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Looking forward, not back: Supporting structuralism in the present

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ABSTRACT

The view that the fundamental kind properties are intrinsic properties enjoys reflexive endorsement by most metaphysicians of science. But ontic structural realists deny that there are any fundamental intrinsic properties at all. Given that structuralists distrust intuition as a guide to truth, and given that we currently lack a fundamental physical theory that we could consult instead to order settle the issue, it might seem as if there is simply nowhere for this debate to go at present. However, I will argue that there exists an as-yet untapped resource for arguing for ontic structuralism – namely, the way that fundamentality is conceptualized in our most fundamental physical frameworks. By arguing that physical objects must be subject to the 'Goldilock's principle' if they are to count as fundamental at all, I argue that we can no longer view the majority of properties defining them as intrinsic. As such, ontic structural realism can be regarded as the most promising metaphysics for fundamental physics, and that this is so even though we do not yet claim to know precisely what that fundamental physics is.

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1. Introduction

Taking Ladyman's seminal 1998 paper to mark its contemporary inception, ontic structural realism (OSR) has now been lurking as a philosophical position for the best part of two decades. Seeming both promising as a response to the master argument against scientific realism and a fitting metaphysic for quantum physics, this period has seen vibrant debate concerning OSR's central contention that it is structure, not objects, that is ontologically fundamental. But while those debates have without question been informative and illuminating, several pieces of the structuralist puzzle remain to be put into place. In particular, it seems that structuralists will need to say something about the *fundamental kind properties* if it is to gain more converts. For if there is one thing that unites the more mainstream metaphysicians of science that OSR stands opposed to, it is the prevailing intuition that the fundamental kind properties are intrinsic in character; fundamental intrinsic properties of *any* sort, however, are anathema to structuralism.[1] Of course, structuralists are likely to object at this point that what anyone's intuitions regarding matters of fundamental ontology happen to be are wholly irrelevant to metaphysics. OSR is, after all, an avowedly naturalistic and self-consciously revisionary thesis, and structuralists will hold that we need to look at the relevant physics if we want to develop a defensible metaphysics of it. However, such a move runs into the difficulty that *we do not currently take ourselves to know what the truly fundamental kinds are* – or at the very least, we do not take ourselves to have a truly fundamental theory of them. Given that we therefore seem to lack the one theory that could be invoked to adjudicate on the matter of what fundamental properties are like, it seems that structuralists must either sit on their hands until we have that fundamental theory, or baldly reject the received intuition; either way, it seems unlikely that they will succeed in persuading the unconverted anytime soon.

In this paper, I want to argue that such pessimism, while understandable, is nevertheless mistaken: OSR need neither be regarded as false, nor as something to be put on ice indefinitely. The reason for this is that, although it is true that we lack a truly fundamental *theory* of the properties that OSR's sights must be trained on, we do nevertheless possess a *framework* for thinking about such theories that can plausibly be regarded as fundamental. This is the framework of *quantum field theory* (QFT). Crucially for structuralism, this framework suggests that the kind properties that will feature in *any* fundamental theory, *whatever* it may be, cannot plausibly be regarded as intrinsic. As such, I will argue that a major stumbling block to OSR can be overcome today, and in a thoroughly naturalistic fashion.

In more detail, the layout of my argument will be as follows. In Section 2 I outline what commitment to OSR involves, and emphasize that (a) it is a thesis about the fundamental in particular,

[1] See, e.g. Ladyman and Ross (2007), p. 131: 'talk of unknowable intrinsic natures and individuals is idle and has no justified place in metaphysics … [T]here are objects in our metaphysics but they have been purged of their intrinsic natures, identity, and individuality, and they are not metaphysically fundamental'.

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and that (b) it seems to prohibit objects from having fundamental intrinsic properties.[2] In Section 3 I present how the case for OSR is typically made in the literature, and emphasize that the widely-held intuition that the fundamental kind properties are intrinsic has been taken to render OSR unfeasible. In Section 3 I consider how structuralists might get around this problem, given that we currently lack the appropriately fundamental theory of physics that could be appealed to in the hope of settling the issue in their favour: my proposal will be that we can use the framework of QFT to probe such theories *prior to our being acquainted with them*. In Section 5 I show that the constraints QFT places on fundamental theories means that fundamental kind properties cannot be regarded as intrinsic, on the grounds that the *fundamentality* of the properties involved has implications for the existence and non-existence of objects distinct from the bearer. Section 6 is the conclusion.

My aim, then, is to show how QFT and the concept of fundamentality embedded within it presents ontic structuralists with a rich new resource – a resource that allows them to deny that fundamental kind properties are intrinsic *qua fundamental* properties. It will doubtless already be clear, however, that the full articulation of the argument is going to be rather involved, and I should come out and say right at the outset that the argument to be outlined here is at best a suggestive sketch. Its tentativeness owes partly to the fact that there remain a few purely kinematic properties not touched by the argument, and partly to the fact that some relevant mathematical methods required to understand fundamental theories in their full generality await further development. My conclusion will therefore not be a categorical claim that OSR is true, but rather the weaker and more tentative one that everything we know about physics is pointing in that direction. Nevertheless, this lack of anything definitive to say at this point need not be seen as a criticism: on the contrary, one could interpret it as showing that OSR remains an ongoing, active, and exploratory research programme marching in step with the progress of physics.

