Why eliminativism?

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1   Introduction

In *the structure of the world—metaphysics & representation* [French, 2014]
Steven French provides a comprehensive articulation and defense of Ontic Struc-
tural Realism (OSR). Throughout the book French engages with a wide range
of interlocutors, which makes the book the most thorough contribution to the
field to date. In his book, French defends ontic structural realism as a successful
response to three challenges every scientific realist has to face: the pessimistic
meta-induction, underdetermination, and Chakravartty's challenge. The latter
is the demand that a realist needs to explain what it is she is a realist about.
Chakravartty's challenge invites an account of the metaphysical commitments
of various forms of scientific realism. A tension French points out and wrestles
with throughout the book arises from this challenge on the one hand, and the
threat of underdetermination on the other hand. While Chakravartty demands
that the realist must provide a metaphysical account, underdetermination wor-
ries suggest that physical theories leave metaphysical questions less than fully
resolved. French's proposal in response to this tension is that structural realism
provides a better response than its competitors. For the structural realist that
means he needs to specify why structure is something we can glean from scien-
tific theories in the face of underdetermination, and he needs to specify what
structure is, if that is what we are to be realists about.

Ontic structural realists hold that "structure is all there is". To specify what
is meant by this slogan, and to defend it, ontic structural realists need to artic-
ulate both what they mean by "structure", and what they take to be excluded
from the ontology. These two questions are addressed in the first half of the
book. With respect to the first, French's answer is "group-theoretic structure",
and he proceeds to defend this answer against a number of competitors and
objections (chapters five and six). With respect to the second question, what
is not part of the ontology, French holds a distinctly more radical view than
other ontic structural realists.[1] For French, structural realism contrasts with
"property-oriented realism", but more importantly, it contrasts with "object-
oriented realism". And while other ontic structural realists are willing to allow

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[1]For more moderate approaches see Ladyman and Ross [2007] and Esfeld and Lam [2008].

that a "thin" notion of object has a role to play in a structuralist ontology, French aims to eliminate objects from the ontology altogether (chapter seven).

Realism about group-theoretic structure, together with eliminativism about objects, then, are the two theses articulating what ontic structural realism is. In the second half of the book French shows what ontic structural realism thus conceived can do. In particular he develops accounts of causation, laws, and symmetries from an ontic structural realist perspective, as well as extending the view beyond physics to philosophical problems in biology. With these latter discussions French takes structural realism significantly beyond its original home in the philosophy of physics.

Here I will be concerned only with the project of articulating ontic structural realism. More specifically I will focus on eliminativism about objects. Understanding eliminativism is important because it is, prima facie, a radical thesis and hence often met with skepticism or puzzlement. What does eliminativism about objects mean? There are actually two readings of this claim to be found in the book (see for example [French, 2014, 177]): a more radical one, and a somewhat more moderate one. On the radical reading, the claim is simply that there are no objects anywhere at all. Objects do not exist. On the less radical reading objects "reappear" in the structuralist ontology, but they are "reconceptualized" in terms of structure, where that "reconceptualization" is taken to be so complete as to leave no traces of genuine objecthood. I will come back to this ambiguity below. I will organize my discussion around three challenges to eliminativism about objects:

1. objects are required to articulate structural realism

2. objects seem obviously a part of the world around us

3. quantum particles might be objects

I will argue that French's responses to these challenges are not fully conclusive, and I will suggest some responses and modifications on the structural realists' behalf. I ultimately suggest that eliminativism about objects is less central to the structural realists' project that French makes it out to be.

2 Objects are required to articulate structural realism

The first of these challenges is a version of oldest objection to OSR on the books: how can there be structure without objects? Isn't that conceptually incoherent? Since the emergence of OSR, this objection has been raised in a number of different forms.[2] The fundamental concern is that we understand what structures are by thinking about relations among objects. In his book

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[2]For a range of different ways of expressing this concern, see Chakravartty [2004], Busch [2003], Psillos [2001], among others.

