Identifying Study Design: Experiments vs. Observational Studies

Learning Objective: Identify the design of a study (controlled experiment vs. observational study) and other features of the study design (randomized, blind etc.).

Experiments vs. Observational Studies

Before assessing the effectiveness of observational studies and experiments for producing evidence of a causal relationship between two variables, we will illustrate the essential differences between these two designs.

Example

Every day, a huge number of people are engaged in a struggle whose outcome could literally affect the length and quality of their life: they are trying to quit smoking. Just the array of techniques, products, and promises available shows that quitting is not easy, nor is its success guaranteed. Researchers would like to determine which of the following is the best method:

1. Drugs that alleviate nicotine addiction.

2. Therapy that trains smokers to quit.

3. A combination of drugs and therapy.

4. Neither form of intervention (quitting "cold turkey").

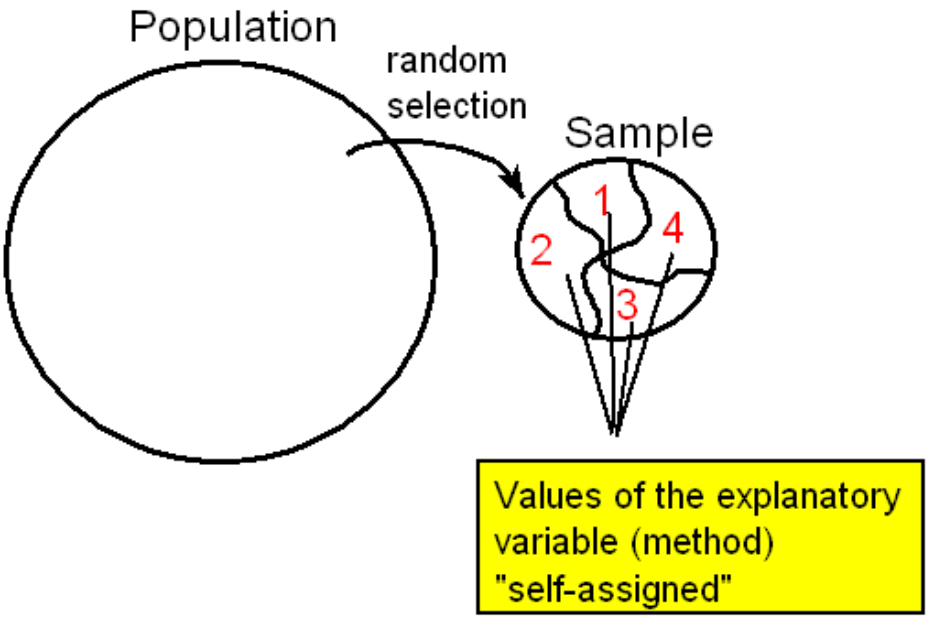
The explanatory variable is the method (1, 2, 3 or 4) , while the response variable is eventual success or failure in quitting. In an observational study, values of the explanatory variable occur naturally. In this case, this means that the participants themselves choose a method of trying to quit smoking. In an experiment, researchers assign the values of the explanatory variable. In other words, they tell people what method to use. Let us consider how we might compare the four techniques, via either an observational study or an experiment.

1. An **observational study** of the relationship between these two variables requires us to collect a representative sample from the population of smokers who are beginning to try to quit. We can imagine that a substantial proportion of that population is trying one of the four above methods. In order to obtain a representative sample, we might use a nationwide telephone survey to identify 1,000 smokers who are just beginning to quit smoking. We record which of the four methods the smokers use. One year later, we contact the same 1,000 individuals and determine whether they succeeded.

