

Against the No-Miracle Response to Indispensability Arguments

I. Overview

One of the most influential of the contemporary arguments for the existence of abstract entities is the so-called “Quine-Putnam indispensability argument.” Proponents of this argument maintain that we have strong *empirical* considerations in favor of the existence of abstract entities. In particular, they maintain that the pervasiveness of mathematics in our best scientific theories, and its apparent indispensability for the purposes of adequately formulating those theories, afford us with strong empirical grounds for believing in the existence of *mathematical* entities.

One kind of response to this argument – one that I will refer to as “the no-miracle response” (owing to its connection with Hilary Putnam’s famous “no-miracles” argument for scientific realism) – involves maintaining that since mathematical entities (if they exist) are causally inert, we need not postulate their existence in order to explain the empirical success of our best scientific theories. Versions of this response (or at least ones that are quite similar) have been put forward by Mark Balaguer, Mary Leng, and Susan Vineberg, among others.¹

In this paper, I argue that the no-miracle response is not an adequate reply to the Quine-Putnam indispensability argument. More precisely, I argue that the no-miracle response is inadequate unless it is supplemented by further considerations, but that those further

¹ See (Balaguer 1998, chapter 7; 2009), (Leng 2005; 2010, chapters 8-9) and (Vineberg 1996). Balaguer does not explicitly endorse what I’m calling the “no-miracle response” but does say some things that lend themselves toward interpreting him as endorsing a response along those lines (he might also be understood, however, as advocating what I refer to in the third section as “the explanatory-irrelevance response”). Leng and Vineberg, however, do explicitly advocate versions of that response. Psillos (2012) gives an explicit statement of what I’m calling “the no-miracle response” and then proceeds to offer his own repudiation of that response. For a brief discussion of how my objections to the no-miracle response differ from Psillos, see note 15.

considerations (if correct) constitute a distinct and successful response all on their own. My conclusion is that the no-miracle response either fails or turns out to be superfluous.

II. Scientific Realism but not Mathematical Realism?

There are various ways in which the Quine-Putnam indispensability argument has been developed in the contemporary literature. Some of these have attempted to remain faithful reconstructions of the original versions of that argument.² Others have simply been concerned with how best to develop it.³ I will not address, in this paper, any interpretive issues pertaining to how Quine or Putnam developed the original versions of this argument.⁴ Nor will I attempt to address specifically each of the contemporary versions thereof. Instead, I will concern myself with what I take to be the most forceful anti-nominalist considerations put forward by the proponents of that argument.

As Susan Vineberg has pointed out, nothing like the Quine-Putnam indispensability argument is likely to carry any freight with those who already deny scientific realism.⁵ Those who are already skeptical of whether empirical considerations afford us with good reasons for believing in things like *atoms* are not likely to be moved by arguments for the conclusion that such considerations afford us with good reasons for believing in things like *numbers*! For that reason, I take the best versions of the Quine-Putnam indispensability argument to be aimed at those who already have a strong penchant for scientific realism. And I think that the best way to advance those considerations is not, strictly speaking, in the form of an *argument* at all, but

² (Quine 1968) and (Putnam 1971) are often taken to be classical sources for this line of argument.

³ See (Colyvan 2001) for one of many contemporary presentations of this line of argument.

⁴ See (Liggins 2008) for a challenge to the claim that Quine and Putnam actually put forward the sort of argument that has come to be labeled “the Quine-Putnam indispensability argument.”

⁵ (Vineberg 1996, p. S259)

rather, in the form of a *challenge* to those who would accept scientific realism but deny mathematical realism.

For the purposes of this paper, I will characterize scientific realists as those who believe that our best scientific theories are to be interpreted at face value (rather than instrumentally or in some other non-literal or non-factive way) and also as those who believe that the empirical support we have for those theories gives us good reason to accept their implications regarding concrete unobservables.^{6,7} Similarly, mathematical realists, as I will characterize them for my purposes, believe that our established mathematical theories (or at least a significant subset of them) are to be interpreted at face value and that we ought to accept their implications (including those involving existential quantification over mathematical entities).⁸

The challenge posed by advocates of the Quine-Putnam indispensability argument toward those who would accept scientific realism but reject mathematical realism, as I see it, comes to this: It seems that our justification for believing in unobservable entities like quarks and electrons primarily stems from the fact that their existence is implied by our best scientific theories. But our best scientific theories are shot through with mathematics and thereby also imply the existence of mathematical entities. Doesn't epistemological consistency demand, then, that those who accept the existence of the concrete unobservables of science accept the existence

⁶ Scientific realism is thus opposed to views like that of van Fraassen's (1980) constructive empiricism.

