

Against Ontic Structural Realism

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1. Introduction
2. Ontic Structural Realism

ABSTRACT. This paper is about so-called ontic structural realism. An argument in favour of this metaphysically radical form of scientific realism is reconstructed on the basis of the existing literature, and its premises are critically assessed. It is concluded that ontic structural realism does not, as things stand, constitute a compelling position.

1. Introduction

Scientific realists argue that scientific theories must be true, for it would be a miracle if they were false and yet successful as they are. Anti-realists, however, contend that an explanation of the success of science need not, and should not, involve the notion of truth: for, past theories that were successful have been at some point superseded by other theories and are now regarded as false (Laudan (1981)).

Structural realists claim that there is a viable middle ground: successful past theories, they argue, were successful because they were at least partly true; and the parts of those theories that were responsible for their success, hence (approximately) true, are theoretical structures that have been preserved (either unchanged or as limiting cases) in later theories. Worrall (1989) introduced this view as an epistemic thesis about what we can know and be realist about: the real-world counterpart of structure preserved across theory-change

- i.e., physical relations¹. Ladyman (1998), however, suggested more strongly that structure is also all there is out there. Since then, this latter, ontic form of structural realism has become progressively more popular. In particular, according to many, physical theory provides very good reasons for being ontic structural realists.

However, especially in view of the consistent amount of metaphysical revision required by such a position, generic claims to the effect that scientific realists should be ontic structuralists clearly need to be backed up by detailed argument. In this paper, it is suggested that such an argument is in fact lacking and, consequently, there is no compelling reason for undertaking the radical conceptual change required by ontic structural realism.

2. Ontic Structural Realism

Let us grant, at least for the sake of argument, the plausibility of the structural realist's reconstruction of the history of science and related epistemic commitments, and focus on the metaphysical component of ontic structural realism (henceforth, OSR). The relevant question has to do with justification rather than possibility: it seems possible to provide a workable definition of structure and consequently claim that reality is constituted by webs of relations not dependent on individual relata - but why be an OSRist?

No explicit argument(s) in this sense can be found in the literature. However, an overall reasoning with which supporters of OSR are not likely to disagree goes as follows:

- 1) To be adequate, any ontological account must be compatible with science and explanatorily efficacious;
- 2) If a traditional ontology of objects (OO) is assumed, a problem arises in the interpretation of quantum mechanics;
- 3) More generally, contemporary physics rules out objects;
 - C1) OO is inadequate;
 - 4) The identity of physical objects depends on relational structure;
 - 5) Relational structure can be regarded as prior to physical objects and their intrinsic properties;
 - C2) OO should be replaced with an ontology of structure.

¹ The idea that the world is mathematical structure can also be found in the literature. However, it is definitely not a popular one, nor is it, *prima facie*, very plausible. It can, therefore, be safely ignored here.

An analysis of this argument, assessing whether conclusions C1) and C2) are truly compelling, will ipso facto provide an evaluation of how justified the endorsement of OSR actually is.

The argument has two parts: a ‘destructive’ one, aiming to show that the entrenched view of material reality, based on objects, is untenable, and a ‘constructive’ one, arguing more directly in favour of a metaphysics of structure on the basis of contemporary physics. Let us look at each step in the argument, then, starting from the inference from 1)-3) to C1).

1) is surely ok, as it expresses a sensible requirement for any ontological view. We can thus move on right away.

2) has to do with an alleged problem with individuality in quantum mechanics. Roughly, all objects are either individuals - entities that can be counted and separately ‘pointed at’ (e.g., people in a room) - or non-individuals - entities that can be counted but not pointed at (e.g., money-units in a bank account). The things that populate the quantum domain, says the OSRist, do not lend themselves to a classification either way: quantum particles appear to violate Leibniz’s Principle of the Identity of the Indiscernibles and obey a non-classical statistics, and this points to their non-individuality; but one can nevertheless insist that they are individuals, by attributing some sort of ‘primitive identity’ to them, and decoupling individuality and classicality in statistical behaviour. The OSRist’s next step is to argue that, in view of this impasse, it is much better to evade the issue entirely and claim that structures, not objects, are fundamental. (For structures, the idea is, the question of (non-)individuality does not arise, and so metaphysical revision allows one to steer clear of metaphysical underdetermination).

This may look compelling at first, but there is the following objection: while the OSRist’s reconstruction just indicates two options as equally open to those aiming to interpret quantum mechanics, a typical metaphysician would preliminarily pick one of them and then see how it fits with the evidence, and this would allow him/her to avoid underdetermination. For instance, suppose that (on independent grounds!) s/he takes difference in (non-identity-involving) monadic properties as essential for individuality. This would directly lead him/her to regard the ontology of quantum mechanics as based on non-individual objects.

