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Rethinking The Connection Between Logic And Philosophy

Dr. Sahanara Khatun

Assistant Professor, Department of Philosophy,

Sarojini Naidu College for Women,

30 Jessore Road, Kolkata – 700028, West Bengal, India.

Abstract: The article assesses the evolving relationship between logic and philosophy, mainly in the context of modern developments in formal and mathematical logic. Historically regarded as a foundational branch of philosophy, logic has recently been viewed by some scholars as more aligned with mathematics than philosophical inquiry. The essay critically examines this shift, distinguishing between philosophical and mathematical logic, while arguing that the two remain fundamentally connected. Through analysis of key thinkers such as Aristotle, Descartes, Spinoza, Leibniz, and Bertrand Russell, it demonstrates that progress in mathematical logic often reflects deeper philosophical insight. Furthermore, the study uses examples such as the problem of entailment and synthetic a priori propositions to show how formal systems contribute to and depend on philosophical interpretation. The findings argue that logic remains central to philosophical reasoning, not just as a technical tool, but as a way of engaging with fundamental questions about truth, meaning, and understanding.

Key Words: Entailment, Logic, Mathematics, Philosophy, Reasoning.

Introduction: In earlier times, the relationship between logic and philosophy was unquestioned. Logic was seen as an essential part of philosophical inquiry, deeply embedded in the way philosophers approached questions about reasoning, truth, and reality. Though, in recent decades, the development of mathematical logic and formal systems has challenged this traditional view. Some modern philosophers and mathematicians now consider logic a subfield of mathematics, divorced from its philosophical roots. At the same time, informal and philosophical logic continues to influence major areas of inquiry in ethics, metaphysics, and epistemology. This dual development raises pressing questions: Is logic still a branch of philosophy? What role does formal logic play in addressing philosophical questions? How should we understand the boundary and the bridge between logical systems and philosophical thought? The research explores these questions by tracing the conceptual shifts in logic's development, examining the contributions of key thinkers, and analyzing the interplay between formal reasoning and philosophical insight.

A Framework of Logic and Philosophy

In previous eras, the relationship between logic and philosophy was generally accepted without much debate. Philosophers naturally assumed that logic belonged within the broad domain of philosophy, and there was little interest especially from outside philosophy in relocating it. Though, in recent years, this situation has changed significantly. Some modern philosophers are now hesitant to regard logic as a branch of philosophy at all. They see it as more mathematical than philosophical and would prefer to classify it as part of mathematics. Interestingly, many mathematicians appear open to this reclassification.

So, figuring out exactly how logic relates to philosophy is difficult. There are two main reasons for this: First, the word 'logic' itself does not always mean the same thing. Even in modern times, people use it in different ways. Second, logical and philosophical ideas often depend on each other. It can be hard to tell when a logical theory is shaping philosophy or when the opposite is true.

In current usage, ‘logic’ refers both to a formal system and to a more informal method of analysis.[1] Over the past fifty years, logic has made major advances in both areas, and this dual growth has prompted a re-evaluation of its connection to philosophy. The development of formal logic especially through axiomatization has given it a highly technical, almost mathematical character. This has made it seem less like traditional philosophy (e.g., metaphysics or epistemology) and even quite different from classical logic as formulated by Aristotle and his successors.[2]

This development raises the question: Is logic truly part of philosophy or should it be considered a branch of mathematics? At the same time, informal logic has evolved into a potent analytical tool for addressing philosophical (and broader conceptual) problems. Its influence now extends into areas like ethics, aesthetics, and the philosophy of religion. This prompts another question: Is philosophy simply logic or does this new kind of philosophy stray from traditional philosophical aims?

