

Critical Thinking

Worksheet 8: Causal Arguments

Exercise 1: Possible explanations for correlations.

Use the chart bellow to help you figure out what explains the following correlations.

1. As the number of pirates in the world has decreased, the average global temperature has increased. Therefore, pirates prevent climate change.

Chance

2. The faster a windmill rotates the more wind there is. Therefore, windmills cause wind.

Reverse causation – wind causes windmills to rotate

3. Sleeping with one's shoes on is strongly correlated with waking up with a headache. Therefore, sleeping with one's shoes on causes headache.

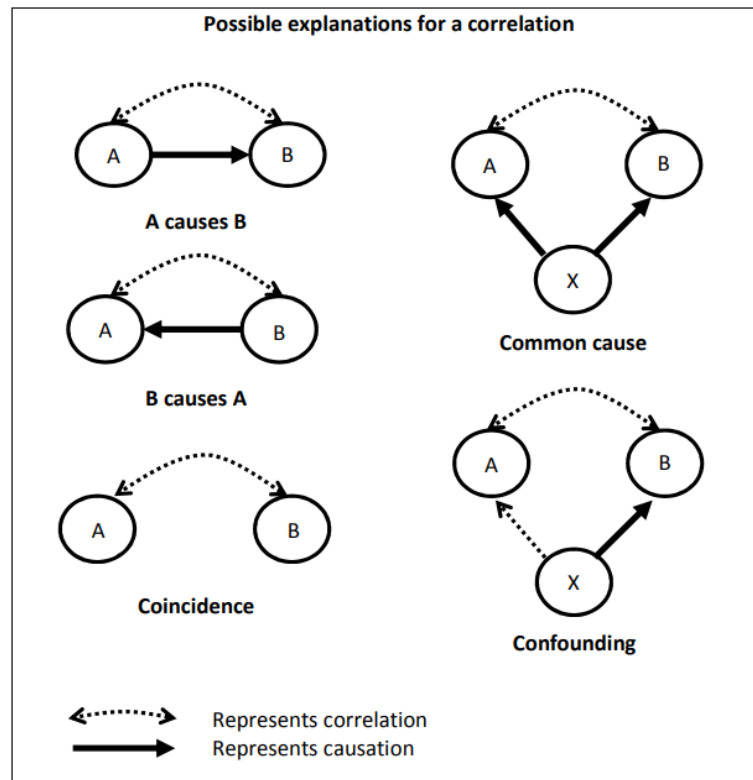
Common cause – drinking too much?

4. Assignments that are submitted several days before the due date typically get better scores than assignments that are submitted on the day. Therefore, you can improve your results by submitting your assignments early.

Confounding variable. Being a hardworking student. Working hard is causally related to getting better scores. And hardworking students are more likely to submit papers early (so there is a correlation between being a hardworking student and being a student who submits early).

5. The presence of mosquitoes in your bedroom is tightly correlated with waking up covered in itchy bumps. Therefore, mosquitoes cause itchy bumps.

Causation – mosquitoes cause itchy bumps.



Exercise 2: More complex cases.

The following examples are adapted from the book *How to think about weird things: critical thinking for a New Age*, T. Schick and L. Vaughn, McGraw Hill, 2002. In each case, some evidence is reported regarding a particular treatment or diet. In each case, say whether there is sufficient evidence to support a causal generalization and explain your answer.

1. Therapeutic Touch (TT) is an alternative medicine technique said to be used by over 40,000 nurses in North America alone. It is supported by major nursing organizations and gets favourable mention in the media. TT practitioners claim that an “energy field” unknown to science surrounds the human body and that practitioners can use their hands to detect and manipulate this field. (No physical touching of the body is involved, though.) In particular, they say that they can cure disease by “balancing” people's fields, which are said to extend four to eight inches from the surface of the skin. Many people do in fact report feeling better after TT treatment.

