

The Causal Leap

When two things move together and an arrow gets drawn between them

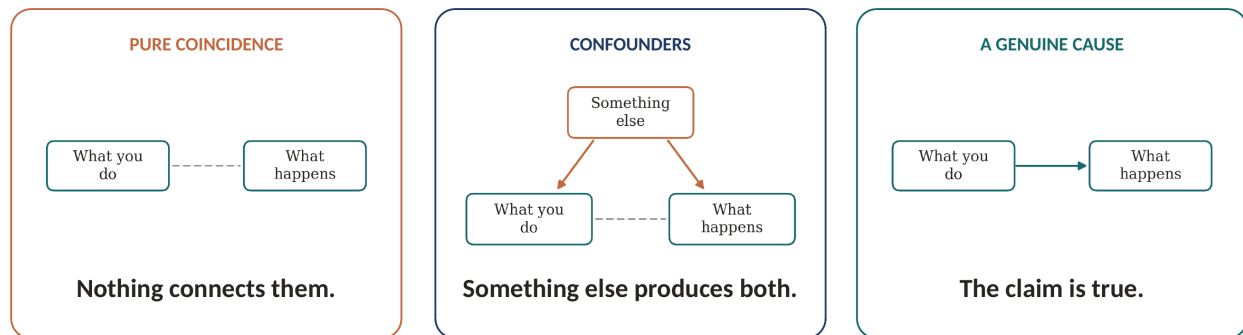
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Fault 5 of six · healthy-skepticism.com · September 2026

The fault

Two things move together, and the headline says one causes the other. That is the fault: confusing correlation with causation. A correlation is a fact about two columns of numbers. A cause is a claim about what would happen if you changed one of them. Nothing in the two columns tells you which you have.

Almost every health headline lives in that gap. "Bird watchers have lower rates of dementia" is a correlation. "Bird watching prevents dementia" is a cause, and the headline writer made the leap for you. A healthy skeptic reads the correlation and asks what would justify the arrow. Every strong correlation belongs to one of three cases, and each case has a question.

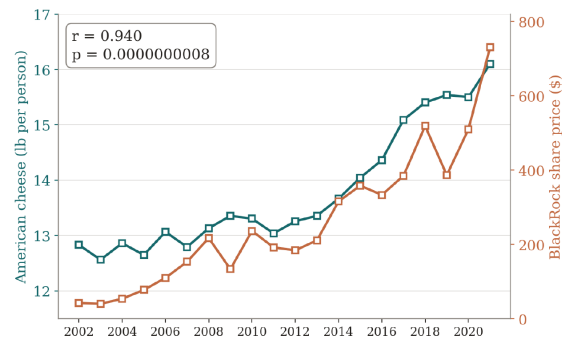
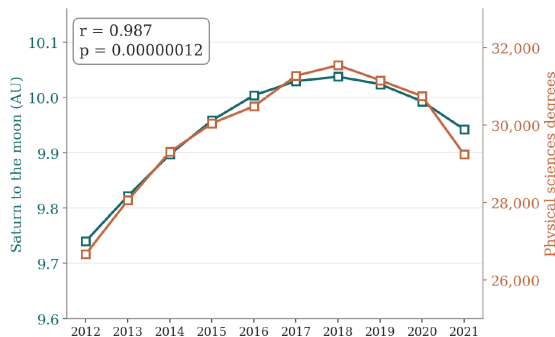


Solid arrow: causes. Dashed line: moves together, which is all the data shows you.

Three explanations for one correlation. Solid arrow: causes. Dashed line: moves together.

Case 1, coincidence: can you draw the grid of people?

Before anything else, ask what one square in the hundred-person grid would be. If the answer is "a year," there are no people in the correlation and nothing to explain. Saturn's distance from the sun tracks the number of physical-science degrees awarded in the United States, $r = 0.987$. American cheese consumption per person tracks BlackRock's share price, $r = 0.94$. Both would clear any journal's significance bar. Both are found by trying millions of pairs of series and keeping the ones that happen to line up, and both are trends measured in years. Take the year-to-year changes instead of the running totals and the cheese correlation falls to 0.29.

