

# Rayo's *The Construction of Logical Space*

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**ABSTRACT** *I wonder which one in a series of characters Agustin Rayo really is, with an emphasis on objective correctness and semantics.*

## I. A Tale of Many Rayos

Enter *Mainstream Rayo*. Mainstream Rayo has philosophical views that are more or less in line with one of the accepted standards. Not that they can't be debated or aren't debated, but they are considered one of the usual ways to set things up, shared by lots of other philosophers. Mainstream Rayo holds, for example, that facts or propositions coarsely understood are the same when they have the same truth-conditions, which is to say when they are necessarily true or false together, or necessarily obtain or don't obtain together. That, of course, doesn't mean that facts or propositions more finely understood could not differ even though they are truth-conditionally equivalent. Still, there is no objectively distinguished way to represent a coarse fact with a fine representation of it. Coarse facts are just truth-conditions, or equivalence classes of fine facts under the equivalence relation of truth-conditional equivalence, and how we pick out those truth-conditions is not for the world to complain about. The goal of inquiry, Mainstream Rayo holds with many others, is to find the truth, understood as finding out which coarse facts obtain. To pin down a particular fact is progress towards this and narrows down the possibilities still left open. To put it slightly metaphorically, it narrows down where in logical space we are, i.e. which possibilities are still left open by what we figured out so far. Mainstream Rayo holds, with almost everyone else, that mathematical truths are necessary

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truths and thus they all have the same truth-conditions coarsely understood. Still, there are many ways to represent these truth-conditions, and there are ways such representations are integrated in our cognitive lives that make sense of why finding out a new mathematical result is a cognitive achievement. Mainstream Rayo, however, sometimes puts labels on common views that make them seem more radical than they are. For example, he calls the view that mathematical truths are necessary truths the view they have trivial truth-conditions, but that is not to be confused with the view that they are trivial, since many are hard to figure out. And he reads a necessary material biconditional  $\Box(A \leftrightarrow B)$  as a 'just is'-statement, the statement for A to obtain just is for B to obtain. But this is not taken to mean that there is a conceptual or analytic connection between A and B, or that we are dealing with a real definition, or anything metaphysical, just sameness of truth-conditions coarsely understood. Mainstream Rayo holds that what is necessary and possible is settled by all true 'just is'-statements, but who would disagree that, say,  $\Box A$  follows from, and thus is settled by,  $\Box(A \leftrightarrow \text{Rayo} = \text{Rayo})$ ? He calls this 'the construction of logical space' which is a nice metaphor, but, of course, nothing is actually constructed and we don't do any constructing. When Mainstream Rayo wants to do something far out he listens to an unusual interpretation of Beethoven.

Next, enter *Carnapian Rayo*. Carnapian Rayo lives on the edge. He rides a motorcycle with no helmet on, smokes unfiltered French cigarettes and he is not afraid to push the philosophical limits and shock the establishment. Carnapian Rayo holds much of what Mainstream Rayo holds, but he takes it further. He thinks the range of possibilities is in part due to us and our goals and interests. Thus what truth-conditions sentences have, which ones are equivalent and which ones are not, is partly our doing and partly a practical matter. To engage in inquiry is to do two things: first to settle the partly practical matter of what the space of possibilities should be in which inquiry is carried out, and second, to find our position in this space. Cost-benefit considerations make it advisable for us to accept certain mathematical 'just is'-statements like

NUMBERS: There being exactly  $n$  Fs just is for the number of Fs to be  $n$ .

Which in turn contributes to constructing logical space so that mathematics has trivial truth-conditions and holds everywhere in the space equally. NUMBERS is true, and the structure of logical space constructed partly by our acceptance of NUMBERS makes clear that it is true. To ask about the objective truth of 'just is'-statements which construct the space itself is to make a certain error, no such question can coherently arise. The notion of truth presupposes that of logical space, which is based on the accepted 'just is'-statements which construct it. Which ones are advisable to accept is a

good, practical question, which ones are objectively true outside of such practical considerations is confused.

