environment differed by Gender.)*
  - c. *There was a main effect of Study Environment (no music vs. music), no main effect of Gender (female vs. male), and an interaction between Study Environment and Gender.*
2. Explain the interaction in terms of the effect of one IV at one level of the second IV. In the example above, the effect of Study Environment depends on participant gender, so there is an interaction between Study Environment and Gender. Thus, first describe the effects of Study Environment for female participants, then describe the effects of Study Environment for male participants.

**Example (a):** *Female participants recalled more words in the music condition than the no music condition, but male participants recalled more words in the no music condition than the music condition.*

Alternatively, describe the effect of Gender in the no music condition and then in the music condition. (This is just a different way of explaining the same result.)

**Example (b):** *In the no music condition, male participants recalled more words than female participants, but in the music condition, female participants recalled more words than male participants.*

3. Describe each independent variable and each condition. The example above refers to both Gender (IV 1) and Study Environment (IV 2), and it describes all four conditions:
  - a. Female, music
  - b. Female, no music
  - c. Male, music
  - d. Male, no music.

4. If you're having trouble figuring out how to describe an interaction, try to look at the conditions in a different way:
  - a. Plot the interaction in a different way. If you plotted a bar graph, plot a line graph instead. If you plotted Gender (IV 1) on the X-axis, plot Study Environment (IV 2) on the X-axis instead.
  - b. Change the order in which you describe the effects of the independent variables. Instead of describing the effect of Study Environment for male vs. female participants, describe the effect of Gender in each of the study environments.
  - c. Think about how your research question is phrased, and try to describe the interaction in a way that best answers your research question.

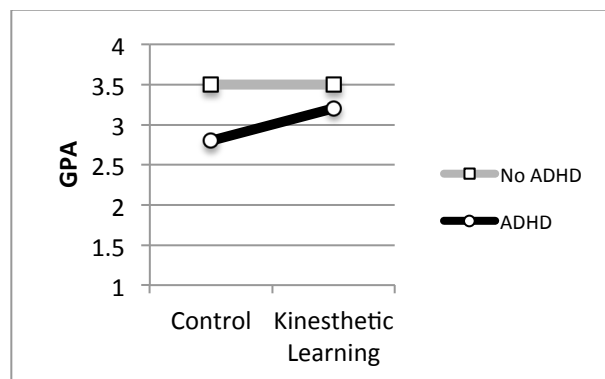
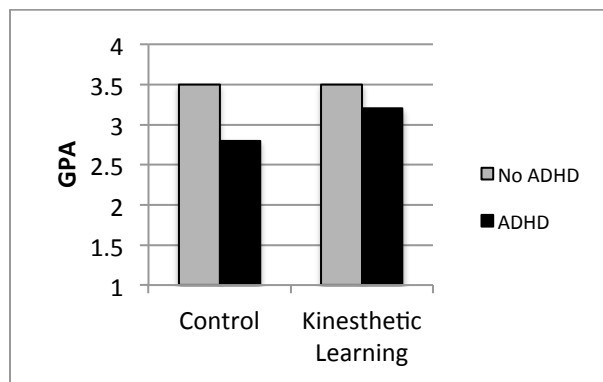
**Example 1. A treatment affects one group of participants but not another.**

*Do kinesthetic learning environments improve performance among students with ADHD?*

IV 1: ADHD Diagnosis (ADHD vs. no ADHD)

IV 2: Learning Environment (Control vs. Kinesthetic)

DV: GPA (measured on a 4.0 scale)



**Main effect:** Overall, students without ADHD earned higher GPAs than students with ADHD, and students in the kinesthetic learning environment earned higher GPAs than students in the control environment. However...

- a. ...these main effects were qualified by an interaction between Learning Environment and ADHD Diagnosis.
- b. ...each main effect depended on the level of the second independent variable, OR ...each main effect differed across levels of the second independent variable.
- c. There was a main effect of ADHD Diagnosis (ADHD vs. No ADHD), a main effect of Learning Environment (Control vs. Kinesthetic), and an interaction between ADHD and Learning Environment.

### Interaction:

Correct: The kinesthetic learning environment decreased the performance gap between students with ADHD and students without ADHD by improving GPA among students with ADHD.

Correct: Students without ADHD performed equally well in the control and kinesthetic learning environments. However, students with ADHD performed better in the kinesthetic learning environment compared to the control.

Incorrect: The kinesthetic learning environment improved GPA compared to the control condition.

*Explanation:* This statement describes only a main effect, not an interaction. To describe an interaction, the statement needs to describe how GPA changed (or did not change) for students with ADHD and students without ADHD.

Incorrect: Students with ADHD earned lower GPAs than students without ADHD.

*Explanation:* Again, this statement describes only a main effect, not an interaction. It needs to include information about how the kinesthetic (vs. control) learning environment affected GPA for students with vs. without ADHD.

