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ABSTRACT

Logical pluralism is the theory that there is more than one right logic. Logical instrumentalism is the view that a logic is a correct logic if it can be used to fruitfully pursue some deductive inquiry. Logical instrumentalism is a version of logical pluralism, since more than one logic can be used fruitfully. In this paper, I will show that a logical instrumentalist must accept linear logic as a correct logic, since linear logic is useful for studying natural language syntax. I further show that this means that the logical instrumentalist must accept a wide range of connectives, in particular concatenation. I end by explaining why this is a feature rather than a bug.

Keywords: Logical pluralism, linear logic, conjunction, concatenation

Introduction

Logical instrumentalism[1] is the view that norms for deductive reasoning should be evaluated based on one's aims and goals in reasoning and the domain of investigation. This means two things. First, as long as there are two domains of investigation which are best served by different norms for deductive reasoning, this will be a logical pluralism: logical instrumentalism will license more than one "correct" logic. Second, should a domain of reasoning call for a particular logic, then logical instrumentalism must license that logic as one of the correct logics.

The bulk of what I will show in this paper is that linear logic is useful for analyzing natural language sentence syntax. Once this is established (using work from Michael Moortgat ((1996, 2009b, 2009a, 2013, 2014)) on categorial grammar), we must concede that the logical instrumentalist must accept linear logic as a legitimate logic. This has interesting implications for the meanings of the logical connectives, notably concatenation and conjunction - the instrumentalist must accept that concatenation is not only legitimate, but may even be a conjunction. One might think that the status of linear logic, its applicability and the relationship between concatenation and conjunction is a mark against instrumentalism. I conclude my paper by arguing that licensing linear logic as a correct logic is a benefit rather than a burden.

Logical Instrumentalism

Logic is often thought of as a tool for figuring out what follows from what.[2] Logical instrumentalism is the position that logic is *only* such a tool. Logical instrumentalism could equally well be called goal-driven logical pluralism, and has a rather neo-Carnapian flavour (see (Carnap 1937) and (Carnap 1950)). In effect, though most people will agree that logic is a tool, they think there is something additional to certain logic(s) which makes them more fundamental, more basic, or "righter". Logical instrumentalism stops short of this. The claim is that logic is a tool for deductive reasoning, *and nothing more*.

What does it mean for logic to be *merely* a tool for studying what follows from what? It means that when we reason, when we try to figure out what follows from a given set of premises, we do so in a logical fashion. That is, reasoning is governed by norms, which tell us when the reasoning is good, and those norms are given by a logic. The difference between this view, and the traditional view that there is exactly one right logic, or one right way to reason, is that it imposes no such restrictions. Logic is a tool because it can be adjusted based on our purpose; logic can be changed based on what we are reasoning about. In this sense, the instrumentalist's tool box is replete. Are you reasoning about classical mathematics? Then do so with classical logic. Are you trying to deduce syntactic relationships between words in English? Then maybe linear logic is right for you. Depending on what we are up to, on what our goal in reasoning is, we will be able to use different tools. Just what follows from what, then, will depend on what we are doing, and

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1   This is not what Haack refers to as a "logical instrumentalism" in her (1978). Her use of the term picks out something closer to what would today be called a logical nihilism (see (Franks 2015) and (Russell 2018)).

2   The "what follows from what" terminology is borrowed from (Priest 1987).

what tool we are using to reason about what we are doing. A logic is right, or correct, or good when it is useful for the task to which it is being put.

The notion of "follows from" here has to be taken very loosely. For our purposes, "follows from" will mean something like "given these inputs, these outputs are the results" - output follow from inputs for us in the same way conclusions follow from premises. This has some odd sounding results: it might be the case that 10 "follows from" 7 and 3, since when we input 7 and 3 into the plus function, 10 is the result. Though this sounds odd on the face of it, since we are using "follows from" as more of a term of art than anything else, it shouldn't be so surprising. 10 is indeed the result of 7+3, and so it follows from 7 and 3 in our loose sense. In section 3, we will see that "Abe is eating" follows from (in our loose sense) "Abe" and "is eating."[3]

If we take this position seriously, and if we assume that there might be more than one useful tool available, one of the most notable fallouts is that we cannot be logical monists, taking it that there is One True Logic, but must be logical pluralists, arguing that there is more than one right logic. Both (Shapiro 2014) and (Kouri Kissel 2018) propose such a view explicitly. (Caret 2017), (Varzi 2002) and (Eklund 2012) might all be thought to provide views in a similar vein. The moral of the story for the logical instrumentalist, then, is that if a logic is useful, it is legitimate, and since more than one logic is useful, we must be pluralists.