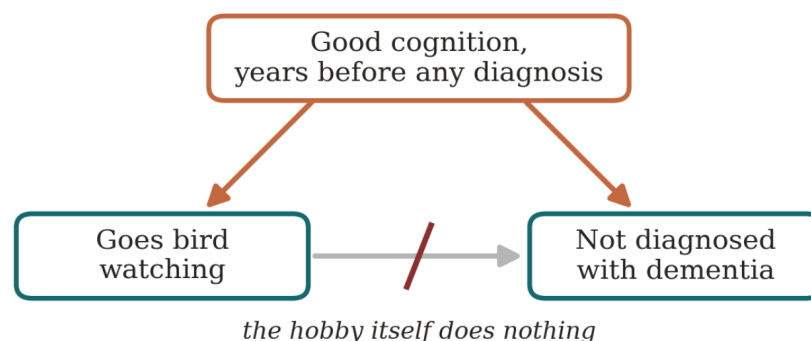


Saturn's distance and physical-science degrees, $r = 0.987$. Cheese consumption and BlackRock's share price, $r = 0.94$. Neither has a person in it.

Vigen T. Spurious Correlations, tylervigen.com, CC BY 4.0, correlations #2,656 and #4,018; the year-to-year figure is computed from his data.

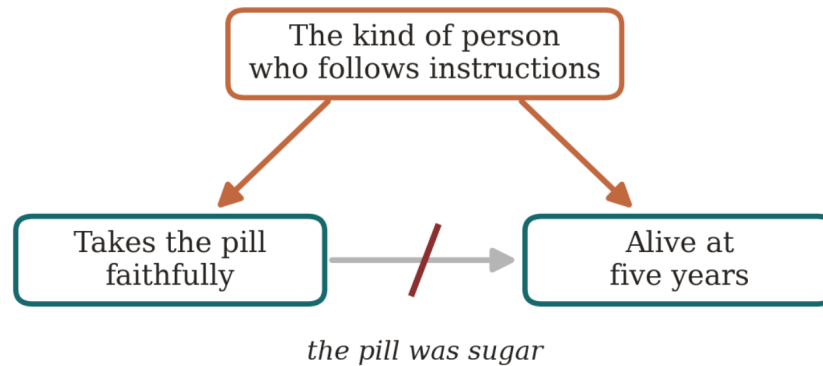
Case 2, a confounder: could something else drive both columns?

Once there are real people, the correlation is real too, and the question becomes whether a third thing sits behind both columns. Bird watchers show lower rates of dementia; the fork has good cognition at the top. People whose minds are still sharp go out with binoculars, and they are the same people who are not diagnosed. Whitehall II followed 10,308 civil servants for 28 years: meeting activity guidelines made no difference to dementia risk, hazard ratio 1.00, and activity fell away in the nine or ten years before diagnosis, when cognition was already declining and took the hobby with it. The arrow was drawn the wrong way.



The bird watching data. Cognition drives both columns. The hobby does nothing.

The sugar pill makes the same point without a hobby. In the Coronary Drug Project, men in the placebo arm who took their pill faithfully had 15.1% five-year mortality; those who did not had 28.3%. The pill was sugar. The gap is carried entirely by the kind of person who follows instructions, and it is as large as many real drug effects.



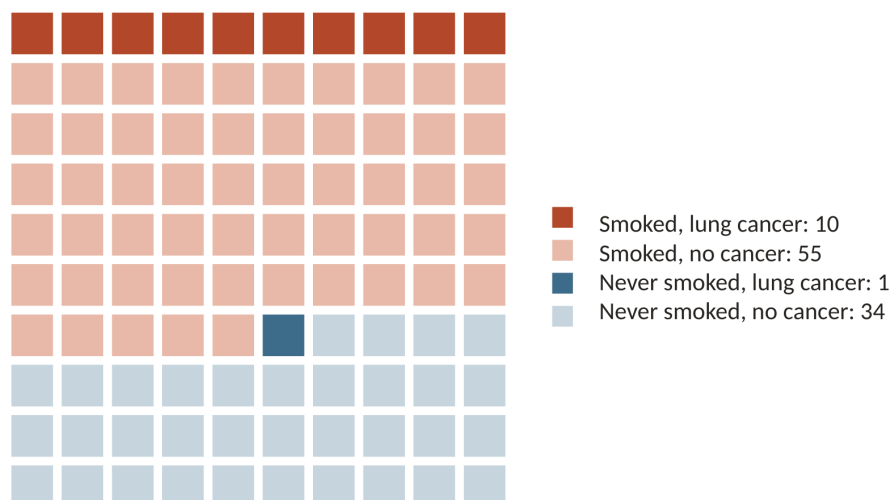
The Coronary Drug Project. The pill was sugar. The person taking it faithfully was the difference.

