Correlation vs. Causation

Objective: The goal of this assignment is to introduce you to various research methods. The terms it covers include: *naturalistic observation, survey, case study, generalizability, correlation analysis, random assignment, prospective study, double-blind study design, and the third-variable problem.* Consider taking notes on these terms. When you finish reading, take the Google Form quiz (linked at the end of the doc).

There are a number of different ways to perform psychological research. Some psychologists simply observe behavior in a natural context. This type of research, known **as naturalistic observation**, minimizes the possibility that the behaviors are contrived or altered by the research conditions. Like Jane Goodall studying chimpanzees in the wild, the researcher is inconspicuous and avoids contact with the subjects, allowing for the collection of data that could not be discovered in an experimental setting. For example, after observing over 1200 instances of naturally occurring laughter, one psychologist found that

1) less than 20% of laughter is in response to formal efforts at humor. Most laughter follows banal remarks such as "Look, it's Andre," "Are you sure?" and "It was nice meeting you too."

2) By the time the average kid reaches kindergarten, he or she is laughing some 300 times each day. Compare that to the typical adult who laughs a paltry 17 times a day.

3) Men and women laugh equally often, but at different things.

Other methods of collecting data include surveys and case studies. **Surveys** are great for collecting large amounts of information, but they tend to be superficial and rely on people being honest and self-aware. Surveys are also the most direct way to learn about people's preferences and attitudes. **Case studies**, on the other hand, go into great depth with a single individual or case, but run the risk of lacking **generalizability**; that is, the individual may be atypical and not representative of the larger population. A lot of early knowledge about brain functions came from case studies of individuals who had suffered brain injuries. You can read about a few notable case studies in psychology here.

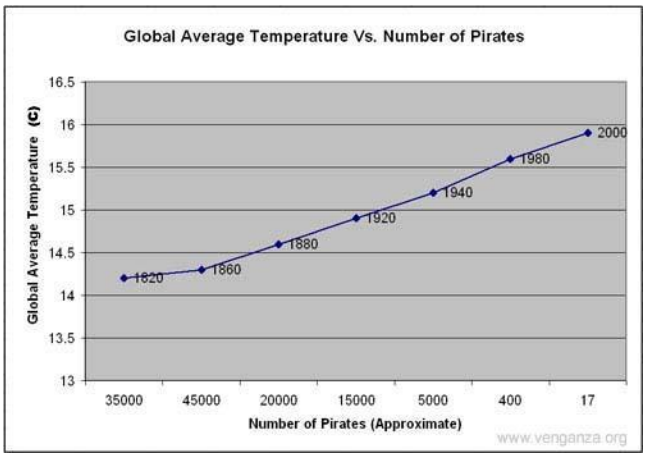
Sometimes, it is important to understand the *relationship* between two naturally occurring variables. Data collected by survey or naturalistic observation may be compared using a method known as **correlation analysis**. In this type of study, the researcher does not manipulate any variables, but rather, gathers data and uses graphs and statistics to quantify the relationship. For example, perhaps I suspect that eating bananas makes people smarter. Before setting up an expensive and time-consuming experiment, I may first want to check if there is a relationship of any sort between banana consumption and intelligence. I could ask people how many bananas they eat in a typical week and compare that to their score on a test. My hypothesis would be that people who report eating more bananas score higher on the test. This would be a **correlation**. One limitation of correlational research is that, even if a relationship is found, it doesn't tell us which variable is the cause and which is the effect (aka, the *causal relationship*). It could be that banana consumption makes you smarter, as I originally suspected. However, it is also possible that being smart makes you eat more bananas (after all, they *are* good for you so eating them would be a smart choice), or that some third factor (say, lots of money) causes both banana-eating and high test scores (both bananas and a good education cost money). This is sometimes referred to as the "third variable problem", although it is only really a problem if you forget that it exists.

Correlation possibilities:

A causes B: *Eating bananas makes you smarter.*
B causes A: *Being smart makes you eat bananas.*

Some third variable (C) causes both A and B.
Money makes you more likely to be smart and more likely to eat bananas.