Now enter *Aristotelean Rayo*. Aristotelean Rayo also holds much of Mainstream Rayo, but has copies of Kit Fine's papers hidden under his mattress. He is a metaphysician at heart, although he is not quite ready to come out as such and is a little conflicted about it all. Aristotelean Rayo suggests a metaphysics of modality which holds that all modal facts are grounded in a select set of facts which are similar to what others have called real definitions, but he calls 'just is'-statements. Aristotelean Rayo holds a similar metaphysics for mathematical facts which takes all mathematical facts to be grounded in a select set of mathematics related 'just is'-statements. This metaphysics of modality and mathematics is based on theoretical considerations similar to those favored by people who engage in serious metaphysics: theoretical simplicity, fruitfulness, etc. Logical Space, the space of all possibilities, is constructed out of these basic 'just is'-facts in the sense that it is grounded in them. It is build up from those facts in some sense of metaphysical priority.

Finally, enter Agustín Rayo, the author of the fascinating, terrific, and puzzling, *The Construction of Logical Space*. How does he relate to the other three Rayos? Agustín Rayo, or Rayo for short, says things that make him seem like each one of the three Rayos in various places, and he says things that suggest he isn't that one in other places. I am unclear in the end where he stands and how radical his proposal is or can reasonably be taken to be. To the best of my judgment Rayo wants to be Carnapian Rayo, but doesn't quite argue for it, he would hate to be Aristotelean Rayo, but a good part of his book makes more sense as Aristotelean Rayo, and he might just end up as Mainstream Rayo. I hope to elaborate why that seems to be so, why I can't find the arguments in Rayo's book for the view of Carnapian Rayo, and what topic and discussion I badly missed in Rayo's book, on which I think much of this will in the end depend.

## II. Objectively Correct 'Just is'-Statements

What Rayo officially says about 'just is'-statements is often very mainstream, but it is clearly intended to be more. 'Just is'-statements claim that two things are truth-conditionally equivalent.<sup>1</sup> 'Just is'-statements construct logical space, but on the official list of some examples on p. 3 they are a diverse bunch. Some of them are obviously true, likely conceptual truths, and will be quite universally judged to be true (although some philosophers will disagree) like SIBLING or DINOSAURS or DEATH, some of them are empirical discoveries like WATER, and some of them are more

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<sup>1</sup>Rayo, 52, and other places. All page references to Rayo are to *The Construction of Logical Shape*, except where specified.

controversial and theoretical like TABLES. One role that such 'just-is'-statements play is to restrict logical space in the sense that accepting one reduces the options in logical space, it closes possibilities,<sup>2</sup> it doesn't allow for certain question to remain open. Some of this discussion of closing possibilities sounds like a discussion of closing epistemic possibilities, something that knowledge might do. But officially that is not the idea, I take it, it closes metaphysical possibilities for the person who accepts a 'just is'-statement. But to accept a 'just is'-statement is not the same as to know it to be true, at least not on the face of it. It is closer to believe it to be true. But belief without knowledge does not close possibilities in the sense that knowledge does, or at least knowledge ones knows one has. To illustrate, one can accept that A is truth-conditionally equivalent to B while being open to the possibility that this is in the end not so, and thus keep the epistemic possibility alive that one obtains while the other does not. I might accept that being water just is being H<sub>2</sub>O, since the evidence so far points in its favor. But this can be so even though I realize that future evidence might undermine this, and thus I might have to accept that water isn't just H<sub>2</sub>O. My accepting that water just is H<sub>2</sub>O does thus not completely close the space of epistemic possibilities. This is not coherent for conceptual truth, i.e. it being a conceptual truth for A being truth-conditionally equivalent to B, but it is coherent, and not uncommon, for equivalences that one accepts on other grounds. Some of the discussion of logical space in Rayo's book sounds like a discussion of epistemic possibility, some of it sounds like a discussion of metaphysical possibility. I take it that it is indented to be the later, and that Rayo, too, would accept a gap between epistemic and metaphysical possibility, but some of the use of 'just is'-statements suggests that they are supposed to close epistemic possibilities. This issue leads me to my more serious concerns about 'just is'-statements and Rayo's use of them. It is connected to the difference, if there is one, between accepting a 'just is'-statement and taking it to be true on the one hand, and it being true on the other.

