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Realism about What? Unobservable Entities and the Metaphysics of Modality[1]

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ABSTRACT

Most philosophers who advocate Scientific Realism (SR) endorse also Modal Realism (MR), i.e., assume commitments with objective modality. However, the precise relationship between these positions has been scarcely explored. In this paper I argue that there is an *indirect* implication from SR to MR. Although the basic thesis of SR does not imply MR, both the main argument for SR and the best realist theory of reference do imply modal commitments.

Keywords: Scientific Realism, Modal Realism, Modality, No-Miracle Argument, Causal Descriptivism.

Introduction

Scientific Realism (SR) and Modal Realism (MR) are both conceptually and historically related. It has been common to define SR as the belief that theories capture (at least approximately) the nomological structure of the world. But the link is also motivational. There is a *realist attitude* towards scientific theories that makes SRists more likely to accept modal commitments. Most philosophers accept both SR and MR in some of their variants, with only a few exceptions, as far as I know—Psillos and Papineau are for sure the most remarkable. Nonetheless, the true nature of the relationship between these positions has been scarcely explored.

SR states, mainly, that the unobservable entities posited by our best scientific theories exist. This ontological claim has epistemic and semantic counterparts, i.e., the claims that we have *knowledge* about those entities and that our statements about them have truth values—as opposed to instrumentalism. So SR comes in many flavors according to which of these claims you decide to commit to, and what kind of commitment you adopt about them. As the scope of this paper is standard SR, I will assume a full commitment at each of those three levels.

On the other hand, modality, like almost everything in philosophy, can be said in many ways. However, it's enough for the aims of this paper to define MR as the position which accepts that there is an objective counterpart that underpins the truth values of modal statements which are not logical truths—mainly of those that assign necessity/possibility to natural regularities or phenomena. In a nutshell, the statement "Necessarily, that all pieces of metal are pieces of metal" is true because "All pieces of metal are pieces of metal" is a logical truth, so the original statement is about *logical necessity*. On the other hand, consider the statement "Necessarily, all pieces of metal

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expand when heated". It is not about logical necessity because "All pieces of metal expand when heated" is not a logical truth. So what can we say about statements of this kind? For the modal anti-realist hey are simply false statements because—as van Fraassen (1977) put it in his now classic essay—*the only necessity is verbal necessity*. Conversely, for MR those statements can have modal features of the world (e.g., necessary connections *in nature*) as their truthmakers. Thus, according to MR the truth value of the aforementioned statement depends on *natural* necessity.

It is worth pointing out that MR is not just committed to objective modality, but to *irreducible objective modality*. There have been attempts to reduce modality to mere regularity (e.g., Psillos, 2014), claiming that constant conjunctions (instead of necessary connections) are good enough as truthmakers for modal statements. There are many reasons to reject that non-modal view of modality. My own is that it collapses in some version of van Fraassen's Constructive Empiricism, but as I'm not going to address that point in this work, I'll restrict my conclusions to MR as committed to *irreducible objective modality*.

In this paper I aim to clarify the relation between SR and MR as one of *indirect implication* from the former to the latter. I hope to precisely elucidate that implication along the following pages, but for now this should suffice: although the basic thesis of SR does not imply MR, both the main argument for SR and the best realist theory of reference do imply modal commitments. In the second section I'll show the modal implications of the notion of explanation underlying the so-called No-Miracle Argument (NMA). In the third section I maintain that the most widely accepted theory of reference for SR, Causal Descriptivism, commits SRists who adopt it to also accept MR. Finally, the last section includes the conclusions and final comments to this work.

Explanation and the No-Miracle Argument

A non-conclusive but still important point to be made is about what could be called a *realist attitude* towards modality, which is typical among SRists. Those who believe that things like atoms really exist—and that includes me—are more likely to believe that some things happen to them *necessarily*. It is very common to maintain that scientific theories provide real knowledge only when they latch onto the modal structure of the world (e.g., Armstrong, 1985; Ladyman, 1998; Chakravartty, 2007). Another reason for positing this attitude is the fact that scientific discourse is often full of modal notions. References to causal processes, objective probability, causal-based equilibrium and the mere enunciation of many scientific laws suggest that some modal commitments are immanent to scientific practice (see Berenstain and Ladyman, 2012, p. 152). But despite all this, it should be noted that MR does not logically follow from SR. It's a perfectly coherent position to assert that unobservable entities exist, while denying objective modality at the same time. As indicated above, that is in fact a position Psillos and Papineau endorse.