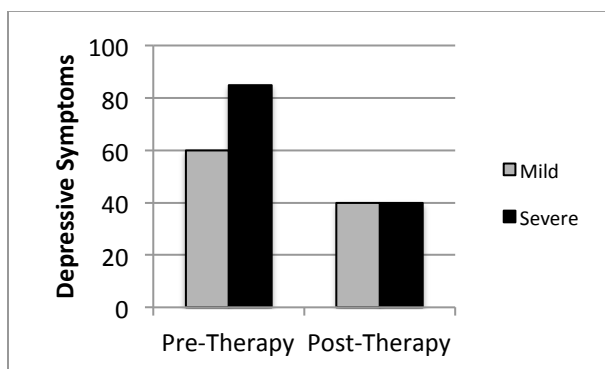
### Example 2: Treatment affects both groups of participants, but it affects one group more than the other.

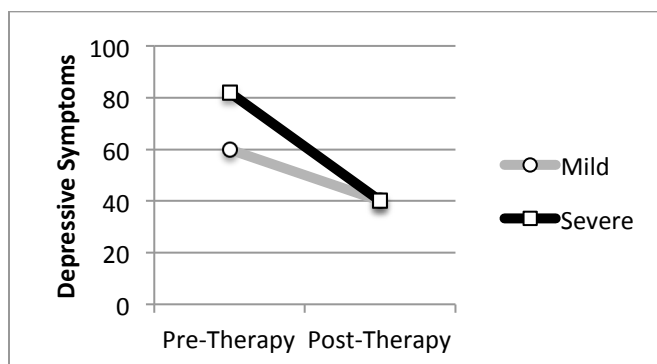
*Is a new therapy more effective for mildly or severely depressed clients?*

IV 1: Time: Pre-Therapy vs. Post-Therapy

IV 2: Level of Depression (Mild vs. Severe)

DV: Depressive Symptoms (measured on a 0-100 scale)





**Main effects:** Overall, the new therapy lowered depression scores for both mildly and severely depressed clients, and mildly depressed clients showed fewer depressive symptoms than severely depressed clients. However...

- ...these main effects were qualified by an interaction between Time and Level of Depression.
- ...these main effects depended on the level of the second independent variable, OR  
...these main effects differed across levels of the second independent variable.
- There was a main effect of Time (Pre-Therapy vs. Post-Therapy), a main effect of Level of Depression (Mild vs. Severe), and an interaction between Time and Level of Depression.

#### Interaction:

Correct: Severely depressed clients experienced a greater reduction in depressive symptoms following therapy compared to mildly depressed clients.

Correct: Before participating in the new therapy, severely depressed clients had more depressive symptoms than mildly depressed clients. After therapy, however, mildly and severely depressed clients showed similar levels of depressive symptoms.

Incorrect: Post-therapy depression scores were lower than pre-therapy depression scores.

*Explanation:* This statement describes a main effect, not an interaction. To describe the interaction, it should include a description of how depression scores changed for mildly vs. severely depressed clients.

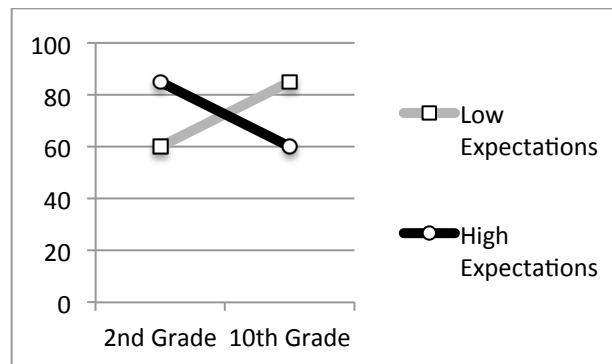
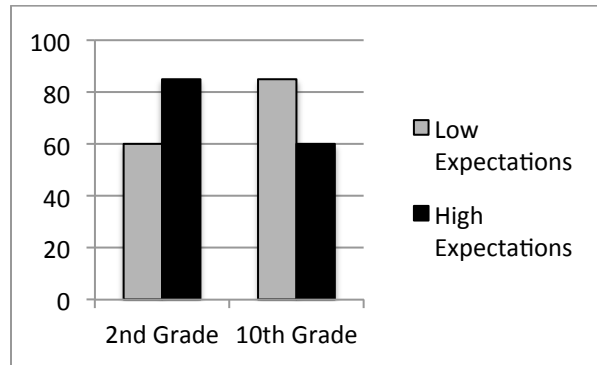
#### Example 3: A treatment has the opposite effect for two different groups.

*Do teachers' expectations about student performance predict how well younger and older students perform on a standardized test?*

IV 1: Grade Level (2<sup>nd</sup> Grade vs. 10<sup>th</sup> Grade)

IV 2: Teacher Expectations (Low vs. High)

DV: Standardized Test Score



**Main effects:** There was no effect of Grade Level (2<sup>nd</sup> Grade vs. 10<sup>th</sup> Grade) or Teacher Expectations (Low vs. High), but there was an interaction between Grade Level and Teacher Expectations.

**Interaction:**

Correct: For 2<sup>nd</sup> grade students, high teacher expectations predicted better performance on a standardized test compared to low teacher expectations. However, for 10<sup>th</sup> graders, high teacher expectations predicted worse performance on a standardized test compared to low teacher expectations.

Correct: When teachers had high expectations about student performance, 2<sup>nd</sup> graders performed better than 10<sup>th</sup> graders on a standardized test. However, when teachers had low expectations, 10<sup>th</sup> graders performed better than 2<sup>nd</sup> graders.