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Inductive Logic

All scientific investigation relies on logical reasoning, and it can be important for science communicators to understand the type of logic underlying a particular scientific finding. Inductive logic is one common type of logic used in science. To define inductive logic, it is first necessary to have a firm grasp of what logic is generally, and then it will be possible to specify what kind of logic is inductive.

Logic is generally identified as the principles and relationships of reasoning. Logic concerns argumentation, but not in the everyday sense of people who are angry at one another. Rather, an argument in the logical sense is a set of two or more statements in which at least one (called a premise) is said to be a reason to believe another is true (a conclusion).

Principally, inductive logic can then be distinguished from deductive logic as follows. *Deductive arguments* are characterized by a necessary relationship between their premises and conclusions. By contrast, *inductive arguments* offer support for thinking that their conclusions are likely to be true. Thus, the relationship between the premises and conclusion in an inductive argument is characterized by probability.

There are many kinds of inductive arguments. Statistical arguments are often good examples of inductive reasoning, when the conclusion drawn is only probable. A batter who has a high rate of hitting home runs is more likely to hit another than his teammates who have hit few, for example. Arguments based on observation of signs, often predictions, are also common inductive arguments. Weather forecasts are good examples. Other forms of inductive premises are claims by authorities, whose evidence is stronger or weaker depending upon their history or the quality of their arguments and capabilities.

History and tradition can be good predictors, but only when relevant. For instance, the fact that the sun has come up every day throughout history is reason to think it will rise again tomorrow. Evidence of having seen the sun rise in the past is called *empirical*. It is evidence gained from people's senses and their memory of what these showed. In this way, traditional (past) practices are empirical predictors of future behavior, unless some other evidence or reason can help to predict a variation from traditional practices.

Finally, analogies are frequently used in inductive arguments. Consider that in biology, for example, animals that share characteristics are likely to have a more similar DNA than animals with more differences. Analogies here are relevant in testing, where mice are selected for medical drug studies because of the similarity of their immune system to humans'. Effectively, studies that are successful in mice in combating disease argue by analogy that the same or a similar treatment could be developed to help treat human beings.

Inductive logic is a crucial tool in the study of science and technology. Scientists do not only attempt to make predictions, of course. Inductive reasoning is also crucial in learning how things happened or how they have worked. When someone thinks about a space ship that does not function properly or explodes, for instance, that person often searches creatively for hypotheses that might explain the dysfunction. Once someone has a theory, he or she can create methods for testing that theory.

Some analyses of theories can involve deductive reasoning, playing out the implications of the relevant definitions, physical laws, and necessary categories of our thinking. They can also have to do with probabilities of certain consequences arising as a result of the conditions in question. In the theoretical sciences, scholars frequently start from principles and the problems we have in reconciling them with other principles or with empirical facts. Theoretical sciences can focus a great deal on deductive proofs, although to test them often includes finding ways to seek inductive evidence for the theories. In the empirical sciences, the work is very often profoundly focused on inductive reasoning.

A crucial purpose for inductive reasoning is to consider what might be the cause of a problem. For instance, when a patient visits the doctor's office, the physician asks many questions to see whether any relevant evidence turns up that could point to the cause for an illness. In diagnosing a patient, deductive reasoning can frequently be necessary, such as in deciding whether certain categories of illness make sense to consider given the symptoms at hand. At the same time, the decisions to be made about what are the most important and relevant symptoms can be crucial elements of diagnosis and are frequently based upon inductive reasoning, particularly because symptoms are signs of underlying causes.

Whether some element of a patient's history is simply an irrelevant fact versus a pertinent symptom of an underlying condition is something for which sometimes only probabilistic reasons can be given. Causal reasoning and studies are done with regard to medicines, technologies, automobile safety tests, and any area in which is it important to be able to predict or determine a causal relationship.

A final word on a philosophical controversy is worth mentioning regarding the relationship between deductive and inductive reasoning. While scholars often like deduction because it involves what some call truth preservation—necessarily true conclusions when the premises are true—scholars who call themselves empiricists have argued that the rules of deduction are known because of empirical, inductive evidence. Empiricists label this idea the problem of induction. It is a problem for those who think that deduction creates more certainty than induction.

Scholars who disagree with this point of view take several approaches. One example is to say that it is not inconsistent to learn about the physical laws of the universe or about the processes of chemical composition through experience in empirical study and inductive reasoning. While either approach may result in learning new things about the universe, certainly the kinds of reasoning involved in deductive logic differ from those in inductive logic.

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See also Deductive Logic; Scientific Method

Further Readings

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Information Seeking and Processing

In the context of science communication, the study of information seeking and processing is focused on what brings people to science information and, subsequently, what they do with that information once they encounter it. This area of research is of value to myriad practitioners, including scientists interested in building the public's (and policymakers') understanding of their work, educators, science museum curators, and scholars who want to maximize the potential for communication interventions to reach the public and improve the state of citizens' science knowledge. Both seeking and processing are often explored in terms of motivational factors and effort expended.

Information Seeking

People can seek information by expending very little or quite a lot of effort. Thus, information seeking is often conceptualized in terms of its intensity. Intensity can be thought of as varying along two dimensions: (1) effort involved in seeking each information source and (2) overall number of sources sought. Seeking can involve interpersonal as well as mediated sources—and often involves a combination of both. In terms of effort, information seeking is often dichotomized as active or passive. Active seeking describes a more goal-driven behavior, while passive seeking describes a more ritual-based behavior. In the case of mass mediated seeking, active seeking is characterized as stimulated beyond routine media use and is driven by such motivating factors as problem solving or the desire for autonomy. Active seeking may involve, for example, seeking out information about climate change on the Internet