ANOVA

1

MORE INFERENTIAL STATISTICS

Overview

- By the end of this unit you should be familiar with:
  - **F-tests**
  - **Regression weights**
  - **Mediation**
  - **Moderation**

ANOVA

- **An**alysis **o**f **Va**riance
- Used to compare three or more cells of factorial experimental design
    - How much, if at all, do the groups differ from each other? Is it a reliable difference?
- Assumes normal distribution of DVs
- Test statistic is F-distribution
- (An F with two cells equals a t^2)
- If there is a significant difference, you may see Tukey's HSD reported
    - This tells you which groups were different from each other and by how much
- η^2 (eta-squared)
    - Measure of effect size in ANOVA

Comparing More Than Two Groups of Observations

- t-tests can only compare one set of observations to a constant, or two groups to each other.

- If you have an experiment with 3 levels of a condition (e.g., high power, low power, no treatment control), you should do a different test: a one-way analysis of variance (ANOVA).

- If you have an experiment with 2 or more crossed factors, then you also would have more than two groups to compare, so you would do a multi-way ANOVA.

In ANOVA, whatever the type, there is always only 1 Dependent Variable

Must be continuous (numerical/scale)

ANOVA is UNIVARIATE (1 Dependent Variable). If there are more than 1 Dependent Variables, use MANOVA

ANOVA can be:

- 1-way
  Must be categorical (nominal/ordinal)
  - 1 independent variable

- 2-way
  Must be categorical
  - 2 independent variable

- 3,4,etc-way
  Must be categorical
 - 3,4,etc independent variable

Reading Results: One-way ANOVA

- "There was a statistically significant difference between groups as determined by a one-way ANOVA, $F(2, 30) = 5$, $p = .0003$. Tukey's HSD indicated that participants' reported self-esteem was statistically significantly lower when presented with sad images ($M = 4$, $SD = .25$) and neutral images ($M = 7$, $SD = 1.2$) compared to positive images ($M = 11$, $SD = 1.9$). "

- Example of one factor with 3 levels. The first df in the F test is from levels-1 or 3-1=2
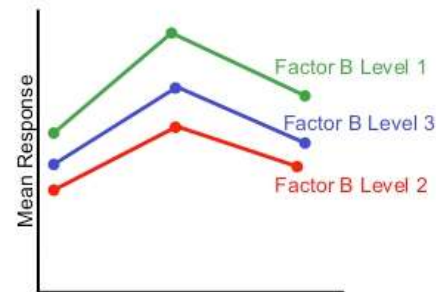
Interactions

- The effect of IV_1 on the DV could be influenced by IV_2
- Factorial design (multiple factors)
  - ANOVA
- The interaction itself is NOT a variable, but a mathematical placeholder representing the relationship between IV_1 and IV_2 on the DV

- A reliable interaction shows that there is a condition to when a statement is true. This can also be known as a dissociation, or one can say that IV_2 *moderates* the influence of IV_1 on the dependent variable X.
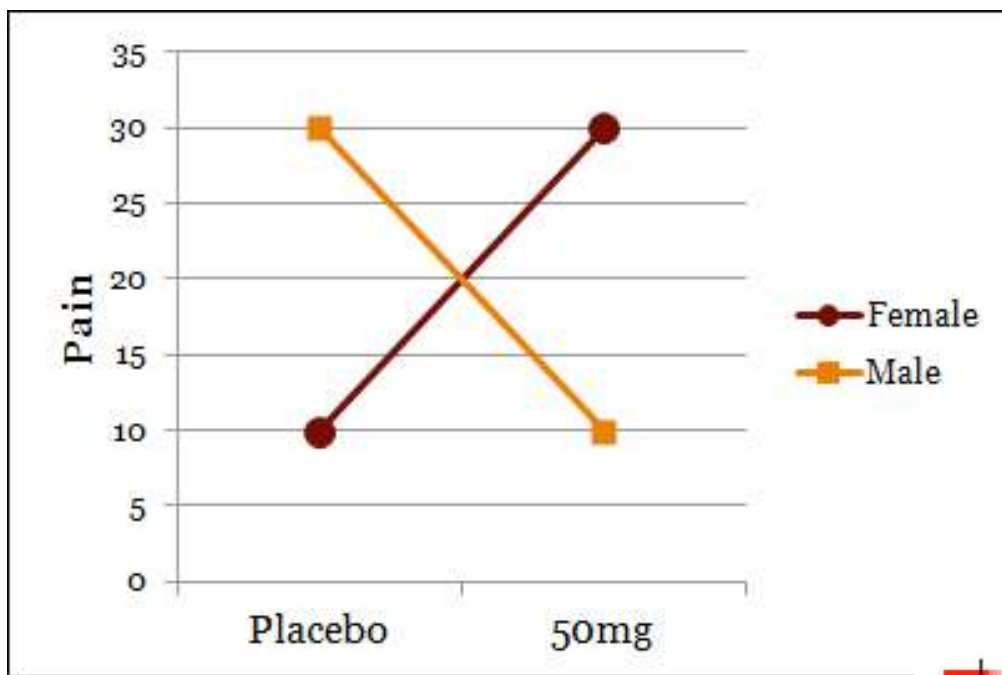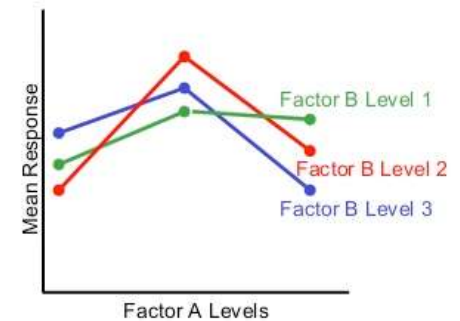
Examples:
Interaction vs. No Interaction

