Week 12 Lecture - Complex Experiments

Undergraduate Research Methods in Psychology

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1 Learning Objectives

1.1 Textbook Objectives

- Explain why researchers combine independent variables in a factorial design.
- Describe an interaction effect in both everyday terms and arithmetic terms.
- Identify and interpret the main effects and interactions from a factorial design.

1.2 Professor's Objectives

- Understand and produce examples of when factorial design would be useful and/or appropriate
- Discuss some basic statistics procedures that can be used with these designs

2 Chapter Overview

2.1 Chapter Overview

- Up until now, we have only talked about experimental designs that deal with ______________ manipulated/independent variable and one measured/dependent variable.
- However, we have designs that can look at two (or more) IVs at once and see their individual and ______________ impact on the DV!
- We refer to these as ______________ designs.

3 Experiments with Two IVS

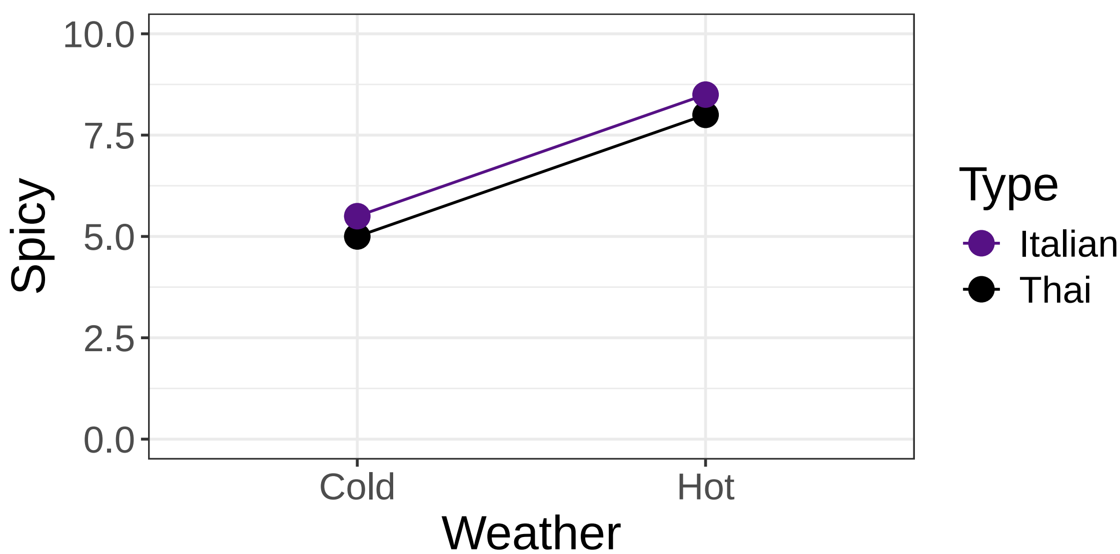
3.1 Overview

- We can add a second (and third) ______________ variable if we are curious about more than one.
- In addition to the individual effects of both of the IVs, we also get an ______________ effect that describes how they change each other's relationship with the outcome.

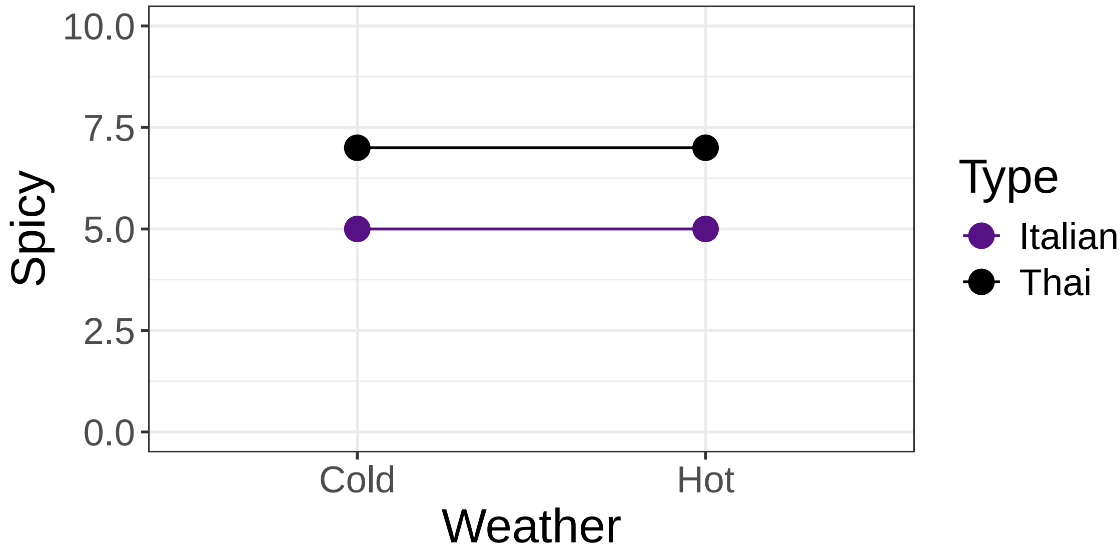
- Statistically, we might say this interaction is a "________ in differences"
  - Practically, this means that the differences between our groups may be different based on some other trait.
  - More on this later