Immediately, there is one drastic consequence of this position: there will be no canonical application of logic, in the sense described in (Priest 1987). There, Priest distinguishes between applications of logics and the canonical application of logic. There are many logics which can be fruitfully applied to different tasks. But, claims Priest, there is exactly one canonical application of logic, namely "the analysis of reasoning" (Priest 1987 p 196), and the logic(s) which is (are) best for that application will be the right one(s). The logical instrumentalist cannot hold that there is a canonical application of logic. The instrumentalist must in fact reject that there is such a canonical application, otherwise she will undercut her own position. For the instrumentalist a logic is legitimate, or correct, as soon as it is useful for something. But to adopt Priest's notion of a canonical application would entail that a logic would only be legitimate or correct if it is useful for the canonical application. So, the instrumentalist cannot accept that there is a single, canonical, application, but must rather hold fast to the claim that any application is a good one.

I will focus in this paper primarily on the system presented in (Kouri Kissel 2018).[4] The basis of the pluralism presented here is that it can account for the fact that there are some contexts in which distinct logics have logical terms which are synonymous, and some contexts in which distinct logics have logical terms which are not synonymous. It uses a framework developed by (Roberts 2012), called the question under discussion framework, to account for this shift. In particular, tracking the acceptance of rejection of a particular proposition by the people making use of the logics in question, one can predict when the connectives in those logics will mean

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3   Thanks to Dave Ripley for urging further articulation of "following from".
4   Though I will focus on only one version of logical instrumentalism here, I take it what I say could be easily extended to other similar theories, including the one given in (Shapiro 2014).

the same thing and when they will not. The proposition in question is called the "correlation as identity proposition", or *CIP* for short. The proposition is that if two words sound alike, are spelled the same way, and are generally used in the same sentences in the same way then they mean the same thing. The proposition is by default in the common ground (the set of propositions everyone engaged in the conversation/pursuit agrees are true), and this means that the connectives in the distinct logics must share a meaning. However, if the proposition gets removed from the common ground, if we are not in the "default settings", then the logical connectives in question might not share a meaning.[5]

A notable feature of this view is that whether the connectives mean the same thing is very closely tied to the goals of the people involved in using the logics in question. If it best suits their goals to treat them as the same, then they are, for the purposes of that deductive enterprise, the same. If it best suits their goals to treat the connectives as meaning something different, then they mean something different. The general rule is that you pick the logic and connectives which best suit your deductive goals, and proceed from there. On this view, then, the connective meanings must be polysemous, meaning related to each other, but not quite meaning the same thing. An example of polysemy is the term "wood" in "a tree is made of wood" and "the 1000 Acre Wood has a lot of trees". There is something that ties both uses of "wood" together, even though they do not mean exactly the same thing. In our case, there is something that ties, say, all the negations, together, but they are subtly different. Ultimately, in most conversations, we can treat them as meaning the same thing, but sometimes the goals of the participants force a different meaning. For example, most of the time, when people are having a conversation using the term "wood", we can take it that they mean the same thing in their use. This would correspond to the "default settings". However, it might become clear throughout the conversation that one of them actually means the material, and the other means a forest. In that case, we need to adjust the default, and go from there. The same goes for conversations where participants are using the term "not".