⁷ Here I am following Leng's (2005, p. 82) advice for characterizing scientific realism in such a way as not to render it incompatible with mathematical anti-realism (see also (Leng 2010, pp. 11-12)). I also do not claim to have given a precise characterization of scientific realism. As I see it, 'scientific realism' denotes a family of views, rather than a single, precise thesis.

⁸ I will also stipulate that part of what it is for a mathematical theory to be taken "at face value" is for its quantifiers to be given an objectual interpretation.

of mathematical entities as well? From now on, whenever I speak of there being a “response to the indispensability argument,” it will be a response to this challenge that I have in mind.⁹

Many different kinds of responses to this challenge have been offered in the literature.¹⁰ The response that I would like to focus on in this paper – the one that I referred to in the first section as “the no-miracle response” – appeals to the claim that since mathematical entities (if they exist at all) are causally inert, postulating their existence is not required in order to account for the empirical success of our best scientific theories (whereas the same cannot be said of the concrete unobservables of science). I explore this response in more detail in the next section.

III. The No-Miracle Response

Susan Vineberg and Mary Leng are examples of individuals who explicitly advocate a version of what I’m calling “the no-miracle response.” If (as Vineberg and Leng point out) one’s primary motivation for being a scientific realist is that one agrees with Hilary Putnam that scientific realism is “the only philosophy that doesn’t make the success of science a miracle,”¹¹ then one can endorse a version of scientific realism that posits only those entities whose existence is required for there to be a good explanation of the empirical success of our best theories.

⁹ Compare my description of this challenge with Hilary Putnam’s (1971, p. 347) own gloss on the Quine-Putnam-Indispensability argument:

Quantification over mathematical entities is indispensable for science, both formal and physical; therefore we should accept such quantifications; but this commits us to accepting the existence of the mathematical entities in question. This type of argument stems, of course, from Quine, who has for years stressed both the indispensability of quantification over mathematical entities and the intellectual dishonesty of denying what one daily presupposes.

¹⁰ I set aside, for the sake of discussion, attempts like that of Harty Field (1980; 1989) to show that our best scientific theories can be given non-mathematical formulations (and therefore that mathematics isn’t indispensable to those theories after all). See (Urquhart 1990) for reasons to doubt that Field’s strategy can be successfully applied to the theory of general relativity. See also (Malament 1982) for reasons to doubt that it can be successfully applied to quantum mechanics, (Balaguer 1998, chapter 6) for a response, and (Bueno 2002) for a counter response.

¹¹ (Putnam 1975, p. 73)

Vineberg and Leng both argue that since mathematical entities are causally inert, appeal to their existence plays no essential role in accounting for the empirical success of our best theories. For that reason, they both conclude, endorsing something along the lines of a no-miracles argument for realism about the concrete unobservables of science does not commit one to the existence of mathematical entities.¹²

It's important to distinguish what I'm calling "the no-miracle response" from another response with which it might easily be conflated. Proponents of this alternative response – which I will refer to as "the explanatory-irrelevance response" – maintain that since mathematical entities are causally inert (if they exist at all), they play no explanatory role in accounting for *any* observable phenomena. Or, at the very least, they play no such *essentially factive* explanatory role (i.e. any explanations of observable phenomena into which they do figure would be just as good if they turned out to be false owing solely to the fact that mathematical entities don't exist). For this reason, proponents of the explanatory-irrelevance response contend, we needn't posit mathematical entities in order to explain the observable phenomena that falls within the scope of our best theories.¹³ Note that while the explanatory-irrelevance response relies on the claim that mathematical entities play no essentially factive explanatory role in accounting for *any observable phenomena whatsoever*, the no-miracle response is much less bold. It relies only on the claim that since mathematical entities are causally inert (if they exist), they play no such role in accounting for *one specific kind of observable phenomena* – namely, the empirical success of our best scientific theories.

¹² See (Leng 2005; 2010, chapters 8-9) and (Vineberg 1996).

¹³ For some proponents of what I'm calling the "explanatory-irrelevance response," or at least something in the neighborhood thereof, see Cartwright (1983, especially Essay 5). (Balaguer 1998b, chapter 7; 2009), (Yablo 2012). As pointed out in note 1 Balaguer says things that lend themselves to be interpreted as advocating the no-miracle response as well as the explanatory-irrelevance response.

If the explanatory-irrelevance response succeeds, the no-miracle response is redundant. But defending the explanatory-irrelevance response looks initially more challenging than defending the no-miracle response. One is likely to endorse the explanatory-irrelevance response only if one is likely to accept the claim that all essentially factive scientific explanation is causal. But that claim is highly controversial. More importantly, the recent literature has seen alleged counterexamples to the claim that there are no essentially factive *mathematical* explanations within science.¹⁴ Since the claim about the explanatory irrelevance of mathematical entities relied upon by proponents of the no-miracle response is more modest, it is also initially more plausible.

