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Scientific Control Group

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A scientific control group is an essential part of many research designs, allowing researchers to minimize the effect of all variables except the independent variable. The control group, receiving no intervention, is used as a baseline to compare groups and assess the effect of that intervention.

If you wanted to determine the effectiveness of a program designed to improve school reading level, you would naturally be interested in measuring children's reading level before and after doing the program. If you did exactly this with a group of children, and their reading level improved by 50%, you would then have to answer a tricky question: how do you know the children's reading level wouldn't have improved on its own anyway?

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What is a Scientific Control Group?

The most common way to avoid this is to build a control group into the research design. Normal biological variation, [researcher bias](#) [1] and environmental variation are all external variables that can interfere with the relationship you are trying to understand. “Anchoring” one group by making it identical to another group in all ways except for one variable gives you much more insight into that variable.

Experimental / Treatment Group: Receives the treatment or intervention, usually manipulation of the independent variable.

Control Group: Receives no treatment or intervention, or else receives standard treatment that can be understood as a baseline.

As well as controlling for variables [2] in this way, control groups in the experimental design [3] also give an indication of the magnitude of effect. If the researcher discovers that children who didn't take the program still increased their reading level by 10%, he can reason that not all the result he sees in his experimental group is due to the program alone. Control groups allow for meaningful comparisons to be drawn.

Another example is an experiment that uses a placebo. A medical study will use two groups, giving one group the real medicine and the other a placebo. A placebo has no effect but is indistinguishable from an intervention that does, for example a pill that resembles medicine but is really just made of sugar. Researchers learnt early on that a patient's condition can improve merely because of their belief that a treatment will work. This is called the placebo effect [4] and is one of the most common reasons for including a control group.

In this particular type of research, the experiment is double blind [5], meaning neither the doctors nor the patients are aware of which pill they are receiving, eliminating potential research bias. Another precaution is to randomly assign participants to either control or treatment group, to try and make the two groups as similar as possible.

In addition to the placebo effect, the Hawthorne Effect [6] is another phenomenon where, if people know that they are the subjects of an experiment, they automatically change their behavior. Researchers sometimes design ingenious ways to get around this, usually by telling participants they are testing for one thing while actually testing for another. This can be a very clever approach, as long as care is given to the ethics of the study first.

In the social sciences, control groups are an especially important part of the experiment [7], because it often very difficult to eliminate all of the confounding variables [8] and bias.

There are two main types of control, positive and negative, both providing researchers with ways of increasing the statistical validity [9] of their data.

Positive Scientific Control Groups

A positive scientific control group is a control group that is expected to have a positive result. By using a treatment that is already known to produce an effect, the researcher can compare the test results with the (positive) control and see whether the results can match the effect of the treatment known to work..

For example, a researcher testing the effect of new antibiotics on Petri dishes of bacteria, may use an established antibiotic that is known to work as the control. If all the samples of the new antibiotic fail, except the established antibiotic, it's likely that the new antibiotics are ineffective.

However, if the control fails too, there may be something wrong with the design. Positive

scientific control groups reduce the chances of false negatives.

Negative Scientific Control Groups

In a negative scientific control group, no result is expected. In this case, the control group ensures that no confounding variable [8] or bias has affected the results.

In the same antibiotic example, the negative control group would be a Petri dish of bacteria with no antibiotic of any kind added. The results of the control and the experimental group are then compared. This allows the researcher to show that any reduction of bacteria in the experimental group is due to the effect of the new antibiotic being tested, since it didn't happen in the control Petri dish.

If all new antibiotic inhibited the bacteria, but the negative control group *also* did, then some other variable [2] may have had an effect, confounding the results.

Finally, control groups can be used to establish a baseline. For example, a researcher testing the radioactivity levels of various samples with a Geiger counter would also sample the background level, allowing them to adjust the results accordingly. The background level serves as a control.

Establishing strong scientific control groups is arguably a more important part of any scientific [10] design than the actual samples. Failure to provide sufficient evidence of strong control groups can completely undermine a study, however high significance-levels [11] indicate low probability of error [12].

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