THE FALSE PROMISES OF LOGIC TEXTBOOKS
HOW LOGIC HAS A MUCH MORE LIMITED ROLE
THAN PEOPLE USUALLY THINK
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ABSTRACT
Logic textbooks advertise that they can teach how to spot a valid argument by its logical form alone. They also boast having collections with the most basic valid argumentative forms people of flesh and blood can use in deductive matters. Think about this for a moment. These are bold statements. If they were accurate, philosophers would be in higher demand than software engineers and no one would be able to make contributions to theoretical physics without ever taking a logic class. Of course, none of that is true. Their basic argumentative forms are nowhere to be seen in real-life argumentation and people will carry on their cognitive business without ever putting their hands on a logic textbook. I believe philosophers overpromise and underdeliver due to a subtle, but profound confusion they make about their own object of study. They take metalogical principles such as hypothetical syllogism for real forms of the arguments that are used in natural language. I try to connect these principles with real-life argumentation by interpreting their ‘premises’ as background assumptions and their ‘conclusions’ as either arguments or categorical assertions. This is not enough to save face for two reasons. First, the arguer’s assumptions should count as additional premises, but they will involve numerous arguments and the resulting formal interpretation will be too cumbersome to be practical. Second, we can’t determine the validity of an argument by formal means except when the conclusion repeats the premise, the premise is contradictory or the conclusion is tautological. These limitations are usually ignored due to the prevalent but questionable assumption that conditionals are connectives and not claims to implication. But conditionals can be elegantly explained as claims to implication in a variety of modal ranges that are all classical in nature. Consequently, the substantial validity of a deductive argument can only be determined in an informal manner and requires an extensive investigation of the nature of the subject. I conclude the article with some observations about the need to rethink the role of logic, its cognitive importance, and its teaching. Logic is important because it allows us to understand the nature of logical consequence and not because it is supposed to be useful for other deductive endeavours. I also make some observations about the need to rethink informal logic. Similarly to baby logic conventions involving formal logic, the textbook fallacies have no uncontroversial corresponding examples in real-life argumentation and are better interpreted as a list of epistemic vices that any honest epistemic agent should avoid. In this sense, informal logic has been misunderstood as a poor cousin of formal logic for decades, when it should be viewed as a speciality of virtue epistemology.
1. INTRODUCTION

‘In the middle of a conference on the logic of science, an eminent biologist once said: “Does it not bother you guys that we scientists do not use any logic at all.” This statement was meant to be a friendly provocation, but there also was a serious message. Scientists often say that the logical analyses are exercises in formal logic and fail to illuminate what the scientists are doing, actual scientific practice.’

― Matti Sintonen, *Argument, Inference and Reasoning*

‘there is no such thing as a classification of the ways in which men may arrive at an error: it is much to be doubted whether there ever can be.’

― Augustus De Morgan, *Formal Logic: Or, The Calculus of Inference, Necessary and Probable*

‘First you make people believe they have a problem, and then you sell them the solution. That’s how advertising works. Every snake oil salesman knows that.’

― Oliver Markus Malloy, *Bad Choices Make Good Stories - Finding Happiness in Los Angeles*

‘Truthfulness in science should be an iron law, not a vague aspiration.’

― Bruce Charlton, *Not Even Trying: The Corruption of Real Science*

Logic textbook authors advertise that they offer the only way to reason properly in deductive matters and that the validity of arguments can be determined by their logical form alone. They also believe they have figured out the basic argumentative forms that encapsulate deductive arguments people of flesh and blood use in real life. If these statements were accurate, logic would be the most important discipline ever conceived for deductive endeavours. People would not be able to make reliable contributions in fields such as physics, mathematics and computer science without taking a logic class. Logic exercises would be more common than code and philosophers would be in higher demand than software engineers. No one would graduate in any serious field without logic. Of course, none of that is true.

You will look in vain for a single modus ponens in physics, chemistry, astronomy, geology, biology, computer science, mathematics, engineering, economics, political science, geography, history, anthropology, and sociology. Even in philosophy, argumentative forms such as modus ponens, modus tollens, hypothetical syllogism and contraposition are rarely expressed in a canonical form. Their mysterious disappearance suggests that they seem to make no meaningful difference in real-life argumentation. A self-indulgence in our own
Idealised conventions would be acceptable if logical theory were not also heavily invested in the classification of real-life arguments and its efficiency. But the repetition of baby logic conventions is not a classificatory endeavour, nor does it help in making real-life arguments. This is just a lie we tell ourselves to make us feel important and signal to our peers that we are co-conspirators in collective wishful thinking.

