Module 7: Relationship between Logic and science,with application in social sciences and Humanities

GSP2205(PHILOSOPHY AND LOGIC)

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Introduction and Preliminaries

The aim of module 7 is the following: To give a flashback on what we already know about Logic and then briefly remind ourselves about science. We then relates Logic and science, and finally, as an application of Logic, its relationship with social sciences and Humanities.

Logic

Logic is the study of reasoning and the principles that govern valid inference and argumentation. It is a formal system of analysis that helps in distinguishing correct reasoning from incorrect reasoning. Logic provides a framework for evaluating the coherence and validity of arguments, making it a fundamental tool in philosophy, mathematics, computer science, and various other disciplines. It is concerned with reasoning and valid inference and other topics that grow out of these [1]. An inference is valid when the conclusion follows from the premises. The classic example being: (1) *Adam is a man*; (2) *All men are mortal*; *Therefore, Adam is mortal*. It is the form, not the subject matter, that makes it valid. Thus, the following argument with false premises and a false conclusion is nevertheless valid: *(1)Socrates is a goat;* (2) *All goats can fly*; *Therefore, Socrates can fly.* Let us consider one more example: (1)*I will go to work either tomorrow or today;* (2)*Im going to stay home today; Therefore, I will go to work tomorrow*. But is this conclusion really correct? After all, isnt it possible that I will stay home today, and then wake up sick tomorrow and then end up staying home again? If that happened, the conclusion would turn out to be false. But notice that in that case the first premise, which said that I would go to work either tomorrow or today, would be false as well! Although we have no guarantee that the conclusion is true, it can only be false if at least one of the premises is also false. If all premises are true, we can be sure that the conclusion is also true. This is the sense in which the conclusion is forced on us by the premises, and this is the standard we will use to judge the correctness of deductive reasoning. All three of the argument in our example are valid arguments. Here is an example of an invalid deductive argument.(1)*Either the butler is guilty or the maid is guilty;* (2)*Either the maid is guilty or the cook is guilty; Therefore, either the butler is guilty or the cook is guilty.* The argument is invalid because the conclusion could be false even if both premises are true, for example, if the maid were guilty, but the butler and the cook were both innocent, then both premises would be true and the conclusion would be false. An argument is sound when it is both valid and has true premises.

Science

The relationship between logic and science is fundamental, as logic serves as a crucial tool in the process of scientific inquiry. Logic is the study of reasoning and the principles that govern valid inference and demonstration. In the context of science, logic helps to ensure that the conclusions drawn from observations and experiments are sound and reliable.

In the scientific method, which is the systematic approach to investigation used in the sciences, logical reasoning plays a key role in formulating hypotheses, designing experiments, and interpreting results. Scientists use deductive and inductive reasoning to make sense of data, draw conclusions, and refine their understanding of natural phenomena.

To learn the truth about the world, the world must be studied scientifically [2]. However, individual truths do not take us very far; a mere collection of facts no more constitutes a science than a collection of stones constitutes a house. The aim of science is to discover general truths(chiefly in the form of causal connections) with which the facts we encounter can be *explained*.

What is an explanation? Every explanation gives an account, a set of statement from which the thing to be explained can be logically inferred. The best account will be the one that most reduces the problematic aspects of what was to be explained. Such an account will comprise a coherent set of general truths, or a theory. To explain some serious disease, for example, we need a coherent account of what causes that disease and how it can be treated. Is the presence or absence of some particular substance the key to the disorder? The theory explaining diabetes, for example, is a coherent account of the use of sugars by the human body and the central role, in the use, of a protein hormone called *insulin*, produced by certain special cells within the body. According to this theory, it is the deficiency of insulin (or the inability of the body to use the insulin it produces) that explains the resulting disorder in the absorption of sugars from the blood. An account of this kind (here greatly oversimplified, of course) gives a scientific explanation of this serious disease. Patients suffer from diabetes *because* of their insulin deficiency. When we say Q *because* P, that may express either an explanation or an argument. It expresses an argument when we are inferring the conclusion Q, from the premises,P. It expresses an explanation when, facing the *fact* of Q, our reasoning moves back from that fact to discover the circumstances that led to it.

A good explanation must offer truths that are *relevant* to the fact explained. If I seek to explain my absence to work on some occasion by calling attention to the rising birth rate in Kano, the fact thus introduced may be correct, but it is not relevant, and it therefore cannot be a satisfactory explanation of my absence, the event in question. In science we seek explanations that are not only true and relevant, but also general.