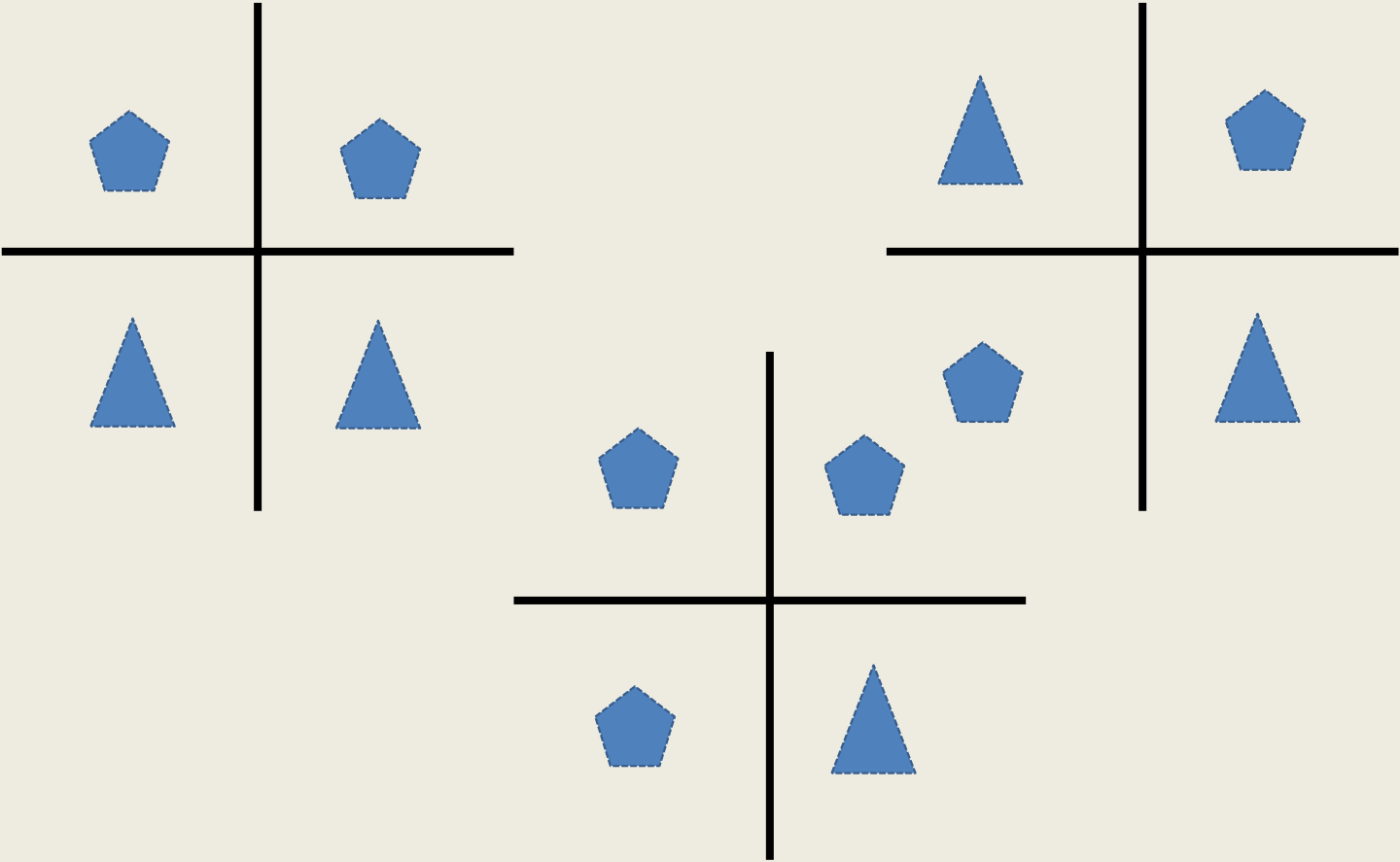- No interaction:

