Experiments, Good and Bad

1 Key definitions:

Factor of interest/Explanatory variable/Independent variable: The variable that the researcher purposely changes or manipulates to see if it impacts a specific outcome is called an explanatory variable.

Response variable/Dependent Variable: An objective measure of the research question that is measured at the end of an experiment and compared across the different levels of the factor of interest (or explanatory variable). In simpler terms, a response variable measures an outcome or result of a study.

Subjects: The individuals studied in an experiment are often called subjects.

Treatment: A treatment is any specific experimental condition applied to the subjects. If an experiment has several explanatory variables, a treatment is a combination of specific values of these variables.

Placebo and placebo effect: A placebo is a dummy treatment with no active ingredients. Many patients respond favorably to any treatment, even a placebo. This response to a dummy treatment is the placebo effect.

Lurking variable: Lurking variables are variables that are not included in the study, but they have an impact on the relationship between the variables being studied. These variables can influence the results without being directly measured or accounted for in the analysis.

Confounding variable: Confounding variables are variables that are not the main focus of the study but affect the relationship between the independent and dependent variables being studied. These variables can be measured and accounted for in the analysis, but if they are not properly addressed, they can lead to inaccurate (or biased) results.

Example: An optimistic account of learning online reports a study at Nova Southeastern University, Fort Lauderdale, Florida. The authors of the study claim that students taking undergraduate courses online were "equal in learning" to students taking the same courses in class.

- Subjects - College students are the subjects in this study
- Explanatory variable - Setting for learning (in class or online)
- Response variable - Student's score on a test at the end of the course

Example: Suppose we want to study the relationship between diet and heart disease risk. A lurking variable in this case might be genetics, as people with a family history of heart disease

may be more likely to have a higher risk of heart disease. Genetics is a lurking variable because it is not directly measured or included in the analysis, but it may influence the relationship between diet and heart disease risk.

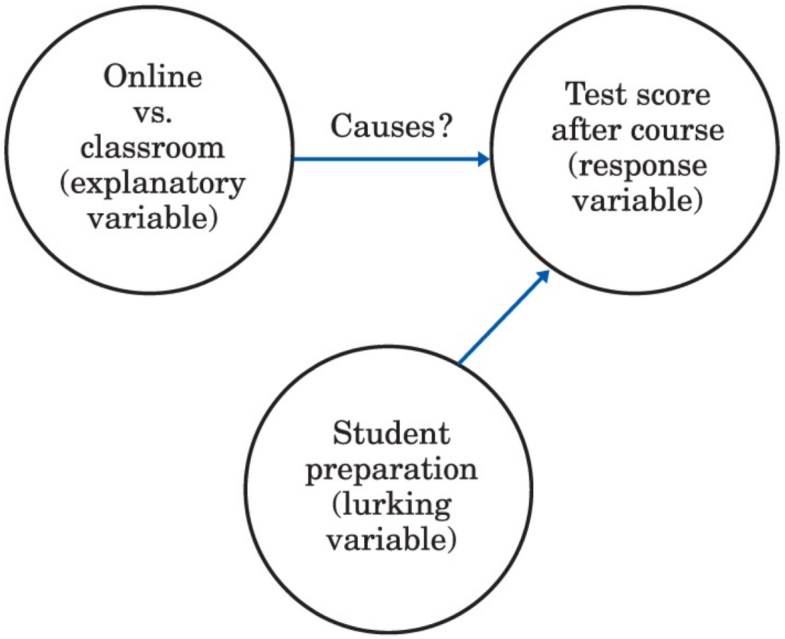
Example: A study might find a correlation between coffee consumption and heart disease risk. A confounding variable in this case might be age, as older people may be more likely to drink coffee and also have a higher risk of heart disease. Age is a confounding variable because it is related to both coffee consumption and heart disease risk and may influence the observed relationship between the two.

Example: Smoking: Suppose we want to study the relationship between air pollution and lung cancer. A confounding variable in this case might be smoking, as smokers may be more exposed to air pollution and also have a higher risk of lung cancer. Smoking is a confounding variable because it is related to both air pollution and lung cancer risk and may influence the observed relationship between the two.

2 Experiment:

- The first goal in designing an experiment is to ensure that it will show us the effect of the explanatory variables on the response variables. Confounding often prevents one-track experiments from doing this.

  Example: This figure below is an example of one track experiment. In this experiment, students chose for themselves whether to enroll in a classroom or an online version of a course. The study simply measured their learning.



