6.1: Scientific Method

Learning Objectives

- Brief discussion of the most important principles of the scientific method

This section contains a brief discussion of the most important principles of the scientific method. A thorough treatment of the philosophy of science is beyond the scope of this work.

One of the hallmarks of the scientific method is that it depends on empirical data. To be a proper scientific investigation the data must be collected systematically. However, scientific investigation does not necessarily require experimentation in the sense of manipulating variables and observing the results. Observational studies in the fields of astronomy, developmental psychology, and ethology are common and provide valuable scientific information.

Theories and explanations are very important in science. Theories in science can never be proved since one can never be 100% certain that a new empirical finding inconsistent with the theory will never be found.

Scientific theories must be potentially disconfirmable. If a theory can accommodate all possible results then it is not a scientific theory. Therefore, a scientific theory should lead to testable hypotheses. If a hypothesis is disconfirmed, then the theory from which the hypothesis was deduced is incorrect. For example, the secondary reinforcement theory of attachment states that an infant becomes attached to its parent by means of a pairing of the parent with a primary reinforcer (food). It is through this "secondary reinforcement" that the child-parent bond forms. The secondary reinforcement theory has been disconfirmed by numerous experiments. Perhaps the most notable is one in which infant monkeys were fed by a surrogate wire mother while a surrogate cloth mother was available. The infant monkeys formed no attachment to the wire monkeys and frequently clung to the cloth surrogate mothers.

History of Attachment Theory

If a hypothesis derived from a theory is confirmed then the theory has survived a test and it becomes more useful and better thought of by the researchers in the field. A theory is not confirmed when correct hypotheses are derived from it.

A key difference between scientific explanations and faith-based explanations is simply that faith-based explanations are based on faith and do not need to be testable. This does not mean that an explanation that cannot be tested is incorrect in some cosmic sense. It just means that it is not a scientific explanation.

The method of investigation in which a hypothesis is developed from a theory and then confirmed or disconfirmed involves deductive reasoning. However, deductive reasoning does not explain where the theory came from in the first place. In general, a theory is developed by a scientist who is aware of many empirical findings on a topic of interest. Then, through a generally poorly understood process called "induction" the scientist develops a way to explain all or most of the findings within a relatively simple framework or theory.

An important attribute of a good scientific theory is that it is parsimonious. That is, that it is simple in the sense that it uses relatively few constructs to explain many empirical findings. A theory that it so complex that it has as many assumptions as it has predictions is not very valuable.

Although strictly speaking, disconfirming an hypothesis deduced from a theory disconfirms the theory, it rarely leads to the abandonment of the theory. Instead, the theory will probably be modified to accommodate the inconsistent finding. If the theory has to be modified over and over to accommodate new findings, the theory generally becomes less and less parsimonious. This can lead to discontent with the theory and the search for a new theory. If a new theory is developed that can explain the same facts in a more parsimonious way, then the new theory will eventually supercede the old theory.