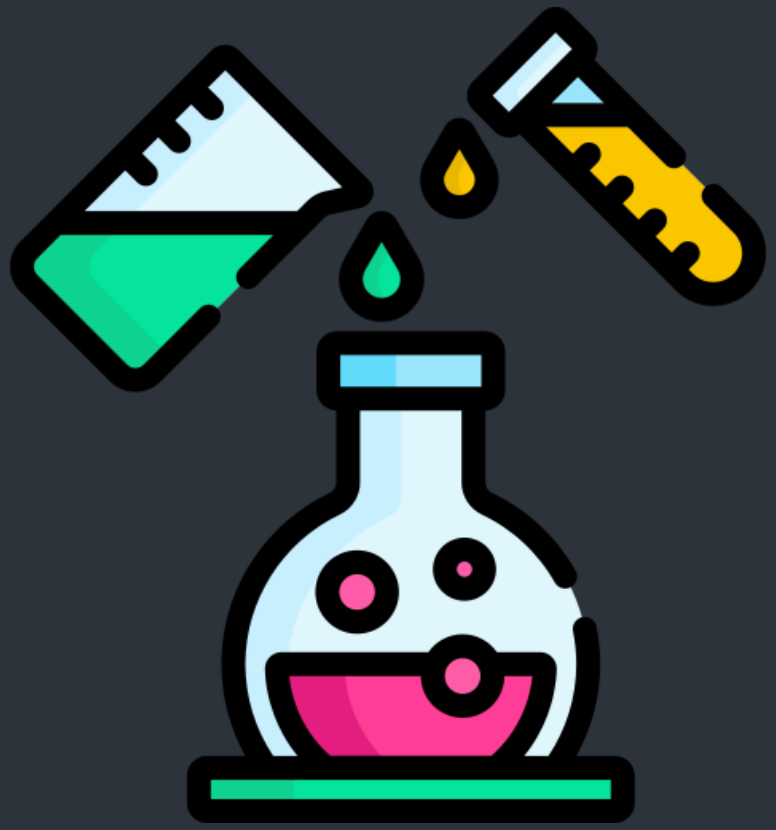


PSY 260- RESEARCH METHODS-II

Control in Single-Factor Experimental Designs

Mixed Design (Mixed Factorial Design)

- A **mixed design** is an experimental design that combines both **within-subjects** and **between-subjects** elements. This means:
- Some independent variables are **manipulated between subjects** (each participant experiences only one condition).
- Other independent variables are **manipulated within subjects** (each participant experiences all conditions).
  - Allows researchers to study both **individual differences** (between-subjects effects) and **repeated measures** (within-subjects effects).
  - Helps control for variability while still allowing for group comparisons.

Mixed Design (Mixed Factorial Design) Example;

- **Independent Variable 1 (Between-Subjects):** Sleep condition (Well-rested vs. Sleep-deprived).
  - Participants are assigned to **one of these two groups.**

- **Independent Variable 2 (Within-Subjects):** Caffeine intake (No caffeine vs. 100mg caffeine).
  - **Each participant** takes tests with and without caffeine.

- **Compare** performance differences within each sleep group (with vs. without caffeine) and between sleep groups (well-rested vs. sleep-deprived).

Class Discussion

1st Scenario: A researcher wants to investigate the **effect of sleep duration on exam performance**. Participants are divided into two groups:

- **Group 1**: Sleeps for 4 hours.
- **Group 2**: Sleeps for 8 hours.
- The next day, all participants take the same exam, and their scores are compared.

❓ **Questions:**

a) Why is this study classified as a .....?

b) How can we ensure that differences between groups are actually caused by sleep duration?

c) If the researcher had tested the same participants on different days, with 4 hours of sleep on one day and 8 hours on another, which design would have been used?

Class Discussion

2nd Scenario: A psychologist wants to study the **effect of different interface designs on user experience**. The same participants first complete a task using the **old interface**, then complete the same task using the **new interface**. The task completion time and number of errors are recorded.

❓ **Questions:**

a) Why is this study classified as a .....?

b) What is a potential disadvantage of having participants use the old interface first and then the new one?

c) How could this be controlled?

Class Discussion

3rd Scenario: A researcher wants to study the **effect of exercise on stress levels**. Participants are divided into two groups:

- **Group 1**: Practices yoga.
- **Group 2**: Goes for a run.

