

Correlation and Causation

Correlation and causation, closely related to confounding variables [1], is the incorrect assumption that because something correlates, there is a causal relationship.

Causality is the area of statistics that is most commonly misused, and misinterpreted, by non-specialists. Media sources, politicians and lobby groups often leap upon a perceived correlation, and use it to 'prove' their own beliefs. They fail to understand that, just because results show a correlation, there is no proof of an underlying causality.

Many people assume that because a poll, or a statistic, contains many numbers, it must be scientific, and therefore correct.



The banner features the Explorable logo at the top center, with the text "EXPLORABLE" in white and "Quiz Time!" in a white script font below it. Below the logo are three square images in a row, each with a white border and a white caption underneath. The first image shows a pair of red roller skates on a wooden deck, with the caption "Quiz: Psychology 101 Part 2". The second image shows a fan of colorful pencils, also with the caption "Quiz: Psychology 101 Part 2". The third image shows a Ferris wheel at sunset, with the caption "Quiz: Flags in Europe". To the right of these images is a white button with the text "See all quizzes =>" in orange.

Patterns of Causality in the Mind

Unfortunately, the human mind is built to try and subconsciously establish links between many contrasting pieces of information. The brain often tries to construct patterns from randomness, so jumps to conclusions, and assumes that a relationship exists.

Overcoming this tendency is part of academic training of students and academics in most fields, from physics to the arts. The ability to evaluate data objectively, is absolutely crucial to academic success.

The Sensationalism of the Media

The best way to look at the misuse of correlation and causation is by looking at an example:

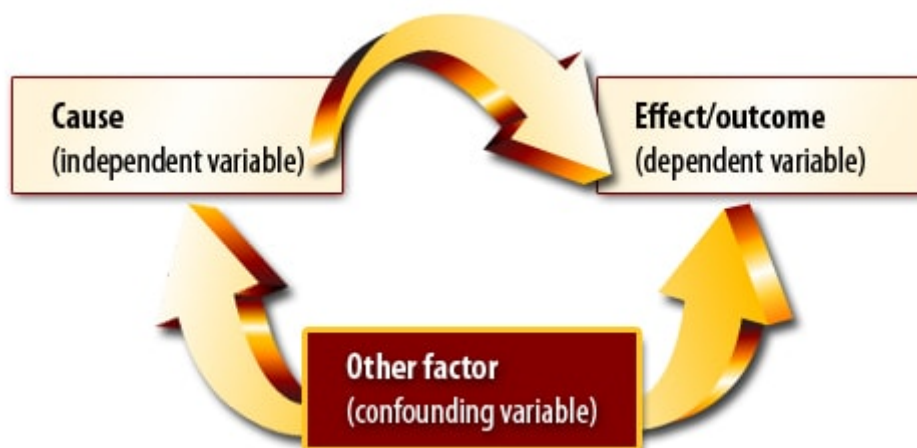
A survey, as reported in a British newspaper, involved questioning a group of teenagers about their behavior, and establishing whether their parents smoked. The newspaper reported, as fact, that children whose parents smoked were more likely to exhibit delinquent behavior.

The results seemed to show a correlation between the two variables, so the paper printed the headline; "Parental smoking causes children to misbehave." The Professor leading the investigation stated that cigarette packets should carry warnings about social issues alongside the prominent health warnings.

(Source <http://www.criticalthinking.org.uk/smokingparents/> [2])

However, there are a number of problems with this assumption. The first is that correlations can often work in reverse. For example, it is perfectly possible that the parents smoked because of the stress of looking after delinquent children.

Another cause may be that social class causes the correlation; the lower classes are usually more likely to smoke and are more likely to have delinquent children. Therefore, parental smoking and delinquency are both symptoms of the problem of poverty and may well have no direct link between them.



Emotive Bias Influences Causality

This example highlights another reason behind correlation and causation [3] errors, because the Professor was strongly anti-smoking. He was hoping to find a link that would support his own agenda. This is not to say that his results were useless, because they showed that there is a root cause behind the problems of delinquency and the likelihood of smoking. This, however, is not the same as a cause and effect relationship [4], and he allowed his emotions to cloud his judgment. Smoking is a very emotive subject, but academics must remain aloof and unbiased if internal validity [5] is to remain intact.

The Cost of Disregarding Correlation and Causation

The principle of incorrectly linking correlation and causation is closely linked to post-hoc reasoning [6], where incorrect assumptions generate an incorrect link between two effects.

The principle of correlation and causation is very important for anybody working as a scientist or researcher. It is also a useful principle for non-scientists, especially those studying politics, media and marketing. Understanding causality promotes a greater understanding, and honest evaluation of the alleged facts given by pollsters.

Imagine an expensive advertising campaign, based around intense market research, where misunderstanding a correlation could cost a lot of money in advertising, production costs, and damage to the company's reputation.

Bibliography

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Related pages:

tylervigen.com ^[7]

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Links:

[1] <https://explorable.com/confounding-variables>, [2] <http://www.criticalthinking.org.uk/smokingparents/>, [3] http://en.wikipedia.org/wiki/Correlation_does_not_imply_causation, [4] <https://explorable.com/cause-and-effect>, [5] <https://explorable.com/internal-validity>, [6] <https://explorable.com/post-hoc-reasoning>, [7] <http://tylervigen.com/>, [8] <https://explorable.com/users/martyn>, [9] <https://explorable.com/correlation-and-causation>