French addresses this worry in its most recent form: if the structure an ontic structural realist is a realist about is group theoretic structure,[3] then how does an eliminativist get around the fact that we need objects in order to introduce group theoretic concepts in the first place?

French responds to this concern by introducing what he calls the *Poincaré Manoeuvre*:

> Although we might introduce the terminology, or perhaps better, symbology, of objects as part of our representation of the relevant structure, these should be regarded as mere devices that allow us to construct, articulate, or appropriately represent the relevant structure, and any representational priority they might have should not be taken to imply that they are ontologically foundational. [French, 2014, 67]

The idea behind the *Poincaré Manoeuvre* is to treat objects relied upon in the construction of group theoretical relations as mere heuristic devices, or as Poincaré [1898] puts it, "a crutch", which can be dispensed with once the construction is completed. French employs the *Poincaré Manoeuvre* throughout the book to ward off the objection that structural realism cannot even be articulated without reference to objects, that objects are integral to any attempt of constructing or representing the relevant structure. Using the *Poincaré Manoeuvre* French accepts the need for objects in the construction of his preferred representational structure, while disowning any commitment to objects apparently represented by such structures. The idea seems to be something like this: when we first introduce the idea of a set, or the notion of a group, we do so by imagining certain relations and operations performed on objects. We might characterise a group, for example, by describing possible rotations of the square. This yields the cyclic group on four elements. Nonetheless we should not take squares and their rotations as somehow essential to this group—they were just a means of getting us there.

Declaring something a 'mere' heuristic device is a familiar way to rid oneself of metaphysical commitments of all sorts, and any such declaration will raise some amount of suspicion. Two questions should be asked: first, in what sense are objects merely heuristic devices in the relevant constructions, and second, is that the only role objects play with respect to the structures in question?

The reason set-theory and group-theory look like they might be representations of objects is that they present certain relations among elements. These elements, in simple intuitive cases, will be objects, including arithmetical objects like numbers. Since the same group-structure might apply to different kinds of objects, no *particular* collection of objects is needed to introduce group-structure. For example, we could have arrived at the cyclic group on four elements using the integers modulo 4 under addition instead of the rotations of

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[3]French actually thinks that we need to distinguish between structures relevant for physics, which for him are group-theoretic structures, and structures that we might employ as philosophers of science to describe scientific theories, which might include set-theory as well as other representational tools.[French, 2014, 139]

the square. The objects used in the construction of a group are *arbitrary*, which suggests that properties beyond those represented by the group structure are irrelevant.

Is that enough to get rid of objects? I don't think so. True, at least some of the features of objects used in the construction and representation of group theoretic structure are not relevant to the construction of the group, and can hence be set-aside. But so far this seems to be the mathematicians familiar insistence that the particular illustration chosen must be disregarded to appreciate the abstract character of the mathematical conception. Poincaré's own description brings this out quite clearly: "For me, on the other hand, form exists before the matter. The different ways in which a cube can be superposed upon itself, and the different ways in which the roots of a certain equation may be interchanged, constitute two isomorphic groups. They differ in matter only. The mathematician should regard this difference as superficial, and he should no more distinguish between these two groups than he should between a cube of glass and a cube of metal". [Poincaré, 1898, 40]

The contrast Poincaré draws seems to be analogous to the contrast between sensible matter and mathematical description. Just as we abstract away from the particular material constitution of an object to give its geometrical description, e.g. saying that it is a cube, we similarly abstract away from the particular relations among numbers, or spatial rotations and translations of particular geometrical figures, in order to arrive at the structure of the group. Poincaré's contrast in both cases is that between form and matter, and he insists that for the mathematician form, in particular the group, is prior to any matter. Note also that, contrary to Poincaré's own presentation, this priority concerns the *identity* of the group, not its existence. Poincaré argues that isomorphism is sufficient for group identity, regardless of the 'matter' which realizes the group. Groups do not depend, for their identity, on a particular mathematical or physical realization. Similarly one might say that two structures are the same if they are isomorphic to one another, even if they are instantiated by different collections of objects. But it does not immediately follow that the structure does not depend for its existence on some objects or other to instantiate it. So even if form, in Poincaré's sense, is prior to matter, it is unclear that this means also that form does not depend on objects for its existence.