To my mind, the most significant action in Rayo's book is in Section 2.3. This is the place where Mainstream Rayo goes toe to toe with Carnapian Rayo, with nothing less than the grand picture of the view at stake. Carnapian Rayo seems to me lose that round. The issue is simply this: are 'just is'-statements themselves true or false? So far both Mainstream and Carnapian Rayo agree: they are true or false. Carnapian Rayo holds that they are true since acceptance of 'just is'-statements constructs logical space, and in the space so constructed the accepted 'just is'-statements are trivially true, alternative ones are false. Mainstream Rayo thinks they are true or false, like all other statements, and acceptance is merely an epistemic matter. But then, can there be a gap between acceptance and truth of 'just is'-statements? Can it be that although we accept certain 'just is'-statements, but they are nonetheless

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<sup>2</sup>Rayo, 18, 19.

false? Rayo takes this to be the question about the *objective truth* of ‘just is’-statements, and it is tied to the question whether there is an objectively correct logical space. Here Carnapian Rayo says no and Mainstream Rayo says yes. For Mainstream Rayo ‘just is’-statements are just statements, and we could accept the ones that are false. For Carnapian Rayo, the question of the objective truth of ‘just is’-statements makes no sense. To ask for it is even to engage in a certain kind of an error, a confusion that highlights the crucial difference between him and the mainstream.

It seems to me that how this turns out is central for assessing Rayo’s project. If there is an objective logical space, and if ‘just is’-statements are just like other statements, then much of what is to come doesn’t really make much progress over the mainstream. But if there is no objective logical space then there is a new angle on the debate over modality and mathematics that puts it into a Carnapian picture in a novel way. Rayo, Agustín Rayo that is, is slightly tentative in the official endorsement of the Carnapian position, in particular in endorsing a practical aspect to the acceptance and truth of ‘just is’-statements. On p. 62, he talks about his ‘suspicion’ that practical aspects play a role, and that ‘there is room for thinking’ that practical considerations play a role. Even when it comes to there being an objective logical space he says at the end of Section 2.3.3<sup>3</sup> that ‘. . . it is important to keep in mind that nothing in what follows will depend on how one ends up thinking about the correctness of a conception of logical space. There is no obstacle to embracing an objective notion of correctness, provided it is adequately understood’.<sup>4</sup> Here I disagree. As I understand Rayo’s position, this is a crucial matter. With an objective conception of logical space his view will likely end up like Mainstream Rayo’s, without it will be like Carnapian Rayo’s, which are very different views.

Despite Rayo’s downplaying of the significance of this issue, there is an argument in the book on pp. 57 and 58 which seems to me to be the central argument on which much depends. This argument is in direct support of Carnapian Rayo over Mainstream Rayo, and we should look at it carefully. The argument strikes me as mistaken, and I would be eager to learn why I don’t fully appreciate it. The argument is on pp. 57–59, it goes as follows. I quote the crucial passages:

But what does it mean to say that a conception of logical space is objectively correct? The most straightforward answer would be to say that for a conception of logical space to be objectively correct is for the ‘just is’-statements it is based on to be objectively true. But, as we shall see, this doesn’t immediately constitute much progress.

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<sup>3</sup>Rayo, 63, 64.

<sup>4</sup>Rayo, 62, 63.

The following, I take it, is a natural way of thinking about truth. To *set forth* a statement is to make a distinction amongst ways for the world to be—to divide logical space into distinct regions—and to single out one side of this distinction; for the statements to be *true* is for the region singled out to include the way the world actually is.

On this way of seeing things, the notion of truth *presupposes* a conception of logical space: the distinction between the true and the untrue is just the distinction between regions of logical space that include the way the world actually is, and those that do not. [...] But in the case of 'just is'-statements, truth or falsity will be determined *entirely* by the background conception of logical space. [...]