One of the immediate benefits to his view is that it allows us to make sense of logical disagreement. Opponents of pluralism often suggest that logical disagreement is not possible when logical pluralism is on the table, since people using different logics are talking past each other, and having a merely verbal dispute. This would be bad for the pluralist, as it seems genuine logical disagreement is possible. The adoption of a view of connective meanings on which they are polysemous solves this problem, making genuine logical disagreement possible. In the case where *CIP* is removed from the common ground and there is more than one meaning for negation (say) in use in the conversation, this disagreement could be a pragmatic and external (in the Carnapian sense) disagreement about which connective it is best to use. On the other hand, when *CIP* remains in the common ground, and the interlocutors are using the same connectives, they can still have genuine logical disagreement, in this case it could be about what follows from a

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5   The position here extends beyond what we might call "traditional conversations". One can make use of the notion of a common ground, and hence the "default settings" even when there is only one person involved, or when there are more than two - like lectures in a classroom, or posts on a blog. The only requirement is that it must be possible for some assumptions to be in place, and that the task which is being pursued requires some type of logic.

particular logic and set of connectives, or other, more traditional, logical disagreements. There is little chance of the interlocutors accidentally talking past each other as they are using connectives with the same meaning. In both cases, then, substantive disagreement is possible.

In the remainder of this paper, I show that a certain form of linear logic is useful, and that it must be accepted by the logical instrumentalist. I also flesh out some consequences of this legitimacy.

Grammar and Linear Logic

The grammatical structure of natural language is complicated, to say the least. One must be careful when trying to use a logic to study its structure. There are two main issues. First, natural language is resource sensitive. Resources in natural language include things like nouns and verbs. Once we compose a sentence out of such parts, we cannot "use them again". In a sense, they are like ingredients in a recipe. If we are baking bread, say, and need one cup of flour, we cannot use that same cup for both the bread and a cake. The same goes for components of sentences: if we use a noun phrase to create a sentence, it gets "used up". It cannot be used again later to make another sentence. If we have two components, say a noun phrase, "Abe", and a verb phrase, "is eating", then we can put them together, to make "Abe is eating". But, once we do this, we no longer have two components, a noun phrase and a verb phrase, we have one, a sentence. We cannot "get back" the noun phrase or verb phrase without decomposing the sentence. So, we cannot "re-use" them to make another sentence (like "Is eating Abe"), since we no longer have access to them. Resources are used up in grammatical construction, and so our logic must be resource sensitive.

Second, the components of sentences do not commute. "Abe is eating Jello" is very different from "Jello is eating Abe": one involves a typical situation, and one a strange world where Jello is carnivorous.

This all leads to one conclusion: if we are going to use a logic to study the grammar of natural language, it cannot be commutative and it must be resource sensitive. This means we need a non-classical logic. There are many such logics which fit this role (and a very lively debate about which is best, see (Barker and Shan 2014), (Allo 2013) and (Pollard 2013)), and I will examine only one such logic here. The system given here is a Lambek system, and adapted from the presentation in (Moortgat 2013).

The system, which is called **NL**, for non-associative Lambek calculus, requires several atomic types, p, and three binary operations. The binary operations are

1. $A \otimes B$

2. $A \backslash B$

3. B / A

Usually, the basic types are taken to be parts of English syntax. So, for example, we have a sentence type, s ("Abe eats"), verb phrases, vp ("is eating") and a type for noun phrases, np ("Abe"). An expression of type $A \backslash B$ (B/A) requires an expression of type A on the left (right) to produce an expression of type B. So an expression of type np/s requires a noun phrase to produce a sentence (ex: "is eating"). The type $A \otimes B$ is a concatenation operation, so it is a kind of product. For example, if we had our $np \backslash s$ object above, "is eating", and concatenated it with an np, "Abe", we would get $np \otimes np \backslash s$ or "Abe is eating". This is the sense in which "Abe is eating" follows from "Abe" and "is eating". If we put "Abe" and "is eating" into the concatenation operation as inputs, the result is "Abe is eating". So the whole sentence "follows from" its parts.