2. OSR as a fundamentality thesis

While it has a number of different articulations, at its core OSR is a proposal concerning what is *ontologically fundamental* to this world. As the name suggests, the position proposes that the mantle of fundamentality, at least in the actual world, belongs to structure and structure alone. Thus while contemporary structuralists are typically not so radical as to claim that there are no objects *simplicter*, their proposal is that the category of objects has to be regarded as ontologically secondary to that of structure. To quote Ladyman, they hold that "*relational structure is more ontologically fundamental than objects*", and for brevity let this be the 'core claim' of OSR.[3]

It is clear that, as a fundamentality thesis, OSR needs to work for the most fundamental objects if it is to work at all. Thus while OSRists have recently elaborated on what OSR has to offer to the special sciences, it must nevertheless be the case that *the most fundamental objects of physics* are amenable to structuralist analysis if the position is to stand up. In focusing its core claim on the fundamental like this, OSR echoes the overall trend in metaphysics away from theorizing about ordinary objects and towards the task of 'limning fundamental structure' – a project also engaged in by leading analytic metaphysicians of the day, such as Sider, 2011, Schaffer, 2009, and Paul, 2012. But while OSRists take themselves to be distinguished from their more analytic counterparts by their more naturalistic approach, they have been criticized for being less explicit than they as to their conception of ontological priority, and have often been guilty of slipping and sliding between non-coextensive relations when spelling out their claims.[4] Another, perennial criticism of it is that how structural features are supposed to be distinguished from non-structural features is likewise left somewhat imprecise. Clearly, however, without some such distinction we cannot even say *of what it is* that is to be graced with fundamental status.

In order to clarify OSR's core claim that structure is more fundamental than objects, then, we must clarify both how ontological priority is conceived and also what it is that is meant by 'structure'. So as not to get too bogged down in the details, I suggest that we do the following. With regard to ontological priority, we will follow Chakravartty in using the relation of *identity determination* to express it: not only is this a relation frequently invoked in the literature, but also one that may be argued on general metaphysical grounds to be an apt relation for structuralism (though I shall not argue for that here).[5] As such, to the extent that the fundamentality claim definitive of OSR does not go through with respect to identity determination – that is, to the extent that the identities of objects turn out not to be determined by structures – we will take it that it that OSR does not go through *simpliciter*. Regarding the contrast between structure and non-structure, I propose that we be somewhat liberal and do not demand that structuralists give necessary and sufficient conditions for what counts as an 'object' and what counts as 'structure' before we agree to examine the warrant for their thesis; for plausibly, all that needs to be shown for OSR to go through is that entities *ordinarily taken as paradigms of fundamental objects* can be shown to be secondary to entities *ordinarily taken as paradigms of structures*.[6] With respect to the first category, it seems that there is no better candidate than fundamental particles, and as such our focus will be on those.[7] With regard to the second category, we will here follow Maxwell and take structural features to be 'those that are not intrinsic', [8] where we will understand intrinsic properties somewhat intuitively as *that may be possessed by an entity independently of what the rest of the world is like*.[9] As such, intrinsic properties are those properties whose possession *neither demands nor precludes* the existence of any object distinct from the bearer of the property. Given this

[2] See though qualifications on this claim in Section 4.

[3] Ladyman and Ross *op cit*., p 145. It might be objected that with this characterization I am equating OSR with its radical version, while OSR also admits a moderate version. But I leave the question of whether the considerations below lend support to one form of structuralism at the expense of the other to another occasion.

[4] See e.g. Hawley (2010).

[5] I discuss this further in McKenzie (in preparation).

[6] Part of the reason it seems folly to me to give necessary and sufficient conditions for objecthood is because the concept has evolved so much over the history of physics – a history that is of course itself a large part of the structuralist story.

[7] Note that my argument will go through whether we speak of particles or directly of quantum fields. I should say too that spacetime points are taken as another – perhaps the only other – candidate for 'fundamental object'; but since it is hard to think of what the analogy of fundamental kind properties would be for these entities, it is likely that structuralism will be easier to secure in the spacetime case. (See Ladyman and Ross (2007), Section 3.2 for discussion of it.).

[8] This quote is from Maxwell (1970), p. 188: while he was an early advocate of epistemic structuralism – but one can find the same equation of structuralism with the denial of intrinsic natures in the OSR canon, e.g. Ladyman and Ross (cf. footnote 1).

[9] Thus Weatherson and Marshall (2014) take it that 'a thing has its intrinsic properties in virtue of the way that thing itself, and nothing else, is'; similarly, for Dunn (1990), 'Metaphysically, an intrinsic property of an object is a property that the object has by virtue of itself, depending on no other thing' (p. 178). While the existence of the minor industry in metaphysics dedicated to defining intrinsicality suggests that this could use some sharpening up, I will be content to rest with this informal characterization in what follows. One reason for this is that the by-now standard formal definition of Langton and Lewis (1998) is far from ideal in this context: for one thing, their analysis makes appeal to perfectly natural properties, which for Lewis are both fundamental and intrinsic by definition – precisely that which this paper denies.

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