However, I maintain that there is strong conceptual support for that *realist attitude* towards modality. It is not in the basis of SR itself, but in the arguments SRists use in favor of their position. If that's the case, SRists who reject objective modality are in a weaker position to defend their realist commitments than the ones who endorse MR. I offer two examples of this. The first comes from the main argument for SR, the NMA. The second, which I'll tackle in the third section, is related to the aim of finding an appropriate theory of reference for SR.

Let's then start with the first example. As is well known, the NMA is the most important argument usually brought forward in support of SR. Its seminal formulation is due to Putnam, for whom SR "is the only philosophy that doesn't make the success of science a miracle" (1975, p. 73). The usual way in which this idea has been fleshed out regards this argument as an instance of Inference to the Best Explanation (IBE): the (approximate) truth of our theories is the best explanation of the predictive success of science.

The NMA has been discussed in many works and has been reconstructed in various ways[3], however, there is a notorious lacuna in the specialized literature concerning the notion of explanation underlying it. Even attending to discussions around IBE itself, not much clues are given about how *explanation* should be understood when applied at a meta-scientific level. I maintain that making some precisions about it can provide a base for the main point of this section, i.e., that the notion of explanation underlying the NMA has some modal implications that the realist must accept if she is using it in support of her position. But I believe the *convenience* of MR can be shown even if that were not the case. Let's say I'm wrong about my first point and a version of NMA that gives up modality can actually be formulated. Even in that case, this non-modal version of NMA would leave the realist in a weaker rhetorical position against anti-realists, by taking away the most compelling aspects of the argument.

Let's review the strong point first. The NMA states, roughly speaking, that the best explanation for the predictive success of science is the truth of our best theories. It is the best, but not the only explanation. The other alternative at hand is a miracle. Things are a lot more complicated than that, but what we need to stress here is that there is some particular notion of explanation in use. But which one could it be? Ruling out some possibilities can be a useful strategy. One cannot think of explanation without considering Hempel's covering-law model. This could seem promising to modal anti-realists given that Hempel's model presupposes a Humean

[3] An interesting and rich overview can be found in Leader (2013). See Borge (2015) for a summary of some recent debates over the NMA.

approach to the problem of natural regularity. But it's easy to see why this couldn't work. The NMA is formulated as a meta-scientific explanation of our best theories' predictive power. Making it fit into the covering-law model requires showing that empirical success is a particular case of some kind of general law involving the truth of scientific theories. But there is no such thing as a meta-scientific law relating confirmation with truth[4]. And even if we could imagine something like that it would still remain an open question whether that law was genuine or a mere accidentally true generalization.

Salmon's (1971) statistical relevance model is also inconvenient for this context. The reason why is extremely simple: explanations in terms of statistical relevance appeal to prior probabilities. In order to say that successful theories (S) are likely to be true (T) rather than false, you would have to know the prior probability of T within S: $P(T|S) = p$; that is, the prior probability of a theory being true if it belongs to the class of successful scientific theories. And of course that is not a piece of information we have.

The causal mechanical model of explanation (Salmon, 1984; Dowe, 2000) cannot be of any help either. This model is focused on the explanation of physical processes, and clearly the relation between truth and empirical success in not one of them. Also pragmatic theories of explanation such as van Fraassen's (1980) will not work. Despite being flexible enough to accommodate to non-modal intuitions, they are the basis of many arguments undermining SR. If the price is to give up realism, it is obviously too high.

Instead, the notion of *metaphysical explanation* seems to fit better with the task of explaining the consistent successful predictions of mature scientific theories by claiming their truthfulness. At least in the context of the philosophy of science, metaphysical explanation can be tracked back to Duhem, for whom "[t]o explain (explicate, *explicare*) is to strip reality of the appearances covering it like a veil, in order to see the bare reality itself" (1991 [1906], p. 7). So to explain is to be engaged in a metaphysical inference that is grounded in its ability to remove the veil of appearance. But besides the *act of explaining* there is a sense in which the explanation is out there to be found, it is independent from its epistemic realization. That is coincident with Lewis' approach to metaphysical explanation. According to Lewis,

> to explain an event is to provide some information about its causal history. *[…] An explanation […] is not an act of explaining. It is a chunk of explanatory information—information that may once, or often, or never, have been conveyed in an act of explaining (1986, p. 218).*