➡ Each participant's stress level is measured **before and after** exercise.

❓ **Questions:**

a) Why is this study classified as a .....?
b) Which variable is **between-subjects**?
c) Which variable is **within-subjects**?
d) If the researcher had tested the same participants on different days, having them do both yoga and running, which design would have been used?

CONTROL IN SINGLE FACTOR EXPERIMENTAL DESIGN

1. Random Assignment
2. Holding Variables Constant
3. Counterbalancing (for Within-Subjects Designs)
4. Using a Control Group
5. Pretesting and Baseline Measurements
6. Time-Related Factors

CONTROL IN SINGLE FACTOR EXPERIMENTAL DESIGN

Random Assignment

- Ensures that participants are randomly placed into different conditions of the independent variable.
- Helps distribute individual differences (e.g., intelligence, personality) equally across conditions.
- Reduces the influence of confounding variables.

CONTROL IN SINGLE FACTOR EXPERIMENTAL DESIGN

Holding Variables Constant

- Keeps all factors **except** the independent variable **identical** across conditions.
- Prevents extraneous variables from influencing results.

For instance, In a **music and concentration study**, if testing occurs in different rooms, noise levels must be controlled so that one group is not distracted while another is in a quiet space.

CONTROL IN SINGLE FACTOR EXPERIMENTAL DESIGN

Counterbalancing

- Do you remember what is **COUNTERBALANCING?**

- **Within-subject design!!**
- Controls for **order effects** (e.g. practice) when the same participants experience multiple conditions.
- Involves **varying the order** in which participants experience conditions.

For instance, in a study where participants read a text **with** and **without background music**, half do the "no music" condition first, while the other half do the "music" condition first.

CONTROL IN SINGLE FACTOR EXPERIMENTAL DESIGN

Control Group

- A **control group** does not receive the experimental treatment, allowing a **comparison** with the experimental group.
- Ensures that any changes in the dependent variable are due to the independent variable and not natural fluctuations.

For example: In a **caffeine and reaction time** research;

- **Experimental group**: Drinks coffee before the test.
- **Control group**: Drinks a placebo (decaf coffee) before the test.

CONTROL IN SINGLE FACTOR EXPERIMENTAL DESIGN

Pretesting and Baseline Measurements

- Measures participants **before the experiment** to account for pre-existing differences.
- Helps in detecting changes caused by the independent variable.

For example: In a **meditation and stress** study, participants' stress levels are measured **before and after** meditation to track changes.

- **Do not forget!! BEFORE – AFTER!!**

CONTROL IN SINGLE FACTOR EXPERIMENTAL DESIGN

Time-Related Factors

- **Control for time of day – Morning vs. Evening effects for performance.**

Solution?? (half/half)

- **Control for time between sessions (for repeated measures designs) – Large gap between sessions?**

Solution??

- **Control for time-related learning effects (for between-subjects designs) -** participants from different groups may have experienced the experimental conditions at different times, leading to differences based on external time-related factors (e.g., societal events, news, etc.)

Solution??

To sum up…

- **Between-Subjects Design** → Use **random assignment**, **control groups**, and **holding variables constant**…

- **Within-Subjects Design** → Use **counterbalancing** and **baseline measurements**…

Main Effects and Interactions (ANOVA)

- Two-way analysis of variance (ANOVA) – statistical procedure used to analyze the variance in a DV between groups created by combining the levels of two factors.

- **ANOVA** is a **statistical method used to compare the means of two or more groups** to determine whether the differences are statistically significant.

Concepts:

- **Between-group variance** → Measures differences between group means.
- **Within-group variance** → Measures variability within each group.
- If **between-group variance is significantly higher than within-group variance**, the groups are considered significantly different.

Main Effects and Interactions (ANOVA)

Types of ANOVA:

1. One-Way ANOVA → Tests the effect of a **single independent variable** on a dependent variable.

- Example: Comparing student performance across **traditional, online, and hybrid teaching methods**.

2. Two-Way ANOVA → Tests the effect of **two independent variables** and their interaction.

- Example: Examining the effects of **teaching method (traditional, online, hybrid)** and **class time (morning, evening)** on student performance.

3. Repeated Measures ANOVA → Compares **the same participants** measured at different times or under different conditions.

- Example: Tracking **weight changes** in participants at **1st, 3rd, and 6th months** of a diet program.