At its core, logic is a formal inquiry into the structure of arguments. The traditional division between deductive and inductive logic is less important here, since both deal with the forms of reasoning. Their differences lie more in the nature of the arguments they address, not in the kind of logic they represent. Therefore, for our purposes, we can treat logic as a unified subject.[3]

Noting, formal logic can be approached either non-rigorously or rigorously. A non-rigorous approach involves studying and listing various forms of argument and rules of inference without building them into an axiomatic system. A rigorous approach, by contrast, constructs such systems where all theorems are derived solely from a set of axioms using defined rules of inference. This axiomatic, or ‘logistic,’ approach is largely a 20th century development, though earlier attempts to formalize logic did exist in the West. In contrast, Indian logic, whether from Jain, Buddhist, or other traditions, never developed formal axiomatic systems. Rather, it remained non-rigorous and discursive. Aristotle’s logic, too, is an example of non-rigorous inquiry.[4]

Logic and Its Philosophical Foundations

Traditionally, philosophy has always included logic as one of its key branches, and this remains largely uncontroversial especially when it comes to non-rigorous logic. Most people still accept that such logic belongs within philosophy. Hence, doubts arise when we consider rigorous logic, that is, formal systems known as logistic systems. Whether or not such systems should be classified under philosophy is, to a large extent, a matter of definition. And like many definitional issues, the outcome can be somewhat arbitrary. Nevertheless, there seems to be no compelling reason to deny rigorous logic a place within philosophy.

Let us now start with the different meanings of the word ‘logic’. These different meanings are clearly explained by the logician H.B. Curry in his book *Foundations of Mathematical Logic*:

i. Philosophical Logic: This is what we mean when we say, “Logic is the study of how we think and reason.” We notice that we sometimes reason correctly and sometimes make mistakes. Some mistakes happen because we have the wrong information, but not always. As time progressed, we learn that if we follow certain rules, our reasoning is more likely to be correct. Studying these rules has always been part of philosophy, and this is called philosophical logic.
ii. Mathematical Logic: When studying philosophical logic, people find it helpful to use mathematics to build logical systems. These systems can also be studied on their own, as part of math. So, logic in this sense becomes a branch of mathematics, and we call it mathematical logic.
iii. Logic as a System or Theory: Sometimes, people use the word ‘logic’ in a general way to talk about any logical system. For example, we can have classical logic, modal logic, Aristotelian logic, Kantian logic, and so on. In this case, ‘a logic’ means a specific system or type of logical thinking.[5]

We can ignore the third meaning of the word ‘logic’ (as just a type or system of logic like classical or modal logic), because it is not very important for what we are trying to understand. Instead, we should focus on the first two meanings: a) Philosophical logic - the study of the rules of valid reasoning (a part of philosophy) and b) Mathematical logic - using math to study and build logical systems.

Now our main questions become:

- How is philosophical logic important to philosophy?
- How is mathematical logic important to philosophy?

Some people think that only mathematical logic matters now, and that philosophical logic is outdated. They consider modern logic = mathematical logic, and all the progress in logic is because we have moved away from philosophy. This view is not justified. Philosophical logic is still very important.[6] In fact, real progress in mathematical logic always involves progress in philosophical logic too.

To understand why, we need to look at how the two are connected. A system of mathematical logic is really built to help solving problems in philosophical logic, that is, problems about what makes reasoning valid.[7] For example, one problem might be finding the basic rules of reasoning. Another might be seeing how those rules are related. So, mathematical logic is not just math, it becomes logical only when it helps answering these philosophical questions. If a mathematical system has nothing to do with the study of reasoning, then it is not really a logical system at all.

Hence, on the surface, formal logic looks very clear: we begin with a small number of basic symbols, clear rules to form correct statements (called 'well-formed formulas'), a set of logical starting points (axioms), and rules to create new truths (theorems) step by step.[8] But in practice, the symbols and technical language make logic feel very distant from the everyday concerns of people who turn to philosophy looking for guidance and meaning. So we must now ask: how truly useful is logic to philosophy?

Here the philosophy is not something you can capture with perfect clarity, like a math equation. Philosophy is not about proving things with absolute certainty. Instead, it is about how thinkers approach life's biggest questions - not by following strict rules, but by using creativity, imagination, and insight. This gives rise to what we call the philosophy of logic, much like we have the philosophy of religion or the philosophy of science. For instance, when we analyze religious language or scientific methodology, we are doing philosophy, not religion or science themselves.