You could try to object that these argumentative forms are implicit in real-life argumentation, but this seems to be a cop-out that only postpones the issue. Why such basic argumentative forms are never explicit in real-life argumentation? You could argue that the non-canonical forms result from a lack of logical training, but natural language speakers can make proper use of prepositions, verbs, nouns, or pronouns without receiving English lessons. You might insist that language is unlike logic, since we have been trained in its use directly or indirectly since our birth, but we also have been practicing and unconsciously repeating techniques of argumentation from an early age. You can factor in all the bad habits we acquire from native speakers and we should still get some of the basics right. But the fateful basic argumentative forms remain out of reach and can only be brought to the surface after some considerable interpretative gymnastics. The very fact that students need to be trained in the art of reinterpreting arguments in canonical form indicates their artificial character. This suggests that something is amiss in the conceptual habits we use to classify argumentative forms. These are fictions that were laboriously created in logic textbooks, but seem to make no meaningful difference in real life argumentation.

Another textbook dogma that defies belief is the notion that the conclusion of a valid deductive argument is contained in its premises. This is perplexing because it suggests that deductive arguments are merely tautological and non-informative. This goes against everything we know about deduction in philosophy, mathematics, computer science and theoretical physics. This view of things is obviously incorrect, so we need to go back to the white board to rethink our baby logic conventions. This article attempts to contribute in this direction and narrow the gap between logic and the realities of argumentation. What starts as a discussion about informal logic matters and their conventions will lead us into a revision in key intuitions in our view of the nature of logical consequence. The practical auxiliary role of logic can help us develop a better understanding of the nature of logic itself.

There are two main approaches to logic. The top-down approach starts with our intuitions about inferences and argumentation and tries to reverse engineer the nature of logical consequence from this informal standpoint. The bottom-up approach begins with a more precise and technical definition of logical consequence and tries to reinterpret our inferential notions so that they fit the formal ones. We will adopt a mixed approach where informal and formal intuitions support themselves in a symbiotic relationship.

The article will start with a discussion about the nature of logical implication in section 2. I defend that a widespread incomprehension about the nature of conditionals prevents a real understanding of the nature of logic. The notion that is widely ignored is that conditionals are claims to implication. I explain why this notion is still unpopular and make a case for the view that conditionals are claims to implication in a variety of modal ranges that are classical in nature. In section 3, I proceed to discuss the disconnection between our baby logic conventions and argumentation in real life. The main insight is that the supposedly central argumentative forms such as modus ponens are metalogical claims that express the properties of implication. I try to close the gap between these claims and real-life arguments by interpreting the premises as background assumptions and their conclusion as the asserted
part, which may be either arguments or categorical assertions. In section 4, I proceed to argue that the formidable promise that formal logic will provide a way to assess the validity of arguments by their logical form alone is motivated by the metalogical claims that express different properties of implication. The validity of these metalogical principles can be determined by formal means, but they tend to be circular in nature, for the conclusion is only valid if the premises are valid. This highlights the inherent limitations of formal logic, which does not have the practical importance we usually attribute to it. In section 5, I conclude with some observations about the need to rethink the role of logic, its cognitive importance, and its teaching. Logic is important because it allows us to understand the nature of logical consequence and not because it is supposed to be useful for other deductive endeavours. I also make some observations about the need to rethink informal logic. The textbook fallacies have no uncontroversial corresponding examples in real-life argumentation and are better interpreted as a list of epistemic vices that any honest epistemic agent should avoid. In this sense, informal logic has been misunderstood as a poor cousin of formal logic, but should be viewed as a specialty of virtue epistemology.

2. THE NATURE OF IMPLICATION

Suppose one asserts that a premise P implies a conclusion C. This corresponds to the assertion of a conditional, ‘If P, then C’. Let us assume you believe that P implies C only in relation to one world w. This means that it is not the case that P is true and C is false in w. This description encapsulates the modal range assumed in most conditionals used in daily life. If I say, ‘If John left, he went to the supermarket’, I assume that it is not the case that John left but went somewhere else. Otherwise I remain uncorrected. If this conditional is true, the premise implies the conclusion. This is a material implication.

The ‘if’ part in the conditional is also known as its antecedent, and what is expressed after ‘then’ is the consequent. According to a popular view, to interpret conditionals as claims to implication is to commit the use-mention fallacy in which the antecedent and consequent are mentioned as the premise and conclusion of an implication relation. Instead, genuine conditionals do not mention statements, but use them to express a relation between facts and objects in the world. This popular view is baseless though. When a conditional is asserted, it’s the whole proposition that is asserted, and not its antecedent and consequent. The assertion of a conditional, then, is done as a statement about a relation between the propositions expressed by the antecedent and consequent. In other words, the antecedent and consequent are mentioned, not used. The speaker is stating that the consequent follows from the antecedent. So, the interpretation of conditionals as claims to implication is still the correct one.

In the example above you believe that P implies C only relatively to one world w. But, depending on the subject at hand, you could assume that P implies C in all possible worlds. In this interpretation, it is not the case that P is true and C is false in any possible world. In this case we say that, in this interpretation, P formally implies C. Other similar expressions that can be used here are ‘P strictly implies C’, ‘P entails C’ or ‘C is a logical consequence of P’. The reference to ‘formally implies’ is not an accident. When P implies C in all possible

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1 This view became influential due to a criticism presented by Quine (1961: 323); (1964: 196). I make a more detailed criticism in my ‘If-then as a version of implies’ (unpublished).
worlds, it is because it involves some necessity that can be recognised or reinterpreted in terms that are exclusively due to formal terms. This is the bread and butter of any logical textbook. Modus ponens, modus tollens and other supposed ‘argumentative forms’ are all examples in which the premises formally imply the conclusion.