The more facts for which a scientific theory accounts, the more powerful it is. An explanation may be relevant and general, and yet not scientific.The regular motions of the planets were long thought to be accounted for by the intelligence that was held to reside in each planet. In some cultures, disease is explained as the work of an evil spirit that has invaded the body.These are certainly unscientific accounts, although the explanations they offer are general and are relevant to the facts of interest. What then distinguishes genuinely scientific from unscientific explanations?

There are two chief differences. The first is *attitude*. An unscientific explanation is presented dogmatically; the account that it gives is regarded as being unquestionably true and not improvable. The opinions of Aristotle were accepted for centuries as the ultimate authority on matters of facts. Aristotle himself appears to have been open-minded, but his views were adopted by some medieval scholars in a rigid and unscientific spirit. One of the scholars to whom Galileo offered his telescope to view the newly discovered moons of Jupiter declined to look, expressing his certainty that no real moons could be possibly be seen because no mention of them could be found in Aristotles treatise on astronomy! In contrast, the attitude of a serious scientist is undogmatic; explanations are put forward provisionally;hypotheses may be thought highly probable, but they are regarded as subject to alteration in the light of the evidence.

The vocabulary of science is sometimes misleading on this point. When what is first suggested as a hypothesis is well confirmed, its status may be elevated to that of a theory;after universal acceptance, it may be further elevated to that of a law. However, the use of these terms is not consistent. Newtons law of universal gravitation is still called the law of gravitation, while Einsteins contribution, which improved and superseded it, is referred to as the theory of relativity. Whatever the terms used, the attitude of genuine scientist is not dogmatic. The general propositions of science are all in essence hypothesis, never absolutely certain.

In everyday speech the word *theory* is often used to refer to a hunch, or a mere opinion. Scientists use the word differently. In Physics and Chemistry we refer-not dogmatically, but nevertheless with great confidence-to quantum theory and to the molecular theory of matter; in Biology we rightly rely upon the cellular theory and the germ theory of disease. These are sets of very well-established truths, not ungrounded speculations. Evolution-the theory of evolution-is also an established fact; doubts about evolution expressed because it is only a theory are the result of this semantic misunderstanding.

The second difference concerns the *basis* for accepting the account in question. In science a hypothesis is worthy of acceptance only to the extent that there is good evidence for it. An unscientific belief may be held independently of what we should regards as evidence in its favor; the explanation is taken as simply true-perhaps because everyone knows that it is so, or perhaps because it is thought to

have been revealed from on high. There is no reliable test of such claims, whereas in genuine science the claims for truth can be tested, and those tests lie in our experience. Thus we say that genuine science is *empirical*.

To say that a hypothesis is *testable* is at least to say that some prediction made on the basis of that hypothesis may confirm or disconfirm it. Science demands evidence. But, of course, the evidence accumulated that could confirm the hypothesis in question can never be complete, as we have earlier emphasized; *all* the evidence is never in hand. Therefore, even when that supporting evidence is very strong, some doubt must remain, and certainty is unattainable. On the negative side, however, if the evidence shows indisputably that the predictions made on the basis of that hypothesis are false, our confidence that the hypothesis must be rejected may be total. Although we cannot complete the verification of a hypothesis, we can, with closure, establish that it has been falsified. For reasons of this kind, some philosophers have held that to say of a scientific hypothesis that it is testable is also to say that it is, at least in principle falsifiable.

The test of truth may be direct or indirect. To determine whether it is raining outside,I need only glance out the window. In general, however, the propositions offered as explanatory hypotheses are not directly testable. If my absence at work had been explained by my claim about some traffic accident, the employer, if suspicious, might test that explanation indirectly by seeking the police accident report. An indirect test deduces, from the proposition to be tested (for example, that I was involved in an accident), some other proposition(for example, that an accident report had been submitted) capable of being tested directly. If that deduced proposition is false, the explanation that implied it is very likely to be false. If the deduced proposition is true, that provides some evidence(but not conclusive evidence) that the explanation is true, having been indirectly confirmed.

Relationship Between Logic and science

The relationship between logic and science is fundamental, as logic serves as a crucial tool in the process of scientific inquiry. Logic is the study of reasoning and the principles that govern valid inference and demonstration. In the context of science, logic helps to ensure that the conclusions drawn from observations and experiments are sound and reliable.