So, against the background of which conception of logical space should one assess the question of whether a given 'just is'-statement is true? One would like to respond: 'against the background of the *objectively correct* conception of logical space'. But the notion of objective correctness is precisely what we were trying to get a handle on. It is for this reason that I find it hard to see how one could succeed in elucidating the notion of objective correctness by saying that for a conception of logical space to be objectively correct is for it to be based on the set of objectively true 'just is'-statements.<sup>5</sup>

Rayo, channeling Carnapian Rayo, then goes on to compare acceptance of 'just is'-statements to settling on the rules of a game, and suggest that it is in part a practical matter as to which ones are the correct ones. Demanding objective correctness for logical space is like demanding to play whatever game has the objectively correct rules.

But this argument seems to me to confuse a dependence of the *notion* of truth on the notion of logical space, as it was elucidated in the example, with dependence of truth itself on logical space. If I elucidate, that is explain or make clear to someone, the notion of truth the way Rayo suggests (which Mainstream Rayo might agree with) then the success of this elucidation depends on having a notion of logical space in place. And thus in the order of elucidation logical space is prior to truth. But none of this shows that there is no objectively correct logical space, or no objectively true 'just is'-statements. To make it clear, let me elucidate the notion of truth with a somewhat, but not completely, analogous example: to set forth statement is to make a distinction of closeness to God. The statement is true if those who believe it are, all things being equal, more similar to what God believes than those who do not. The goal of inquiry, in the end, is perfect similarity to God when it comes to belief. Successful inquiry approximates God until it reaches this end. But does it make sense to ask whether it is objectively correct to

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<sup>5</sup>Rayo, 57, 58 (emphasis in the original).

accept that God exists? You might think: sure, as long as it is objectively true that God exists. But the notion of truth was elucidated by reference to God, so it makes no sense to tie objective correctness of acceptance of God to truth. Acceptance of the existence of God is in the end a practical question to which objective standards of correctness don't apply, or so the analogous argument might go.

Now, this is all a mistake. Priority in elucidation doesn't support a rejection of objective correctness and objective truth. Mainstream Rayo might well be a theist who accepts an omniscient God and thus can accept the elucidations of truth in terms of logical space, or of truth in terms of God. But none of that supports that there is no gap between acceptance and truth when it comes to 'just is'-statements or theistic statements. All of this business about the elucidation of truth in other terms is compatible with there being one objectively correct, acceptance independent, logical space, or God.

In a sense its worse than all that. Carnapian Rayo does not want to accept a gap between acceptance of 'just is'-statements and their truth.<sup>6</sup> Logical space is based on the 'just is'-statements. Is it based on the acceptance of 'just is'-statements, or the truth of 'just is'-statements? Mainstream Rayo can certainly hold the latter, as can anyone else, barring special views in modal logic or about modality in general. And Mainstream Rayo can hold that in the acceptance of 'just is'-statements we can be wrong: even though we all accept *A* just is *B*, in fact it can be that *A* while not *B*. This seems to be all the notion of objectivity that is needed to distinguish Carnapian from Mainstream Rayo. Mainstream Rayo can hold that logical space is objectively correct just in case it is built on true 'just is'-statements, and the truth of 'just is'-statements is not directly tied to our acceptance of them. This minimal notion of objective correctness that allows for a gap between acceptance and truth is all we need. But Carnapian Rayo cannot allow this. This difference is crucial, as I hope to make clear in the next section, for what Rayo says about semantics. And Mainstream Rayo seems to have the better cards here.

Many of Rayo's examples of 'just is'-statements are examples where we generally all accept the truth of the biconditional, while the modal status of the truth is more problematic. But that is not essential for the story as I understand it. I might well accept the following 'just is'-statement:

TENOR To be Thomas Hofweber just is to be the greatest tenor ever.

