

Will the aliens have a different logic?

Abstract. What kind of logic could beings totally alien to us have? Could it be an unexpected variation on our logic, e.g. with *modus ponens* replaced by *affirming the consequent*? In this paper I argue that as no logic with *affirming the consequent* in place of *modus ponens* can exist, the logic of the aliens cannot be exotic in this way. Sure, the aliens could perhaps lack anything that we would call logic, but if they do, their logic cannot be too far-fetched vis-à-vis our one. I think this conclusion does not tell us anything deep about the (possible) aliens, but it does tell us something deep about logic.

Keywords. Logic; aliens; modus ponens; affirming the consequent; constitutive rules

Alien logic?

Suppose we do eventually encounter some extra-terrestrial beings: the slew of sci-fi movies have taught us to expect such aliens to differ greatly from ourselves, with different heads, different numbers of limbs (tentacles?), different colors (probably green or brown), different languages, different socks (tentacle pads?), etc. etc. But will they also have different logic? And what kind of logic could that be?

To answer this, however, we first need to know what logic is. And that's a notoriously complicated question. But for our current purposes, it will be enough to simplify it a little and accept that logic is a system of inference rules, i.e. rules for when conclusions can be correctly drawn from given assumptions. So the question is whether potential aliens might possess a set of rules substantially different from those with which we operate.

Language

It is clear that any logic is always encountered as embedded in a language. If it is a set of rules for drawing conclusions from assumptions, then these conclusions and assumptions must be sentences of some meaningful language, and the logic must be entrenched (maybe imperfectly) in that language. Then, of course, the question arises as to why we simply have logic, and not the logic of English, the logic of Turkish, the logic of Chinese, etc. The answer is that logicians believe that all human languages are so similar in terms of what concerns logic that logic can be studied through artificial languages that embody the essential common core of all natural ones¹. (More precisely, many logicians seem persuaded that logic is somehow "above" all languages and is embodied by natural languages only somewhat imperfectly. This is not a view I endorse, but here we may dispense with probing this divergence of opinions.)

The question now becomes: can aliens have a language so distinct as not to be translatable into our earthly languages and, indeed, beyond the scope of the artificial languages of our logic? Donald

¹ See Peregrin (2020).

Davidson (1974) came up with an argument, the conclusion of which, simply put, is that the very idea of a language that is completely untranslatable into ours is senseless. And this is because translatability is a criterion for being a language in the first place.

But that an alien language might differ from our own in at least partially untranslatable ways seems obvious. Aliens, for example, may possess a sense which we do not, and hence we would find their terms relating to such a different sensory experience impenetrable. So it is possible to imagine that the language of aliens might differ radically more from our own than any of our earthly languages differ from one another.

Fortunately, this kind of deviation need not be important for logic. This is because, as we said, it deals with inference - but not all cases of inference. It concentrates only on those that are a matter of the "logical expressions" of our language. Thus, in the artificial languages of logic, we do not find equivalents of our predicates based on sensory experience (logic is not interested, for example, in the statement *This sound is audible* being inferable from *This sound is shrill*) and artificial languages of logic usually contain only a skeleton formed by logical expressions and abstract from the rest. (Again: this is often justified by the view I do not share, namely that all inferences are inherently logical even though they sometimes do not explicitly state some of the premises that make them logical. But once again, fortunately, we need not deal with this difference of opinion here.) So the question whether extraterrestrials might have a logic different from ours is now essentially reduced to the question whether they might have some other logical expression, different in the sense that it would support drawing inferences different from those we draw.

Modus ponens

Anyone who has taken a logic course will be acquainted with the rule of *modus ponens* (hereafter MP). In the language of standard logic, it can be written as follows:

(MP) $\frac{A \quad A \rightarrow B}{B}$;

while in English it would be

(MPE) $\frac{A \quad \text{If } A, \text{ then } B}{B}$,

illustrated, for example, by

$\frac{\text{It's raining} \quad \text{If it's raining, then it's wet}}{\text{It's wet.}}$

However, there is a significant difference between these two versions. The formal language version holds *ex definitione*, and thus is guaranteed to be valid without exception. There may not be a version

for English without exceptions, counterexamples being discussed in the literature (McGee, 1985), but few will dispute that it applies in the vast majority of cases.

Let us now consider a prototype of argument that is clearly *not valid* - the so-called *affirming the consequent* (AC):

(AC) B A → B

A;

which in English would be

(ACE) B If A, then B

A,

and illustrated by

It's wet If it's raining, then it's wet

It is raining.

