

Summary

- Medical science stands accused of providing an incomplete understanding of health because it is supposedly founded on linearity, reductionism, and positivism.
- These criticisms misrepresent the scientific method.
- The alternatives offered by complexity theory, postmodernism, and qualitative research risk falling into the traps that the scientific method avoids.
- The hypotheticodeductive model of science provides both a coherent description of the growth of scientific knowledge and a prescription for the conduct of good science.

MEDICAL science has been frequently characterised as providing an incomplete model of health and health care by critics from several quarters: complexity theory, postmodernism, and qualitative research. In contrast, alternative models are promoted as being more holistic or having better explanatory power of complex phenomena. In explaining the limitations of science, critics identify, in some degree or in combination, three purported characteristics of science: linearity, reductionism, and positivism.

There are two good reasons for challenging these critiques. Firstly, they misrepresent science, setting up what can be described as straw man arguments — false characterisations that are easy to knock down. Secondly, the alternatives they offer fall into the very traps that the scientific method has evolved to avoid.

Linearity

Writing in the *British Journal of General Practice*, Burton stated:

*'Most ideas behind modern medicine and organisational management are grounded in the paradigm of linear external control ... Complex systems thinking, on the other hand, suggests that order and adaptation arise within the system, and secondly that adaptation depends more on the interactions of the parts of the system than the actual parts themselves.'*¹

This is a straw man argument: most concepts in modern medicine are based on non-linear relationships and on interactions. For example, medical science views HIV infection, like most infections, to be an interaction between the infective agent and the host in whom there is variation in susceptibility to infectivity, resulting in a spectrum of disease from AIDS Related Complex (ARC) to AIDS. Physiological homeostasis is a good example of the interaction of parts, so one wonders where Wilson *et al* got this erroneous idea of doctors' view of diabetes?²

'The physiological variation of blood glucose levels has been generally assumed to be linear, but in fact there is a chaotic non-linear and unpredictable component in the profiles of both diabetic and non-diabetic individuals.'

The term non-linearity has been taken out of context from chaos theory, a mathematical system that reached popular consciousness in the 1980s. Previously, complex phenomena, such as the weather, had been thought to arise from variables so numerous that their interactions could not be computed. Through the application of non-linear equations, chaos theory demonstrated how such complexity could arise from the interactions of just a few variables. 'Non-linear' is a technical term used in contrast to linear equations; the latter have proportionality but the former do not (Box 1). At times the proponents of complexity theory in medicine appear to confuse the technical use of the word linear with the general use of the word, meaning X causes Y.

Box 1. Example of linear and non-linear equations.

Linear equation: cardiac output in the healthy heart:

$$CO = SV \times HR$$

Non-linear equation: relation of birthweight to gestation age³:

$$\text{Birthweight (kg)} = -22.693 + (102122 \times \text{age}) - (0.104102 \times \text{age}^2)$$

Chaos theory has been applied to physiology. For example, the heart-rate fluctuations of normal sinus rhythm have been postulated to exhibit deterministic chaos arising from the interactions of pacemaker cells.⁴ Only a few medical phenomena have been successfully analysed in this way so to state that complexity theory is a new paradigm for medicine (if indeed non-linearity were new) is premature. Furthermore, complexity theory is used as a Trojan horse from which to attack the value of controlled experiments. In experiments, some parts of the system under study are controlled in order to understand how the other parts work; this in no way precludes or prevents studying interactions within the system as a whole. However, this feature of research is often dubbed 'reductionist'.

Reductionism

The use of the term reductionist to mean breaking down systems into their constituent parts in the process of investigating them,⁵ is not a complimentary one. Reductionism is seen as limiting the power of science to understand people and phenomena.

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*'Positivism's concentration on the body and brain sees real pain as neurological reactions to visibly damaged tissue ... Positivism's strength in precise observation can be a limitation when pain is being assessed.'*⁶

This assertion misrepresents the medical understanding of pain, which is far more sophisticated (another straw man argument) including, as it does, psychological and social factors as well as describing pain in situations where no damage occurs.

Alderson also accused science of being founded on dichotomies:

*'Three centuries of modern science are founded on sharp dichotomies: the binary system used in computers, life/death, mother/child.'*⁶

She has made a selective choice of examples and generalised from them. There are many more examples where science does not have dichotomies: blood pressure, depression scores, the cluster of over-lapping mixed connective tissue diseases. What is more, dichotomies are not the prerogative of science, as shown by these dichotomies: yin /yang and good/evil. This is another straw man argument.

The term reductionism is also used for the belief that all phenomena can be explained by more basic phenomena and that higher level sciences can be reduced to lower level sciences, for example, psychology would be explained by neurology, which would be explained by biochemistry. This belief leaves no room for anything that is not explicable by science and has inevitably led to reductionist becoming a term of abuse. It is not, however, essential to be a reductionist (in this sense of the term) in order to practise good science. It is, therefore, unfortunate that critics of medical science often conflate this belief with science itself.

Given these distorted images of science, the alternatives offered by critics are bound to appear more satisfactory than science. This poses a particular threat to the liberal minded scientist when they are wrapped up in radical language such as:

*'... it [postmodern psychiatry] opens up spaces in which other perspectives can assume a validity previously denied them. Crucially, it argues that the voices of service users and survivors should now be centre stage.'*⁷

Positivism

Nineteenth century sociologists sought to gain the prestige of the natural sciences for their subject by copying what they thought — erroneously — were the defining characteristics of science: observation and

the testing of theory through verification. They described themselves as positivists. Logical positivism went further in stating that anything that could not be verified through observation (science) or appeal to axioms (mathematics and logic) was meaningless.

Qualitative research has been promoted as more holistic than positivism. The spectrum of philosophies and methods within qualitative research is broad. At the post-modernist and constructivist end it is believed, in the words of an editorial in the *BMJ*, the 'truth is "not out" there'.⁸ Gray repeated the postmodernist rejection of science in denying an external reality and claiming that all interpretations are equally valid:

*'... there are no such things as objective facts ... reality has a plurality of meanings and is contingent ... the objectivity that science has claimed as its defining characteristic is spurious and unsupportable ...'*⁹

This notion that the world can only be understood as a subjective product — a social construct — rather than an objective reality is not original. It is a new twist on an old philosophy called solipsism. Would any postmodernists accompany the author into the middle of a busy road and remain there while he got out of the way of the oncoming social construct? A belief in external reality means that people can cross the road safely; it also means that scientists can study the world.

Not all interpretations can be equally valid. If they were, how can a decision be made between these two competing statements: that MMR vaccine causes autism and that it does not? The issue of vaccination is as important for survival, although not with the same immediacy, as safely crossing the road. In order to make a sensible decision on the role of MMR vaccination in the aetiology of autism, a productive combination of observation and inference is needed. This combination is the scientific method.

It is possible to accept that social factors influence research and its interpretation while still believing in an objective reality. For example, one can observe that the debates over screening for prostate and breast cancers divide along the seams of providers, special interest groups, and epidemiologists.¹⁰⁻¹² But that is not the same thing as denying the existence of prostate or breast cancer. Nor is it the same thing as maintaining that the belief that these cancers do not exist is as valid as the belief that they do.