Another reason to think that groups require objects, at least for the case of finite groups, is that one important feature of a (finite) group is its order, which depends on the cardinality of its elements: the cyclic group on four elements has different properties from the cyclic group on five elements. So while it may be arbitrary for any abstract group, which realization of the group we use to illustrate it, group structure nonetheless imposes some constraints on which collections of elements might be able to realize it. In particular, finite groups require that collections of objects have a determinate cardinality.

Another respect in which Poincaré's original manoeuvre seems to differ from French's employment of it, is that form and matter distinctions can be reiterated. The relation between form and matter seems to be that of the more general or abstract to the more specific or concrete. By contrast, the difference between

structure and objects, especially on the eliminativist understanding, seems to be one of two competing metaphysical categories. French also suggests a kind of iterative approach to structure at times, but it seems to be somewhat different in character.

> [...] I shall respond to it by appealing to a kind of iterative move: the distinction ESR is based on is really one between structures and putative 'objects', such as electrons, protons, and so forth. In those terms, one can still make the desired structuralist claim about where the relevant continuity [across theory change] lies. However, and this is the next step in the iteration, the metaphysical consequences of, for example, Permutation Invariance, mentioned earlier, lead us to conclude that the putative objects should either be regarded as what we shall call [...] 'thin' objects, at best, or should not be regarded as objects at all. Thus in the first stage of the iteration we begin with a putative distinction, one side of which we then discard in the second, leaving only the structure (or, at best, as we'll see, structure with 'thin' objects). [French, 2014, 19]

The iterative move suggested by French might prima facie seem similar to the idea proposed by Poincaré. First you start from some physical posits, like electrons, protons and so forth, and draw a distinction between objects and their structure. The epistemic structural realist then goes on to declare that we can only know about their structure, whereas the ontic structural realists insist that a closer look reveals that the putative objects were never (real, substantial) objects to begin with. Whether this second move works will depend on the status of quantum particles (see below). Crucially, though, it seems that the iteration here is quite different from the one suggested by Poincaré. For Poincaré, the objects initially used to introduce group structure simply become irrelevant for the further purposes of the mathematics of groups. By contrast, ontic structural realists want to say that the objects used to discover the relevant physical structures turn out not to be objects.

Finally, even if we grant Poincaré that taking form as prior to matter is the right perspective for the mathematician to take, is it the right move to make for a structural realist? Not entirely, it seems to me. For ontic structural realism as French understands it, is ultimately a view about physical structure, not mathematical structure. So it seems we need to know not only which group structure is appropriate for a given physical theory, we also need to accept that the world contains elements that stand in relations that can be described by that group structure.

I would like to raise two questions for French regarding the Poincaré Manoeuvre. First, is the intended difference between structure and objects really captured by the contrast between form and matter? And secondly, is it really the case that the ontic structural realist can take the mathematician's abstract view of group structure? In particular, how does this move fit with the claim later on, that the structures in question are interpreted structures? Interpreted

structures suggest that what Poincaré calls the matter of a group matters, not just its form.

3   The world contains physical objects

Let me now turn to the remaining two challenges for the eliminativist about objects, namely the idea that objects are all around us, and the idea that quantum particles might be objects. Steven French addresses both concerns explicitly in the book, and he offers a mix of old and new arguments to defend eliminativism in light of these objections.