This account is conceived for the explanation of singular events, but as Lewis himself makes clear (1986, p. 225), it could be easily extended to general kinds of events. So there is something like a piece of information that is capable of explaining the causal history of the empirical success of science, and according to NMA that is no other thing that the truth of scientific theories. But in this sense of metaphysical explanation the outcome described in the explanandum is grounded in the items conforming the explanans, so that without any of them what is described in the explanandum "would not have happened, or at least it would have been very much less probable than it was" (Lewis, 1986, p. 214). That is *precisely* the sense the NMA gives to the truth of our best scientific theories—if they weren't true science wouldn't have been as successful as it is, or at least its success would have been very much less probable, say, a miracle. The crucial point here is that none of this can be maintained without a modal account of counterfactuality. The truth and independence of the explanation depends on the possibility of some counterfactual assumptions being true. And there is no way to do that without modal commitments. Both Duhem's and Lewis' notions of metaphysical explanation show how some account of modality should be assumed in order to maintain that science *wouldn't have been* as successful as it is if theories were not true or approximately true.

Since Duhem and Lewis little has been said about metaphysical explanation as an independent issue. However, the concept has been widely discussed in relation to the notion of *grounding*, one of the central and fastest growing topics in contemporary metaphysics. Grounding is taken to be a relation of metaphysical dependence, some kind of constitutive determination or "ontological ground" (Fine, 2012), often cashed out in terms of in-virtue-of relations between facts or truths about them. Despite its structural and logical properties are usually thought to be shared with those of explanation, the precise relation between grounding and metaphysical explanation is a matter of controversy between *unionist* and *separatist*[5]. For the former, grounding *just is* a kind of metaphysical explanation, for the latter grounding is the relation—perhaps the *primitive* relation—that makes possible the formulation of metaphysical explanations. Since we are just dealing with the modal implication of metaphysical explanation—and those of grounding, if friends of this notion are right—it does not matter for the present purposes who must win. The important question here is if the adoption of a grounding-related approach to metaphysical explanation implies a commitment to MR. Again it is (as almost everything is in the lands of grounding) a matter of discussion. Although this is not the place to argue for a positive answer, I will mention a simple

[4] Lakatos often referred to "an inductive principle which connects realist metaphysics with methodological appraisals, verisimilitude with corroboration, which reinterprets the rules of the 'scientific game' as a—conjectural—theory about the *signs* of the *growth of knowledge*, that is, about the signs of *growing verisimilitude of our scientific theories*" (1978, p. 156). However, he never got to formulate it, and it is hard to see how such an inductive principle could be articulated as a meta-scientific law.

[5] The terms of this distinction are due to Raven (2015, p. 326).

point that strongly suggest there is a close relationship between grounding and modality.

Grounding is universally recognized as a kind of ontological dependence relation between facts. It is more than just that, since it involves an extra connection signified by 'in virtue of' or 'because', which can hold or not in a relation of ontological dependence. But just for being a kind of ontological dependence grounding seems to inevitably rest on modal notions. It is also assumed that there are different types of grounding, corresponding to different kinds of necessity: *metaphysical*, *natural*, and *normative* necessity (Fine, 2012, p. 38), but in any case modality is part of the game. For that reason friends of grounding generally accept what Correia and Benjamin (2012, p. 20) call the principle of 'Necessitarianism':

> *For all facts f, g, g' , ... , if f is grounded in g, g', ... , then as a matter of metaphysical necessity, f obtains if g, g', ... do.*

Of course there is a road the modal anti-realist might take: to claim that the modality presupposed in Necessitarianism is *reducible* to non-modal facts. I cannot fully argue here against that alternative, but let me give some remarks regarding that point. First, the very idea of positing and describing a substantive relation of metaphysical determination or ontological dependence between facts in terms of in-virtue-of relations seems to be (at least pragmatically) at odds with the motivation to embrace a Humean framework. After all, the idea is to show how those events are strongly (necessarily!) connected, not just how they coexists in a mosaic of non-related ontological units. Second, it may be said that those in-virtue-of relations between facts can be cashed out in terms of supervenience, which is happily assumed to be part of the Humean menu. But supervenience is precisely one of the relations that are taken to be grounding-based.

