Week of January 30

1. Within-subject designs: Definitions, advantages, and disadvantages
2. Sources of variability in a single-factor within-subjects design
3. The single-factor within-subject design: ANOVA
4. The single-factor within-subject design: MRC

Within-Subjects Designs: Definitions

- Within-subjects factor: An independent variable for which each participant is exposed to each level (i.e., condition)

- Within-subjects design: A design that includes at least one within-subject factor

Within-Subjects Designs: Pros

- It's the only way to study some things, such as change over time
- Because we can remove variation due to stable individual differences, the error term is made smaller, and thereby power is increased
  - This means that, other things being equal, to achieve a given level of power you need fewer participants in a within-subjects design than in a between-subjects design

Within-Subjects Designs: Cons

- Not all variables can be studied as within-subjects factors (e.g., gender, ethnicity)
- General practice effects (e.g., repeated learning of the same information)
- Specific carryover effects (e.g., placebo-first vs. treatment-first)
- Within-subject analyses assume that the correlations between pairs of assessment times are equal for all possible pairs (sphericity); this assumption is often violated in longitudinal data

Sources of Variability in a Single-Factor Within-Subjects Design

- A: Effect of the within-subjects factor that is consistent across participants; $df = a - 1$
- S: Individual differences among the participants that are consistent across levels of the within-subjects factor (conditions); usually not tested for significance; $df = s - 1$
- $A \times S$: Variability due to the unique ways that different participants were affected by the within-subjects factor; used as the error term; $df = (a - 1)(s - 1)$

Conducting a Within-Subjects Analysis: ANOVA

- The data file
  - Each row is one participant; need s rows
  - Use one column/variable for each level of the within-subjects factor
- The analysis
  1. Use GLM—Repeated Measures
  2. Enter the name and number of levels for your within-subjects factor, click Add, then click Define
  3. Define the levels of your within-subjects factor
  4. Optional: Ask for Descriptives (in Options) and Plots
  5. Click OK

Reading Output from GLM— Repeated Measures

- For *A*—the effect of the within-subjects factor— look at the row labeled with the name of your within-subjects factor and "Sphericity Assumed" in the **Tests of Within-Subjects Effects** section
- For *S*—the individual differences between participants—look at the row labeled Error in the **Tests of Between-Subjects Effects** section
- For *A* x *S*—the error term—look at the row labeled "Error" and "Sphericity Assumed" in the **Tests of Within-Subjects Effects** section

Conducting a Within-Subjects Analysis: MRC Data File

- Each row is one level of the within-subjects factor for one participant; need *a* x *s* rows
- Use one column for scores on the dependent variable
- Use *a* – 1 columns to code the within-subjects factor
- Use *s* – 1 columns to code the participants

Conducting a Within-Subjects Analysis: MRC Analyses

- Use Regression—Linear
  - For *A*—the effect of the within-subjects factor— regress the DV on the (*a* – 1) vectors used to code the within-subjects factor
  - For *S*—the individual differences between participants—regress the DV on the (*s* – 1) vectors used to code the participants
  - For *A* x *S*—the error term—calculate $(1 - R^2_A - R^2_S)$
  - Calculate the *F* ratios by hand

An Example

- A professor wonders whether time of day affects students' tardiness to a class or appointment.
- Over the course of two weeks, the professor schedules three meetings with each of eight students. The meetings are scheduled in the morning (8 AM), at noon, or in the afternoon (4 PM), with order randomized.
- This results in a one-way within-subjects design, with time of day as a three-level within-subjects factor.
- The dependent variable is how many minutes after the hour the student arrives for the meeting.