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Class:	36.207 Social Influence
Title of Coursework:	How is scientific knowledge different from lay knowledge?
Deadline:	Weds. 22nd Oct.

I affirm that this essay is my own work, and does not include any unacknowledged material taken from another source.

Signed: Date:

This essay will examine both scientific and lay knowledge, examining the history of modern science and scientific method, and will illustrate some of the ways in which scientific knowledge diverges from lay knowledge. It will examine the particular difficulties that face the scientific study of psychology in relation to the objectivity of experimenters and the ethics of their experiments.

Science has been defined as 'a branch of knowledge conducted on objective principles involving the systematised observation of and experiment with phenomena' (Concise Oxford Dictionary, 1996). From this definition we can see that scientific knowledge must be arrived at objectively, and must be subjected to rigorous testing and examination.

Scientific knowledge as we know it is a relatively recent occurrence. Early scientists like Galileo and Newton could only publish theories that were in accordance with the teachings of the church. To do otherwise could be construed as heresy: a capital crime. It was not until the enlightenment and the 'age of reason' of the late eighteenth and early nineteenth centuries that science came into its own as a self-supporting and self-justifying structure, and lost the constraints of agreeing with the scriptures.

Isaac Newton produced a phenomenal body of work. He deduced the existence of gravity and the laws of motion in his book *Philisophiae Naturalis Principia Mathematica*, and explained the nature of light in his later work *Opticks.* Newton was an ardent believer, crediting the apparent perfection of his discoveries to God, although he was less convinced about the church, resisting the placement of Catholic scholars at Cambridge and playing an active role in the Glorious Revolution of 1688[1]. Newton was the Lucasian Professor of Mathematics at Cambridge University, the position now held by Professor Stephen Hawking (Westfall, 2003).

Professor Hawking argues that Galileo may be the single most influential person in the birth of modern science. Galileo supported the Copernican theory that the Earth revolves around the Sun, and was willing to defend his argument with the Catholic Church. This may well have been the point at which scientists began to realise that the church was not always correct in matters of science (Hawking, 1988).

One of the first examples of independent scientific publication came from French writer Denis Diderot. In 1747, with the collaboration of such luminaries as Voltaire and Montisquieu, he produced the *Encyclopédie ou dictionairre raisonné des sciences, des arts et des metiers,* commonly known as the *Encyclopédie.* Diderot ended up in jail for it, but this was the first successful attempt to publish a comprehensive encyclopaedia without the influence of the church (Foden, 2003).

The process by which scientists arrive at their conclusions, scientific method, is a subject of study in itself. To summarise it briefly, informal observations may lead a scientist to form an idea about the origins of, or relationships between, observable phenomena. This idea, combined with other research findings in the

[1] This is not meant to display Newton in a sectarian light; the Catholic Church was more strenuous in its defence of the literal truth of the Bible than the Anglican Church. Newton's work could have suffered through the interference of more zealous Catholic scholars at Cambridge.

field, is formalised into a hypothesis, the basis of the study process. Experiments or observations are devised in order to test the hypothesis, and if the hypothesis is found wanting, it may be amended or even reversed. The designs of the experiments, or the criteria for the observations, are of critical importance because all outside influences must be anticipated, and accommodated or eliminated at that stage (Hogg & Vaughan, 2002).

One such criterion is whether to conduct the experiment in the highly controlled environment of a laboratory, or in the less controlled but often more realistic environment 'in the field'. You could not, for instance, successfully examine the behaviour of a football crowd within the confines of a laboratory, but research into the effects of nerve gas on humans using a public space would be disastrous.

The word lay derives from the ancient Greek *lāikos,* meaning 'of the people' (American Heritage Dictionary, 2000). Lay knowledge may have similar roots to scientific knowledge, but lacks the systematic testing that distinguishes the two.

Lay knowledge suggests that eating chocolate and greasy foods causes teenage acne. Scientific studies, however, indicate that there is no such link between acne and chocolate consumption (Fulton, Plewig, Kligman, 1969), and that instead there may be a link between acne and eating highly processed cereals and breads (www.newscientist.com, 2002).

Why does lay knowledge suggest that eating chocolate causes acne? Acne frequently occurs in adolescents, and adolescents frequently eat more than their share of chocolate, and that may well be enough of a correlation for the lay observer to regard it as a causal link, something a scientist must be very wary of.

The difference between the two sets of beliefs about chocolate and acne is quite marked. It could be that Fulton, Plewig and Kligman actually set out to prove that there would be a link between chocolate and acne, but the fact that their study showed otherwise does not make it a failure or bad science. Fulton, Plewig and Kligman were quite happy to publish their results, even if they may not have supported the hypothesis that the study was originally based upon, because they approached the subject objectively and methodically. Their results stand up, although it must be said that testing can disprove a hypothesis but cannot prove it to be correct (Popper, 1969, quoted in Hogg & Vaughan, 2002).

Not all lay knowledge is inaccurate: many homeopathic and traditional medicines have been researched and found to be effective, and they are based on lay knowledge passed down from generation to generation. The World Health Organisation is so enthusiastic about traditional medicine that it is promoting formal recognition of the value of traditional remedies to the governments of developing countries (WHO, 1999).