You have to be very careful not to jump to conclusions about causation when reading correlation studies, as the following research illustrates quite clearly:



"You may be interested to know that global warming, earthquakes, hurricanes, and other natural disasters are a direct effect of the shrinking numbers of pirates since the 1800s. For your interest, I have included a graph of the approximate number of pirates versus the average global temperature over the last 200 years. As you can see, there is a statistically significant inverse relationship between pirates and global temperature. (http://www.venganza.org/)"

While there *is* a correlation between the number of pirates and global temperatures, the author wrongly assumes that the lack of pirates is *CAUSING* the temperature increase. In fact, it is probably a third variable that is causing both an increase in temperature and a decrease in pirates. (Take a minute and see if you can guess what that third variable might be.)

The only way to tease out the direction of causation is to do the tried-and-true **experiment**. An experiment differs from a correlation because the researcher controls (or attempts to control) all the variables except for the one in question. Rather than simply *asking* individuals about their banana consumption, a researcher would need to *assign* subjects to eat varying numbers of bananas, and then, assess their intelligence at some later point. To control for natural variation among people, the researcher might assign subjects to banana-eating conditions **randomly**, with the expectation that given a large enough sample, the groups will be largely equivalent with respect to most relevant variables. Because the researcher manipulates a variable, and then waits for an effect, a true experiment is **prospective** ("forward-looking"). Contrast this with the correlation study, in which the researcher simply gathers data about a variable (in this case, banana-consumption) after it had occurred (known as a retrospective, i.e., "backward-looking" study). Finally, to minimize the likelihood that expectations of the subjects or researcher will influence results, the best experiments are conducted in a **double-blind** manner, with neither the subjects nor the researchers aware of the experimental condition to which each subject belongs. To do this in our banana study, perhaps we could hire chefs to hide varying amounts of banana into the subjects' diets without their knowledge. The resulting study would be described as a **randomized** (subjects were randomly assigned to conditions), **controlled** (subjects were treated the same), **double-blind** (neither the subjects nor researchers know who is in what condition), **prospective** (forward-looking) study. Known as the "gold standard" of research, these studies provide the most reliable means of studying the causal relationship between two variables.

The "gold standard" isn't always reasonable, though, and in some cases, it isn't even possible. For example, I can't randomly assign people to a gender to determine if gender affects personality. It wouldn't be ethical to randomly assign people to lead exposure to determine how it would affect their unborn children. And while it *is* perfectly reasonable to assign subjects to different levels of banana-consumption to test the effects on intelligence, it may be prohibitively expensive to provide the supervision needed to assure subjects comply. Even if you are willing to shell out the cash to keep all the subjects on-site with access to food restricted for the duration of the study, might the *knowledge* that they are subjects in an experiment or

the *unnatural environment* in which they are living alter the subject's behavior in some way making the results irrelevant to what might happen under natural conditions? The limitations of each study type can often be compensated for by another type. Robust theories are those that are confirmed, not only by replication, but also by various different types of research.

Unfortunately, the subtle difference between retrospective studies (like correlation analysis and naturalistic observation) and prospective studies (i.e., the "gold standard" experiment) is one our media doesn't always respect. Reporters often draw conclusions about cause-and-effect from retrospective research, whether by mistake or simply to gain attention. After all, which article are you more likely to read? The one titled, "Bananas make you smarter!" or the one titled, "Banana-consumption and test scores are positively correlated"?

Read the following examples and judge whether the procedure described would be considered a correlational approach or an experimental approach. Submit your answers on this form. **When you are finished, read the feedback and learn from your mistakes. If you have questions, ask me at the orientation.**

1. **Social Media**
   In 2014, Primack and his colleagues sampled 1,787 young adults, ages 19 through 32, using an established depression assessment tool and questionnaires to determine social media use.The questionnaires asked about the 11 most popular social media platforms at the time: Facebook, YouTube, Twitter, Google Plus, Instagram, Snapchat, Reddit, Tumblr, Pinterest, Vine and LinkedIn.

