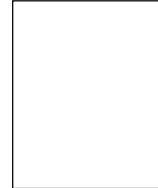

Is Psychology a Science?

Kamala V Mukunda

For many people, the word 'psychology' conjures up images of couches and bearded psychiatrists, or men in lab coats watching rats running around mazes. To someone who has studied psychology seriously for a number of years, this general view of the subject is somewhat disheartening! The various sub-disciplines of psychology differ widely not only in the phenomena under investigation, but also in their research methodologies. In trying to understand the human brain, mind and behaviour, psychologists have taken very different approaches to different questions. Sometimes, they treat the brain as a 'black box', whose processes we have to infer from the study of observable behaviours. At other times, they examine the physiology of the brain itself, and it is especially exciting when discoveries from neuropsychology coincide with inferences made about mental processes from other areas of psychology. A third approach is to study a particular behaviour with a view to understanding what function it serves (evolutionary psychology). Regardless of the approach, however, all psychologists work with theories.

The question I would like to explore in this article is the following: can we call psychologists' theories 'scientific', and can we say that they employ the scientific method of enquiry? The answer to the question, as it turns out, is not a simple 'yes' or 'no' - it depends on the area of psychological study, on the particular theory within an area, and often on the way the researcher chooses to study a phenomenon. It also depends on what you mean by 'scientific' - for the philosopher of science Karl Popper, for example, the most important criterion was what he called 'falsifiability'. Yet there are other criteria for the definition of 'scientific' that I believe are worth exploring. Thus the first part of this article will examine psychological research in the light of four different aspects of scientific endeavour. In



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the second part, I will describe two experiments in cognitive psychology in some detail, thereby demonstrating their scientific nature.

Empirical Falsifiability

A truly scientific theory is one which can be empirically tested. However, since no amount of confirming evidence can ever *completely* verify a theory (there is always the possibility of finding a counter-example in the future), to be scientific a theory must, at least in principle, be falsifiable. That is, it must be possible to imagine some evidence which, if obtained, would completely refute the theory. Freud's psychoanalytic account of personality is a perfect example of a non-falsifiable theory – no matter what symptom or behaviour a person expresses, it is always possible to explain it with reference to early childhood complexes, defense mechanisms, or constructs like the id, ego and superego. Far from being a strength, this 'capacity' to explain everything imaginable is in fact a weakness that many personality theories share. By contrast, the Swiss psychologist Jean Piaget's theories of the cognitive development of children are eminently falsifiable (to the dismay of some of his ardent followers!) and, to that extent, are scientific. For example, according to Piaget, infants develop a sense of 'object permanence' (an understanding that objects continue to exist even when they are out of sight) in several distinct stages during the first 8 months of life. Tests of this involved various specific ways of hiding an object in front of the child and recording her reactions. More than 25 years after Piaget described his findings, researchers began to discover situations where children well under 8 months were already showing evidence of object permanence, i.e., they were behaving in ways inconsistent with Piaget's theory of object permanence. Their experiments were carefully designed to separate the effects of the child's *understanding* of object permanence, from the effects of her limited memory span, and her inability to reach for and grasp objects. It became clear that some of the behaviours that Piaget



had taken as evidence for a lack of object permanence, were actually the result of other limitations in the child. Thus his theory of object permanence as originally formulated has been refined, yielding a more detailed theory that is able to explain all the known facts about this phenomenon.

Most psychological theories do offer testable predictions. Most are also rejected in due course, when new evidence comes along that they cannot explain. Sometimes, researchers who propose a theory tend to resist, and ‘explain away’, evidence that contradicts it. As Popper has said, however, continually rejecting theories in favour of better ones is the very stuff of scientific endeavour. The most fruitful attitude is to view any theory as ‘the best picture so far’, instead of as ‘the complete picture’.

Parsimony of Theory

A good scientific theory explains the existing evidence making as few independent assumptions as possible. Most psychologists instinctively tend to seek the simplest possible explanation for a given phenomenon, thus formulating reasonably parsimonious theories. Perhaps this tendency lies in our instinct as human beings to look for a small number of simple guiding principles behind even the most complex phenomena. But in psychology, perhaps because of the number of variables influencing and reinforcing each other, and our inability to completely separate or isolate them, the theories that work well are usually somewhat complex. It is possible, therefore, to put forward too parsimonious a theory, as is illustrated by an example from learning theory. Roughly 50 years ago, the psychologist B F Skinner proposed a theory of learning/behaviour called operant conditioning. It had only one major assumption, the Law of Effect, which says that the probability of a certain behaviour occurring in a certain situation depends on the response that the behaviour has evoked in the past in a similar situation. Thus if a behaviour accidentally produced (you smile at someone) is positively reinforced (the person

“The human understanding is of its own nature prone to suppose the existence of more order and regularity in the world than it finds. And though there be many things in nature which are singular and unmatched, yet it devises for them parallels and conjugates and relatives which do not exist”.