But let's leave those discussions behind and turn our attention to the second (weaker) point of this section. After all, some may think that there is some other notion of explanation that fits better with the NMA. Or maybe that there is a non-modal way to deal with counterfactuality, or even with metaphysical explanation and grounding. But even if that were the case, there would still be reasons to endorse MR. Those reasons come from the debate around the status of natural laws. As is well known, scientific speech is full of modal statements—especially in the enunciation of laws and its implications. Claims like *Nothing can travel faster than light* are very common in scientific theories. A natural way to think about them is as statements that have truthmakers in some *modal objective facts* like necessary connections in nature or necessitation relation between properties. But for Regularism that's an exaggerated answer—it's enough to conceive the truthmakers of scientific laws as contingent sequences of regular events. As it has been emphasized by Swartz (1985), pushed to its limit, Regularism claims natural regularity is like a big cosmic coincidence. Regular events just *happen to be* the way they are. It is true that the main motivation for the NMA is to affirm the existence of some unobservable entities given the success of science. But that success has a lot to do with science's capacity of anticipating future events, and if the regularity that allows successful predictions is relegated to the status of an unexplained fact, the realist commitment to unobservable entities seems to become too thin. After all, to say that natural regularity is a brute fact, a sort of major cosmic coincidence, is not far from the miraculous alternative the NMA is supposed to be ruling out. So a non-modal version of the NMA turns to be a very weak one.

Realism, reference and modality

It is widely recognized that both purely descriptivist and purely causal theories of reference are insufficient to account for the reference of theoretical terms within the framework of SR (see for example Nola, 1980; Lewis, 1984; Psillos, 2012). In short, the reasons go like this: The reference of a theoretical term cannot be fixed ostensibly, simply because there is nothing observable to point at. Positing a theoretical entity requires providing a description of which are its properties and of the functional role it is supposed to play. That description will include some indication of how the posited entity causes some observable phenomena. According to pure descriptivist theories of reference, changes in the theoretical descriptions associated to a term lead to changes of reference. Given that theory change usually implies significant changes in the associated descriptions of theoretical terms, descriptivism must admit also changes of reference, even in cases when according to SR this is not supposed to happen. Take for example the term 'atom.' The realist believes it refers to the same entities described by Dalton *and* by contemporary scientists—the only difference is that Dalton had *some things wrong* about the same entities. But that is not possible under pure descriptivist theories. They are too restrictive. So why not moving to causal ones? They have the advantage of not making reference stability depend on descriptions, so after all Dalton and Bohr could have been speaking about the same thing. But, according to causal theories, given that reference-fixing is mediated by some observable phenomena, the reference of a term is *whatever* is causing the phenomena. So 'phlogiston' ends up referring to *oxygen*. Therefore, causal theories turn out to be too loose, to the point of making referential success trivial. The most usual way out of this problem is a hybrid theory called Causal Descriptivism (CD) (defended among others by Enć, 1976; Lewis, 1984; Kroon, 1987; Psillos, 2012). According to CD, the reference of a theoretical term is fixed by a mixed mechanism:

> *R(x) = x causes phenomena Φ and D(x).*
> *Term t refers to x if and only if R(x).*

The descriptivist component is given by $D(x)$, while the causal one is given by $\ulcorner x$ causes $\Phi\urcorner$. The central idea is that CD can capture two reasonable intuitions: that descriptions are essential to reference-fixing in the case of theoretical terms, and that the causal relation between the posited entity and the user of the new term is relevant to guarantee (non-trivial) referential stability. There are a lot of issues with CD—actually I have my own objections to it (see Borge, forthcoming)—but it is without doubt the most accepted theory of reference within SR. This is not the place to go through all the details, but I just want to mention some aspects of CD that strongly suggest a commitment to MR. (i) Reference transmission is *causal* and can be tracked back following causal chains; (ii) regular phenomena are *caused by* some unobservable entities in a way that can be captured by the *causal* component of CD, in virtue of some *causal properties* or *powers*, $D(x)$; (iii) it is not just a matter of singular causation, therefore in every circumstance in which Φ is observed, or even when *it's not actually* observed, it should be taken as caused by x in the way described by $D(x)$; (iv) x constitutes a new natural kind, commonly characterized by some *essential* or *kind constitutive properties*; (v) the causal element in reference-fixing is frequently understood as a rigid designation, i.e., designation *in every possible world*; (vi) this is also fleshed out in terms of *counterfactual facts* that function as truthmakers of modal statements about reference.

This is of course not conclusive, since a modal anti-realist who wants to keep herself a SRist can look for an alternative to CD. However, she will have to deal with two difficulties. First, she has to reject the main theory of reference within the framework of SR. Second (and more importantly), she must build an alternative theory that avoids not only modal commitments, but also the difficulties of both purely descriptivist and purely causal theories of reference.

Conclusion

It is not hard to show how what I called a *realist attitude* toward scientific theories makes it very likely that if you are a SRist, you also have a commitment to MR. It is something like a statistical fact among philosophers of science. In this paper I attempted to expound some of the rational bases for that attitude. There may be other important reasons for it, but if I'm right those who advocate SR while rejecting MR are in a weaker position to defend SR from anti-realist threats.

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