The question now is: could someone have a logic so different from ours that, for example, AC would apply instead of MP?

"Pre-logical mentality"

In the historical literature we can find arguments that in certain cultures (generally referred to as "primitive") some logical rules that we take for granted are not accepted. I will give two such examples.

The first comes from the Russian psychologist Luria, who studied natives in Kirghizstan and elsewhere (Luria, 1976)². He found that when he presented them with the following task:

In the Far North, where there is snow, all bears are white. Novaya Zemlya is in the Far North. What color are bears there?

instead of the response he expected (*White*), he received replies such as:

There are different sorts of bears.

I don't know; I've seen a black bear, I've never seen any others ... Each locality has its own animals: if it's white, they will be white; if it's yellow, they will be yellow.

We always speak only of what we see; we don't talk about what we haven't seen.

So it seems that the Kirghiz natives declined to reason according to rules that are quite obvious to us.

² See also Levi (1996).

It is similar with the natives of the Azande tribe, whose reasoning was recorded by Evans-Pritchard (1937)³. He claims that the natives believed that *All witches' daughters are witches* and that *All wizards' sons are wizards*. One would therefore expect the natives to accept that *All the descendants of a witch and a wizard are necessarily witches and wizards*, but, according to Evans-Pritchard, they did not.

So it seems we have two examples of cultures that don't work with logic as we know it. So does this indicate that there can be logics other than ours; and that we should not necessarily expect aliens to have the same as ours? (True, the given examples are logics that, measured against ours, we can deem "imperfect", but at least this shows that it is possible to live with a logic other than ours.) However, before jumping to this conclusion, I think we should analyze the given examples in more detail.

Can MP be invalid?

The crucial thing to note is that in such examples there is always necessarily a translation from the language of the natives into ours (or into the language of formal logic), which is usually completely ignored when the examples are presented. The essential thing is that the argument that is at stake in the case of the Kirghiz natives is of course formulated in *their* language. So, for example, if we have an argument that aspires to be declared MP, it will not have the form of MPE, but some form in which there is a native expression in the place of our *if-then*, say *aka-oka*. Now note that the given argument can be MP only if the logical expression that plays the key role in it is *an implication*. For example, if we replaced the implication with a conjunction, we would get the rule

$$\frac{A \quad A \wedge B}{B},$$

which is obviously valid (admittedly a bit strange, because premise A is somehow superfluous in it, the rule would be valid even without it), but we certainly wouldn't call it MP. The lesson from this is that before we can make statements about the role of MP for the natives, we need to identify the exact expression (or expressions) in their language that is an implication.

So what does it mean to say that an expression *is an implication*? Well, it seems to mean something like it behaves similarly (or has a similar meaning) to the prototypical (for us) cases of implication - i.e. \rightarrow of the language of standard logic or *if-then* of English. How similar does it have to be to these expressions to be warrantably called implication? The answer to this is not entirely straightforward; but it seems that the most characteristic for \rightarrow or *if-then* is precisely that it is governed by MP. (Of course, this does not mean that, conversely, anything that satisfies MP is an implication. In order to be an implication, the conjunction must also satisfy something else, but there is no complete agreement on what exactly⁴.) But this way, it seems, we get into a position where in order to identify MP in a language, we would have to already know that MP holds there.

³For discussions, see e.g. Triplett (1988) or Da Costa, Bueno & French (1998).

⁴ The most usual proposal, of course, is that $A \rightarrow B$ if B is inferable from A.

So let's return to the Kirghiz natives and the alleged cases of logic failure. We have here some connection of two sentences, which we understand as an implication, but which does not obey MP. Maybe they obey some other rule, for example

A aka A oka B vida B

B,

where *vida B* means *I witnessed B* (according to one of the answers given: *we only talk about what we see*). This is, however, a really strange argument, because it seems that the first two premises are completely redundant.

Let's summarize our argument once more:

1. We are concerned with whether the logic of natives involves MP.
2. We identify a rule in their language which appears to us to be MP and which the natives do not seem to accept, e.g.

(MPN) A aka A oka B

B.

3. But in order to be sure that it is MP, we need to check whether *aka-oka* is an implication.
4. The essential part of such verification is to verify that *aka-oka* obeys MP, that is, that MPN holds for it.
5. So in order to identify MP in a native language, we must already know that MP holds there. Ergo, there is no such thing as an invalid MP.