It is initially plausible, that is, that positing mathematical entities is not necessary to account for the empirical success of our best theories, *even if* those theories put forward purported mathematical explanations of observable phenomena (since, plausibly, those theories would still be *empirically successful* even if the explanations put forward by them turned out to be incorrect owing to the fact that mathematical entities don't exist).¹⁵ So those who would accept scientific realism but deny mathematical realism might hope that an adequate defense of the no-miracle response could be given in absence of a defense of the claim that it is never the

¹⁴ See, for example, (Baker 2005; 2009), (Colyvan 2010), (Psillos 2012).

¹⁵ Psillos's (2012) objections to the no miracle response have mostly to do with the fact that he is skeptical of how its proponents appeal to the notion of nominalistic adequacy, which is not the issue that I am concerned with in this paper (see note 1). He does also seem to take it for granted, however, that the no miracle response fails if mathematics plays an explanatory role in accounting for observable phenomenon. While I will *argue* in the next section that it is indeed the case that the success of the no-miracle response turns on its being the case that mathematical entities play no essentially factive explanatory role in our best scientific theories, I do not believe that this can merely be taken for granted. It is indeed *initially* plausible, for the reasons that I am suggesting here, that the no-miracle response does not turn on any such general claim about the explanatory irrelevance of mathematical entities within science.

case that mathematical entities play an essentially factive explanatory role within science. As I will argue in the next section, however, such a hope would be in vain.

IV. Why the No-Miracle Response is Inadequate

Here is a brief summary of the argument I plan to make in this section: Proponents of the no-miracle response are forced to give up the claim that the *truth* of our best scientific theories is required for there to be a good explanation of their empirical success. By so doing, they significantly weaken their dialectical position as it pertains to fending off objections from Van-Fraassen-style anti-realists. Without a decent response to these objections, furthermore, their insistence that the existence of the concrete unobservables of science is required for there to be a good explanation of the empirical success of our best theories becomes arbitrary and unmotivated. They have a decent response to these objections, I will further argue, only if they can successfully defend the general claim that mathematical entities play no essentially factive explanatory role within our best science. But if they can defend that claim, the no-miracle response becomes superfluous. Allow me to elaborate.

As proponents of the no-miracle response are well aware, the mathematical anti-realist who endorses a no-miracles argument for realism about the concrete unobservables of science cannot take herself to be endorsing an argument for the conclusion that our best scientific theories (taken at face value) are *true*.¹⁶ Those theories imply, after all, that mathematical entities exist. Rather, what the scientific realist who argues along these lines must be taking

¹⁶ See, for example, (Balaguer 1998, chapter 7; 2009), (Leng 2005; 2010 chapters 8-9), and (Vineberg 1996). Vineberg (1996, p. S262) notes that the mathematical anti-realist cannot take mathematically formulated scientific theories to be true if those theories are interpreted literally, but she points out they might be taken to be true by the mathematical anti-realist if their mathematical portions are taken in some non-literal way – for example, along the lines of something like Chihara’s (1990) constructability theory.

herself to be doing is giving us an argument for the conclusion that those theories are *nominalistically adequate* (i.e. correct, or at least approximately correct, in their implications that are solely about the concrete world).¹⁷ There are, therefore, two claims at issue here. The first is that if our best scientific theories were not at least nominalistically adequate, their empirical success would amount to an unexplained coincidence (“a miracle”). The second is that the nominalistic adequacy of those theories is sufficient for there being a good explanation of their empirical success.

The scientific anti-realist may not want to dispute the claim that the nominalistic adequacy of our best scientific theories is *sufficient* for there being a good explanation of their empirical success, but she will certainly want to put pressure on the claim that their nominalistic adequacy is *necessary* for there being such an explanation. And once it is conceded by the scientific anti-realist that truth is not required, the door is potentially opened to alternative explanations. The scientific anti-realist could argue along the lines of Van Fraassen, for example, that the empirical success of our best scientific theories is better explained in Darwinian terms. That is, what best explains the success of those theories is that they are the survivors of a winnowing process of trial and error, one in which theories that fail to be empirically successful are rejected in favor of ones that are.¹⁸ The scientific anti-realist might well argue, furthermore, that this Darwinian explanation is superior to one that invokes the

¹⁷ This is meant only to be an intuitive gloss on the notion of nominalistic adequacy, not a precise characterization. See (Balaguer 1998, chapter 7), (Dorr 2010), (Leng 2010; chapter 8), (Rosen 2001), (Yablo 2012) for various attempts to characterize this notion. I am granting to proponents of the no-miracle response that there is a way coherent way of stating what it is for a theory to be nominalistically adequate which is both suitably precise and suits their purposes. But see (Colyvan 2010) and (Psillos 2012) for some expressions of skepticism about that claim.