To the reply that it is illegitimate to start from a priori assumptions when doing science-based (or, at any rate, scientifically-informed) metaphysics, it can be replied in turn that what is truly illegitimate is to refer to the questions, concepts and categories typical of a priori philosophical analysis only to point

to a problem, but not to solve it. Agnosticism or full-blown eliminativism towards metaphysics would appear to be much more consistent attitudes².

Consider now premise 3) (Contemporary physics rules out objects). The preferred example here is relativistic quantum field theory, where no-go theorems exist that tell us that

- a) Particles cannot be sharply localised
- and
- b) Their number and even existence is frame-dependent,

and so the very notion of ‘object’ seems to be undermined.

Indeed, the mentioned results do rule out the possibility that, at root, reality is constituted by ‘classical objects’ behaving like small billiard balls. But the equation ‘Object=whatever is described as a self-standing thing by classical mechanics’ is by no means compelling. As a matter of fact, the possibility exists of refining the very notion of object in view of the evidence, without giving it up altogether. And the supporter of OO could present this as a preferable alternative based on a general criterion of minimisation in conceptual revision, as well as on the fact that the relevant theories and results presuppose an essentially non-classical conception of space-time (see Bain (2011)).

Given the foregoing, it can be contended that C1), the claim that OO is inadequate, is not compelling because it is the conclusion of an unsound argument.

What about the second sub-argument? Perhaps OSR receives direct support from contemporary physics anyway? To recall it, the argument to be assessed now looks as follows:

- 4) The identity of physical objects depends on relational structure;
- 5) Relational structure can be regarded as prior to physical objects and their intrinsic properties;
- C2) OO should be replaced with an ontology of structure.

To discuss 4), it is necessary, first of all, to consider again the issue of the identity and individuality of quantum systems. Assume a Leibniz-Quine view of identity and individuality as derivative on qualitative difference. In quan-

² Purely a posteriori metaphysics, notice, is not an option: physical data always lend themselves to multiple interpretations, and in any case do not come ‘packaged with’ their own philosophical gloss. OSRists, therefore, cannot claim that their view ‘flows’ directly from science, and must instead accept a priori notions and tools at least in part.

tum mechanics, it was ‘discovered’ recently (Saunders (2006)), this view can in fact be preserved by invoking irreducible irreflexive relations (‘weak discernibility’). Whatever one thinks of relations of this sort, this is good news for OSRists, as their view - as we have seen - is exactly that reality is a network of physical relations that are fundamental and do not depend on anything. And other considerations about contemporary physics can be made that go in the same direction: most notably, ‘permutation invariance’ - the fact that exchanging identical entities makes no difference (consider particles in quantum statistics, or space-time points in general relativistic models) - is readily accounted for by conceiving of identity as determined extrinsically, i.e., by the relationships holding between things. Overall, the idea of an ontological priority of relational structure seems to gain plausibility.

However, one can object to the above reasoning that:

- i) Weak discernibility may depend on rather than ground the identity of particles;
and/or that:
- ii) The extrinsicness (‘contextuality’) of identity is sufficient but not necessary for explaining permutation invariance.

Here too, then, the ‘conservative’ can legitimately resist the move from physics to OSR.

What about 5)? Several OSRists have carried out quite detailed studies of physical theory (see, e.g., French (1999) and Ladyman and Ross (2007)), aiming to show that the analysis of physical properties and entities inevitably points to a fundamental role played by symmetries, invariants etc., and so there is reason for regarding the latter, hence the formal structure ‘encoding’ them, as ontologically ‘loaded’ and fundamental.

However, the force of this inference is far from clear. First, those being pointed at might just be facts about the language and concepts we use, not about reality. Even independently of this, the language-ontology link is left unacceptably obscure. When one says, for instance, that ‘Symmetries are prior to objects’ (Kantorovich (2003)) one seems to be making a patent category-mistake, conflating the abstract with the concrete (recall that practically no OSRist claims that the world is mathematical structure). If this worry is to be dispelled, certainly more needs to be said by way of explanation. Simply pointing to the allegedly relevant formalism and refusing to add anything under the presumption that filling that structure with ontological content is

straightforward (as Ladyman and Ross (2007; 158) seem to do) is certainly not an acceptable way of proceeding - keep in mind how revisionary OSR is.

Overall, then, conclusion C2) appears to follow from questionable premises too, and so the more general claim seems warranted that the argument(s) for the justification of OSR that can be reconstructed from the extant literature are not compelling.

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