And this conclusion seems absolutely absurd.

There is no MP without implication; and there is no implication without MP

But is it really absurd? Let us imagine that we are observing a native game that is similar to our chess. We want to find out if there is a rule in this game that bishops only move diagonally. Suppose we find that a piece moves other than diagonally. In order to claim this as proof that their bishops are different from ours, we would have to know that the piece in question is a bishop. How do we find out? It seems justified to declare something a bishop when it can only move diagonally. So to find out that the bishop does not move diagonally is simply impossible - if it does not move diagonally, it is not a bishop. And that doesn't look particularly absurd - since the bishop is the very piece that moves diagonally, *the bishop moving other than diagonally* is simply a contradiction in terms. And in an analogous sense, *an implication that does not obey MP* is also a contradiction, so it is simply impossible to find out that some implication does not follow MP.

Put another way, rules like MP are *constitutive* (Searle, 2018; Kaluziński, 2019) - they do not tell us how to correctly do something we already do (for example to infer logically), but they create (constitute)

something for us that we did not have before. Specifically, MP constitutes an implication as a logical connective, with the help of which we can then form various kinds of conditionals and engage, for example, in counterfactual reasoning. (However, it is not the case that until we have this logical conjunction explicitly constituted in this way, we have nothing like an implication - we have an implication in natural language, constituted by the relevant - for the most part implicit - rules of the language.)

Analogously, it can be argued that we cannot have a valid argument of the form AC: for if this were the case, then the connective that occurs in it could not be an implication, and thus the argument could not be an AC. Therefore, it is simply impossible to have a logic in which AC would be valid instead of MP.

What does this tell us about the possibility of alternative logics? Certainly not that we cannot have alternatives to the logic we have converged on as standard (or, as it is often called, classical). Indeed, the entire development of modern logic is imbued with the investigation and establishment of such alternatives (originally called non-classical logics). However, these alternatives are mostly based on particular motivations – for example, the fact that some arguments are not accepted unambiguously by the speakers (For example, *It is not unhealthy, therefore it is healthy*).

But don't we find in the huge number of logics that have been created in this way, perhaps some that reject MP? Well, there is nothing easier than to take some logic, perhaps the classical one, and simply remove the MP from it. But then it will be necessary to justify why the connective this argument features continues to deserve to be called implication. And if it doesn't deserve it (and I personally can't imagine any reasons trumping the fact that it does not follow MP), then the question is whether the invalidated rule deserves to be called MP.

Can we have logic without MP and without implication?

We cannot have a MP that is not valid; but of course we can have no MP at all and with it no implication. Something similar can perhaps be said about the Kirghiz natives, tested by Luria: they do not have a connective that can be used as an implication. But can they even be said to have *logic*? Can there be logic without implication?

This is largely a matter of terminology. Carnap (1934, p. 52) in his now almost one hundred-year-old work promotes the principle of tolerance, which also resonates with parts of contemporary logic:

In logic, there are no morals. Everyone is at liberty to build up his own logic, i.e. his own form of language, as he wishes. All that is required of him is that, if he wishes to discuss it, he must state his methods clearly, and give syntactical rules instead of philosophical arguments.

If we accept this principle, then surely we can have logic without implication (because we can have absolutely any logic). But note that we do not need to adopt Carnap's conception of logic: instead we may conceive of it as having a certain *function*, so that it necessarily requires means that enable it to

fulfill this function. From this point of view, logic may not be able to do without such means. And if so, can't implication also belong to such means?

As an example, I will describe one such "functionalist" conception of logic, which is close to me personally; this is so-called *expressivism*⁵. According to this conception, the function of the logical expressions of natural language is to make explicit the inferential relations between non-logical propositions.

Let's imagine a hypothetical "primitive language" in which there is an expression for tiger (which is a rudimentary equivalent of our sentence "Beware, tiger!") and an expression for danger (which is a rudimentary equivalent of our sentence "Beware, danger!"). Using the second of these statements it is, for understandable reasons, always correct when it is correct to use the first - the second therefore follows from the first in this sense. So we have a rule of a natural language that speakers follow (or perhaps sometimes violate)

The idea of expressivism is that it is advantageous to be able to express such a rule explicitly. If we can do that, we can talk about it explicitly, and maybe even reject it if it turns out to be obstructive. (Imagine, for example, that some of our ancestors, based on contact with tigers, developed a rule that if something is striped, it is dangerous. But then they discovered zebras and found out that some striped animals can be a welcome source of meat. So the rule that if something is striped it is dangerous was no longer useful and it became sensible to abolish it.)