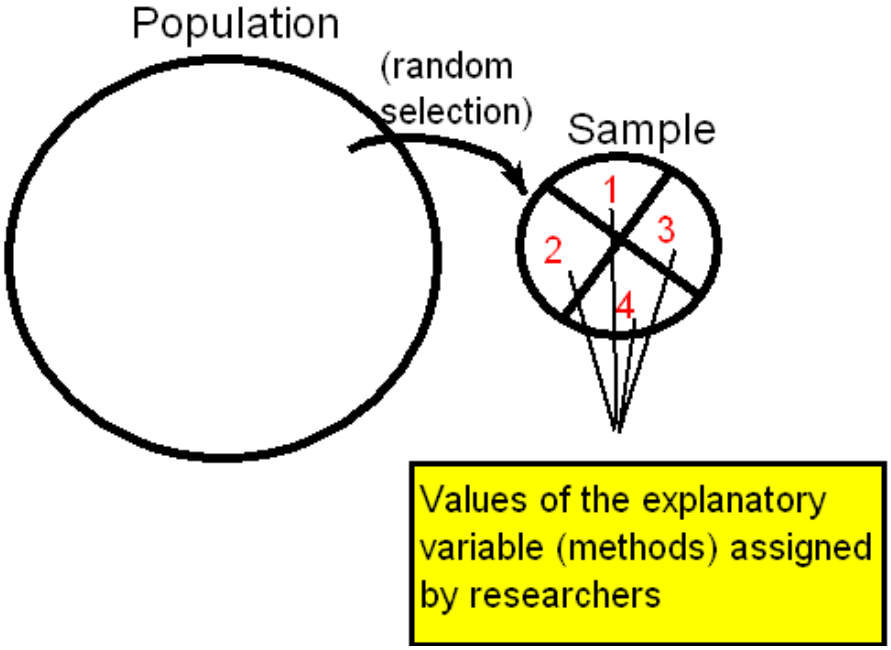
2. In an **experiment**, we again collect a representative sample from the population of smokers who are just now trying to quit, using a nationwide telephone survey of 1,000 individuals. This time, however, we divide the sample into 4 groups of 250 and **assign** each group to use one of the four methods to quit. One year later, we contact the same 1,000 individuals and determine whose attempts succeeded while using our designated method.

The following figures illustrate the two study designs:

1. Observational study:



2. Experiment:



Both the observational study and the experiment begin with a random sample from the population of smokers just now beginning to quit. In both cases, the individuals in the sample can be divided into categories based on the values of the explanatory variable: method used to quit. The response variable is success or failure after one year. Finally, in both cases, we would assess the relationship between the variables by comparing the proportions of success of the individuals using each method, using a two-way table and conditional percentages.

The only difference between the two methods is the way the sample is divided into categories for the explanatory variable (method). In the observational study, individuals are divided based upon the method by which they **choose** to quit smoking. The researcher does not assign the values of the explanatory variable, but rather records them as they naturally occur. In the experiment, the researcher **deliberately assigns** one of the four methods to each individual in the sample. The researcher intervenes by controlling the explanatory variable, and then assesses its relationship with the response variable.

Now that we have outlined two possible study designs, let's return to the original question: which of the four methods for quitting smoking is most successful? Suppose the study's results indicate that individuals who try to quit with the combination drug/therapy method have the highest rate of success, and those who try to quit with neither form of intervention have the lowest rate of success, as illustrated in the hypothetical two-way table below:

	Quit	Didn't Quit	Total	% Who Quit
Cold Turkey	12	238	250	5%
Drugs only	60	190	250	24%
Therapy only	59	191	250	24%
Drugs & Therapy	83	167	250	33%

Can we conclude that using the combination drugs and therapy method caused the smokers to quit most successfully? Which type of design was implemented will play an important role in the answer to this question.

Decide which type of study design was used for each of the following scenarios:

Did I Get This

1/1 point (graded)

In order to discover which of 4 weight loss programs gets the best results, subjects are randomly selected to each of the programs.

- (•) experiment ✔
- ( ) observational study

Answer

Correct: We assigned each subject to a weight loss program.

Submit

Did I Get This

1/1 point (graded)

In order to find out which graduates have the highest starting salaries, we gather information from graduates of ivy league, private, and public universities.

- ( ) experiment
- (•) observational study ✔

Answer

Correct: We would not be able to assign each student to a university.

Submit

Did I Get This

1/1 point (graded)

A delivery company that owns a fleet of trucks performs a study to determine whether rotating tires at specific intervals has any effect on the number of miles a set of tires lasts.

- (●) experiment ✔
- ( ) observational study

Answer

Correct:

The company would be able to decide which trucks will have their tires rotated and which ones will not.

Submit