Part 4: Causal Claims

Causal claims can only be made when an experiment has been conducted. Often media articles refer to experiments when they don't meet the precise definition of an experiment in statistics.

It is important to note that it is not always possible to conduct a true experiment for ethical reasons, and designing a perfect experiment is very difficult, and often time-consuming and expensive. Experiments must:

1. Have participants **randomly allocated** to the treatments
2. The **variable of interest must be measured**
3. The **results must be compared** between the treatment groups, or between the treatment and control groups.

When looking at an experiment we want to make sure that these things have all happened before a causal claim can be made. It is also worth thinking about the **ethical** considerations if it was an experiment.

For any article that is referring to an experiment it is important to ask the following questions. We will use an example of a new drug being tested.

1. **Who was the experiment conducted on?**
   It is important to note who the experiment was conducted on. Often times the experiments are not conducted on people, but rather on mice or cells in a lab. It is also worth noting if the experiment was conducted only on males or only on females, as males and females can react differently to drugs. It is important the results are only applied to the group on which the experiment is conducted on.
2. **What is the explanatory variable?**
   The explanatory variable is the variable that attempts to explain or cause (at least in part) the changes observed in the response variable. In our example the explanatory variable would be the amount of the new drug received. All other variables must remain unchanged.
3. **What is the treatment?**
   The treatment is one of, or a combination of, explanatory variables assigned by the researcher. In our example there could be several treatment groups, one that gets none of the new drug, and the other groups receive various levels of the new drug.
4. **What is the response variable?**
   This is what we are measuring or wanting to see change. In our example this might be a measure relating to how much the symptoms for the disease the drug is trying to combat have reduced.
5. **How were the participants put into groups?**
   It is really important that people are put into the groups randomly. This is because this helps balance out any characteristics that we cannot control. It helps makes the groups similar apart from the treatment they receive, which allows researchers to say the treatment caused the observed result.
6. **Was there a control group?**
   Often in experiments there is a control group. This group creates a baseline of what would happen if there was no treatment. In our example this would be the group who did not receive any of the new drug.
7. **Was a placebo used?**
   A control group is sometimes given a placebo. This is often a sugar pill with no drug inside it. This is done because of the "placebo effect". This is when people who receive no drug still experience positive changes. For more information about the placebo effect watch this video.
8. **Was blinding used?**
   Often times researchers who are creating a new drug really want their drug to work, so are biased towards seeing positive results. To avoid such biases, good researchers will use a blinding procedure. There are two types of blinding – single blinding and double blinding. With single blinding either the participant knows **OR** the researcher knows who has received which

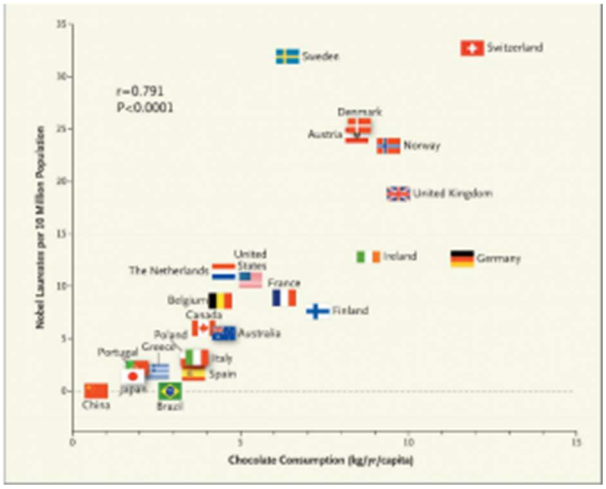
treatment. With double blinding neither the researcher nor the participant knows who has received which treatment. When this happens an independent party will allocate the participants to the two groups. Only after all measurements have been taken will they reveal which treatment group participants belonged to. Double blinded experiments are always better than single blinded experiments, however sometimes they are not practical.

9. **Are there any ethical considerations that need to be made?**
   In many situations it is not ethical to conduct an experiment. For example, you can't get some pregnant mothers to drink alcohol and some not to, to see how it affects the development of their unborn child. In this case only an observational study can be done where you record which mothers did and didn't drink and the effect on their unborn child's development. Because there may be other variables connecting those that choose to drink and those that do not a causal claim cannot be made.

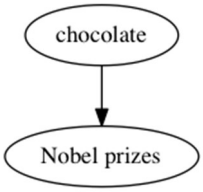
If you think about these 9 points when looking at a causal claim you should cover off everything that needs to be covered for the answer.

It is important to note, just because there is a correlation (two variables are related to each other) it doesn't mean that one causes the other.

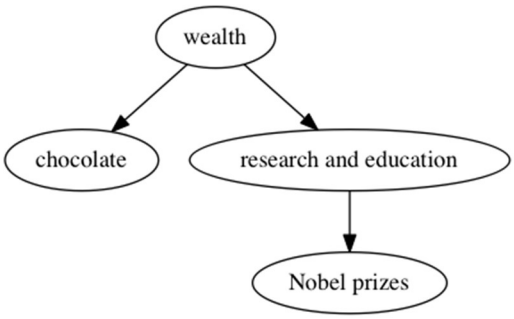
For example, this graph on the right shows the correlation between chocolate consumption and the number of Nobel Laureates.



There is clearly a correlation, but there is probably a **lurking variable** involved. This means rather than having a relationship that looks like this:



It probably looks like this:



If you want to read more on this there is an excellent article here:
https://www.statschat.org.nz/2017/03/09/causation-correlation-and-gaps/

But this is why we need to be careful when we look at causal claims.