Only one thing that might be called ‘evidence’ is given here: “Many people do in fact report feeling better after TT treatment.” But clearly that is not sufficient to establish that they got better because of the therapeutic touch. The talk of an ‘energy field unknown to science’ is a further cause for scepticism. Very unlikely claims require stronger evidence.

2. A macrobiotic diet can be effective against cancer. Macrobiotics is a lifestyle and diet derived from Far Eastern ideas and promoted by many adherents. The diet is semi-vegetarian and low in fat. In recent years there have been many published accounts of

people who say they have recovered from cancer because they ate a macrobiotic diet. There have also been several case reports. Attempts have been made to compare the outcomes of these cases to those of patients with comparable cases of cancer who did not follow a macrobiotic diet. These comparisons show that people on the macrobiotic diet often have better outcomes.

The fact that people say they recovered because of their diet is not good evidence that they really did get better because of their diet. People's opinions about what caused what are not very reliable, especially when it comes to complex issues such as the relationship between diet and health. How could people really know what caused them to get better? How could they know they wouldn't have got better if they had not been on the macrobiotic diet?

The second item of evidence is that there is an observed correlation between being on a macrobiotic diet and recovering from cancer. This is much better than relying on self-reports but it is still only a correlation. For all we know, the two groups might well have differed in lots of other relevant variables, not just on whether they were on the macrobiotic diet.

3. Shark cartilage has been called to public attention by a CBS *60 Minutes* program focused on the theories of biochemist William I. Lane, Ph.D, author of *Sharks Don't Get Cancer*, Narrator Mike Wallace began by calling attention to the book and stating that Lane says that sharks don't get cancer. The program focused on a Cuban study of twenty-nine "terminal" cancer patients who were given shark-cartilage preparations. Wallace visited the site of the experiment, filmed several of the patients doing exercise, and said that most of the patients felt better several weeks after the treatment had begun. Two American cancer specialists then said that the results were intriguing. One, who was aligned with the health-food industry, said that three of the patients appeared to have improved. The other, who appeared to be solidly scientific, noted that evaluation was difficult because many of the X-ray films were of poor quality, but he thought that a few tumours had gotten smaller.

Firstly, twenty-nine is a small sample. All the people in the sample were given shark cartilage: there was no control group of similarly sick people who were not given shark cartilage. Since there is no control group, we cannot tell whether these people would have felt better even if they had not got the shark cartilage. Also note that 'feeling better' is not quite the same thing as 'being better'. There might have been no change at all in the underlying progress of the patients' cancer. They might just have said they felt better to please the producers of the TV documentary. Or they might have felt better because they were getting lots of extra attention and perhaps feeling hopeful again.

The evidence obtained by actually looking at the tumours is more objective of course. But deciding whether tumours have grown or shrunk by looking at a fuzzy X-ray might be inaccurate. There is also a possibility of bias: if you expect or want to see the tumours shrinking, you might (even inadvertently) overestimate the effect. This would especially relevant for the cancer specialist who was 'aligned with the health-food industry' but not entirely absent from the other doctor either.

In a properly done experiment, the people looking at the X-rays would not know whether they were looking at X-rays from a patient who got the shark cartilage or an X-ray from a patient who did not.

(That is, they would be 'blind' to whether the patient was in the control or treatment group). That way, their hopes and expectations cannot systematically bias the results.

Exercise 3: Historical Cases.

In each of the following historical cases, identify what causal claim is being made and what evidence is being used to support it. And then evaluate 1) whether or not these studies provide compelling evidence for their conclusions and 2) how you might improve on them.

1. In order to test whether pellagra – a disease characterized by dermatitis, diarrhea, dementia, and ultimately death that decimated the American South between 1907 and 1940 – was an infection disease spread or one caused by an inadequate diet, Joseph Goldberger increased the allotment of fresh meat at two orphanages and an asylum where pellagra was prevalent. He found that this intervention all but eradicated instances of pellagra. The study involved 702 subjects, 414 of which suffered from pellagra. Of these, only one had a recurrence of pellagra, after the dietary changes were made. And there were no cases of healthy subjects developing the disease.