Think about great philosophers like Socrates, Plato, Aristotle, Descartes, Hume, and many others. Their work is full of discussion and arguments, but they do not use formal logic in the strict way modern systems do. Their greatness lies not in rigid methods but in bold, thoughtful exploration.[9] Just being 'clear' is not enough; it can even be a cover for saying nothing new or important. Of course, when combined with real insight, clarity is helpful. But on its own, it is empty. Take Plato's Dialogues for example. His style is conversational, full of back-and-forth discussions, jokes, stories, and imagination. Socrates does not give strict definitions or step-by-step logic. Instead, he asks questions in a way that makes people to see things in a new light. There is no formal system here, just an effort to understand deep ideas like justice, love, or happiness through open conversation.

Thus throughout history, many philosophers have been drawn to the idea of absolute, unquestionable knowledge, like the kind we find in mathematics. Plato thought this kind of certainty existed in the world of perfect 'Ideas.' But even he and others who admired mathematical thinking, never actually used formal proofs in their philosophical writing. This desire for certainty has crossed many philosophical 'schools' such as rationalists, empiricists, idealists, realists, and even logical positivists - all have been influenced by the dream of exact truth. Yet, no major philosophical discovery has ever come from a strict, logical deduction. Important breakthroughs come not from formal reasoning, but from people who felt deeply puzzled by ordinary things and were brave enough to look at problems in a new way.

We consider here famous thinkers like Descartes, Spinoza, and Leibniz who were excellent mathematicians and tried to bring that precision into their philosophy. Descartes, for example, tried to build a new system of knowledge starting from the statement "I think, therefore I am". But this idea was not proven by logic in the formal sense; it was more of a powerful insight. His other 'proofs' (like for the existence of God or the outside world) also do not follow strict logic. His true contribution was in defining the mind and matter in a way that helped make science possible.[10] In that sense, Newton carried Descartes' ideas forward more than anyone else.

Spinoza also tried to build a system based on definitions and axioms, like math. But again, his strength was not in his method; it was in his vision of unity in nature. That kind of vision of seeing how everything is connected has always inspired deep thinkers. And it comes not from logic, but from imagination and insight.

In Leibniz's philosophy, logic played a big role in shaping his ideas. He prescribed that all statements (or propositions) have the same basic form: a subject with a predicate (something said about the subject). From this logic, he developed the idea of the monad, a kind of soul or unit of reality that contains all its future states inside it. According to Leibniz, everything a monad will ever be or do is already part of it. This view came directly from his logical belief that every truth can be seen as a subject-predicate statement.[11]

Logic functions as a special tool in philosophy. Philosophers have used both the techniques and the results of logic far more intensively and creatively than those in most other disciplines. In the early 20th century, Bertrand Russell's theory is a prime example. He did not just use logic to reason clearly, he used it to build his entire ontological framework, known as logical atomism. Logic gave him not only rules for argument, but also a conceptual toolkit with which to construct a new philosophical vision of reality. In fact, as the philosopher Urmson says:

> Logical atomism was meant to be a better kind of metaphysics that would replace weaker ones, not to get rid of metaphysics entirely. Actually, logical atomism is one of the most complete and detailed metaphysical systems ever created; even though Wittgenstein's book *Tractatus Logico-Philosophicus* also seems to oppose metaphysics in some ways.[12]

Indeed, philosophical reflection on logic is by no means new. Works like F.H. Bradley's Principles of Logic, John Dewey's Logic - The Theory of Inquiry and F.C.S. Schiller's Logic for Use are filled with deep philosophical questions arising from logic. However, these earlier thinkers often blurred the lines between logic and philosophy, sometimes treating them as indistinguishable. Recognizing the distinction between logical and philosophical issues can bring greater clarity and precision to both fields. Of course, the finer the distinction, the easier it is to miss; and yet, overlooking real distinctions is often a mark of philosophical immaturity.

We observe that sometimes mathematical systems are a mix - part of them helps with philosophical logic, part of them does not. But we often still call the whole system 'logic' because the second part grows out of the first. Still, we should remember that only the part connected to reasoning really deserves to be called logic. H.B. Curry, a great logician, agrees and says:

> It would be a mistake to suppose that philosophical and mathematical logic are completely separate. Actually, there is a unity between them…… Any sharp line between the two aspects would be arbitrary.[13]

So, any real progress in mathematical logic also means progress in philosophical logic. And if we had truly left philosophical logic behind, we would have stopped doing logic altogether. Luckily, we did not.