- Interaction is present:

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More on Interactions

- Because they are contingencies, they can be hard to think about at once.
- An interaction means at least 2 different things happened.
- When someone has to describe ANOVA results with an "IF" in them, they might have an interaction.
- Interactions are also called "moderation" (because one variable "moderates" the effect on another one.
- Interactions are also called "dissociation" in experimental psychology, because one effect get unassociated with the other.

Reading Interaction Results

- From Naranyana et al (2013) Study 3

"A 2 (high power vs. low power) x 2(exclusion vs. inclusion) between-participant ANOVA on the intention to connect with others revealed a significant main effect of power, $F(1,114) = 12.34$, $p < .05$, $\eta^2_p = .04$. Consistent with our prediction … the high power group ($M = 7.52$, $SD = 2.34$) displayed a greater intention to connect with others than the low power group ($M = 6.68$, $SD = 2.16$), $t(113) = 2.01$, $p = .05$. There was no main effect of social feedback, $F(1,114) = .84$, $p = .36$."

Reading Interaction Results

- From Naranyanan et al (2013) Study 3

"A 2 (high power vs. low power) x 2(exclusion vs. inclusion) between-participant ANOVA on the intention to connect with others revealed a significant main effect of power, $F(1,114) = 12.34$, $p < .05$, $\eta^2_p = .04$. "

This sentence tells us what analysis they did, the DV, and that there was a reliable main effect of power condition.

Reading Interaction Results

- From Naranyana et al (2013) Study 3

"Consistent with our prediction … the high power group (M = 7.52, SD = 2.34) displayed a greater intention to connect with others than the low power group (M = 6.68, SD = 2.16), t(113) = 2.01, p = .05. "

This sentence tells us the means and SD of each power condition, and that they followed up the overall F test with a test that compared the high power condition with the other two conditions together.

Reading Interaction Results

- From Naranyana et al (2013) Study 3

"There was no main effect of social feedback, $F_{(1,114)}$ = .84, p = .36."

This sentence tells us that there was no main effect of social feedback. Even effects that are not reliable ("significant") have to be reported.

" Social feedback moderated the effect of power on intention to connect, $F(1,115) = 3.99$, $p < .05$, $\eta^2_p = .03$, such that power led to a greater intention to connect only when participants were excluded."

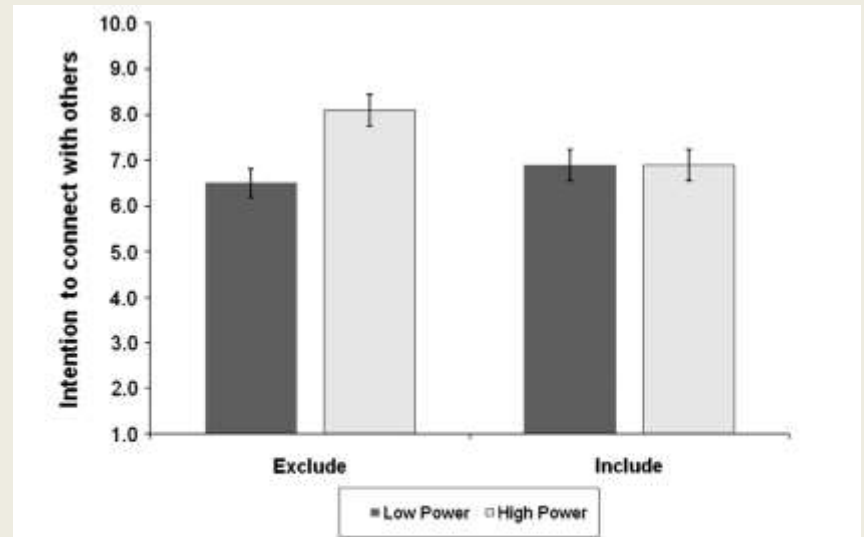This sentence tells us there IS an interaction, and its form.

Fig. 2. Results from Study 3: Mean score on intention to connect with others in respective social feedback conditions (exclude, include). Error bars indicate standard errors of the means.