3.2 Intuitive Interactions

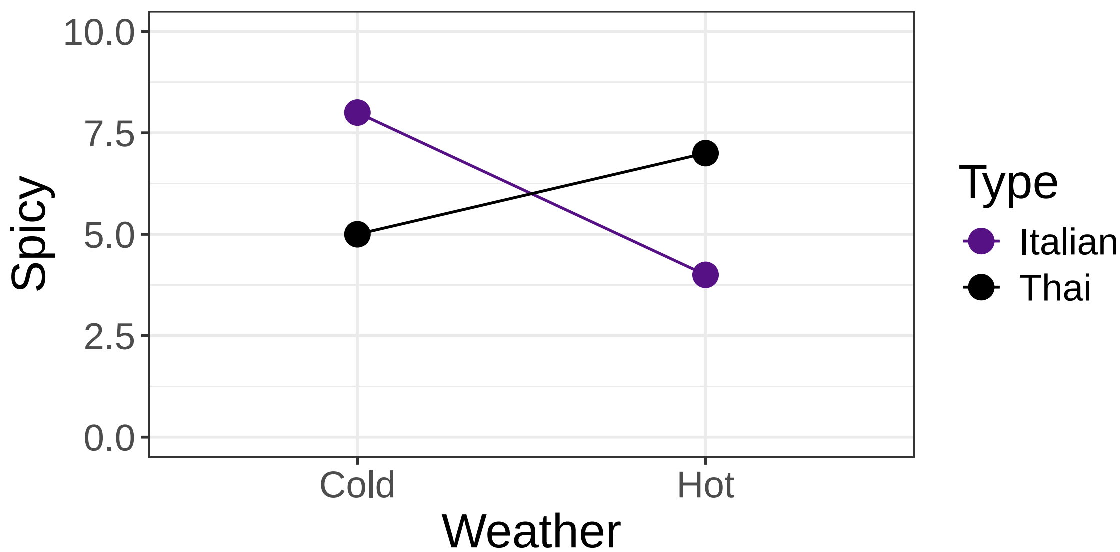
- When confronted with a causal relationship, sometimes we might say, "well it ________" - what it depends on is the second (or third) IV
- We can see this even in our personal experiences, and many relationships do depend on ________ factors
- *Example:* I am assessing how spicy I like my food (on a scale of 1 to 10; my outcome). First, is it cold or hot outside (IV 1)? Second, am I eating Thai or Italian (IV 2)? It is possible that my answer will be different based upon both of the IVs.
- **4 Possible Outcomes:**
- I like all of my food spicier when it is hot - Weather effect, but *not* food



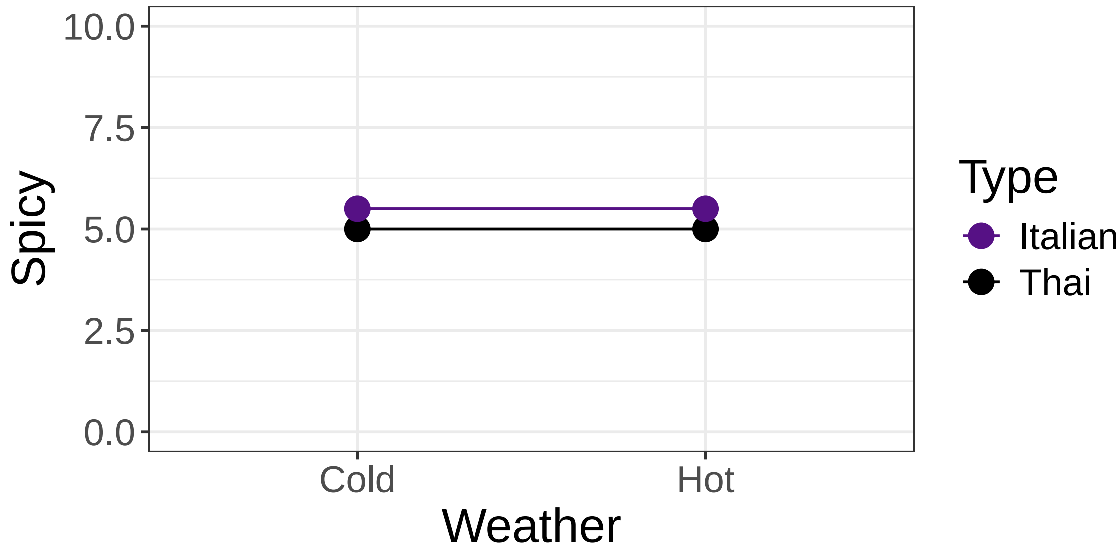
- I like Thai food spicier that Italian, regardless of weather - Food effect, but *not* temperature



- Whether I like by food spicy or not depends on both the weather, and type of food - interaction effect
- Specifically, we are looking to see whether we have a ________ interaction, like in the graph below:



- My preference for spice doesn't change, regardless of food type or weather - null findings



3.3 Study Two IVs

- When we work with __________ than one IV, we use a factorial design.
- This creates more __________ unique conditions = # of Conditions in IV 1 x # of Conditions in IV 2 = total number of conditions
- Both IVs do *not* have to be __________. Often, one will be some categorical, measured trait (e.g., gender, ethnicity, etc.)
- In addition to our statistics, we should show these differences in __________! Interaction effects become especially clear with visual evidence.

