What is Science and Why do Health Professionals Need to Know?

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What is Science?

Science is a regimentation of the correct ways of discovering empirical truths about the world: namely, the truths about the world for which we have to depend on experience.

There are many truths that are non-empirical or not obviously empirical, such as truths about logic, mathematics and metaphysics. Some of the non-empirical truths, or assumptions about them, might even be used by science. In Physics, we use the apparatus of mathematics extensively to calculate predictions and build explanations.

For empirical truths, we cannot discover them using reasoning alone. We have to consider the way the world is. But science gives us norms of how to investigate the world and gather truths about it. E.g. observations must be repeatable under certain conditions and objective rather than subjective.

These norms are contested, hence the need for philosophy of science. Note that even if the scientist debates these norms, they are ceasing to do science and starting to do philosophy. *Why?:* because the question of how we should gather empirical knowledge is not itself an empirical question. It is a normative, hence philosophical one.

Causal Science

Science aims more than just to gather empirical facts. It aims to be practical too, which means it wants to be able to explain facts and predict future facts. It also aims to be useful in invention of technology.

It is able to do most of these tasks via the construction of general theories than can be used as premises for further reasoning. Science tells us not just that an apple fell to the ground, but that all objects gravitationally attract with a force, $F = Gm_1m_2/d^2$. This moves us from the singular to the general.

A major part of science, which is behind most of its practical uses, is the discovery of what is causally connected with what, e.g. seismic shift causes earthquakes, earthquakes cause tsunamis, tsunamis cause flooding, flooding causes death and disease.

Causation is a central concept in medical science. We want to understand the causes of illness and what, if anything, causes recovery or alleviation from illness.

Scientific Methods and Methodologies

What are the correct methods in science has always been controversial and our view now of what is the correct method has gradually evolved over a long time.

For many centuries, it was thought we should just consult the ancient works of expert authorities, such as Aristotle and Galen, the latter especially for medical matters.

Galileo introduced the idea of experimental method. But his experiments were not what we would now think of. He primarily used thought experiments because reasoning seemed exact and trustworthy. 'Hands-on' experiments were unreliable because we didn't have good measuring devices.

Bacon was notable for, as a former lawyer, introducing a forensic method into science. He offered a legal model for nature, conceptualised in terms of laws of nature. Newton gave laws scientific credibility in *Principia Mathematica*.

Should these laws be discovered inductively (Bacon), through enumeration of instances, or hypothesised (J. Herschel)? Does experience lead to discovery of new theories, or is it just for testing hypotheses about theories?

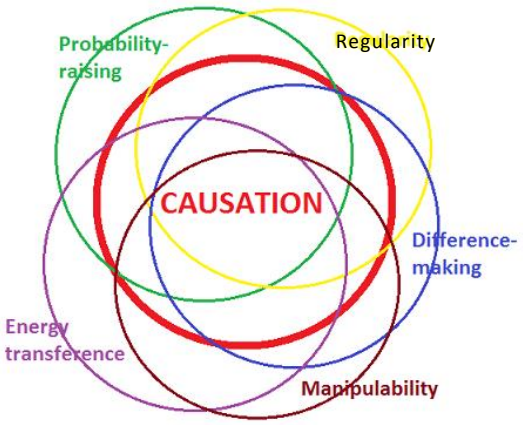
This takes us from methods (specific experimental techniques) to methodologies (overarching principles of knowledge discovery), e.g. falsificationism is a methodology.

Causation and its Symptoms

In the task of finding causal connections, we are hampered by the metaphysically primitive nature of causation itself. We can find data of correlations, for instance, that is indicative of causation but is not causation itself.

The best way we can know of causation is through its plural symptoms. Causes tend to produce correlations, to make a difference, to raise the probability of an effect, to facilitate interventions, and so on.

A symptom accompanies some phenomenon *X* with more or less reliability. There could be *X* without its symptom or its symptom without *X*. But we might still infer with a degree of reliability from the symptom to *X*, as with causation.



Evidential Pluralism

One's philosophical theory of causation, determines what one then looks for as evidence of causation.

Suppose causation really is a primitive, equivalent to no easily identifiable empirical datum? What does science do, especially medical science?

Bad metaphysics costs lives. Adherence to a single method or methodology suggests reliance on an analysis of causation. But causation seems to be unanalysable. If we take the symptomatic approach, we should adopt plural methods and methodologies and look for a convergence of results.