Week 12 Lecture - Complex Experiments

Undergraduate Research Methods in Psychology

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1   Chapter Overview

1.1   Chapter Overview

- Up until now, we have only talked about experimental designs that deal with _____ manipulated/independent variable and one measured/dependent variable.

> **?** Prior to experiments, we dealt with designs only focusing on measured variables, what were those called?
>
>   A) Correlational
>
>   B) Observational
>
>   C) Probabilistic
>
>   D) Multivariate
>
> Explanation:

- 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, and they can be helpful in unpacking nuance in certain relationships.

2   Experiments with Two IVs

2.1   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.

> **?** We still have to be concerned about causality, because this is still an experiment - what validity is that most related to?
>
>   A) External
>
>   B) Statistical
>
>   C) Internal
>
>   D) Construct
>
> Explanation:

- 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

2.2 Intuitive Interactions

- When confronted with a causal relationship, sometimes we might say, "well it _____" - what it depends on is the second (or third) IV

> **📢** Discuss: Previously, we described two types of variables that play a role in the casual link between two others. What were they and describe each? (hint: they both start with the letter M)

- 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
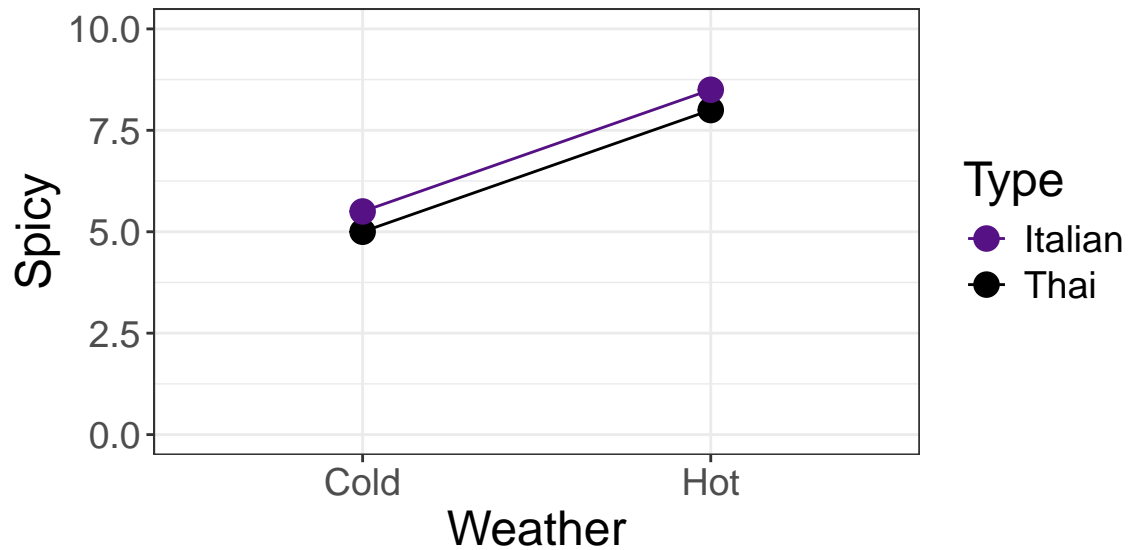
- I like Thai food spicier that Italian, regardless of weather - Food effect, but *not* temperature
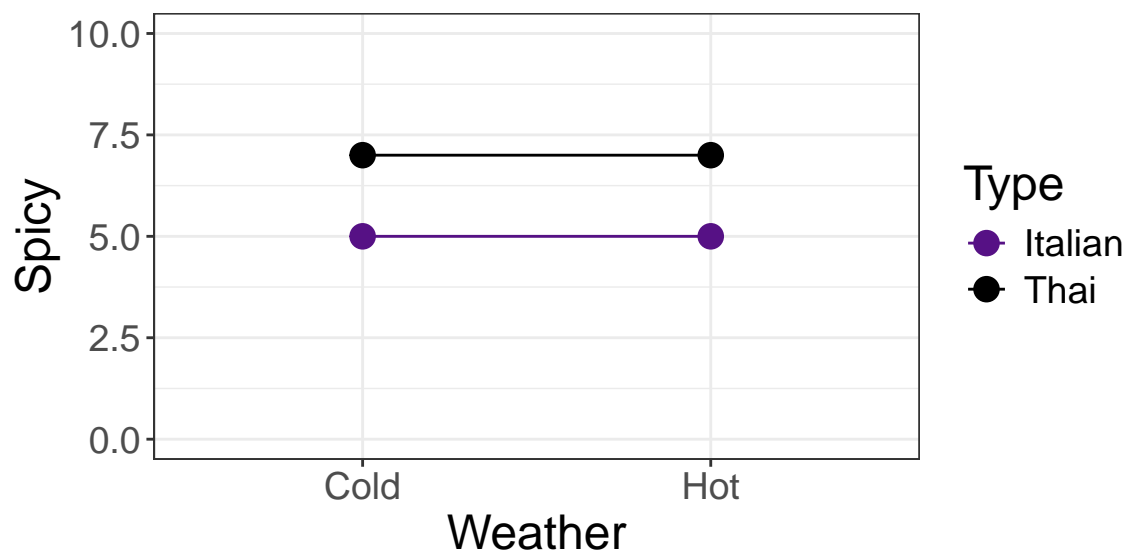
- Whether I like by food spicy or not depends on both the weather, and type of food - interaction effect

