



Causal Reasoning ^[1]

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Causal reasoning is the idea that any cause leads to a certain effect, and is an example of inductive reasoning.

It is based around a process of elimination, with many scientific processes ^[3] using this method as a valuable tool for evaluating potential hypotheses ^[4].

Medical practitioners, as an example, will try to establish and deduce what is causing a certain symptom. By isolating and treating this cause, through eliminating others, the symptom can be alleviated.

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Reasoning Cycle Scientific Research

Causal reasoning may be used to direct scientific research ^[5] and eliminate unlikely hypotheses for understanding certain phenomena.

As an example, we are certain that global warming is happening but are unsure exactly what factors are contributing to the phenomenon.

There are five methods of using causal reasoning to determine what causes a certain effect, as set down by the philosopher John Stuart Mill.

1) The Method of Agreement

For this, the researcher must try to find the conditions under which a certain effect occurs and try to isolate the causes that underpin and occur in every case. This method shows that a certain cause or causes must be present for the effect to occur.

In addition, this process is reversible and can show that the effect occurs only without the specified cause.

2) The Method of Difference

By contrast, this method determines which potential causes existed when an effect happened, and were not present when the effect did not happen.

For example, causal reasoning is used to suggest that humanity is contributing to Global Warming. The earth's atmosphere, although it has gone through historical periods of warming, has never warmed up this quickly. Therefore, we assume that humanity adding greenhouse gases is causing this accelerated rate of change.

This cause was not present during historical warm periods in the earth's history but is present during this unique period of rapid warming. We can assume that this is a sound basis for a testable hypothesis [6].

3) Agreement and Difference

In many circumstances, both agreement and difference will be present and provide reinforcement to the causal reasoning [7] process.

Increased CO₂ levels appear to have caused the atmosphere to warm throughout the long history of our planet, an example of agreement.

This process is now occurring more rapidly, with modern society pumping greenhouse gases into the atmosphere. This cause was not present in antiquity, a notable difference. Therefore, this method would suggest that humanity is contributing to the rapid warming of the atmosphere.

4) Concomitant Variation

This is an even more powerful causal relationship where a cause of increasing intensity leads to a increasing magnitude of effect.

If we look at the historical composition of the atmosphere, via ice cores, and find that high carbon dioxide levels coincide with high global temperatures, this reinforces the causal link.

5) The Method of Residues

This is a process of building up and amalgamating likely causes. For example, assume that the link between carbon dioxide emissions is established.

We find that temperatures are increasingly more rapidly than they should, at the same time that the levels of methane in the atmosphere are increasing. Using the same methods, we can deduce [8] that methane may also contribute to global warming.

Causal Reasoning is not Proof

It cannot be assumed that a causal relationship constitutes proof as there may be other unknown factors [9] and processes involved.

For example, the dynamics of the atmosphere and their interaction with oceanic temperatures are too complicated to be explained by a single factor.

The Mills methods can be useful as a process of elimination but scientific proof is always needed to back up the findings. Causal reasoning may aid in uncovering useful lines of research [5] but is not accepted as verification. The method's strength is in uncovering plausible and realistic lines of research.

For example, another method, such as abductive reasoning [10], may have generated a few likely hypotheses [4].

Causal reasoning can help to eliminate a few and strengthen the case for researching others, focusing research and targeting resources.

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