The old argument is the well-worn underdetermination argument: quantum statistics, claims French, leaves it underdetermined whether quantum particles are individuals or non-individuals. The best response to this underdetermination, French suggests, is to move away from an object-based ontology, thereby avoiding the question of individuality or non-individuality of objects altogether. To do so reduces the overall humility we have to accept in our metaphysical picture of the world. The underdetermination argument has been widely discussed in the literature (see especially Brading and Skiles [2012] for a critical discussion), so I will set it aside for the remainder of this paper.

Instead I would like to focus on a new line of argument developed in the book, which is the attempt to articulate eliminativism through the employment of a dependence relation. French develops this account separately for ordinary objects and quantum particles.

The general strategy is to show that putative objects depend on structure in such a way as to eliminate the objects altogether. Dependence relations are typically thought to be metaphysical priority relations, where the priority might be existential, essential, or explanatory [Correia, 2008]. If a existentially depends on b, then necessarily, if a exists, b exists. If a essentially depends on b, then necessarily, for a to be that very entity, b must exist. If a explanatorily depends on b, then necessarily a exists in virtue of/because of b. It helps to illustrate these relations using the frequently employed example of Socrates and singleton {Socrates}.[4]   Necessarily, if Socrates exists, then {Socrates} exists, and vice versa. So singleton {Socrates} depends existentially on Socrates, and Socrates depends existentially on singleton {Socrates}. If the last dependence relation seems counterintuitive, other dependence relations might come into play. For example, one might try to articulate the dependence of singleton {Socrates} on Socrates using essential dependence: singleton {Socrates} depends, for its identity, on Socrates, but not vice versa.

French uses a combination of essential and explanatory dependence relations to articulate his eliminativism about ordinary objects and quantum particles as objects. This is an odd strategy, since dependence relations are not usually thought to eliminate one of the relata. To say that b is prior to a is not usually the same as saying that a does not exist, or that a can be eliminated from the ontology at no cost. What a dependence of a on b might show is that b is more

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[4]The example was famously used by Fine [1994] to argue against modal reductionism.

fundamental than a. Combined with the view that only what is fundamental (really!) exists, this might yield the view that a does not exist fundamentally. French seems to want to go further, though: "[L]abelling where a and b sit in some metaphysical hierarchy does not obviate the original concern. So, in the case of explanatory dependence, if all the facts about a hold in virtue of and explained by facts about b, then we can certainly mount a case that a is at best derivative upon b, or may even be eliminable in favour of b". [French, 2014, 166]

French seems to insist, then, that some dependence relations might very well eliminate dependent entities, if, so to speak, not much is left of the explanandum after the explanation has been given. Objects are not merely ontologically less fundamental than structure, they are to be eliminated in favour of structure. This makes the relevant dependence relation sound awfully like a reductive explanation, to which dependence was supposed to be an alternative. At this point, the debate is in danger of turning into foot-stomping over whether such dependence relations are possible.

Here is perhaps a way forward, at least if we understand the dependence to be a kind of explanatory dependence. We might try to distinguish between vindicatory explanations, and non-vindicatory explanations.[5] Vindicatory explanations explain that things appear a certain way in terms of the fact that things in fact are as they appear. A meta-ethical realist, for example, might explain the fact that ethical judgments appear (to their proponents) to be universally valid and objectively true, by suggesting that they are in fact objectively true. There is not much to be said beyond this to explain their appearance. Contrast this with a non-vindicatory explanation, where the goal is to *explain away* the appearance of certain facts. The meta-ethical error theorist, for example, might explain away the appearance of our ethical judgments as universal and objectively true, by explaining these features in terms of certain aspects of our psychology: we feel threatened by behavior which does not conform to norms we have internalized, and social coordination depends on a shared understanding of what's right and wrong. This explanation is meant to be non-vindicatory, because the facts in virtue of which our ethical judgments appear to be universal and objectively true, undermine the claim that these judgments are in fact objectively true. Their appearance turns out to be misleading. For an eliminativist about objects the question then becomes, whether the dependence of objects on structures can be understood in a non-vindicatory way. To do so we have to distinguish the two cases French considers: ordinary objects on the one hand, and quantum particles on the other.