There is an obvious connection between material and formal implication. The relation of material implication may occur in the actual world, but it doesn’t need to be restricted by it. When P formally implies C, P also materially implies C in any possible world. In a sense, the notion of formal implication is complemented by the notion of material implication, since formal implication is a material implication under the scope of a necessity operator. They also share many characteristics, e.g., they are both transitive, antisymmetric, monotonic and reflexive. In fact, what we have here is a relation of implication that can admit different degrees of modal reach. When it is extended to all possible worlds, we say the relation of implication is formal, but when is restricted to a given world, we call it material—see the image bellow.

Now we have a distinction between material and formal implication. The former is satisfied in at least one possible world, while the latter extends over all possible worlds. How about the implication relations in between? Their range will vary according to the arguer’s beliefs about the subject matter. If we do not expect physical truths to be metaphysically necessary, we will place them in the intermediary range between material and formal implication. This is not written in stone and it does not have a pre-existent nature. The range of implication will be dependent on the arguer’s beliefs. The only thing that is objective is that no implication is valid if it fails in its range. If it is formal, it will fail if there is a possible world where the premise is true and the conclusion is false. If it is material, it will fail in case the premise is true and the conclusion is false in the world that is taken as a parameter.

One could object that I’m ignoring a third option in what is known as a variably strict implication, whose range varies according to the closest worlds in which the premise is true. The variable strict implication is then said to be ‘valid’ if the conclusion is true in the closest worlds (in the sense of most similar to the actual world) where the premise is true. You could in principle debate what should be our criteria of similarity. There is a distinct possibility that we will not be able to tell in certain cases if the claim to variable implication is true or not.

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2 There are different versions of this hypothesis, but they all interpret conditionals as connectives, not implication statements, and assume that its truth conditions should redirect us to one or more close worlds where the antecedent is true. Two influential names are Stalnaker (1968: 102) and Lewis (1973). There are many other possible worlds semantics inspired on the same idea—see Davis (1979). These details and their subtle differences don’t impact on my argumentation, since they all face the same difficulties.
There are a couple reasons why I avoid this approach. First, this idea makes the relation of implication dependent on a check involving hypothetical assumptions about the truth of the premise. This incorporates an element that is completely foreign to the notion of implication, which intuitively will hold even if the premise is false. Second, it gives the wrong answer in some obvious examples, e.g., when I say, ‘If John is telling the truth, I’m more intelligent than Barcan Marcus’, I’m making a claim to implication that can be obviously satisfied in the material range, but will be always invalid in the variable one. The conclusion is false in all the closest worlds where the premise is true, but that’s because it’s a claim to a material implication made under the assumption that the premise is false in order to demonstrate that the premise is false by a reductio of sorts. This type of blunder occurs with variable implication because it is a notion motivated by superficial intuitions associated with the use of modus ponens. They are tilted in the direction of the premise being true because that is what occurs when you are employing a conditional in a modus ponens. Thus, if we want proper implication variation, it will be different ranges of necessitation. The closest worlds where the premises are true do not need to factor in it.

So, we have claims to implication. These claims will be true if the corresponding implication relations occur, i.e., when the corresponding arguments are valid. In order to determine if they are valid, we need to consider the worlds in which they are supposed to hold. This modal range is determined by the proponent of the implication and her beliefs on the subject. We can give different names to implication relations according to their modal range. The intrusion of epistemic elements is allowed when they involve the demarcation of modal ranges, but what happens in each range is the necessitation of the truth of the conclusion given the truth of the premises. The implication is valid when the truth of the premises necessitates the truth of the conclusion relatively to a certain range. In a formal implication the truth of the premises necessitates the truth of the conclusion tout court. Implication statements can be expressed as conditionals and arguments in natural language. When arguments contain conditionals as one of its premises, we have an argument within an argument.
3. REAL ARGUMENTATIVE FORMS WANTED

We need to make a terminology decision at this point. Since there is only one type of implication and formal implication is usually represented with the double turnstile symbol ‘⊨’, let us use this symbol to describe any form of implication. The material implication will be accompanied by a little ‘m’, the intermediate range by a little ‘i’, and the formal implication without any qualification. This is probably for the best, since the distinction between material and formal implication is too confusing and only attracts unwanted puzzled intuitions from natural language. The validity of the implication will depend on whether it satisfies its range or not. This will keep the notation lean. I will use capital letters such as ‘P₁, P₂…Pₙ’ for premises, and ‘C₁, C₂…Cₙ’ for conclusions.