   Participants who used seven to 11 platforms had 3.1 times the odds of reporting higher levels of depressive symptoms than their counterparts who used zero to two platforms. Those who used the most platforms had 3.3 times the odds of high levels of anxiety symptoms than their peers who used the least number of platforms. The researchers controlled for other factors that may contribute to depression and anxiety, including race, gender, relationship status, household income, education and total time spent on social media. The media concludes that using social media causes depression.

   Is this an experiment or a correlational (retrospective) study?

   How do you know?

   Is the media's conclusion valid? If not, what are the three possible causal explanations?

2. **Weight Loss Plan**
   Scientists are testing the effectiveness of different weight loss strategies. Participants are divided into four groups. For two months, each group is assigned a different weight loss strategy: Group 1 does cardio for 1 hour per day, Group 2 participates in strength training exercise of 1 hour per day, Group 3 drinks 8 glasses of water per day, and Group 4 is given a vegetarian diet. At the end of this 8-week experiment, the strength-training group has lost the most weight. The media concludes that the best weight loss comes from strength-training exercise.

   Is this an experiment or a correlational (retrospective) study?

   How do you know?

   Is the media's conclusion valid? If not, what are the three possible causal explanations?

3. **Anxiety and Depression**

Dutch scientists studied 1,500 children who were surveyed for signs of anxiety or depression and questioned them about ecstasy use. They found that those exhibiting signs of anxiety or depression were more likely to report using ecstasy. The media concludes that anxiety and depression led to ecstasy use in their sample.

Is this an experiment or a correlational (retrospective) study?

How do you know?

Is the media's conclusion valid? If not, what are the three possible causal explanations?

4. **Smiling**
Researchers asked scientists trained to analyze smiles, to review vintage photographs of 230 major league baseball players of the 1952 season. The team classified each player's smiles as non-smilers or smilers. Then the team retrieved data relating to how long-lived the 184 players who had already died were. Of the deceased players, smilers tended to live longer. 70% of smilers lived to age 80, as compared to 50% of non-smilers who survived to that age. The media concludes that smiling causes people to live longer.

Is this an experiment or a correlational (retrospective) study?

How do you know?

Is the media's conclusion valid? If not, what are the three possible causal explanations?

5. **Adventurous Play**
Researchers surveyed 2500 parents of children aged 5-11 years. Parents completed questions about their child's play, their general mental health (pre-Covid), and their mood during the first Covid-19 lockdown. Researchers found that children who spend more time playing outside had fewer "internalizing problems" -- characterized as anxiety and depression. Those children were also more positive during the first lockdown. The media concludes that encouraging more adventurous outdoor play among children will promote better mental health.

Is this an experiment or a correlational (retrospective) study?

How do you know?

Is the media's conclusion valid? If not, what are the three possible causal explanations?

6. **Social Media Break**
Researchers randomly assigned 154 individuals, aged 18 to 72 who used social media every day into either an intervention group, where they were asked to stop using all social media for one-week or a control group, where they would continue scrolling as normal. Baseline scores for anxiety, depression, and well-being were taken at the beginning of the study and compared to data collected at the end of the week. Results revealed that participants in the intervention group spent an average of only 21 minutes per day on social media, compared with 7 hours per day in the control

group. The intervention group also showed significant improvements in well-being, depression, and anxiety. The media concludes that even a small break from social media can impact your mental health.

Is this an experiment or a correlational (retrospective) study?

How do you know?

Is the media's conclusion valid? If not, what are the three possible causal explanations?

7. **Screen Time**
   Researchers collected screen time usage data from over 800 14 and 15 year-olds. They also examined school test scores for those students. They found that an extra hour in front of the TV or online at age 14-and-a-half was linked with 9.3 fewer exam points at age 16 -- equivalent to two grades, for example from a B to a D. Two extra hours was linked to 18 fewer points.
   The media concludes that screen time causes lower test scores.

   Is this an experiment or a correlational (retrospective) study?

   How do you know?

   Is the media's conclusion valid? If not, what are the three possible causal explanations?