3.4 Limit Testing

- Factorial designs can help us find whether outcomes are different for different __________ of people.
- A strong intervention may not be as effective in a different group of people.
- This can be a __________ to our external validity, as we demonstrate findings in a more heterogeneous group.
- We also can establish whether one variable appears to __________ another on the relationship with the outcome variable.

3.5 Test Theories

- For some ____________ reasons, we may have good reason to believe that an effect differs based on some demographic variable.
- *Example:* I have a new intervention meant to encourage flexibility in learning and taking in new content. However, I recognize that the neuroplasticity of older adults is just lesser in general. Therefore, I believe my intervention will likely be more effective for younger adults, than it will for older adults.
- In essence, we may be able to add ____________ and "it depends" to our hypotheses and investigate with factorial designs.

3.6 Main Effects & Interactions

- **Main Effects** are those that come from each IV on the outcome.
  - The main effect is ____________ as an average over the levels of the other IV. Similar to how we "control" for other variable in multiple regression.
  - You have 1 main effect for each IV
- **Marginal Means** are the ____________ that we use to determine whether a main effect is present
  - We can test significance by taking the difference of the two marginal means, and calculating 95% CIs. If CIs ____________ 0 $\rightarrow$ non-significant

DV: Reaction time (ms)		IV$_1$: Photo type		
		Alcohol	**Plant**	Main effect for IV$_2$: Word type
IV$_2$: Word type	**Aggressive**	**551**	**559**	**555 (average of 551 and 559)**
	Neutral	**562**	**552**	**557 (average of 562 and 552)**
Main effect for IV$_1$: Photo type		**556.5 (average of 551 and 562)**	**555.5 (average of 559 and 552)**	

- An **interaction effect** can be detected by looking at the differences of the main effect differences. If they are ________ different from one another, then we would say that there is an interaction effect
  - Interactions are often treated as ________ important, theoretically, that main effects - when they are significant.
- Conventional wisdom: If interaction is significant, focus on that mostly. If interaction is non-significant, focus on main effects of IVs.
  - Interpreting the main effects with a significant interaction can be leaving out important information!
- *Stats sidebar:* This type of analysis is usually done via Two-way ANOVA, which does all the work of calculating significance of interactions, and main effects for us.

4 Factorial Variations

4.1 Overview

- Just like with other experiments, we can lay out a factorial design as being between-groups or ________-groups.

- But, we can designate ________ variable as between or within, leading to a total of 3 possible designs:

- Independent-Groups Factorial
- Within-Groups Factorial
- Mixed Factorial

4.2 Independent-Groups Design

- This is when ________ IVs are between-groups (i.e., participants are arranged into entirely separate groups)
- One nuance is that this will likely require the largest sample ________, as each group will have about 1/4th the total number of participants

4.3 Within-Groups Design

- Much like with previous within-groups designs, this is when participants see ________ possible condition.
- One thing to watch out for is the need for ________ to prevent order effects
  - Think about how many permutations of condition orders you may need!

4.4 Mixed Factorial Design

- This is when one IV is ________-groups, and the other is within-group.
- This is fairly common if we have one demographic variable (between-groups) and one manipulated variable that both demographics are exposed to each level (within-groups).

4.5 More Conditions

- Many ________ are going to naturally have more than one level
  - E.g., race, ethnicity, gender, etc.
- We can use these in factorial designs all the same - and we write it as: AxB Design.
  - Where A = Number of conditions in IV 1
  - Where B = Number of conditions in IV 2
- Statistics here get more ________ to interpret - but a good starting point is to use a line plot just like what we have done previously and see if lines cross or are parallel.

4.6 More IVs

- Prof. Paul Moes: "God himself cannot interpret a 4-way interaction - neither can you"
- We can do 3 IVs, but with each additional variable the interpretation becomes exponentially more difficult and complicated.
  - One popular alternative is to do this as a multiple ______________ model instead
  - *Stat sidebar:* ANOVA and linear regression are both types of the general ______________ model, so, in a roundabout way, these are actually equivalent!
- Remember to think carefully about what sorts of conclusions you can draw with a design before you use it, and whether an alternative provides a more ______________ conclusion.

5 Identify Factorial Designs

5.1 Reading Empirical Articles

- Look for words like …
  - "______________ ANOVA"
  - "Factorial"
  - "Interaction" or "Main Effects"
- You may also see phrasing like "2 x 2 design", referring to the two conditions of each IV.

5.2 In Popular Media

- Look for words like …
  - "______________"
  - "Only when"
- You may also look for demographic variables …
  - "For males this was the results, but for females…"