This structures logical space in a certain way, it accepts and rejects certain distinctions, etc. But is acceptance and rejection of TENOR partly a practical question, the result of cost-benefit analysis on how to conceive of logical space? And is its truth determined by these considerations? I see little hope

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<sup>6</sup>Carnapian Rayo could accept a gap between individual acceptance and truth, as opposed to collective acceptance and truth. I leave all this aside, as does Rayo.

for Carnapian Rayo here. TENOR is simply false, and no cost-benefit analysis will make any difference to that. The question then remains whether the particular 'just is'-statements that Rayo most essentially relies on are in fact true or not. To settle that it might seem that we have to look at the relevant sentence A and B that are claimed to be truth-conditional equivalent, and determine whether they indeed have the same truth-conditions. Sometimes Rayo speaks as if acceptance and rejection of 'just is'-statements is related to fixing the meaning of certain expressions, as in the zoologist example on p. 39. This could be done also for TENOR, where the issue might be about how to use words like 'greatest tenor', and for some meanings of that phrase I might well be it. But in general, or so I take the view to be, this is not what is at issue. Rayo is not like Eli Hirsch, he does not hold, to modify Hirsch to fit in here, that accepting different 'just is'-statements corresponds to speaking different languages, which are, as languages, equivalent.<sup>7</sup> The relevant sentences we are considering are sentences of English, in general with their shared and given meanings. Are these English sentence truth-conditionally equivalent? If we take a regular 'just is'-statement we can ask whether the left and right hand side has the same truth-conditions in English. This seems to be a question about English sentences, thus a question to be addressed in semantics. And this leads to the issue of what Rayo says about semantics and the semantics he offers for arithmetic statements, our final topic.

### III. Rayo on Semantics

Let's consider Rayo's example

NUMBERS: There being exactly  $n$  Fs just is for the number of Fs to be  $n$ .

If NUMBERS is true then

(1) There are (exactly) four moons of Jupiter.

and

(2) The number of moons of Jupiter is four.

are truth-conditionally equivalent. Carnapian Rayo holds that the truth of NUMBERS flows from our acceptance of NUMBERS, which in turn is a good practical decision to make due to its cost-benefit profile in inquiry. So, no question why or whether (1) and (2) are equivalent. Carnapian Rayo does not face this question, but there is good reason not to be Carnapian Rayo,

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<sup>7</sup>See Hirsch, *Quantifier Variance and Realism*.



and non-Carnapian Rayo does face the question. As a question about the truth-conditional equivalence of English sentences, one would expect considerations about the semantics of English to be relevant for this question. The question whether (1) and (2) are indeed truth-conditionally equivalent in English is a great and puzzling question. As Frege had already observed,<sup>8</sup> one puzzle about it is that the word ‘four’ appears in apparently quite different grammatical positions in these sentences. Nonetheless, almost everyone would judge them to be equivalent. But why would such an equivalence be so obvious, in particular since the equivalent sentences seem to be about different things. That they are equivalent seems to be widely held among the philosophically uncontaminated and surely not on the basis of cost-benefit analysis. Does the semantics of the left and right side of the English NUMBERS support that they are equivalent? Does it explain why it seems to be obvious that they are equivalent? Does the semantics that Rayo gives to it?

The way Rayo engages in semantics is quite puzzling to me, and I feel it only makes sense if Rayo is Carnapian Rayo. What’s puzzling about Rayo’s treatment of semantics is that he doesn’t really give a semantics of the English sentences at all. Nothing he does could be recognized as natural language semantics in a reasonable contemporary style. Rather he specifies truth-conditions in a formal logic style, assigning denotations and satisfaction conditions to phrases in artificial languages, but not natural language. But why is what we do with these simple formal languages relevant, given that they are far removed from natural language or formal languages that are more suitable to model features of natural languages? After all, NUMBERS is an English sentence, and we want to know whether the truth-conditions of the left and right side are the same. It would make sense if one is Carnapian Rayo. That NUMBERS is true is settled by our acceptance of it and the logical space that results. There is no question about whether the left and right side have the same truth-conditions, that is just what was settled. Its not something we can try to determine by semantic analysis, we just settled it by accepting NUMBERS. But if we are not Carnapian Rayo then there is such a question as whether NUMBERS is indeed true, that is if the required truth-conditional equivalence indeed obtains. And that question is partly one about the semantics (natural language semantics, that is) of the left and right side of it.