Understanding Modern Logic Through a Philosophical Lens

A common definition is that logic is the study of valid reasoning. Here David Mitchell notes, "Elementary logic is the study of the forms of valid arguments, and more widely, of the different types of proposition, which are logically true."[14] So, logic focuses on how we think and whether our thinking is valid, not whether our thoughts are true or false. Since our thinking happens in the form of statements, a logician studies these statements and how they relate to one another. The logician does not care if the statements are factually correct, just whether the reasoning is valid. Logic is very general and deals with structure or form, not with content.

This is true whether we are talking about old (traditional) logic or new (modern) logic, they look very different, but the core idea behind both is the same. Modern logic just uses a more technical language and symbols, and it is broader, it even includes parts of mathematics. Traditional logic focused mostly on syllogisms (simple logical arguments), while modern logic is much more complex. Still, modern logic is really just a more advanced version of traditional logic.

We find that philosophical logic is a branch of philosophy. So, one way to show that mathematical logic is relevant to philosophy is by showing that it is connected to philosophical logic. That is fairly easy to do, because, by its nature, mathematical logic is designed to help answering questions in philosophical logic. But usually, when people ask, 'How is mathematical logic important to philosophy?,' they do not just mean 'How is it important to philosophical logic?' Instead, they are asking a bigger question: 'How is mathematical logic connected to other areas of philosophy - outside of logic itself?'

There are two ways we can answer this: firstly, showing that mathematical logic helps philosophical logic, and then showing that philosophical logic helps other areas of philosophy. Or, directly showing that mathematical logic is useful in other areas of philosophy.

It is actually pretty easy to show that mathematical logic clearly helps philosophical logic. For example, we can look at how conditional arguments (if-then reasoning) connect with systems like propositional logic (a branch of mathematical logic).

There is a two-way influence between philosophy and logic. Some people think either: Philosophy controls logic, or Logic controls philosophy. But in real life, it is not that simple. In most cases, they often shape each other at the same time, in very complicated ways. So it is hard to say which one shapes the other. To make this easier to understand, we are going to show how logic and philosophy connect by looking at a specific example - the problem of entailment.

We should remember that the two statements below are not true paradoxes when we are talking about strict implication, as defined by the logician C.I. Lewis:[15]

- An impossible statement strictly implies any statement.
- A necessary statement is strictly implied by any statement.

Why? Based on Lewis definition, it is said that both of these strange-sounding statements are actually logically true. Let us break it down:

If a statement p is impossible (meaning it leads to a contradiction), then for any statement q, the combination ‘p and not-q’ will still have a contradiction in it, because p itself already includes a contradiction. So in this case, p strictly implies q.

If q is necessary (meaning it must always be true), then ‘not-q’ is impossible; it leads to a contradiction. So again, for any p, the combination ‘p and not-q’ includes a contradiction. Therefore, p strictly implies q.

Now the case is: when p is impossible and when q is necessary - the combined statement (p.~q) leads to a contradiction; and then p strictly implies q. Even though these are logically true in the strict implication system, they feel strange or paradoxical, and they are actually false if we use the more common sense of entailment (which involves meaning or relevance, not just formal truth). Lewis knew these results seemed odd if you confuse strict implication with entailment. But he did not see them as real paradoxes, only as surprising or unfamiliar outcomes. He even tried to prove them.

Next, we will look at how Lewis tried to prove this specific paradox: “An impossible statement entails any statement.” We should understand that the statements Lewis makes about strict implication only seem like paradoxes, they are not really paradoxes if we follow his system. But the proof Lewis gives to support one of these claims that “an impossible statement implies any statement” has serious problems. Let us look at his reasoning. Lewis starts with two statements:

1. p or q (written as ‘p ∨ q’)
2. ~p

He concludes from these that q must be true.[16]

Why does he think that? Because if p is contradictory (i.e., p and ~p cannot both be true), then p must be false. And if p is false, then the only way for p or q to be true is if q is true. So Lewis maintains that q follows.