Francis Bacon



A Unified Theory of Behaviour either still eludes us, or doesn't exist!

smiles back), the behaviour is more likely to occur under similar conditions; but if the behaviour is 'punished' (the person ignores you), it will be less likely to occur. The theory was extremely attractive because of the possibility that one could explain all of human behaviour from this one simple principle. Skinner himself made surprisingly convincing accounts of language development, moral and social behaviour based on his theory. Unfortunately, operant conditioning turned out to be too simplistic a theory, and almost all psychologists today agree that there are aspects of human behaviour that it cannot account for. Today, there is no one theory of behaviour that can replace Skinner's ideas; instead, there are different explanations of the various facets of human behaviour, each with its own assumptions. A Unified Theory of Behaviour either still eludes us, or doesn't exist!

Experimental Control

Psychologists have relatively little control over a large number of so-called 'nuisance' variables (or 'noise'), which influence the behaviour they are measuring. Bringing subject participants into a laboratory allows the experimenter some control over things, such as the surroundings, the time of day, etc. But there are a host of other factors unique to the human being under observation that the psychologist cannot control, such as whether she received bad news that morning, or her lunch didn't agree with her. By contrast, it is relatively easy to measure the volume of a gas at varying temperatures under highly controlled conditions, without having to worry about the idiosyncrasies of those particular samples. How do psychologists make reliable, strong inferences about human behaviour given this problem? They use many individuals in each experiment, in the hope that idiosyncratic unsystematic errors will 'cancel each other out'; they use experimental designs which guard against systematic bias (eg., control group, random assignment, placebo, etc.); and they use tools of statistical inference to enable them to generalize their findings beyond their



samples. Consider a simple example: you wish to determine whether people can complete a particular task faster if they are offered an incentive. A single individual may be, say, slower on a given day because he had a late night, so you should test a number of people. But your *entire group* of subjects may be slower on that day because the weather suddenly turned cold, so you should randomly divide them into two subgroups, one of which is offered an incentive while the other is not. This ensures that the only *systematic* difference between the two subgroups is the offer of a reward, and thus any speed difference in task completion may reasonably be inferred to be either a result of the offer, or of random chance. Statistical analyses enable us to calculate the probability of obtaining the observed speed difference, *just by chance*—if this probability is small, and if the observed speed difference is ‘significantly’ greater than what pure chance could have led to, then we conclude that the offer of a reward did affect performance speed. Experiments in psychology frequently include several variables, carefully manipulated to allow us to make quite complicated inferences, but the basic principles are as described above.

Measurement Issues

A particular problem psychological research faces is that of operationally defining a construct¹ before you can measure it. Consider the construct ‘weight of an object on the earth’ in the more exact science of physics. It can be defined as ‘the force it feels due to the gravitational pull of the earth’, and physicists everywhere will agree on this definition. If psychologists wish to operationally define ‘intelligence of a person’, no such consensus can be hoped for! Many researchers take the definition to be ‘the person’s score on a well-constructed, reliable intelligence test’, which sounds ridiculously circular. But it reflects the fact that the test was constructed to measure something (call it ‘X’) which some psychologists feel comfortable calling ‘intelligence’. Research spanning several decades has found that ‘X’ is partly hereditary, is normally distributed in the popula-

¹ A construct usually refers to a quantifiable property (or trait) of a system of interest.

“The different sciences are in a hierarchy—in the complexity of the things they deal with—with physics at the base and (I suppose) psychology at the apex”.

— Sir Martin Rees



Box 1. Operational Definitions.

An operational definition is a definition in terms of the exact operations that are used to measure the construct. It clarifies exactly what you mean when you use a particular word, so that you cannot be misunderstood by your readers. They may, of course, disagree with the way you defined the construct. For example, a successful researcher may be operationally defined as “one who has a publication rate of at least 5 papers a year”, or “one who publishes in American or European journals at least once a year”, but not as “one who publishes high quality articles”.

tion, is correlated with several other interesting variables (ranging from the obvious school achievement to short term memory capacity, and even the incidence of certain psychological disorders), and that individual differences in ‘X’ remain relatively stable across age. A fairly rich theory of ‘X’ has developed around these findings. Yet however rigorous the research methods, and however scientific the theory when stated in terms of the unknown ‘X’, we can never know whether we are measuring intelligence, or indeed what exactly we are measuring. A few years ago, the psychologist Howard Gardner came forward

Box 2. The Wechsler Adult Intelligence Scale.