Notice that once we have decided to interpret conditionals as implication statements our conceptual habits will change significantly, to the point that we will be able to understand what is wrong with our baby logic conventions. For instance, the talk about hypothetical syllogism as an argumentative form commits a category mistake. The reason is that it does not make sense to talk about an argumentative form that contains two implication statements as premises and another one as a conclusion, since real people do not make arguments where the premises are arguments themselves. Rather, hypothetical syllogism should be interpreted as a metalogical statement about the properties of implication involving three implication statements. This is what is wrong with the received view of logic: the supposed argumentative forms are actually metalogical statements about the properties of implication. In fact, they are nothing more than expressions of these properties. This changes everything.

Logic offers us an explanation of the nature of implication. This insight allows us to make a classification of the relations of implication which can be determined by their logical form alone. These implication patterns are dependant upon the properties of implication. This explains why these argumentative forms have such a rare species feel to them and all the attempts to present arguments in this structure feel contrived and artificial. They are not really argumentative forms, but an illustrative representation of the properties of material implication. Since we have been indoctrinated into believing that this represents a real argument, we tend to repeat what we have learned, and this becomes an artificial reality that has no correspondence in real life. The same can be said about the other metalogical principles involving implication. Each will express a different property of implication. The modus tollens tells us that a valid material implication cannot have a false premise if the conclusion is false, antecedent strengthening represents the monotonic aspect of implication, and so on. The same patterns repeat themselves with formal implication.

The supposed tautological character of valid deductive arguments is another myth we have created due to the excessive importance attributed to pedagogical tools like modus ponens. Indeed, in a modus ponens argument we are supposed to start with a claim to an implication statement, proceeding then to state the premise of this implication statement and then infer the conclusion already contained in the initial statement. It is circular.

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3 One worry is that we should not assume theoretical commitments with modal distinctions involving necessary and contingent truths. In this case, the notion of implication is that an argument is valid if, and only if, it is not the case that the premises are true and the conclusion is false. If we should decide to make such drastic choice the result would be the collapse of formal implication into material implication. Make of that what you will.
Of course, it would be weird if valid implication had such properties and we had no corresponding examples in real-life argumentation. One way to approximate such notions to real-life argumentation is to apply the following recipe: if the premises are conditional sentences, interpret the ‘premises’ as shared background assumptions and their ‘conclusions’ as arguments. The representation of a hypothetical syllogism using our notation then would be as follows:

\[
\text{argument } \{ P_m \models C_2 \}
\]
\[
\text{shared assumptions } \{ P_m \models C_1, C_1_m \models C_2 \}
\]

That is more like it. It is reasonable to accept that a series of arguments were made in the background and that further implication statements were based on these assumptions. But notice that in this case the actual premises are only the antecedents of the conditional sentence that convey the implication statement. We assume that there are numerous premises and leave their precise number open.

Let us continue with our revision and test the other supposed argumentative forms that involve implication statements. Take for instance an example of controversial argumentative form such as the first paradox of material implication. No one will use the falsity of a premise to make a restricted implication statement. This is understandable, since this is a metalogical statement that expresses the notion that any material implication is trivially valid when the premise is false. Since the implication in this case has a narrow range and is bound by a parameter world, it will be automatically satisfied when the premise is false in that world alone. If we were to make this work in real-life argumentation, the closest thing to an argumentative form would be something like this:

\[
\text{argument } \{ P_m \models C \}
\]
\[
\text{shared assumption } \{ \neg P \}
\]

The argument is that \( P \) vacuously implies \( C \). When will a person of flesh and blood ever make a claim to implication because the premise is false? This is hardly ever applied because usually it does not help in increasing our understanding of the world. But there are a few cases in which this strategy can be helpful, namely, in reductios which are intended to highlight the falsity of the premise by an implication that leads to a false conclusion. Since the implication is valid, the audience is expected to infer from the falsity of the conclusion that the premise is also false. When the implication is restricted by a parameter world it can be used in reductio-like constructions such as Dutchman conditionals, e.g., ‘If John is an honest guy, I’m a Dutchman’. In such cases the audience is expected to infer that John is not honest from the obvious fact that I am not a Dutchman.

Let us also consider antecedent strengthening. This expresses the monotonicity of implication in a narrow range. The corresponding in argumentation would occur when a reasoner assumes the validity of an implication statement, which motivates the assertion of another implication statement with a strengthened premise:

\[
\text{argument } \{ P_1 \& P_2_m \models C \}
\]
shared assumption \( \{ P_1 \models C \} \)

