

Chapter 2 – Designing Observational Studies and Experiments
Section 3 – Observational Studies and Experiments

Objectives

1. Identify the following components of a good study: treatment group, control group, placebo, single-blind, and double-blind, random assignment, and large-enough sample size.
2. Identify experiments and observational studies.
3. Identify explanatory variables, response variables, association, and causation.
4. Identify lurking variables and confounding variables.
5. Redesign an observational study into an experiment.

Vocabulary

1. treatment group
2. control group
3. placebo effect
4. single-blind/double-blind study
5. random assignment
6. experiment
7. observational study
8. explanatory/independent variable
9. response/dependent variable
10. association
11. lurking variable
12. confounding variable

Opening/PurposeLesson/Activity

OBJECTIVE 1 – Identify the following components of a good study: treatment group, control group, placebo, single-blind, and double-blind, random assignment, and large-enough sample size.

Definition: Treatment group and control group

Each **treatment group** in a study is a collection of individuals who receive a certain treatment (or have a certain characteristic of interest). The **control group** is a collection of individuals who do not receive any treatment (or do not have the characteristics of any treatment group).

When designing a study, it is important that each treatment group be as similar to the control group as possible, except for the characteristic of interest.

1. A researcher wants to investigate whether a new drug lowers the blood pressure of patients who have high blood pressure. Describe the design of a possible study, which includes a treatment group and a control group.
 - The **placebo effect** occurs when the characteristic of interest changes in individuals due to the individuals believing the characteristic should change.
 - A **placebo** is a fake drug or procedure administered to the control group.
 - In a **single-blind** study, individuals do not know whether they are in the treatment group(s) or the control group.
 - In a **double-blind** study, neither the individuals nor the researcher in touch with the individuals know who is in the treatment group(s) and the control group.

2. Explain how the design of the study you described in Problem 1 could be modified so that it would be double-blind and use a placebo.

Definition: Random assignment

Random assignment is the process of assigning individuals to the treatment group(s) and the control group randomly.

3. A researcher wants to test whether a high-protein diet improves college male sprinters' performances. The researcher randomly selects the 10 college male sprinters shown in the following table. Use the seed 892 to randomly select 5 of the sprinters for the treatment group. The other 5 students will be in the control group.

Benny	David	Nico	Austin	Daniel
Ryan	Matt	Marcos	Cameron	Randell

Components of a Well-Designed Study

In a well-designed study,

- There should be a control group and at least one treatment group.
- Individuals should be randomly assigned to the control group and the treatment group(s).
- The sample size should be large enough.
- A placebo should be used when appropriate.
- The study should be double-blind when possible. If this is impossible, the study should be single-blind if possible.

OBJECTIVE 2 – Identify experiments and observational studies.

Definition: Experiment and observational study

In an **experiment**, researchers determine which individuals are in the treatment groups(s) and the control group, often by using random assignment. In an **observational study**, researchers do not determine which individuals are in the treatment group(s) and the control group.

4. Identify whether the study is an experiment or an observational study. Discuss whether the components of a well-designed study were used.

In a study to determine whether the drug latrepirdine improves the mental impairment of patients with Huntington disease, researchers randomly assigned 403 patients with mild to moderate Huntington disease to a treatment group and a control group. For 3 times daily for 26 weeks, latrepirdine was orally administered to the treatment group and a placebo was orally administered to the control group. The study concluded that latrepirdine does not improve the mental impairment of patients with Huntington disease (Source: A randomized, Double-Blind, Placebo-Controlled Study of Latrepirdine in Patients with Mild to Moderate Huntington Disease, Kibbutz).

5. Identify whether the study is an experiment or an observational study. Discuss whether the components of a well-designed study were used.

In a study to determine whether elite athletes have unbalanced postures, researchers measured the posture of the following elite athletes: 29 rugby players, 29 bikers (motorcyclists), 10 skiers, and 10 judokas. The postures of 71 amateur athletes were also measured. The study found that elite rugby players, elite skiers, and elite judokas had unbalanced postures but elite bikers had balanced postures (Source: Assessment of Body Plantar Pressure in Elite Athletes: An Observational Study, G. Gobi).

OBJECTIVE 3 – Identify explanatory variables, response variables, association, and causation.

Definition: Explanatory and response variables

In a study about whether a variable x explains (affects) a variable y ,
We call x the **explanatory variable** (or **independent variable**).
We call y the **response variable** (or **dependent variable**).

An explanatory variable may or may not turn out to affect (explain) the response variable.

6. In a double-blind study, 40 healthy foreign students were randomly assigned to take pills of the natural substance Rhodiola rosea extract SHR-5 or a placebo for 20 days during an examination period. The study concluded that the substance improves people's mental fatigue caused by stress (Source: A Double-Blind, Placebo-Controlled Pilot Study of the Stimulating and Adaptogenic Effect of Rhodiola Rosea SHR-5 Extract on the Fatigue of Students Caused by Stress During an Examination Period with a Repeated Low-Dose Regimen, Spasov et al).
- Describe the treatment and control groups.
 - Is the study an experiment or an observational study? Explain.
 - Describe the sample and the population.
 - What are the explanatory and response variables?
 - What does it mean that the study is double-blind? How could that be accomplished?

There is an **association** between the explanatory and response variables if the response variable changes as the explanatory variable changes.

If the change in the explanatory variable *causes* a change in the response variable, we say there is **causality**.

Determining Causality

- A well-designed experiment can determine whether there is causality between the explanatory and the response variables.
- Most observational studies cannot determine whether there is causality between the explanatory and response variables. They can only determine whether there is an association between the two variables.

OBJECTIVE 4 – Identify lurking variables and confounding variables.

Definition: Lurking variable

A **lurking variable** is a variable that causes both the explanatory and the response variables to change during the study.

Lurking variables must be avoided. We can usually do so by using random assignment.

Definition: Confounding variable

A **confounding variable** is a variable other than the explanatory variable that causes or helps cause the response variable to change during the study.

A well-designed experiment requires careful planning so that there are as few confounding variables as possible.

OBJECTIVE 5 – Redesign an observational study into an experiment.

7. A researcher wants to determine whether watching television and playing video games causes attention deficit hyperactivity disorder (ADHD) in children. The researcher randomly selects 200 children and asks their parents how much television their children watch daily and whether their children have ADHD. The researcher analyzes their responses and concludes that watching television and playing video games causes ADHD in children.
 - a. Describe some problems with the observational study. Include in your description at least one possible lurking or confounding variable and identify which type it is.
 - b. Redesign the study so that it is a well-designed experiment.

Homework/Assessment

1, 3, 5, 7, 11, 13, 15, 17, 19, 23, 29, 33, 41