The main mistake in Lewis’s proof is that he tries to get a conclusion (q) from a contradictory statement (p and ~p). But this is not allowed. Some say that from a contradiction, anything can be logically deduced, but we do not think that is right. Why not? Because once you accept a contradiction, you are temporarily ignoring the rule that says contradictions cannot be true. And if you do that, no logical steps can be taken. You have left the rules of logic.

Now, you might ask: What about arguments called *reductio ad absurdum*? These are arguments where we assume something false to show that it leads to a contradiction. Does that also not involve contradictions? Yes, it does. But we consider *reductio* is not a normal inference, it is more like changing one form of a sentence into another. It is a kind of linguistic transformation, not a step in real reasoning. In a proper inference, we move from one proposition to another, not just from one sentence to another. Bertrand Russell once said that a real inference is making one assertion based on another, and you assert propositions, not just strings of words. So when we just rewrite one sentence into another (as in *reductio*), that is not really ‘inference’ in the strict sense, it is just symbol manipulation.[17]

Another reason we generally hesitate to say that nothing can come from a contradiction is this: sometimes, even analytic (always true) statements depend on logic involving contradictions.[18] For example, we know that: If p entails q, then ~q entails ~p. This is a valid rule. But if both p and q are necessarily true (analytic), then ~q and ~p are contradictions. And if you state that nothing can follow from contradictions, then you would have to say that q does not entail p. That is a problem, because it seems like it should. That is why we think the issue is complicated. But overall, we assert Lewis’s proof is logically flawed because it uses a contradiction and assumes that the contradiction is not valid in the same argument. That is inconsistent.

Now let us deal with the synthetic a priori propositions:[19] Is whether the proposition possible. It can be started with the nature of an entailment statement something like:

‘p’ entails ‘q.’

This kind of statement is necessary, and therefore, a priori (not based on experience). But is it analytic? That depends on how we define ‘analytic.’ According to Kant, a proposition is analytic if it can be shown to be true just by applying the law of contradiction. But many statements of entailment cannot be validated by this law alone. For example:

'It is raining' entails 'it is raining or it is snowing.'

This cannot be proven just by showing that denying it would lead to a contradiction. To avoid this problem, some philosophers changed the definition of 'analytic' to mean: 'A proposition is analytic if it can be validated by some logical principle.' But this creates a new issue - if logical principles themselves are taken as true without being proven, then they start looking like synthetic a priori truths which the analytic theory is trying to avoid. So, philosophers changed the definition once more: 'A proposition is analytic if it is either a principle of logic, or can be validated using one.' This version tries to block the idea of synthetic a priori truths in logic.[20]

However, G.E. Moore, who first introduced the idea of entailment, thought that entailment was not limited to logic alone.[21] For instance, he stated: 'x is red' entails 'x is coloured.' This is not a logical truth, yet it feels necessary and a priori. If this is a real example, then entailment can exist outside logic, and that kind of entailment would be synthetic a priori.

Here, we only mention it to suggest that logical and non-logical entailment may have deep similarities. If so, understanding one may help us understand the other, again showing the strong connection between logic and philosophy. In this way, we show how logical theories are deeply connected to philosophical questions especially about truth, necessity, and meaning.

Conclusion: Logic and philosophy, though distinguishable, are inseparable in their deeper aims. While mathematical logic has given rise to highly technical systems that resemble mathematics more than traditional philosophy, its ultimate purpose remains philosophical: to clarify the nature of valid reasoning, meaning, and necessity. The evolution of logic has not diminished its philosophical relevance but has instead extended its reach into more rigorous and abstract domains. Philosophical questions such as the nature of entailment, the possibility of synthetic a priori truths, or the boundaries of rational inference, remain at the heart of logical inquiry. From the classical dialectic of Socrates to the formal systems of Bertrand Russell, logic has always been a tool for thinking deeply and precisely about the world. As long as philosophy continues to grapple with foundational questions about knowledge and reasoning, logic both philosophical and mathematical will remain an indispensable part of that quest.

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