In a modus ponens, the resulting interpretative strategy also bears fruit and perplexing results. As a metalogical principle, modus ponendo ponens assure us that, given the truth of the premise and the validity of an implication statement, it follows the truth of the conclusion. As an argumentative form, it is completely different. The arguer assumes the validity of an implication statement and the truth of the premise. So, what is left is the assertion of the conclusion. It follows, then, that the only thing that is asserted in a real-life modus ponens is an assertion of an unconditional statement. This avoids the circularity issue mentioned earlier. In our notation conventions this can be represented as follows:

assertion \{ C \}
shared assumptions \{ P \models C, \}

Another example is contraposition. It can be interpreted as follows: a potential arguer assumes the validity of an implication and, based on this, asserts that the negation of the conclusion of this implication follows the negation of its premise. In our notation this is interpreted as:

argument \{ \neg C \models \neg P \}
shared assumption \{ P \models C \}

The counterexamples advanced against this metalogical principle usually involve even-ifs statements that can’t be contraposied. Suppose that the following inference is uttered while one waits for the judges’ decision: ‘Well, if he didn't win, he certainly tried his hardest. Therefore, if he didn’t try his hardest, he won.’ The point is that one could accept the ‘premise’ but reject the ‘conclusion’. But notice that the ‘premise’ is accepted due to the truth of the conclusion, which suggests that the real logical form here is:

argument \{ \neg C \models \neg P \}
shared assumptions \{ C, P \models C \}

Thus, the conclusion is accepted due to the falsity of the premise. The implication, \( \neg C \models \neg P \), seems invalid when \( \neg C \) is true, but that is obviously not the case here. So, the counterexample is disarmed.

Condition negation is usually interpreted as follows: it is an inferential rule that states that, from a negation of a conditional, we can infer a conjunction with the antecedent and the denial of the consequent. In our approach conditional negation means something entirely different, namely, that given that one would assume that an implication is invalid in a given world, she would be willing to state that the premise is true and the conclusion is false in that world:

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4 Skyrms (1978: 178).
assertion \( \{P \& \neg C \} \)
shared assumption \( \\{ \neg (P_m = C) \} \)

This metalogical principle is supposed to face counter-intuitive instances when someone accepts the assumption due to intensional evidence, but the conclusion is a conjunction she ignores. For example, if I deny the conditional ‘If God exists, then the prayers of evil men will be answered’ I must admit that ‘God exists and the prayers of evil men will not be answered’. Thus, from the negation of a simple conditional, I can prove that God exists\(^5\). This is implausible, because someone could refuse the conditional based on assumptions about the moral dispositions of God even if she does not believe in the existence of God. Our hypothesis provides a simple explanation for this example. The arguer assumes that the truth of the premise is conceptually inconsistent with the truth of the conclusion, since she believes the properties of God would be fundamentally inconsistent with helping bad men. So, what the arguer would really want to assert is a claim to equivalence between the existence of God and the prayers of evil men not being answered. Thus, what we really have is a completely different picture that has nothing to do with conditional negation:

argument \( \{P \leftrightarrow \neg C \} \)
shared assumption \( \\{ \neg (P_m = C) \} \)

The reason why the counterexample seemed so compelling is that it assumes endorsing the notion that some conditional sentences are material means they should all be. But the range of classical implication, and therefore its negation, is determined by the arguer’s beliefs.

The considerations presented here also have repercussions for our understanding of formal fallacies\(^6\). A formal fallacy is an invalid argumentative form that seems valid due to its misleading logical form. There are two formal fallacies: affirming the consequent and denying the antecedent. The first can be expressed in our notation as follows:

argument \( \{P_m = C \} \)
shared assumption \( \{P_m = C \} \)

This is supposed to be a formal fallacy because it may be wrongly perceived as valid due to its superficial resemblance to modus ponens. Denying the antecedent has the following structure:

argument \( \{ \neg P_m = \neg C \} \)
shared assumption \( \{ P_m = C \} \)

This argumentative form is invalid but it can be confused with a modus tollens. But if structures such as modus ponens and modus tollens are not real-life argumentative forms, then these structures can’t be confused with them, and, thus, cannot be considered genuine

\(^6\) I thank Eli Vieira for bringing this up.
fallacies. They can be saved if we approach this topic from a different angle: these argumentative forms are pedagogical tools that illustrate potential basic mistakes students of logic can make in their first encounter with the subject. So they describe potential fallacies logic students are prone to make in a logic class. If there were any versions of affirming the consequent and denying the antecedent in real life, the conditional premise would be underneath the assertion surface and it would be a mistake motivated by a lack of understanding of the nature of implication, not the supposed form of modus ponens or modus tollens.

Of course, there are many references in informal logic about the role of assumptions in argumentation. The problem is that they invariably end up trying to shoehorn background assumptions in metalogical principles that were never argumentative forms in the first place. The present approach is more elegant because it manages to integrate background assumptions in a seamless way while at the same time identifies the real basic argumentative forms that were out of reach.

Is this representation of real-life argumentation good enough? Unfortunately, it is still lacking in many aspects. A deductive argument is nothing more than an arguer’s claim to validity, so it is obvious that the arguer’s reasons to accept both the premises and the conclusion should be involved in the evaluation of the argument. Thus, the question of whether the premises of a given argument necessitate the conclusion or not will depend on whether the reasons that support the premises together with the premises necessitate the conclusion or not. Consequently, an accurate representation of argumentative forms will be more complex and require considerably more analysis of the arguers’ reasons.

