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Science and theory building

Psychology at A-level has just been formally classified as a science subject alongside such old favourites as physics, chemistry and biology. ‘How science works’ runs throughout the specification. In this article, the well known and respected psychologist, Albert Bandura, shares his views with us. In particular he shows us that science is not just about ‘finding facts’ but about being able to explain them — theory building.

Psychologists endeavouring to explain human behaviour necessarily begin with an incomplete theory. Human behaviour is caused by a plurality of determinants; these are intricate and dynamic and there is interaction between all of them. It is not possible to unravel them by intuition alone. Initial formulations prompt lines of experimentation that help to improve theory. Each successive refinement of the theory brings us closer to an understanding of the behaviour in question. We also need to understand that theory building is socially contextualised rather than proceeding in isolation. The layperson frequently fails to appreciate this. Einstein once said that he could see further than others because he stood on the shoulders of great people. It also explains why different ‘types’ of theories go in and out of fashion, like the demise of behaviourism and the ascendance of cognitivism in the late 1950s. We shall return to this later in the article.

The nature of science

There is a lot of idealisation in the declarations of how science is to be done. A prominent group of social scientists was once brought to a mountain retreat to report on how they went about their theory building. The beginnings were rarely formal. A problem sparked their interest and they had some preliminary hunches that suggested experiments to test them. The findings from verification tests (checking accuracy) led to refinements of their theory that in turn pointed to further experiments that could provide additional insights. Theory building is a long haul: the formal version of the theory that appears in print is the distilled product of many empirical investigations and conceptual insights.

Verification of effects is central to experimental enquiry. The social sciences face major obstacles in the development of theory. Controlled experimental approaches use information for verification, but their scope is severely limited. They record phenomena that cannot be reproduced in laboratory settings because such factors require a lengthy period of development, are the products of complex constellations of influences by different social sources operating interactively, or are prohibited ethically. American experimental studies of love and attraction carried out in the 1960s and 1970s are good examples.

Controlled field studies that systematically vary psychosocial factors under real-life conditions provide greater ecological validity, but they are too limited in scope. Finite resources, limits imposed by society on what types of interventions they permit, hard-to-control fluctuations and ethical considerations place constraints on these studies. Therefore, controlled experimentation must be supplemented with investigation of naturally produced behaviours. This is indispensable in the social sciences.

Verification requires converging evidence from different research strategies. Therefore, in the development of my social cognitive theory, we have employed controlled laboratory studies, controlled field studies, longitudinal studies, behaviour modification of human dysfunctions not producible on ethical grounds and analyses of naturally occurring behaviour.

Testing theories

Testing theories is a complex matter. Empirical tests of a theory include the core theory itself, a set of assumptions fundamental to the theory, operations presumed to create the relevant conditions in which the appropriate theory would operate (good examples here include models of stress. See Meichenbaum’s article on anger management in Psychology Review, Vol. 14, No.1, pp. 2—5), and how the key features are measured. Therefore it is not the core theory alone that is being put to the test. Evidence of discrepancy between the behaviour predicted by the theory and observed behaviour leaves doubt about what is at fault within this complex mix.
Considering the complexity of what causes human behaviour, the severe constraints on controlled experimentation and the coupling of the core theory with the other factors just mentioned — that themselves have to be well founded — the notion that a single instance of non-validation falsifies the theory is an illusion. But these inherent difficulties are not cause for despondency.

Psychological theories differ in their predictive and operative success. A scientific enterprise can improve a theory to predict human behaviour and to promote improvements in the human condition. Weak theories are discarded not because they are falsified, but because they are withered by so many limiting conditions that they have little predictive or operative value. When better theoretical alternatives exist, there is little to be gained by pursuing the veracity or falsity of a theory that can, at best, explain behaviour under only a narrow range of conditions and has little to say about how to effect psychosocial changes.

In summary, because we are testing not only the core theory but also the concepts behind it and because we require theories to serve useful purposes, testing theories is a complex business. It can never be as easy as asking: 'Is this theory right or wrong?' Once again, this is not well understood by the average layperson.

Publish or be damned?

Getting a theory into print is notoriously difficult. It is one thing to generate innovative ideas that hold promise for advancing knowledge, but quite another to get them published. Therefore, the publication process warrants comment from the researcher's point of view. We may regard this as the final stage of the scientific process. Sadly, it is not the case that if a theory is good enough (however we might define that), it will make it into the journals and perhaps even the textbooks.

Researchers have a lot of psychic wounds from inevitable skirmishes with journal reviewers. This presents special problems when there is a conceptual inbreeding in editorial boards. The path to innovative accomplishments is strewn with publication hassles and rejections. This final part of the scientific enterprise is often the most frustrating.

It is not uncommon for authors to experience repeated rejection of their work, often with hostile embellishments if it is too discordant with what is in vogue. Recall what I said earlier about science always being carried out in a social context — the intellectual contributions later become the mainstays of the field of study. John Garcia, who was eventually honoured for his fundamental psychological discoveries, was once told by a reviewer of his often-rejected manuscripts that one is no more likely to find the phenomenon he had discovered than bird droppings in a cuckoo clock.

Gaus and Shepherd (1994) asked leading economists, including Nobel prize winners, to describe their experiences with the publication process. Their request brought an outpouring of accounts of publication troubles, even with seminal contributions. Publication hassles are an unavoidable but frustrating part of the research enterprise. In fairness, it has to be accepted that the journals are to a certain extent the guardians of scientific integrity and a protection against quackery and false claims. Unguarded media, such as television, abound with supposedly 'scientific' claims that are clearly unsustainable. The regular Guardian column 'Bad Science' gives splendid and entertaining examples of quackery dressed up as hard-nosed science.

The next time a researcher has his or her ideas rejected they should not despair too much, but take comfort in the fact that many of those who have gone on to fame have had a rough time. In his delightful book, Rejection, John White vividly documents that the prominent characteristics of people who achieve success in challenging pursuits are an unshakable sense of belief that they can achieve things and a firm belief in the worth of what they are doing. This belief system provides the staying power in the face of failures, setbacks and unmeritorious rejections. As a student you may believe in the unchallengeable wisdom and status of the 'big name' psychologists you read about in your textbooks. If only that were the case!

There is much talk about the validity of scientific theories but surprisingly little attention is devoted to their social utility. For example, if aeronautical scientists developed principles of aerodynamics in wind tunnels tests but were unable to build an aircraft that could fly, then the value of their theorising would be called into question. Scientific theories are predictive and operative tools. In the final analysis, the evaluation of a scientific enterprise in the social sciences will rest heavily on its social utility.

Further reading


Professor Albert Bandura is David Starr Jordan Professor of Social Science at Stanford University. He is a proponent of social-cognitive theory, which is rooted in an agentic perspective. His landmark book, Social Foundations of Thought and Action: A Social Cognitive Theory, provides the conceptual framework for this theory. His recent book, Self Efficacy: the Exercise of Control, presents people's belief in their personal and collective efficacy as the foundations of human agency.