Rayo nowhere in the book engages this question. Nowhere, for example, does he address the puzzle how the English word ‘four’ can occupy one syntactic position on the left side of NUMBERS, while an apparently different one on the right side. Nowhere does he address why ordinary speakers generally and immediately judge NUMBERS to be true. I

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<sup>8</sup>Frege, *Die Grundlagen der Arithmetik*.

personally have spent quite a bit of time on trying to answer just these questions, with the results, be they as they may, in the papers cited in the footnote.<sup>9</sup> But why does Rayo seem to think that none of these questions are even relevant for his project? My own view, for what it's worth, is that by thinking about the puzzling syntactic features of the relationship between number words in the left and right side of NUMBERS supports the view that they are indeed truth-conditionally equivalent, but also that no reference to numbers occurs on either side. In (2), 'four' is not a name for an object, but a determiner that is displaced from its canonical syntactic position (which it occupies in (1)) to help achieve a focus effect. In particular, in English 'four' is nothing like a constant or name, which is how it is commonly understood in formal languages, like the ones Rayo uses. The relationship between (1) and (2) is thus analogous (though the analogy is not perfect) to the relationship between

(3) Agustín likes Carmen.

and

(4) Carmen is who Agustín likes.

Both have the same truth-conditions, and thus represent the same coarse fact, but they do so with different information structure. One represents it neutrally, the other with focus on a particular part of the information. It is our linguistic competence that explains why we immediately judge them to be equivalent. Cost-benefit analysis has no place here. The motivation comes simply from considerations about natural language.

Rayo wants to have the result that the question whether or not reference occurs in (2) is trivial in a sense. He endorses the neo-Fregean line on this question and holds that for reference to occur just is for an expression  $t$  to have the syntactic role of being a singular term, and it being true that, I quote ' $\exists x(x = t)$ '<sup>10</sup>. But that is not really a view about reference in natural language, more a view about reference in formal languages like the ones used in standard predicate logic. The notion of a singular term is not a notion that is clear in natural languages. However it is made more clear, it is a substantial question whether or not singular terms so understood are uniform or diverse in their semantic functions. And the relevant  $\exists x(x = t)$  that is supposed to be true is not an English sentence. It is not clear (and I believe false) whether the English 'Something is  $t$ ' or ' $t$  exists' are uniform in that they only have one reading allowed semantically.

Rayo contrasts his own view with a metaphysically loaded view he calls *metaphysicalism*. The metaphysicalist holds, as Rayo characterizes them, that there is a distinguished way to carve up facts into objects and properties,

<sup>9</sup>Hofweber, 'Number Determiners'; Hofweber, 'Innocent Statements'.

<sup>10</sup>Rayo, 15.

and thus it is puzzling how a fact can be expressed both with (2) as well as (1). But this is not really a puzzle if facts are understood just as truth-conditions, or as being the same up to having the same truth-conditions. For fine-grained facts this is puzzling, but no matter what ones metaphysical views about facts are in the end, everyone can agree that facts understood coarsely do not have a distinguished structure. It is up to the world to settle what can be the case, and so it might just be that two completely different fine-grained facts have to obtain together, and thus are fine-grained representation of the same coarse-grained fact. Rayo's own compositionism can come out as a quite innocent view, in essence what I just said, and Mainstream Rayo couldn't agree more, or as a much more substantial one, giving a special role to 'just is'—statements that would make Carnapian Rayo proud. What seems to me to be telling about Rayo's view in the end is what style of semantics he engages in and what this suggests about what the view overall has to be.

What Rayo does when he does semantics is to specify or assign truth-conditions. To focus on his prime example, he assigns every arithmetical sentence truth-conditions such that all mathematical truths come out as necessarily true. Rayo essentially employs his 'outscoping' idea in doing this, which I will have to sideline now, although it is certainly worthy of closer discussion. What I would like to focus on instead is that this, as understood so far, can be done quite easily, much more easily than how Rayo does it. Consider this assignment:

$$\phi \leftrightarrow 0 = 0 \Leftrightarrow PA^2 \models \phi$$

$$\phi \leftrightarrow 0 \neq 0 \Leftrightarrow PA^2 \not\models \phi$$

Or even simpler:  $\Phi$  is equivalent to  $0 = 0$  just in case it is true, and equivalent to  $0 \neq 0$  just in case it is false. That assignment is correct, and gets the coarse truth-conditions of arithmetical sentences right, just as Rayo's does. But Rayo goes beyond this in that he gives a *compositional* assignment of truth-conditions. But it remains unclear to me why that makes a crucial difference. Neither assignment is anything like natural language semantics. None of them illustrates what is really going on in the semantics of the actual English sentences. Rayo takes a first-order language of arithmetic, with various terms like number constants, number terms like  $\#_{x_i} \Phi(x_i)$ , and so on, and gives a compositional semantics for it, in the style of a denotational semantics for a first-order language using number terms while doing all this. But we know, and Rayo wouldn't disagree I am quite sure, that formal languages like those of standard predicate logic are bad guides to the semantics of natural language. For example, the English

(5) Every number has a successor.

is semantically or syntactically nothing like

(6)  $\forall x(\text{Num}(x) \rightarrow \exists y(S(x) = y))$

(6) gets all kinds of facts about (5) wrong. It misrepresents the argument structure, it falsely puts in a conditional, etc.

It is pretty well motivated that natural languages should have a compositional semantics. But it isn't clear to me why Rayo's specification needs to be compositional, nor why he can sideline natural language semantics. Unless, of course, it goes like this: the goal of the specification of truth-conditions is to show how all the truth-conditions of arithmetic are determined by 'just is'-statements, which in turn are constitutive of all mathematical truth. That makes sense for Carnapian Rayo, maybe also for Aristotelean Rayo. It doesn't try to investigate the actual truth-conditions of English sentences, but rather constitutes stipulated truth-conditions, which is not an empirical project. Maybe they replace or regiment the English truth-conditions in a new and improved language (but what was wrong with the old one)? Maybe they are an idealization or simplification (but why not look at the real thing)? In any case, if Rayo is neither Carnapian Rayo nor Aristotelean Rayo then assigning truth-conditions the way he does shouldn't count as a semantics that illustrates what is going on in NUMBERS or similar statements. So, how is it supposed to be understood?

#### IV. Conclusion

If Rayo is Mainstream Rayo then I have few objections, but little progress will have been made over the mainstream. Rayo needs to be Carnapian Rayo to make sense of what is going on in most of the book. But I find little reason for agreeing with Carnapian Rayo in the book, and some reasons which strike me as pretty good for rejecting the views of Carnapian Rayo. A lot of the book would also make sense as Aristotelean Rayo. Rayo is clear all over the place that he does not want to be Aristotelean Rayo, but is that wishful thinking? Rayo makes explicit, for example, that 'just is'-statements are not to be seen as anything like real definitions or having any metaphysical significance since they are intended to be symmetric. But then just a little later he introduces partial versions of this which are not symmetric. Rayo is clear that he doesn't want to read anything metaphysical into this, that, or the other, which I understand as that he intends his view to be closer to Carnapian Rayo than to Aristotelean Rayo. But how the view makes the most sense overall is a different question. I find Carnapian Rayo to be problematic, Aristotelean Rayo to be more coherent, but not well supported either, and Mainstream Rayo to be unproblematic, but a bit mainstream. Like many important

books in philosophy, Rayo's *The Construction of Logical Space* is highly suggestive of a truly novel way of solving old problems, but it is elusive in what that way is supposed to be more precisely, elusive enough, but also suggestive enough, to require going back to it, almost inviting scholarship. I have tried, but surely failed, to pin down how it is supposed to go. Good thing we have the author right here to elucidate it all. Will the real Agustín Rayo please stand up?

## References

- Frege, G. *Die Grundlagen der Arithmetik: eine logisch mathematische Untersuchung über den Begriff der Zahl*. Breslau: W. Koebner, 1884.
- Hirsh, E. *Quantifier Variance and Realism: Essays in Metaontology*. Oxford: Oxford University Press, 2011.
- Hofweber, T. 'Number determiners, Numbers, and Arithmetic'. *The Philosophical Review* 114, no. 2 (2005): 179–225
- Hofweber, T. 'Innocent Statements and Their Metaphysically Loaded Counterparts'. *Philosophers' Imprint* 7, no. 1 (2007): 1–33.
- Rayo, A. *The Construction of Logical Space*. Oxford: Oxford University Press, 2013