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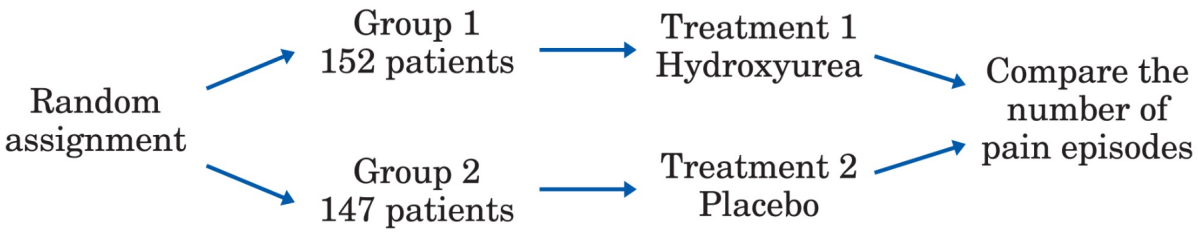
- A good experiment compares two or more treatments. Subjects are divided into treatment group and control group. Control group are given a placebo and treatment group are given a treatment. Then, their responses are recorded and analyzed.

  Example: The National Institutes of Health carried out a clinical trial of the drug hydroxyurea for treatment of sickle- cell anemia. The subjects were 299 adult patients who had had at least three episodes of pain from sickle-cell anemia in the previous year. Attached below outlines the design of a randomized comparative experiment to compare hydroxyurea with a placebo for treating sickle-cell anemia.



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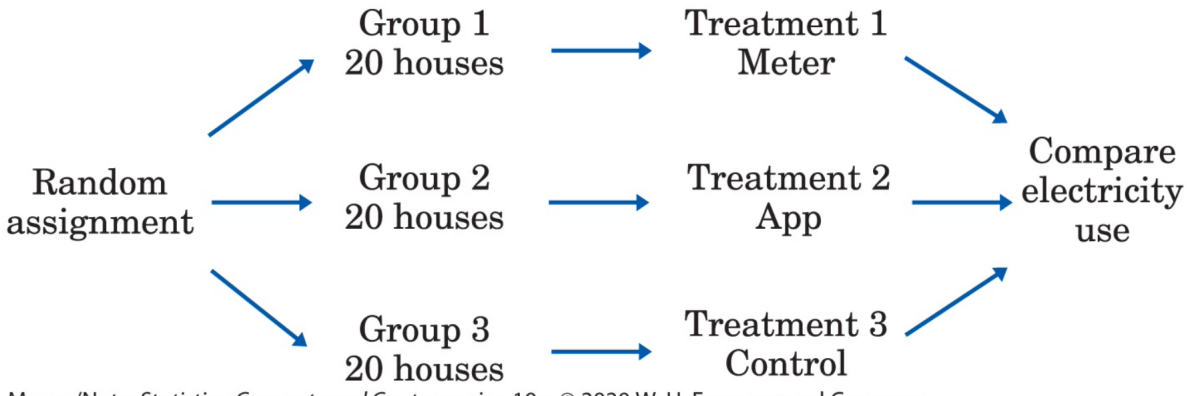
Example: An electricity company decides to design an experiment on 60 houses to monitor energy using two methods: placing a meter outside customers' house or providing the customers with an app to monitor their energy use. The experiment below compares these two approaches (meter, app) and also a control. The control group of customers receives information about energy conservation but no help in monitoring electricity use.



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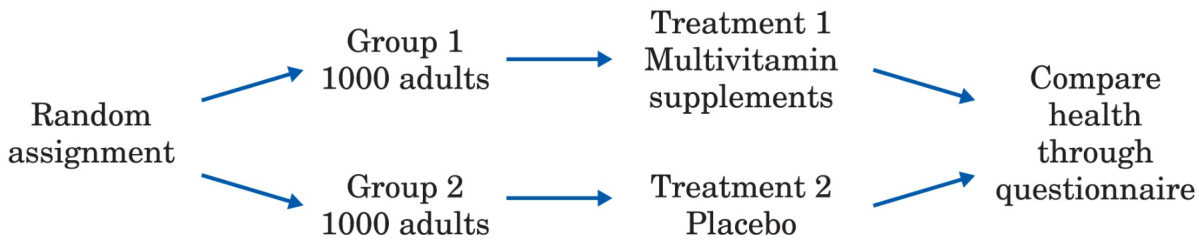
Example: Do multivitamin supplements improve health? To answer this question researchers recruited 2000 adults. All were provided with supplies of capsules and were asked to take one capsule per day. One thousand of the adults received capsules that were multivitamin supplements and one thousand received capsules that were a placebo. The researchers used an extensive questionnaire to assess the health of all participants at the start of the study and after two years into the study. Outline the design of this study.



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