¹⁸ (Van Fraassen 1980, pp. 39-40)

nominalistic adequacy of these theories, insofar as it leaves us with fewer ontological commitments.

The scientific realist does, however, have a plausible, initial response to this proposed alternative explanation. She can contend that it targets the wrong explanandum. The relevant explanandum in this context, she may insist, is not the fact that we have come to be in possession of empirically successful theories (as opposed to different theories that are not empirically successful). It is, rather, that *those very theories* (the ones we just so happen to be in possession of) are empirically successful. The Darwinian explanation sketched above, she can concede for the sake of argument, does successfully account for the former explanandum; nevertheless it does not account for the latter. But the Van-Fraassen-style anti-realist also has her own initially plausible counter-response to this objection. She can concede that her Darwinian explanation only accounts for the fact that we've managed to come in possession of theories that are empirically successful, and not for the fact that those theories themselves are empirically successful. But all that is required for there to be a good explanation of the latter, she can maintain, is that the observable portion of reality behaves *as if* the unobservable portion of reality were as those theories portray it to be (and that it is no surprise, given the Darwinian considerations that she raises, that we have managed to come across such theories, even if those theories are false).¹⁹

Here is where (when it comes to formulating a counter-reply) the more standard kind of scientific realist (the one who believes that the no-miracles argument gives us good reason to believe that our best scientific theories are true, or at least approximately true) and the proponent

¹⁹ See (Lyons 2003) for both a summary of this dialectic and a defense of the anti-realist's position that runs just along these lines.

of the no-miracle response to the indispensability argument are apt to part ways. The more standard kind of scientific realist can reply by maintaining that it would be an extraordinary coincidence – a “miracle” – that the observable portion of reality just so happened to behave as if the unobservable portion of reality were as our best scientific theories say it is, unless the unobservable portion of reality really were that way (i.e. unless what our best scientific theories imply about the unobservable portion of reality is true). The proponent of no-miracle response to the indispensability argument can’t respond in just this way, however. She does not believe that *everything* our best scientific theories imply about the unobservable portion of reality is true, because she does not believe that what they imply about the existence of mathematical entities is true.

What she must say instead is that it is sufficient for there to be a good explanation of the empirical success of our best scientific theories that the observable portion of reality behaves *as if* what those theories imply about the existence of mathematical entities (and their relations to concrete objects) is true. The same does not hold, she must maintain, when it comes to what those theories imply about the various concrete unobservables that exist according to them. Those implications, she has to argue, must actually be true (or approximately so). But on what grounds might she take herself to be justified in discriminating in this way between the mathematical entities whose existence is implied by our best scientific theories and the concrete unobservables whose existence is so implied? We are right back to the problem of answering challenge that lies at the heart of the Quine-Putnam indispensability argument. There are only two ways, furthermore, it seems to me, that the proponent of the no-miracle response can (at this stage in the dialectic) respond to this challenge.

The first way would be to argue, on a *case by case basis* (without necessarily appealing to any general claims about the relationship between causation and explanation) that whereas the concrete unobservables of science do play essentially factive explanatory roles in our best scientific theories, mathematical entities do not, and that this is adequate grounds for distinguishing between the two. Note, however, that if this response were to be successfully carried out, there would no longer be any need for the mathematical anti-realist to appeal to the no-miracle response. That's because she would no longer need to argue (as proponents of the no-miracle response do) that mathematical entities *are explanatorily idle* in accounting for the success of our best theories *because they are causally idle*. Rather, it would have been established *independently of any general considerations about the relationship between causation and explanation* that mathematical entities play no essentially factive explanatory role within those theories. And it would be for *that reason* that postulating them is not required to account for the empirical success of our best theories.

A second way that the proponent of the no-miracle response might attempt to respond to the above challenge would be to argue that since the concrete unobservables of science (if they exist) enter into causal relations, it cannot be plausibly maintained that they play no essentially factive explanatory role in science; whereas the same cannot be said when it comes to mathematical entities. Given that the concrete unobservables of science do play such an explanatory role (provided that they actually exist), it would be an extraordinary coincidence (“a miracle”), she might then contend, that observable portion of reality *just so happens* to behave as if those entities exist (unless, in fact, they do); whereas the same need not be said of mathematical entities. Note, however, that this reply just repeats claims at issue in the

explanatory-irrelevance response. And, as we have seen, a successful defense of the explanatory-irrelevance response would render the no-miracle response redundant.

As I said, it seems to me that the proponent of the no-miracle response must offer one of the above responses to the challenge posed by the Van-Fraassen-style anti-realist. But if either of those responses succeeds, the no-miracle response is no longer needed. I conclude that the no-miracle response either fails or turns out to be superfluous.

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