Let us take a look at a more complicated example. Consider the sentence "Bonnie slowly gave Casper socks". The expressions "Bonnie", "Casper" and "socks" are all of the type np. "Gave" is a transitive verb, so could be considered type vp. However, since we need to concatenate this sentence together, we will need to use a different type. Here, "gave" will be of type $((np \backslash s)/np)/np$. That is, this particular verb takes two names of the right, and one on the left, and produces a sentence. Finally, since "slowly" is an adverb, it will essentially map verbs to verbs, and it suffices here to consider it as type $(np \backslash s)$. Now, we can see how this might work. In order to construct the sentence "Bonnie slowly gave Casper socks", we calculate the following: Bonnie $\otimes$ (slowly $\otimes$ (gave $\otimes$ Casper) $\otimes$ socks). With the types we have selected for each term, this looks like: $np \otimes ((np \backslash s)/(np \backslash s) \otimes (((np \backslash s)/np)/np \otimes np) \otimes np)$. Once this calculation is complete, we can see that our sentence is of type s, as expected.

Having this calculus in hand reduces the requirement of providing a formal syntax for a language to providing a lexicon and the types of objects in the lexicon for that language. This is a big step forward, and makes **NL** a very useful logic.

Concatenation and Conjunction

In the previous section, I showed that **NL** is a useful tool for studying the syntax of natural language. However, if this is true, then the logical instrumentalist must accept **NL** as a legitimate logic. It is a useful tool, and so it must be admitted to the instrumentalist's system. At the very least, the instrumentalist needs to accept that some logic which is resource sensitive and non-commutative is an admissible logic, because otherwise she will not have a useful tool to study natural language syntax.

So far so good: the instrumentalist has added a tool to her tool kit. There is at least one odd consequence to this view, though. The logical instrumentalist now has to admit that $\otimes, \backslash$ and $/$ are logical connectives. Even weirder, it seems that since $\otimes$ is a product, it is a candidate for being a logical conjunction.

There are two options for what type of operator $\otimes$ is. Either it is a conjunction-like operator, or it is an operator of its own type. It seems like being a product operator is somehow conjunction-like. Products join things together, as do conjunctions. For the logical instrumentalist, this is

enough for $\otimes$ to count, at least sometimes, as a conjunction. This is because the instrumentalist must agree that the logical connectives in play are of whatever type that best advances the goals of the people using them. And it is certainly at least fathomable that sometimes it might suit an investigation best to treat $\otimes$ as a conjunction. So, sometimes $\otimes$ must be a conjunction.

There are even examples where we can see that concatenation and conjunction behave similarly enough that they should be treated as the same thing. Consider, for example, the portmanteau "Brangelina". This is a concatenation of the names Brad Pitt and Angelina Jolie, and is meant to refer to them as a couple. So, Brangelina might be though to mean "Brad and Angelina". In this (albeit silly) case, the concatenation of Brad and Angelina has the same meaning as the conjunction of Brad with Angelina. Thus, there are cases where it is best to treat concatenation and conjunction as meaning the same thing.

However, $\otimes$ is certainly not like the conjunctions we are used to seeing.[6] The typical logical conjunction commutes, for example. One might think that admitting $\otimes$ as a logical conjunction is good reason to dismiss logical instrumentalism entirely, rather than accepting **NL** as a legitimate logic.

But we should not be so hasty! Recall that (Kouri Kissel 2018) argues that the logical connectives are polysemous and share a pre-theoretic meaning. On this view, admitting $\otimes$ as a logical conjunction is fine so long as it shares a pre-theoretic meaning with our typical logical conjunction. But there is a good argument to be made that it does share something like a pre-theoretic meaning with, say, classical conjunction, in that they are both "products". And, further, they do not seem to be too different to be related in a polysemous way. They both serve a similar role in their respected logical systems. Since the instrumentalist's admitting linear logic, and the logical connectives that comes with it, as a legitimate logic would fit very nicely into any of these systems, we can see how this admission is a feature rather than a bug. What we have essentially done is made our list of resources longer, and since the systems in question can make sense of the connectives, we have done so at essentially no cost. We get more tools for the same price!

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6   This is not the only strange conjunction. Conjunction in dynamic semantics, for example, also does not commute, though there we have the benefit of its name actually being "conjunction".

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