Now it is obvious that the arguer’s assumptions should count as additional premises. There is no meaningful distinction between assumptions and premises from a logical point of view. In real-life argumentation, especially of the sophisticated theoretical kind that interest us in our logical analyses, these assumptions will involve numerous arguments. Since assumptions that support an argument should count as additional premises, multiple arguments should now be included in additional premises which state these arguments are cogent. Let’s say that we decide to analyse an argument in Russell’s *Introduction to Mathematical Philosophy*. It’s expected that the analysis of this argument will require at least a few dozen additional premises about arguments that are taken for granted in the background—including this book and/or other works.

I won’t bother myself with carrying out this tedious exercise—you can choose other examples of your choice and test it yourself. The point is that its mere possibility will require so much complexity that a formal interpretation will be too cumbersome to be practical. No one would write one or more pages of formulae to analyse the validity of the argument and even if one would bother with this hassle it is not obvious that any decision about its validity will be a mere protocol as the regular logic textbook suggests. At the very least, this will be inherently controversial on top of being cumbersome. This is important because logic is supposed to be a practical tool to analyse complex argumentation, but if the resulting analysis end up being as complicated as the regular natural language analysis there is no meaningful gain with the use of formalisation. In fact, it will be considerably worse since the conceptual connections and insights involved in the argumentation are now hidden under a clutter of formalism that serves no real purpose.

Notice that this simple complication requires an entire revision of the way we usually present and analyse individual arguments in philosophy. There is a tendency in philosophy to
analyse key arguments as pristine and self-contained argumentative forms, but this is obviously misguided and ignores an obvious limitation in the use of formalism. Take, for example, the way alternatives to classical logic are motivated by counter-examples that not only take metalogical principles as if they were real arguments, but also analyse them individually and without any meaningful background assumptions. This practice is misguided and has no basis in reality.

4. THE NATURE OF METALOGICAL PRINCIPLES

Notice that once we have decided to interpret conditionals as implication statements, our conceptual habits will change significantly to the point that we can understand what is wrong with our baby logic conventions. For instance, the talk about hypothetical syllogism as an argumentative form commits a category mistake. The reason is that it does not make sense to talk about an argumentative form that contains two implication statements as premises and another one as a conclusion, since real people do not make arguments where the premises are arguments themselves. Rather, hypothetical syllogism should be interpreted as a metalogical statement about the properties of implication involving three implication statements. This is what is wrong with the received view of logic: the supposed argumentative forms are actually metalogical statements about the properties of implication. In fact, they are nothing more than expressions of these properties. This changes everything.

Logic offers us an explanation on the nature of implication. This insight allows us to make a classification of the relations of implication which can be determined by their logical form alone. These implication patterns are dependent on the properties of implication. The same can be said about the other metalogical principles involving implication. Each will express a different property of implication.

Modus ponens express the property of reflexivity, which is an uninteresting property. This can be show with general conditional proof, the principle that states that if two premises formally imply a conclusion, then one of these premises will formally imply that the other premise materially implies the conclusion. The demonstration is as follows:

\[
\text{Prem } (1) \ P_m \models C, P \models C \quad \text{modus ponens} \\
1 \quad (2) \ (P_m \models C) \models (P_m \models C) \quad 1, \text{ general conditional proof}
\]

Modus ponens is then the claim that \( P_m \models C \) implies itself, i.e., is the property of reflexivity. It’s symptomatic that some authors tried to refute modus ponens because this would amount to deny that \( P_m \models C \) implies itself. Now let’s consider modus tollens, which can be expressed as \( P_m \models C, \neg C \models \neg P \). This amounts to accept that from a material implication and the denial of its conclusion it follows the denial of its premise. This is exactly the same meaning conveyed by contraposition. Consider the following inference using modus tollens and general conditional proof:

\[
\text{Prem } (1) \ P_m \models C, \neg C \models \neg P \quad \text{modus tollens} \\
1 \quad (2) \ (P_m \models C) \models (\neg C_m \models \neg P) \quad 1, \text{ general conditional proof}
\]

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The acceptance of modus tollens lead us to contraposition, which is nothing more than the claim that if a premise materially implies the conclusion then the denial of the conclusion leads to the denial of the premise. It’s a simple property of material implication.

Antecedent strengthening represents the monotonic aspect of material implication. If it is accepted that a premise materially implies a conclusion, then the inclusion of another premise will not defeat this claim, so we have \( P_1 \models C \) \( \vdash (P_1 \& P_2 \models C) \). The other metalogical principles will follow through in seamless fashion. Hypothetical syllogism can be expressed as \((P \models C_1), (C_1 \models C_2) \vdash (P \models C_2)\), and represents the transitivity of material implication. Conditional negation can be expressed as \( \neg (P \models C) \models P \& \neg C \) and express the invalidity of a material argument, and so on.