In the scientific method, which is the systematic approach to investigation used in the sciences, logical reasoning plays a key role in formulating hypotheses, designing experiments, and interpreting results. Scientists use deductive and inductive reasoning to make sense of data, draw conclusions, and refine their understanding of natural phenomena. Logic provides a language, or perhaps better a syntax, for modeling scientific discourse [3]. Avicenna himself seems to have

believed as much, when he writes, The relation of logic to inner reflection, which is called internal reasoningis like the relation of grammar to the explicit interpretation, which is called external reasoning, and like the relation of prosody to the poem. In this respect, Avicenna notes, logic is a tool that guarantees a certain precision in scientific reasoning and even safeguards science against the introduction of hidden assumptions and formal fallacies. There is a deeper question, however, concerning the relation between logic and science as well: What is the relation between the objects of logic, namely, the universal predicable, which at least for Avicenna are purely mental objects, and the objects of science, namely, the things in the world and their causal connections, which for Avicenna are purely extramental objects?

In other words, what is it that ensures that objects that exist only in the mental world map onto objects that exist only in the external world? What bridges the gap between these two worlds? Avicenna is a scientific realist inasmuch as for him the goal of science is ultimately a type of necessary certainty about the way the world is. Thus, if one cannot be certain that the objects of logic and the conclusion derived from logic actually capture the way the world really is, then logic, for all the precision in reasoning it might bring, would fail to be an adequate tool for doing sciences, at least to Avicennas mind. If logic is to play a role in the scientific enterprize, as Avicenna believes that it does, then there must be some bridge, or common element, linking the universal predicable treated in logic with the concrete particulars that make up the world that the sciences attempt to explain.

Application of Logic in social sciences

The application of logic in the social sciences is vital for constructing valid arguments, analyzing data, and drawing reliable conclusions. Logic plays a central role in various aspects of social scientific research, helping researchers to formulate hypotheses, design studies, and interpret findings. Here are some key applications of logic in social sciences:

- Hypothesis Formulation:

  Social scientists use logic to formulate hypotheses that are clear, testable, and logically sound. Logical reasoning ensures that the proposed relationships between variables are plausible and coherent.

- Research Design:

When designing research studies, social scientists apply logic to develop methodologies that are valid and reliable. This includes selecting appropriate sampling techniques, designing surveys or experiments, and minimizing biases.

- Data Analysis:

  Logic is crucial in the analysis of data collected during social research. Whether using statistical methods or qualitative analysis, researchers apply logical reasoning to draw valid inferences from the data and to assess the significance of their findings.

- Causal Inference:

  Establishing causal relationships is a common goal in social sciences. Logic is employed to identify potential confounding variables, assess the strength of evidence for causation, and distinguish correlation from causation.

- Critical Evaluation:

  Social scientists use logic to critically evaluate existing theories, research studies, and arguments within their field. This involves assessing the coherence and internal consistency of theories and scrutinizing the logical foundations of research methodologies.

- Argumentation and Persuasion:

  Researchers in the social sciences often need to present and defend their findings. Logical reasoning is essential in constructing persuasive arguments, whether in academic writing, policy reports, or public discourse.

- Interpretation of Social Phenomena:

  Logic aids in the interpretation of complex social phenomena. Social scientists use logical frameworks to understand patterns, trends, and relationships within societies, cultures, and communities.

- Theory Development:

  The development of social theories relies on logical reasoning. Social scientists use logic to build theoretical frameworks that explain observed social phenomena and predict patterns of behavior.

- Ethical Analysis:

  Social science research often involves ethical considerations. Logic is applied to assess the ethical implications of research designs, participant interactions, and the potential impact of findings on individuals and communities.

- Cross-Disciplinary Integration:

Social sciences encompass a variety of disciplines, and researchers often draw on insights from different fields. Logical reasoning helps integrate knowledge from diverse sources and disciplines to provide a comprehensive understanding of social issues.

In a nutshell, logic is an indispensable tool in the social sciences, facilitating rigorous and systematic inquiry. It enables researchers to navigate complexities, critically assess information, and contribute to the development of reliable knowledge about human societies and behaviors. Logic remains essential but is often applied in a different manner. In these fields, the subject matter is often more complex and may involve qualitative data, diverse perspectives, and a variety of interpretative methods. While the scientific method is still relevant, social sciences and humanities also rely on other forms of reasoning and argumentation. The social sciences(including:economics,sociology anthropology) are often distinguished from the natural sciences and thought to be fundamentally different. Humans are self-interpreting and our beliefs about ourselves can have an effect on ourselves. Anthropology deals with the economic activities of simple societies whereas Economic studies the economic activities of complex societies.