One of the more popular IQ tests contains eleven subtests, briefly described as follows.

- a) General information
- b) Short term memory for digits
- c) Vocabulary
- d) Arithmetic
- e) Comprehension questions testing practical knowledge, social judgement and the ability to organise information
- f) Picture completion, testing visual alertness and attention to detail
- g) Similarities (“In what way are A and B alike?”) to measure inductive reasoning ability
- h) Picture arrangement, to test sequencing ability and planning
- i) Block design (arranging blocks to match specified designs) testing visual pattern analysis
- j) Object assembly (putting puzzle pieces together to form a picture)
- k) Digit symbol (a simple perceptual motor task), tests attentiveness, quickness, and persistence.



Box 3. The Natural and the Social Sciences: A 'Radical Discontinuity'.

Although the thrust of this article has been to ask whether psychology can be considered a science, one could well ask the question, is it at all reasonable to expect the behavioural sciences to yield strict laws of the kind found in the natural sciences? The philosopher John Searle examines what he calls the "radical discontinuity" between the social and natural sciences. He says that it is impossible to match mental and physical events in a way that will make for strict laws of human behaviour, because mental events are based on human intentionality, i.e., they are all 'about something' (eg., belief about something, desire for something, hoping for something, etc.). The range of possible neurophysiological stimuli that can produce a given belief or feeling is infinite, and this is what prevents us from systematically correlating the mental with the physical. For a science of intentionality, there is no way we can ever come up with causal laws that are "timeless, eternal or inevitable". In Searle's words, "'Science' has become something of an honorific term, and all sorts of disciplines that are quite unlike physics and chemistry are eager to call themselves 'sciences'.....To many minds (the word 'science') suggests an arcane infallibility....The rival picture I want to suggest is this: what we are all aiming at in intellectual disciplines is knowledge and understanding. There is only knowledge and understanding, whether we have it in mathematics, literary criticism, history, physics or philosophy."

to challenge existing notions of intelligence. Among other things, he postulated that it consists of seven different unrelated dimensions, which develop fairly independently over the first 6 years of life. Gardner's theory must, and does, subsume earlier accounts of intelligence. It explains the findings of earlier research by suggesting that traditional intelligence tests only tapped three of the seven dimensions he describes – language, numerical and spatial. A great deal of observational data agrees with his general claims, and the theory itself is rich in explanatory power and applicability in preschool settings. However, within this area of study, there are some questions that cannot be scientifically addressed. For instance, if one protests that musical and kinesthetic² abilities are 'talents', and not 'intelligences' (as Gardner claims), there is no empirical way of deciding one way or another. Yet Gardner has defended, convincingly and eloquently, his thesis that there is no fundamental psychological difference between what society labels 'intel-

² The awareness of bodily movement or muscular effort.



ligence' and certain 'talents'. His arguments, although not scientific, add much to our understanding of human beings and society.

While reading this brief treatment of the question 'Is Psychology a Science?', it may have occurred to you that if only one could operationally define all the constructs involved, any theory could be scientifically tested. You could use the definitions to measure the constructs, run experiments, statistically analyse the data and then falsify, or fail to falsify, the theory³. But for some questions, this process would be inappropriate and useless. Some of the most fascinating questions in psychology are about the very nature of mental constructs, and it would be premature to nail oneself down to a particular operational definition. Suppose you were asked the question, "Is kinesthetic ability a talent, or an intelligence?" A little reflection would indicate that the question is not trivial, not "just a matter of words". The way that society answers it has important implications for the school years and beyond. You also see that operationally defining the constructs involved will not help at all! Questions of this sort do come up in psychology, and are interwoven with other more scientific questions. It would be impossible to consider them separately in, say, a subject called 'metapsychology'. Perhaps this is one of the more crucial differences between psychology (considered a behavioural 'science'), and the exact sciences.

³ You can only really test the theory *at the level of the operational definitions*.

Suggested Reading

- ◆ B F Skinner. *Reflections on Behaviourism and Society*. Englewood Cliffs. NJ. Prentice-Hall, 1978.
- ◆ John Searle. *Minds, Brains and Science*. Penguin Books, 1984.
- ◆ John Flavell. *Cognitive Development* (2nd ed.). Englewood Cliffs. NJ. Prentice-Hall, 1985.
- ◆ Howard Gardner. *Frames of mind: The Theory of Multiple Intelligences*. New York: Basic Books, 1985.
- ◆ David Hothersall. *History of Psychology* (2nd ed.). New York. McGraw-Hill, 1990.
- ◆ Peter Gray. *Psychology*. Worth Publishers, Inc. (or any other recent introductory psychology book), 1991.

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