The same patterns repeat themselves with formal implication. Antecedent strengthening has an unrestricted cousin in left weakening, namely, that if \( P_1 \models C \) then \( P_1 \& P_2 \models C \). Hypothetical syllogism has an unrestricted parallel in transitivity of entailment, which is exactly the same logical form now with formal implication instead of material implication, \((P \models C_1), (C_1 \models C_2) \vdash (P \models C_2)\). The unrestricted version of conditional negation can be expressed as \( \neg (P \models C) \models \Diamond (P \& \neg C) \), and so on.\(^7\)

The supposed tautological character of valid deductive arguments is another notion we created due to the excessive importance we tend to attribute to pedagogical tools like modus ponens. Indeed, in a modus ponens argument we are supposed to start with a claim to an implication statement, proceed to state the premise of this implication statement and then infer the conclusion already contained in the initial statement. But if arguments aim to convince the audience, the premises need to be more plausible than the conclusion, and an implication statement cannot be more plausible than the conclusion it already contains. This goes against the very aim of argumentation.

Perhaps the most important consequence of the previous statements is that we can’t have a formal demonstration of validity in general. Let’s consider an obvious example of validity, such as modus ponens. It is undeniable that if the argument presented as a premise is valid, and the second premise that states the premise of this argument is true, then the conclusion of the argument presented in the premise must be true. But this assurance will confirm nothing of substance about whether the initial argument was valid or not. The conclusion is merely conditional: if the argument is valid and the second premise is true, the conclusion is true. But this is just a reinstatement of the nature of validity. It doesn’t guide us to the validity of argumentative forms.

The implication premise in a modus ponens is not circular because it states that it is not the case that \( P \) is true and \( C \) is false in a given modal range, and that these truth values can be ascertained in an independent manner. But if the purposed implication claim is substantial, the truth values of \( P \) and \( C \) will be controversial and we will have to consider independent reasons and possibly other implication statements to decide whether \( P \) implies \( C \) or not. Let’s say that the implication statement is ‘If the Taniyama–Shimura conjecture is true, then Fermat’s last theorem is true’. The justification for such statement involves hundreds of additional assumptions and at least a few dozen additional theorems. The truth of this conjecture was unknown until Andrew Wiles came along. It is certainly not something whose validity can be ascertained by a circumstance surveyor. What can be shown by using such

\(^7\) I make a case for this connection in my ‘The Inextricable Link Between Conditionals and Logical Consequence’ (unpublished).
textbook techniques, however, is that if this statement is valid, you can infer the truth of its conclusion from its premise, but this result is uninteresting and doesn’t help us in our attempts to gain more knowledge.

The circularity of metalogical principles is also evidenced in the use of contraposition, which allows us to move from a premise that states that \( P \) implies \( C \) to a conclusion that states that \( \neg C \) implies \( \neg P \). Where is the justification to accept that \( P \) implies \( C \) in the first place? The fact that it is not the case that \( P \) is true and \( C \) is false. How do I know that? I need to check in the real world to determine whether this truth value combination is satisfied or not. But real-life implication statements are not so obvious that you can tell the truth value of their propositional components in advance. So, you will have to rely on indirect evidence and other implication statements in order to get to this conclusion. This is not something that can be achieved by mere logical form alone. The same can be said about modus tollens, hypothetical syllogism, and antecedent strengthening. Their logical form will assure you that the conclusion is valid if the premise is valid, but that doesn’t provide any formal guarantees that the premise was valid in the first place. It’s assumptions in, assumptions out. The conclusion is just as good as the information you inserted in the premises in the first place.

One potential misunderstanding here is assuming that logic can be useful as an epistemic guide to find valid implication in the real world, since it encapsulates the nature of valid implication. It is a non-sequitur and it is similar to the trap of confusing truth conditions with the criteria of truth. Truth conditions have logical significance for they determine the conditions in which a proposition is true or false, but criteria of truth only have epistemic significance because they are standards used in contexts of imperfect information to distinguish whether a given proposition is true or false, i.e., in contexts where the only evidence available to assess the relevant proposition is intensional. Neither truth conditions provide criteria of truth, nor a concept of implication provides criteria of validity.

The circularity of metalogical statements explains why someone would be led to the notion that the conclusion of a valid deductive argument is contained in its premises. If your notion of implication is determined by an innocuous metalogical observation about the properties of implication, then valid deductive arguments will be seen as merely tautological. Things don’t work that way in the real world. In order to ascertain whether a particular deductive argument is valid or not, we need to consider the reasons that support such statement. That occurs because the elements that allow you to assess the validity of a deductive argument are the same devices that allow you to build a deductive argument. That is, you know that a deductive argument is valid in a non-trivial way by considering whether the claim to a conceptual connection between the premises and the conclusion is true.

That also explains why experts in other areas will be able to carry on doing their cognitive business without the hassle of reading logic textbooks; and why nobody excepts philosophers know what is a modus ponens and why real life deductive arguments are not tautological. The ability to judge the merits of a claim to implication are specific in nature and demand understanding of the subject matter involved in the allegations. In order to do math, you need to know math, and in order to do philosophy you need to know philosophy. The competencies you acquire doing math are not transferable to philosophy any more than the competencies you acquire doing philosophy can be transferable to math. A body of knowledge and conceptual understanding cannot be moved around and automatically inserted in different domains like a pile of books is inserted on an empty shelf. But if the promises of formal logic were to be believed, we would be able to determine the validity or invalidity of a deductive
argument in any domain of our choice, irrespectively of whether we have any knowledge about the subject or not. That would require a single method that could be applied to any domain and all it would require of us is taking a mere logic class and doing some exercises on a piece of paper. It is a narcissistic infatuation that trivialises all deductive enterprises so that they can fit in our preconceived textbook notions.