- Specifically, we are looking to see whether we have a _____ interaction, like in the graph below:
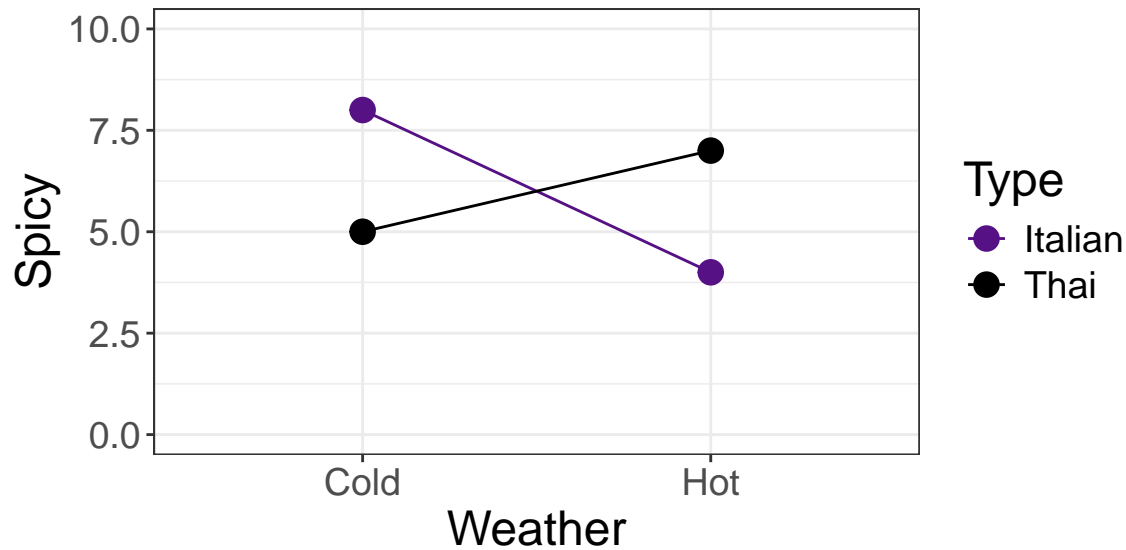
- My preference for spice doesn't change, regardless of food type or weather - null findings
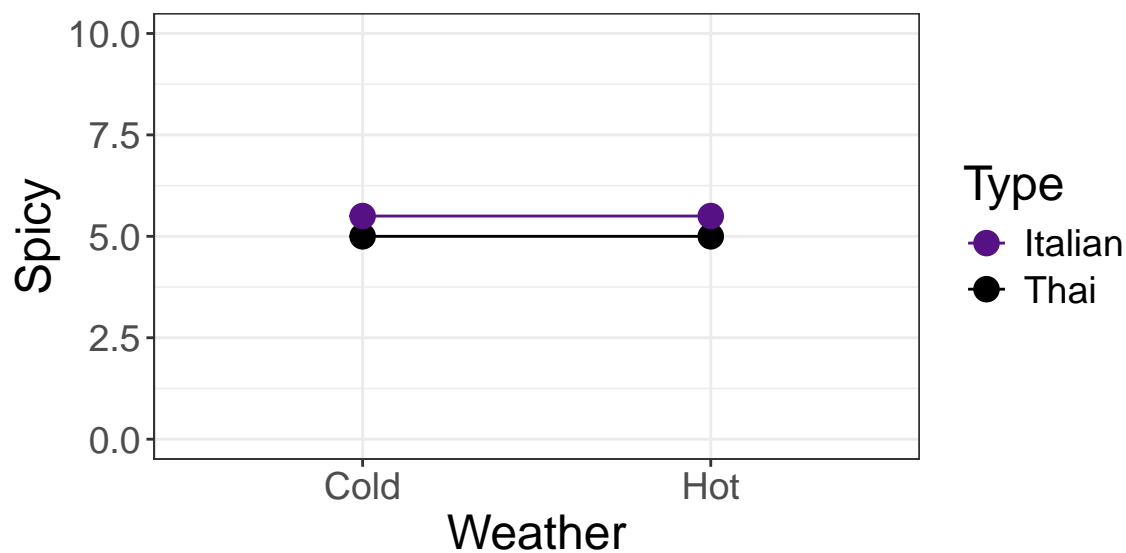
2.3 Study Two IVs

