

1.4: Types of Statistical Studies (2 of 4)

Learning Objectives

- Determine if a study is an experiment or an observational study.
- From a description of a statistical study, determine the goal of the study.

In general, there are two types of statistical studies: observational studies and experiments.

An **observational study** observes individuals and measures variables of interest. The main purpose of an observational study is to describe a group of individuals or to investigate an association between two variables. We can answer questions about a population with an observational study. We can also investigate a relationship between two variables. But in an observational study, researchers do not attempt to manipulate one variable to cause an effect in another variable. For this reason, an observational study does not provide convincing evidence of a cause-and-effect relationship.

An **experiment** intentionally manipulates one variable in an attempt to cause an effect on another variable. The primary goal of an experiment is to provide evidence for a cause-and-effect relationship between two variables. But the experiment has to be well-designed to provide convincing evidence of a cause-and-effect relationship. We study experiment design in the section “Collecting Data – Conducting an Experiment.”

For now, our goal is to distinguish between these two types of studies. We focus on the connection between the research question, the type of study, and the kinds of conclusions we can make.

Example

Music and Learning

Many students listen to music while studying. Does listening to music improve learning? Students in a statistics class decide to investigate this question. They write more specific research questions related to the topic of music and learning. Then they design the following three studies:

Study 1

Specific research questions: *Do the majority of college students listen to music while they study? Do the majority of college students believe that listening to music improves their learning?*

To investigate these questions, the statistics students conduct a survey in their other classes. They ask these two questions:

- Do you listen to music while you study?
- Do you think listening to music improves your concentration and memory?

This is an observational study designed to answer two questions about a population of college students. Each question contains a claim about the population of college students. We can use data from this study to see if these claims are true. But data from this study cannot provide evidence of a cause-and-effect relationship between listening to music while studying and improvements in learning.

Study 2

Specific research question: *When we compare students who study with music to students who study in a quiet environment, which group gives higher ratings for understanding what they studied?*

To investigate this question, the instructor divides the class into two groups: (1) those who listen to music when they study and (2) those who do not listen to music when they study. The students keep a journal for a week. Each time they study, they record the following information:

- Length of study session (in minutes)
- A rating of how well they understood what they studied, on a scale of 1–10: 1 = no understanding, 10 = excellent understanding.

This investigation is also an observational study. It compares two populations: (1) college students who listen to music when studying and (2) college students who do not listen to music when studying. We can also view this as an observational study of one population (college students) that investigates the relationship between two variables: *listening to music while studying* and *perceived understanding of material studied*. From this study, we might learn something interesting about the connection between

college students' study habits and their perception of their learning. But since this is an observational study, data from this study cannot provide evidence of a cause-and-effect relationship between listening to music while studying and improvements in learning.

Study 3

Specific research question: *Does listening to music improve students' ability to quickly identify information?*

To investigate this question, the instructor uses word-search puzzles. She divides the class into two groups. Students on one side of the room do a word puzzle for 3 minutes while listening to music on an iPod. Students on the other side of the room do a word puzzle for 3 minutes without music. The instructor calculates the average number of words found by each group.

This study is an experiment. The instructor manipulates music to investigate the impact on puzzle completion. Data from this study can provide evidence of a cause-and-effect relationship between listening to music while studying and improvements in learning. But the improvement in learning is more narrowly defined as the ability to quickly identify information, such as words in a puzzle.

Learn By Doing

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