3.1 Ordinary objects

As an eliminativist about objects, French claims that objects do not exist. In the case of ordinary objects, this claim might seem to be in good company with a number of non-structuralist metaphysical views. As French himself points out

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[5] I'm loosely borrowing this notion of vindicatory explanation from Wiggins [1991].

(see French [2014, 170]), there are many positions in mainstream metaphysics which similarly treat ordinary objects as non-fundamental. Some of them, like certain types of nihilism, might also agree that their non-fundamental status means that ordinary objects do not exist. Very much like other eliminativists, French later introduces a number of metaphysical manoeuvres to reconcile our talk about ordinary objects with the assertion that, fundamentally, there are no objects. If so, is French's eliminativism really as radical?

For ordinary objects, French illustrates his position using Eddington's famous two tables: the commonplace table, which is extended, colored, and substantial, in contrast to the scientific table, which is mostly empty and not substantial. The eliminativist, it seems, wants to claim that the commonplace table, as a substantial object, does not really exist. It does not really exist, because its features are thoroughly explained by the underlying physics, in particular for us today, quantum field theory. The solidity of the table, says French, "holds in virtue of the relevant physics as expressed in the Exclusion Principle and, more fundamentally, the anti-symmetrization of the relevant aggregate wave-function. In this case one might then insist that the latter feature of quantum mechanics entirely explicates the solidity of every day objects and in doing so eliminates the predicate from the scope of our fundamental ontology" [French, 2014, 170].

There are a few comments I would like to make about this account of how quantum mechanics eliminates objects. First, the crucial feature of objects, both in Eddington's example and French's use of it, seems to be solidity. But while solidity is certainly a salient feature of many everyday objects, it is not clear that it metaphysically essential for objects to be solid. For example, most of us would be happy to call a hot air balloon an ordinary object, even though we know it's mostly just hot air, and definitely not solid. So focussing on solidity might be a bit misleading. Solidity does seem to be a crucial feature of what we call 'bodies', and it seems to me that this turns out to be quite crucial in the discussion that follows.

Second, and more importantly, for French, the crucial issue seems to be whether the explanation is complete, that quantum mechanics "entirely explicates the solidity of everyday objects". But as I suggested earlier, the completeness of the explanation does not seem to be the crucial point, although it is a necessary condition. Even a complete explanation can be vindicatory, and so a friend of everyday objects might take the fact that quantum mechanics gives a complete explanation to provide a reason for being justified in solidity talk, and by extension, object talk. What French needs to show is not only that the explanation is complete, but also that it is non-vindicatory.

Why should the quantum-mechanical explanation be non-vindicatory? Unlike the explanation given by the meta-ethical error theorist, nothing in the quantum mechanical explanation obviously undermines that objects are solid in the way in which describing ethical judgments as the result of particular psychological and social conditions undermines their claim to universal truth. But even scientific explanations are sometimes non-vindicatory. A classic example is the heliocentric explanation of the observed motion of the sun. For an observer on the surface of the earth it looks as though the sun moves around the earth,

but that appearance is brought about by the rotation of the earth instead. The quantum mechanical explanation of the solidity of objects would have to be of a similar sort in order to count as non-vindicatory.

If we take solidity to be a characteristic feature of objects, that is, if we think that what is at issue is that ordinary objects are bodies, I think a case can be made for this. What makes the explanation non-vindicatory is that it explains the solidity of objects in terms of something that is not solid, and, French will argue, should not be thought of as objects either. On behalf of the eliminativist, let's put this as follows: The fact that there are solid objects (bodies) holds in virtue of facts about non-solid non-objects. In particular we might say that solid objects exist in virtue of the anti-symmetrization of fermionic wave-functions.[6]