Causal Claims: *Eating a more balanced diet can cure pellagra (alternatively, pellagra is caused by an impoverished diet).*

Evidence: *He provided fresh meat to an orphanage with many pellagra cases and then, 1) those with pellagra got better, and 2) no healthy children developed pellagra.*

Is this study compelling evidence for Goldberger's conclusion?

Two things stand out here.

First, there is no obvious control group in Goldberger's experiment. We also need to know what would have happened had the orphans not receive a dietary boost. Would they still have gotten better? (Perhaps Goldberger was relying on background knowledge that pellagra doesn't go away on its own?)

Can we really be sure that the participants all ate the food he supplied? Might the wardens have taken it for themselves?

Goldberger's study is very suggestive! But it doesn't rule out all confounding factors.

2. In a later study Goldberger tried to induce pellagra by feeding 11 volunteers at a prison farm an impoverished corn heavy diet. The prison farm had no recorded cases of pellagra. 6 of the 11 developed the disease (The volunteers were offered shortened sentences for their participation). Does this strengthen Goldberger's case?

Is this study compelling evidence for Goldberger's conclusion?

Absence of control group. Sample size is small and not random (these prisoners can't represent the population – all people – because of many factors). Moreover, this is extremely unethical!

3. In a later study still, Goldberger tried to infect himself and his family with pellagra via known methods of germ transmission. He swabbed the throats of pellagra patients and then wiping the swab on the throats of his family members. He even fed them bits of scabs and faeces from pellagra patients! None of his volunteers developed pellagra. Does this strengthen Goldberger's case?

Is this study compelling evidence for Goldberger's conclusion?

It seems suggestive. However, do we know if the people were *infectious* at the time Goldberger swabbed them (and took other samples). Moreover, we don't know if pellagra germs transmit via this way (i.e. it could be airborne). Again, no control and treatment groups. So, we can't isolate the causal relationship.

Overall: Goldberger certainly was able to show strong evidence diet being the causal mechanism in pellagra. However, he was not able to conclusively show this, nor was he able to isolate the exact nutrient deficiency involved.

4. Ignaz Semmelweis, a Hungarian obstetrician working at the Vienna General Hospital (Allgemeines Krankenhaus) in 1847, noticed the dramatically high maternal mortality from puerperal fever following births assisted by doctors and medical students. However, those attended by midwives were relatively safe. Investigating further, Semmelweis made the connection between puerperal fever and examinations of delivering women by doctors, and further realized that these physicians had usually come directly from autopsies. Asserting that puerperal fever was a contagious disease and that matter from autopsies were implicated in its development, Semmelweis made doctors wash their hands with chlorinated lime water before examining pregnant women. He then documented a sudden reduction in the mortality rate from 18% to 2.2% over a period of a year. Despite this evidence, he and his theories were rejected by most of the contemporary medical establishment.

(Wikipedia entry on the Germ Theory of disease)

Causal Claim: puerperal fever is a contagious disease and that matter from autopsies is implicated in its development.

Evidence: washing hands with chlorinated water between autopsy and assisting birth. Subsequent to this intervention, there was a sudden reduction in the mortality rate from 18% to 2.2% in the women who gave birth (and were assisted).

Is this study compelling evidence for Semmelweis's conclusion?

Semmelweis uses the ward run by midwives as the 'control' group and the ward run by doctors (with the high death rate) as the 'treatment' group. He adjusted several variables in the treatment ward without any change in the death rate occurring (attempting to isolate the cause). Then, he enforced handwashing in the treatment ward (upon making the connection: the doctors who were assisting with birth have performed autopsies). After the handwashing, the death rate dramatically reduced.

Chlorinated water could have removed dangerous germs/stuff not from autopsy, but from another source. So, we are perhaps not sure about the *exact* cause of puerperal fever on the basis of this experiment. But Chlorinated water is a highly effective antiseptic – it is killing germs. Today, we understand that puerperal fever is any bacterial infections of the female reproductive tract following childbirth or miscarriage (i.e., postpartum infections).