

Week 2. Experimental Research

SOLUTIONS TO PREPARATORY QUESTIONS.

Q1. Read the following hypotheses and identify the **independent** and **dependent** variables in each hypothesis.

*The independent variables are colored **GREEN** and the dependent variables are colored **ORANGE**.*

- a. There is no difference in users' **reading speed** and **retention rate** when they view the news on a **smart phone** or on their **laptop**.
- b. There is no difference in **target selection speed** and **error rate** between **joystick**, **touch screen** and **gestural interface**.
- c. There is no difference in the **analytical reasoning skills** of the children who used **Khan Academy videos** to learn as compared to the ones who used a **book**.

Q2. Imagine you have been tasked to evaluate a brand new **smart walking stick for visually impaired users**. As a result, you design an experiment and recruit 35 visually impaired users within the city of Rotterdam. Each participant will have to use the *new smart stick* and the *conventional walking stick*.

- a. Describe what kind of experiment is this (true, quasi, or non-experiment), and what can you say about the design of the study (between-group, within-group or split-plot)?

This is a quasi-experiment because you won't be able to randomly assign participants to one of the two conditions. Also, the specific nature of the participants, combined with the difficulty of getting them to participate in research, means that you won't be able to control many aspects that are necessary for a true experiment. This experiment follows a within-group design.

- b. Describe how you can prevent or mitigate sources of random and systematic errors in your study design?

The random errors can be reduced, if not eliminated, by having a larger sample size, using repeated measurements (if possible), and controlling for extraneous variables. The systematic errors, on the other hand, can be reduced by ensuring that the experimental design is sound and uses counterbalancing, that researchers follow a strict protocol, that environmental factors including participant comfort and fatigue are considered in the experimental design, and that measurement instruments are properly tested.

Q3. Read the following situations that may happen during an experiment and comment if they are sources or random errors, systematic errors, or both.

- a. You only recruit males to participate in your experiment.

Systematic Error.

- b. The sensors that you are using to measure participants' stress levels are not accurate.

Systematic Error (when all measurements are inaccurate). In general, we would expect any sensor to have some level of noise (Random Error).

- c. Your participants are often disturbed by loud voices from outside the room.
Systematic Error.
- d. In a writing task designed to assess participants' writing speed, participants occasionally make spelling mistakes.
Random Error.

Q4. Design a **quasi-experiment** to validate/invalidate the following Null Hypothesis. Please choose the most appropriate design (*between-, within-group or split-plot; factorial vs. non-factorial design*) for your study and explain the rationale behind your choices.

"There is no difference in reading speed and retention rate when users read a news on smart phones, laptops, and newspapers."

Given the nature of the hypothesis and the need to compare reading speed and retention rate across different mediums (smartphones, laptops, newspapers), a **within-group** design would be the most suitable approach.

Rationale for choosing a within-group design:

1. **Control over individual differences:** By using the same group of participants for all conditions, we can control for individual differences such as cognitive abilities, reading habits, etc., which could otherwise confound the results.
2. **Increased statistical power:** Since each participant serves as their own control, within-group designs typically provide increased statistical power compared to between-group designs.
3. **Need for smaller sample:** Using a within-group design allows for efficient data collection since the same participants are exposed to all conditions, reducing the need for recruiting and managing multiple groups.

Now, let's outline the quasi-experiment using a within-group design:

Participants: A sample of participants (e.g., university students) recruited from the university campus or library.

Conditions: Participants will read the same news article under three different conditions:

1. Reading on a smartphone
2. Reading on a laptop
3. Reading from a printed newspaper

Variables:

1. **Independent variable:** Medium of reading (Smartphone, Laptop, Newspaper)
2. **Dependent variables:** Reading speed (measured in words per minute) and retention rate (measured as the percentage of information retained from the news article).

Procedure:

1. Randomize the order of conditions to control for order effects, i.e., counterbalancing.
2. Participants will read three news articles of same length in each condition.
3. Measure the time taken to read the article (reading speed) for each participant in each condition.
4. After reading each article, administer a comprehension test or ask questions to assess retention rate.
5. Collect data on reading speed and retention rate for each participant in each condition.