Observational Study

Martyn Shuttleworth, Lyndsay T Wilson270.7K reads

In the fields of social science, psychology, epidemiology, medicine and others, observational study is an essential tool.

In classical scientific experiments, the researcher finds a way to manipulate the independent variables to see the effect this has on the dependent variables. However, manipulating the independent variable is sometimes impractical or outright unethical.

For example, a neuroscientist may be interested in the outcomes of patients with a rare kind of brain damage. But it will never be feasible to deliberately cause that kind of brain damage (the independent variable here) in an experimental group to measure patient outcomes (the dependent variable).

Thus, observational methods (sometimes called “un-manipulated studies”) entail merely observing phenomena that are already underway. For a study of long-term effects of brain damage, for example, researchers have to use patients with pre-existing brain damage or their medical records. An observational study can then make inferences from that small sample to the general population, helping neuroscientists understand any new instances of that kind of brain damage.

The researcher may want to study an extremely small sample group, so it is easier to start with known cases and works backwards. The thalidomide cases, for example, are an example of an observational study where researchers had to work backwards and establish that the drug was the cause of certain disabilities.

Kinds of Observational Studies

Observational studies can take many forms, though they all share the common feature of lack of control over the independent variable. Some studies identify two different groups and compare them according to some presupposed causal link or connection. Such case-control studies are commonly used in epidemiological research or to understand the development of individuals with a disease.

Longitudinal studies are when researchers make repeat observations of the same sample over time – sometimes even over decades. Cross-sectional studies, on the other hand, involve just one observation from a sample at one time. Epidemiological studies and ecological studies use observational research but on a larger group scale.

Disadvantages and Advantages of Using Observational Research

Imagine you wanted to test a new cancer drug. Ideally, you would have a group of cancer patients who you could divide into an experimental and control group. Then you could give the drug to the experimental group and compare their outcomes with the control group who didn't get the drug. This would yield useful information, but would be entirely unethical. It would be very unfair to deny patients a potential cure!

You might then decide to merely compare the new drug's effect with observations you've made on another group who deliberately choose not to medicate their cancer, as a control group. But one of the main problems with observational studies is that the experimenter has no control over the composition of the control groups [1], and cannot randomize the allocation of subjects. If he observes a group who embark on alternative therapies to treat their cancer, he has no way of determining whether other factors were involved in the results he sees with them. Could this group have other genetic, environmental or social factors that account for their difference compared to the group that took the new drug?

This can create bias [2], and can also mask cause and effect relationships [3] or, alternatively, suggest correlations [4] where there are none (error in research [5]). Randomization is assumed to even out external causal effects, but this is impossible in an observational study [6].

Another problem with observational studies is the difficulty in isolating what the independent variable [7] actually is, making it tricky to identify cause and effect relationships. Lack of clarity and control around variables can lead to misunderstandings where the media might laud the next wonder food, sensationalize a political debate or subscribe to pseudo-science [8].

Despite the limitations, an observational study is sometimes the most appropriate approach. Taking a step back allows a useful insight into a "real world" phenomenon, and eliminates all the problems associated with researcher manipulation or bias.

Sometimes, researchers simply don't have the legal or bureaucratic power to control the independent variable, and so observational studies allow them to investigate phenomena that they otherwise could not. Lastly, observational study sidesteps the many possible ethical [9] and practical difficulties of setting up a large and cumbersome medical research project.

Links
[1] https://explorable.com/scientific-control-group
[2] https://explorable.com/research-bias
[3] https://explorable.com/cause-and-effect
[4] https://explorable.com/statistical-correlation
[5] https://explorable.com/type-I-error
[6] http://en.wikipedia.org/wiki/Observational_study

[7] https://explorable.com/independent-variable
[8] https://explorable.com/pseudoscience
[9] https://explorable.com/ethics-in-research