Since Economics as a science is one in which conclusions generally are not made from controlled tests done in a laboratory but from the analysis of statistics drawn from real world happening, making sound conclusions from a set of data depends on a sound application of the principle of logic. Economists often based their disagreements with each other on logical grounds, pointing out fallacies of logic which may invalidates the others position.

Application of Logic in Humanities

Logic was one of the central disciplines, with every student in the incoming classes required to study it. Humanities(study of human cultures) includes: History, Languages, Law, Politics, Literature, Performing art, Religion e.t.c. There is, no doubt, an intimate relation between logic and law [4]. This fact is apparent from expressions we frequently hear after the trial of a well-contested case where the best legal talent has been employed on both sides. We often hear expressions as this: The lawyer for the defence gave a very logical argument to the jury. The plaintiffs attorney introduced his evidence in a logical manner. The influence of logic upon law arises from one fundamental fact, that laws are not self-applicable-and a rule of law isolated from a world of facts is no more than a speculative ghost.

Law, accurately speaking, is organized principle, and from a political point of view, is the chart by which human action, in terms of fact is regulated. Manifestly,

the inertia of such a non-automatic machine calls for a force to give it vitality and action as well as a supplementary art of manipulation. Such energy must be supplied by human life. It is sometimes said that law is applied logic.Obviously this epigrammatic statement has a foundation of truth, for the practice of law is fundamentally argumentative. It deals with subjects in controversy, and its primary aim is the settlement of disputes-sometimes by persuasive methods out of court and sometimes in fiercely contested legal battles-in either instance the instrument of reasoning playing a dominant part.

Now, the results sought by the process of argumentation are either to prove the truth or falsity of a given proposition, or with less absoluteness to induce the mind to believe at least in its truth or falsity, or still less, merely to accept the same on general principle.

The relationship between logic and the humanities is complex and multifaceted. While logic is traditionally associated with formal reasoning and deduction, the humanities encompass a broad range of disciplines, including literature, philosophy, history, art, language, and cultural studies. Here are several aspects of the relationship between logic and the humanities:

- Critical Thinking:

  Logic is a fundamental component of critical thinking, and critical thinking is crucial in the humanities. Scholars in the humanities use logical reasoning to analyze texts, arguments, and cultural phenomena. They critically evaluate different perspectives and assess the validity of claims.

- Argumentation:

  Humanities disciplines often involve constructing and de-constructing arguments. Logic plays a role in building coherent and persuasive arguments, whether in the form of literary analysis, philosophical discourse, or historical interpretation.

- Philosophical Inquiry:

  Philosophy, a central component of the humanities, heavily relies on logic. Philosophers use logical reasoning to formulate and assess theories, identify fallacies, and engage in rigorous analysis of concepts and arguments.

- Interpretation:

  Logic aids in the interpretation of texts, artworks, historical events, and cultural phenomena. Humanities scholars apply logic to derive meaning, uncover underlying themes, and make connections between different elements within their field of study.

- Ambiguity and Subjectivity:

  Unlike the natural sciences, where logic often deals with more objective and quantifiable data, the humanities frequently involve ambiguity and subjectivity. Logical reasoning is applied in navigating and making sense of these complexities, even when dealing with less formalized and more qualitative information.

- Language and Semiotics:

  The study of language, a prominent aspect of the humanities, involves semiotics and the analysis of signs and symbols. Logic is employed to understand the structure of language, the relationships between words, and the ways in which meaning is conveyed.

- Ethics and Values:

  Logical reasoning is applied in ethical discussions within the humanities, where scholars explore and evaluate different moral perspectives. Philosophical ethics, for example, relies on logical analysis to assess the consistency and coherence of ethical theories.

- Historical Analysis:

  Historians use logical reasoning to analyze historical events, understand causation, and interpret the actions and motivations of individuals and societies. Logical structures are often applied to construct narratives that are both coherent and faithful to the historical evidence.

In summary, while logic is foundational in the humanities, its application is diverse and adapted to the particular methodologies and nuances of each discipline within this broad category. Logic in the humanities is not only about formal deduction but also involves critical thinking, interpretation, and engagement with the complexities of human experiences and expressions.

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