So what do we need to make the rules explicit? We need a means that allows us to express a given rule as a sentence. So, for example, if we have a rule that leads us from premise P (for example, *Striped*) to conclusion C (for example, *Danger*), then it seems that what we need will be some kind of implication. If we have a suitable implication, we can formulate the sentence $P \rightarrow C$, which is the desired explication of our rule.

Hence from the point of view of expressivism, logic without implication does not make very good sense. And it is probably similar to any functionalist view of logic (which is therefore not as libertarian as Carnap's), according to which the logical expression fulfills a purpose, and is not just a tool of an arbitrary game.

More perfect logic?

Now let's get back to the aliens. So can they have a logic radically different from ours? If we understand logic as inevitably including a rule of type MP, then the answer is not entirely clear. Let's try to break it down a bit.

The first question we can ask ourselves is whether English can be without MPE and more generally a language without an analogical rule. There is an unequivocal answer to that: Of course yes, even MPE is *de facto* not generally valid in English. But we can also ask if English can be without something *close*

⁵See Brandom (2000); Peregrin (2008); Arazim (2017).

to MPE, i.e. without something that could be regimented by an implication governed by MP, i.e. without something that is at least approximately an implication? Such a question is of course indeterminate, but the answer to it is, I think, essentially negative: there must be something at least close to implication in a language. And it is the same with negation, conjunction, etc.

So, given that one of the important things we need language for is argumentation, there must be rules in any such language that are at least approximated by the rules of (our) logic. Could there be any other rules that we don't know (yet?) and that would significantly improve our ability to argue or reason?

What we discussed in the previous sections were various *impoverished* variants of our logic: we came to the conclusion that it is possible to imagine a logic (or "logic"?) that lacks something compared to ours. However, we are rather expecting the aliens to have "better" logic than ours, so we are faced with the problem of whether an *enriched* logic can also exist in addition to an impoverished one. So would it be possible for aliens to have some logical constants that we don't (and that we would need)? Of course, new logics are always being created, and with them new logical constants. But the question is whether such constants can enrich our very ability to reason in a non-trivial way.

Of course, we can expect that aliens, if they were to come here, might have tools to deal with problems that we can't deal with. Maybe they could have a cure for cancer. Or they could have powerful and safe nuclear fusion reactors. Or they could have a device that could transmit scents over a distance. So why couldn't they also have some revolutionary logical constants for us?

It seems to me, however, that the above examples are of tools that solve problems we face (and can't deal with). But what problems would such new logical constants solve? Do we have any analogous problem in our reasoning that we could imagine being solvable with the help of some new constants that we are unable to create? I can't imagine what it could be⁶.

Conclusion

I do not think we should expect the aliens to have a logic very different from our own. Of course, they may have nothing that would warrant the name *logic*; their ways may be so enigmatic (for us) that we may not be able to make any sense of them. But they cannot - and, for that matter, nor can anybody else - have a logic different from our own in the manner of having MP replaced by AC.

Logic is a tool for solving specific practical problems - it is probable that beings evolved in a world not utterly dissimilar to our own will have faced similar problems and developed similar tools. But it is also

⁶ We must, of course, distinguish between the problems dealt with by logic as a system of deductive rules embodied in our (natural or artificial) language, and the problems that have arisen around the theoretical grappling with this logic. Of course, it is possible that the aliens, if they arrived at the same theories as us, would be able to solve some of the latter problems, even if we may not yet. It is conceivable that perhaps they will be able to prove the non-contradiction of set theory. But this is not directly related to the question we are asking in this article. (Except that it assumes that their logic will be in some way the same as ours.)

conceivable that they will handle their problems completely differently from how we do, and that hence their evolution will go in truly alien ways. What is not possible is that they will have basically gone our way, but jumbled its cornerstones.

The moral I think we should draw from these considerations does not concern the aliens, but logic. Our logic is a complicated construction the parts of which support each other in delicate manners. If we are careful enough, we can reshuffle some of the parts so that it still maintain its stability, thus gaining various alternative versions of the logic. But we should not imagine that other, less careful reshufflings are possible and mark varieties of logic alien to us - for these would merely lead to a collapse of the construction.

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