Sabia S et al. Physical activity, cognitive decline, and risk of dementia: 28 year follow-up of Whitehall II. BMJ 2017;357:j2709. Coronary Drug Project Research Group. N Engl J Med 1980;303:1038–1041.

Case 3, a cause: how big would the rival have to be?

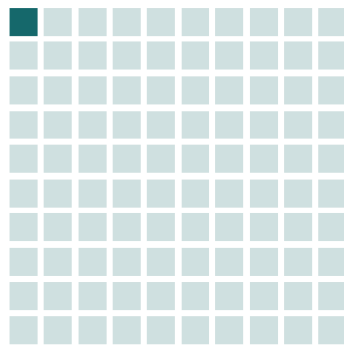
Smoking and lung cancer is the one genuine cause in the course, and the point of including it is that calling something a cause is hard even when it is true. The 1950s cohorts found smokers got lung cancer far more often. R. A. Fisher, inventor of the significance test, objected: perhaps a gene drives both the craving and the cancer. That is a fork, exactly like the ones above, and it fits the two-column data as well as the headline arrow does. He was a paid consultant to the tobacco industry, and a smoker, but the objection was legitimate and deserved an answer.

The answer used counting twice. First the direction: among 100 British men of the era, about 65 smoked; about 10 of those and 1 of the 35 never-smokers got lung cancer. Cancer given cigarettes is about 16%, against about 2% for never-smokers, eight times apart. Then the rival. Cornfield showed in 1959 that for a gene to produce an eightfold risk on its own, it would have to be at least eight times as common among smokers as among never-smokers. That is a prevalence, and it can be checked. No such gene exists, and studies of identical twins who differed in smoking later confirmed that the smoking twin carried the excess risk. The arrow survives because the arithmetic was done, not because the correlation was strong.



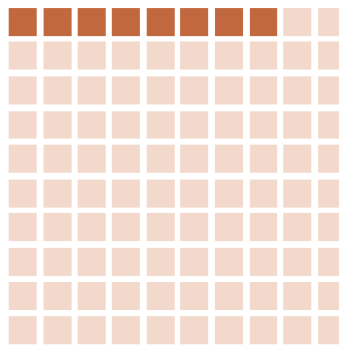
One hundred British men around 1950. Sixty-five smoked. Ten of them and one never-smoker got lung cancer.

100 who never smoked



1 of 100 would carry the gene

100 cigarette smokers



8 of 100 would carry the gene

Fisher's gene. To produce an eightfold risk on its own it would have to be eight times as common among smokers. No such gene was found.

Doll R. Br J Cancer 1953;7:303. Crispo A et al. Br J Cancer 2004;91:1280–1286. Cornfield J et al. J Natl Cancer Inst 1959;22:173–203. Hjelmborg J et al. Thorax 2017;72:1021–1027.

Why it happens

Correlations are cheap and causes are expensive. A correlation comes from two columns anyone can download; a cause needs a prevalence, a design that rules out the fork, and often years. Headlines are written on the cheap side of that gap, and readers, who want to know what to do, supply the arrow themselves. Every step past the correlation needed a number the correlation never contained. That is the course in one sentence: the probability reversal of fault 2 is not a separate fault from the causal leap; it is the tool that closes it.

What to ask

- What would one square in the grid be? If it is a year, stop.
- Who are the people, and what else is true of the ones doing the activity?
- Draw the fork. What would have to sit at the top for the headline arrow to be an illusion, and does the study design rule that out?
- If a rival cause has been named, how big would it have to be? Has anyone checked?