The metalogical principles presented in logic textbooks and that tend to be at the centre of attention in the philosophy of logic discussions suggest three patterns in which the validity of an implication claim can be assessed exclusively by formal means: (1) when the conclusion is already contained in the premises; (2) when the premise is contradictory and (3) when the conclusion is tautological. This result is not stellar, since the validity in such cases is either trivial or vacuous. Certainly, it is not what we would expect from a field we have held in such high esteem. Imagine telling a student that she should diligently apply herself in the study of formal logic so that she would be able to spot the validity of a circular argument or an ex contradictione quodlibet.

Naturally, one can learn many interesting things about the nature of implication itself. The metalogical statements presented in textbooks express properties that are interdependent and assure us that any alternative logical system is severely limited in scope. If an alternative notion of implication violates hypothetical syllogism, it must also violate the transitivity of entailment and modus ponens; the refusal of conditional negation implies a denial of modus tollens and contraposition, and the abandonment of antecedent strengthening violates monotonicity and hypothetical syllogism, and so on. But beyond that, these properties will either presuppose the validity of the target implication used as a source, or they will be trivial. They are illuminating as far as the nature of implication goes but tend to be useless in real-life argumentation. Consequently, these principles should not be confused with real-life argumentative forms or an epistemic guide to real-life argumentation, which is too complex and dependent on content to be identified exclusively by formal means. Logic is the science of logical consequence, but paradoxically this means that it cannot help us find meaningful logical consequence. It is too general and abstract to be useful.

The only reason why these simple truths are so widely ignored is that we lost our way in our own hype and misleading advertising. We repeat the ludicrous notion of a validity-machine that will manufacture ‘validity’ in a reliable manner and the absurd promise that we can feed natural language data into formal procedures and receive the validity verdict that comes out. But there is no formal method that can replace individual deductive judgments in any given domain. We simply don’t have a method to ensure validity using a blind procedure that repeats a series of steps.

4. WE NEED A CHANGE OF PARADIGM

The harsh criticisms presented in this article should not be confused with a demeaning attitude towards logic itself. Logic is the science of implication and should be measured only by this cognitive metric. The fact that it is a theoretical field that is inherently speculative and requires deep conceptual analysis does not diminish its value. But pretending that it can achieve impossible goals will only make it look like a caricature of a serious discipline. In this sense, here is a critique to the notion that logic needs to offer practical uses and needs to

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8 I make a detailed explanation of this interdependence on my ‘The Logical Web’ (unpublished).
be more formal in order to be respectable. More importantly, we need to change the way logic courses are conceived, especially in philosophy departments. Logic should be understood primarily as a speculative pursuit of the nature of logical consequence. The potential connections of this discipline with other areas of philosophy should come as a bonus, and not as its main motivation.

It is also important to draw a parallel between the limitations of formal logic and some pessimistic findings about the applications of informal logic. There is plenty of data that suggest that critical thinking abilities cannot be taught in abstract and instead rely on specific areas of expertise in which they can be exercised. The evidence is clear: there is no such thing as a generic critical thinking skill that can be learned in informal logic courses. Similarly, to the metalogical principles discussed here, the paradigmatic unequivocal examples of fallacies happen primarily in textbooks, but are rarely found in real life, where the presumed fallacies are either controversial or resemble closely related, but defensible forms of reasoning. Informal logic resembles its formal counterpart in the difficulties it faces as an epistemic guide to the practice of argumentation. It wouldn’t be a stretch to suggest that informal logic would never be conceived in such terms if it weren’t for the hype about the importance of formal logic in the first place.

But if the fallacies presented in logic textbooks have no obvious corresponding examples in real-life argumentation, what are they? I believe they are actually a list of epistemic vices that any honest epistemic agent should avoid. Take the post hoc ergo propter hoc fallacy. If a person would conclude that an event Y must have been caused by event X simply because it followed it, this would be gullibility and negligence. The ad hominem fallacy considered without any context represents prejudice, the fallacy of equivocation represents negligence and begging the question will express dogmatism and closed-mindedness, and so on. In this sense, informal logic has been misunderstood as a poor cousin of formal logic for decades. Instead, it should be viewed as a specialty of virtue epistemology and focus on what kind of intellectual vices may be assumed by epistemic agents. It has nothing to do with logic per se because it isn’t logic. It is epistemology.

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11 See Boudry, Paglieri and Pigliucci (2015: 446).
12 See Hahn and Oaksford (2007); Hansen and Pinto (1995); Yap (2012).


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