Publication is an important aspect of scientific knowledge. Papers are published in scientific journals for review by the authors' peers. This peer review is where theories are made and broken. There have been articles published refuting Fulton, Plewig and Kligman's conclusions (Bullock, 2000), but the majority opinion seems to support their findings, and further research has been based on their initial findings, such as the processed cereals study mentioned above.

Lay knowledge is passed on by word of mouth, or by less stringent forms of publishing, and the truth or accuracy of what is said may not be as important as whether or not it sounds good. There is a persistent rumour that Bob Holness, a television game show presenter, played a famous saxophone solo on a 1978 hit record, 'Baker Street' by Gerry Rafferty. The song credits for Baker Street name jazz saxophonist Raphael Ravenscroft, who appeared on television playing the song at least twice in March and April 1978 (BBC, 2003), but the rumour refuses to die (try typing 'bob holness baker street' into an internet search engine)[2].

The science of psychology faces a particular problem. Just as biologists must ensure that they do not contaminate their experiments with their human bodies, psychologists must ensure that they do not contaminate their experiments with their human minds. In psychology it is necessary to view scientific knowledge as 'both an accumulation of knowledge and an accumulation of research methods that function to limit self-deception by serious observers' (Levine & Parkinson, 1994). Self-deception by serious observers almost sounds like an oxymoron. Why would a serious observer deceive his or her self?

Consider the case of Hans the clever horse. (Pfungst, 1911, quoted in Edwards, 1972). Hans gave the impression that he could add numbers together and tap out the answer with his hoof, but in fact he was just responding to unconscious cues he was picking up from his human questioners. In order to truly establish whether Hans could add up or not, the observer and the horse's questioner would have had to include themselves as factors in the experiment, which is to question their own objectivity.

The inaccuracies in this case were not due to the horse, it was just doing what it normally did. The inaccuracies were due to the human observers emitting unconscious behaviour, such as breaking off eye contact or visibly relaxing, when the horse had tapped its hoof the requisite number of times. In this way, without realising it, the experimenters had deceived themselves.

A better designed experiment was the case of the farmer from Whidbey Island, who claimed to be able to divine water with a whale bone. In this case, the experimenter had an assistant fill a number of containers with water, and leave an equal number of containers empty. The containers were covered, the assistant left the room and the farmer and his whale bone were brought in to determine which contained water and which did not (Edwards, 1972).

The important aspect of this experiment was that the experimenter in the room with the farmer was not the person who filled and distributed the containers. There was no way that the person in the room with the farmer could have unconsciously betrayed himself, because he simply did not know which containers were full.

This experiment could still be criticised for its design, because it is a very basic bi-polar design. In order to better simulate actual 'in the field' conditions for water divining, the skill that the farmer claimed, an unknown number of containers of water could have been placed under a raised platform by the experimenter's

[2] This is the only way I can think of to reference a rumour in an essay

confederate, and the farmer asked to mark the position of each on the platform with chalk. In this way, the farmer is not faced with a 'heads or tails' decision over a container either does or does not hold water, and is instead looking for instances of water under a uniform surface.

A further problem with psychological research is the problem of ethics. Lay knowledge would suggest that keeping young children in dark cupboards is bad for them, but it would be considered extremely unethical for psychologists to test this hypothesis by deliberately locking children away in the dark. Although this example is quite extreme, the dilemma it raises is very pertinent.

If psychologists are not allowed to engage in experiments that may unduly stress, traumatise or injure their subjects, how are they meant to find out about the psychological consequences of events that do so? There is plenty of lay knowledge about car crashes, bereavement, debilitating illness and other such events, but that is not enough for psychologists.

Zimbardo's prison study is one example of an experiment which went too far and had to be halted for the good of the participants. Zimbardo had hypothesised that the participants acting as guards would become dominant and overbearing, and that the prisoner participants would become submissive, but he did not anticipate the strength of both sides' reaction to the situation. After six days, Zimbardo had to stop the experiment, not because it was a failure; in fact it was a great success, but because his professional ethics would not allow him to continue in such a confrontational and abusive situation (Zimbardo, 1971 / 1999).

Institutions that engage in psychological research usually have an ethics committee and a code of conduct, usually under the auspices of the relevant governing body for psychological practice. In the case of the University of Strathclyde, the Ethics Committee operates using the code of practice of the British Psychological Society, and all practical experiments under the auspices of the department must be vetted for any potential ethical issues.

The code of conduct places great emphasis on the issue of 'real consent', and ensuring that vulnerable people, those with impaired abilities, children or detained persons, are not exploited in the course of a psychological experiment. The top priority should be that 'foreseeable threats to their [the participants] psychological well-being, health, values or dignity should be eliminated' (www.strath.ac.uk, 2003).

This essay has examined the differences between scientific and lay knowledge, starting with the history of modern science and examining some of the differences between scientific method and lay knowledge. It has examined the specific problems faced by psychologists in their scientific methods, both in objectivity and ethics. Whilst lay knowledge is a useful starting place for many scientific studies, the apparent truth of it is not always supported by the results of scientific study. In psychological research, scientists must question whether their own presence is adversely influencing their experiment, that is to question their own objectivity, and must remember that the damage caused by conducting an experiment in an unethical fashion may outweigh any potential scientific gain from its outcome.

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