Interpreting ANOVA Results:

- **F-value** → Ratio of between-group variance to within-group variance.
- **p-value** → If **$p < 0.05$**, the difference between groups is considered statistically significant.
- **Post-hoc tests** (e.g., Tukey, Bonferroni) are needed to determine **which groups differ**.

📌 **ANOVA** does not indicate which specific groups differ, only that at least one group is significantly different. – to see the group differences **– POST-HOC TESTS…**

Main Effects and Interactions (ANOVA)

- A **two-way factorial design** is an experimental design that involves **two independent variables (factors)**, each with two or more levels, to examine their separate (main effects) and combined (interaction effect) influence on a dependent variable.

This design analyzes;

1. **Main effect of Factor A** → Does the first independent variable affect the dependent variable?
2. **Main effect of Factor B** → Does the second independent variable affect the dependent variable?
3. **Interaction effect (A × B)** → Does the effect of one independent variable depend on the level of the other independent variable?

Main Effects & Interaction Effects

Main Effect

- A **main effect** refers to the **independent influence** of one independent variable (factor) on the dependent variable.
  - 📌 **In other words, we examine how a single independent variable affects the dependent variable while ignoring other factors.**

Example:
A study investigates the effects of **sleep duration (6 hours vs. 8 hours)** and **coffee consumption (drinker vs. non-drinker)** on **exam performance**.

- **Main effect of sleep duration**: If **students who sleep for 8 hours perform better than those who sleep for 6 hours**, there is a **main effect of sleep duration**.
- **Main effect of coffee consumption**: If **students who drink coffee perform better than those who do not**, there is a **main effect of coffee consumption**.

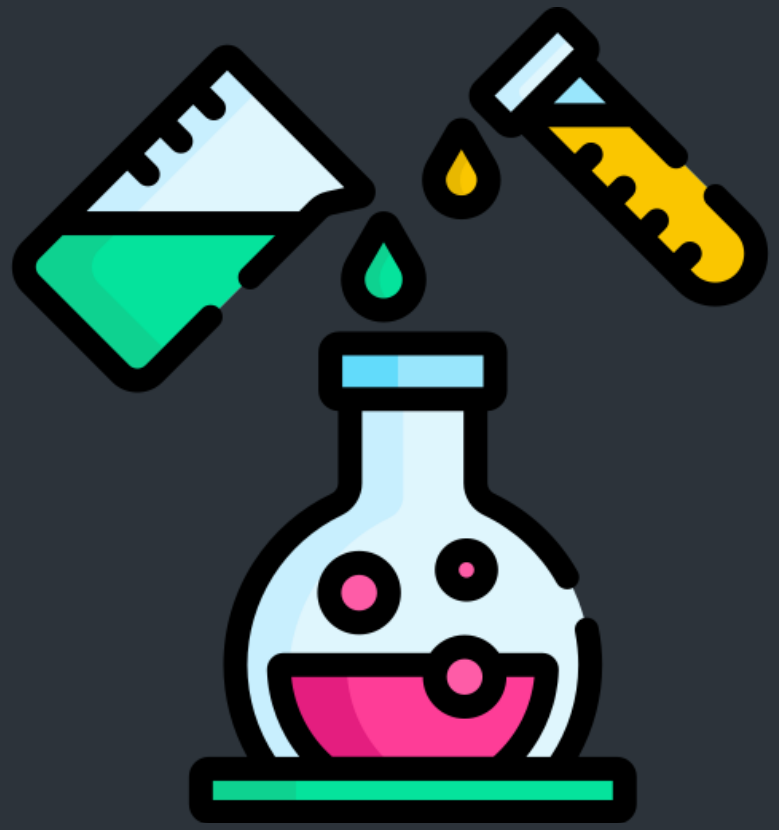
- **To determine a main effect, we analyze each factor separately.**

Main Effects & Interaction Effects

- An **interaction effect** occurs when the effect of one independent variable on the dependent variable **depends on the level of another independent variable**.
  - 📌 **In other words, an interaction exists when two factors influence each other.**

Example:
The interaction between sleep duration and coffee consumption:

- If **coffee consumption significantly improves exam performance for students who sleep only 6 hours but makes no difference for those who sleep 8 hours**, this indicates an **interaction effect**.
  - In this case, **the effect of coffee consumption depends on sleep duration**.
- *When an interaction effect is present, the impact of one factor changes based on the level of another factor.*



Any questions??