- 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.)

- Sometimes these get called "quasi-manipulated" because they are not actually manipulated but we _____ them as such.

- In addition to our statistics, we should show these differences in _____ ! Interaction effects become especially clear with visual evidence.

2.4   Limit Testing

- Factorial designs can help us find whether outcomes are different for different _____ of people, or maybe an intervention only works if another intervention is present

- A strong intervention may not be as effective in a _____ group of people.

> **?** Review - When it comes to a 'strong' intervention what aspect of statistical validity will be mostly looking at?
>
>   A) Precision
>   B) Significance
>   C) Reproducability
>   D) Effect Size
>
> Explanation:

- 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.

2.5   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.

> 📣 Discuss: Try coming up with another example of a situation where you might find an effect 'depends' on something else? (Maybe something in your own proposal)

2.6 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		Main effect for IV$_2$: Word type
		Alcohol	**Plant**	
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 _____ , 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 _____ information!

📢 Discuss: Try explaining, in your own words, why you suspect only looking at the main effects is a bad idea when you have a significant interaction?

- *Stats sidebar:* This type of analysis is usually done via Two-way ANOVA, which does all the work of _____ significance of interactions, and main effects for us.

3   Factorial Variations

3.1   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
    - _____ Factorial

3.2   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

> 📢 Discuss: What validity does a smaller sample size primarily hurt. Explain why this happens

- *Example:* I measure whether honors or regular students have differential benefits when they are place in living-learning or regular dormitories

3.3   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 _____ of condition orders you may need!

- *Example:* I am interested in seeing whether a certain note-taking strategy and a review strategy help performance on a test - so I have the same people counterbalances to different combinations of both conditions.

3.4   Mixed Factorial Design

- This is when one IV is _____-groups, and the other is within-group.

- This is fairly common if we have one _____ variable (between-groups) and one manipulated variable that both demographics are exposed to each level (within-groups).

- *Example:* I am determining whether first-generation college students or legacy students benefit more from a mentoring program, in terms of confidence. Both first-gen and legacy students have a period that they are exposed to the mentoring program and a time period without.

3.5   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 try to use a line plot just like what we have done previously and see if lines cross or are parallel.

3.6   More IVs

- Prof. Paul Moes: "God himself cannot interpret a 4-way interaction - neither can you"

- We can do 3 IVs, but with each _____ 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 simpler conclusion.

> **?** Review - we previously emphasized the importance of keeping conclusions as simple as possible, what vocab word captures that sentiment?
>
>   A) Pattern
>
>   B) Purpose
>
>   C) Parsimony
>
>   D) Promise
>
> Explanation:

4 Identify Factorial Designs

4.1 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.

- Sometimes a multiple _____ model and a factorial design can be described in somewhat similar conclusions - you might have to work through the results to figure out which one was used

4.2 In Popular Media

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