

Module 4: Data Collection

4.1. Experimental and Observational Studies

Observational study

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Experimental study

In an **experimental study**, or an experiment, a researcher assigns subjects to experimental conditions (or **treatments**). Each treatment corresponds to an assigned value of an explanatory variable. The researcher *manipulates* this variable in order to determine if this *causes* a change in the response.

Observational studies vs. experiments

It is not possible to establish cause-and-effect relationships with observational studies because of *extraneous variables*.

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Well-designed experiments reduce (and can statistically eliminate) confounding variable.

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Because treatments are randomly assigned, groups of subjects receiving different treatments will be balanced with respect to these extraneous variables. For example, groups will have similar distributions with respect to age, lifestyle, gender, and so on.

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- Eating habits: It is likely that smokers do not eat as many vegetables as non-smokers. If eating vegetables prevents cancer, this might explain the association seen between smokers and lung cancer.
- Genetics: Is there an aspect of somebody's genetic makeup that makes them more likely to both smoke and to develop lung cancer?

Now consider the following experiment to determine whether smoking (tobacco) might cause cancer:

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One hundred genetically identical mice are divided into two groups of 50 mice each. The first group is exposed to a fixed amount of tobacco smoke 3 times a day for a year; the second group was exposed only to air in the room. All mice were put on the same diet.

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Any difference in cancer rates between the two groups is likely due to exposure to tobacco smoke.

Facebook use can lower grades by 20 percent, study says

Study finds university students distracted by social networking site

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Does using Facebook result in lower student grades?

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4.2: Observational studies and sampling

When observational studies are appropriate

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- estimating the average height of all adult females in the United States
- gauging public opinion on a topic, such as capital punishment
- marketing studies to assess how people rate a new product
- estimating the efficiency of a sorting algorithm

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No! Our sample should be representative of all Eastern students with respect to gender, age, class status, demographic data, proportion of student-athletes, etc. This is an example of a sampling design chosen out of convenience but one that does not represent the population

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The key to selecting a sample that is representative of the population is to sample in such a way that each individual has the same chance of being in the sample. This is known as a **simple random sample**.

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A **convenience sample** is a sample chosen out of convenience and is almost never representative of the population.

How survey questions are worded is extremely important

Consider these survey questions?

- What are your feelings toward Obamacare? Do you feel very positive, somewhat positive, neutral, somewhat negative, very negative, or do you not know enough to say?

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Despite the fact that Obamacare and the ACA are the *same law*, 46% oppose Obamacare compared to 37% who oppose the Affordable Care Act (Oct. 2010).

Also see: <https://www.youtube.com/watch?v=sx2scvIFGjE>

The order and context of questions is important

1. On a scale of 1-10, with 1 being the least happy and 10 being the most happy, how happy are you with your life right now?
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4.3: Summary

Summary

- One can only conclude that there is a cause-and-effect relationship based on data collected from a well-designed experiment.
- The sample used to conduct the study must be representative of the population of interest.
- The wording of survey questions (and the specific variables measured) must be carefully defined and set a context through which the results should be interpreted.

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- The sample used to conduct the study must be representative of the population of interest.
- The wording of survey questions (and the specific variables measured) must be carefully defined and set a context through which the results should be interpreted.

All of these should be taken into account when considering limitations or weaknesses of a research project.

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Student Drug Testing Not Effective in Reducing Drug Use

A drug use questionnaire was filled out by over 76,000 students in 497 high schools and 225 middle schools nationwide. The study found that drug use was similar in schools that tested for drugs and in schools that did not test for drugs.

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Drug Tests?	Drug Use		n
	Yes	No	
Yes	0.37	0.63	5,653
No	0.36	0.64	17,437

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No	0.36	0.64	17,437

1. Is this an observational study or an experiment? **An observational study since no variables are being manipulated. An experiment would have randomly selected the schools that perform drug testing.**

2. Do you agree with the headline 'Student Drug Testing Not Effective in Reducing Drug Use'?

2. Do you agree with the headline 'Student Drug Testing Not Effective in Reducing Drug Use'? **No! It is possible that drug testing was performed primarily in schools with high drug use rates to begin with. Even if this led to a decrease in drug use, then overall you might not see a difference in drug use between schools that do and do not administer drug tests.**

Example

Which diet is better? A group of 100 individuals who want to lose weight are randomly assigned to either Diet #1 or Diet #2. Those on Diet #1 will meet weekly with Dr. Jones while those on Diet #2 meet weekly with Dr. Smith. All patients are put on an exercise program which involves walking/jogging 20 minutes a day for 3 times a week.

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After 3 months of dieting, subjects on Diet #1 have lost 18 pounds, on average, while those on Diet #2 have lost 6 pounds, on average. The researchers conclude that Diet #1 is more successful than Diet #2.

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Is this the correct conclusion?

No! The doctor is completely confounded with the the treatment! It is possible that the personality of the doctor, rather than the diet itself, could explain the difference between the two groups. One solution is to use the same doctor for both groups, ideally in a way that the doctor does not know which patient is receiving which treatment.