Can we understand these 'in virtue of' explanations as non-vindicatory? We have to ask what exactly is undermined by these explanations. Not, I take it, the appearance that there are solid objects. That there appear to be objects, and that they appear to be solid, is the explanandum. What is undermined, instead, is the straightforward explanation of this appearance, namely that there appear to be objects simply because there are objects. More importantly, the quantum-mechanical explanation also undermines a sophisticated version of the straightforward explanation: there appear to be solid objects because the world ultimately consists of very small solid objects, which combine together to form larger solid objects. The quantum-mechanical explanation, because it is in conflict with at least some of the key features we attribute to ordinary objects, rules out corpuscularianism. What is undermined, in the first instance, then, is a particular physical hypothesis: it's bodies all the way down.

If this is indeed the argumentative role of the dependence relation, then the resulting "eliminativism" is not the thesis that ordinary objects do not exist, nor is it the claim that ordinary objects are structurally re-conceptualized. For the quantum mechanical (or quantum field theoretical) account of the features of ordinary objects is not a conceptual or even a metaphysical explanation, it is a (kind of) causal explanation. Objects as we know them exist; they are particular macro-level effects of certain quantum level interactions, operating under certain constraints (like the Exclusion Principle). Presenting eliminativism about ordinary objects as a first-order metaphysical thesis seems to be a bit misleading.

The quantum mechanical explanation does create a problem for "object-oriented metaphysics", the idea that our metaphysical categories and theories should be based around the notion of solid, individual objects. What is undermined is the idea that something like objects will be the fundamental constituents of the world around us, and that the features we regard as essential to objects will be preserved by whatever we find at that fundamental level. Object oriented metaphysics, on this gloss, turns out to be the view that while macroscopic objects may not be fundamental, they are nonetheless metaphysically interesting because they are ultimately made up of objects, just smaller ones. What the non-vindicatory explanatory dependence of ordinary objects on quan-

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[6]Dependence relations of this sort are invoked on pp. 170 and 176 [French, 2014].

tum mechanics shows, is not so much that there are no objects, or even that we are wrong about their features, but instead that theories shaped by our ideas about objects are not suitable as a framework for fundamental metaphysics. It does not work, because quantum physics suggests that what explains the existence and features of ordinary objects is in turn very much unlike ordinary objects. That's taking a stance against object oriented metaphysics, but without elimination of objects. Instead it is something closer to a meta-metaphysical thesis, a thesis about how do to metaphysics. The suggestion is that we should base our metaphysical theories on our best physical theories, and that the latter suggest an ontology quite different from that suggested by ordinary objects.

There are two questions I would like to raise at this point: First, if the explanatory dependence is indeed causal, then it seems metaphysical dependence is too strong a relation. Do we really want to say that solid objects are necessarily such that they exist in virtue of the existence of appropriate wavefunctions? That is, do we want to rule out corpuscular/Newtonian universes as metaphysically (or even physically) impossible? Second, how does the would be eliminativist respond on the emergentist about objects, who might agree with most of the argument offered, but insist that this shows that objects are emergent entities, not present at the physically most fundamental level, but part of our universe nonetheless?

3.2   Quantum-particles as non-objects

Let's turn to the final concern about objects, the question whether quantum particles are objects. Talk of quantum particles might seem to pose a challenge for eliminativism. If they are objects, then it would seem that even if ordinary objects are not fundamental, we re-encounter objects at the fundamental level.

French again appeals to a notion of dependence, although at first glance it seems to be slightly different notion from the one employed earlier in the argument against ordinary objects. He suggests that in quantum physics "The very constitution (or 'essence') of the putative objects is dependent on the relations of the structure" [French, 2014, 181]. He explicates this notion of essential dependence further: "x depends$_E$ for its existence upon y =df. It is part of the essence of x that x exists only if y exists" [French, 2014, 182].

The new idea here seems to be that putative quantum objects are essentially such that in order to exist, necessarily a (certain kind of) structure has to exist. Once again it is not clear that, even if such a relationship indeed holds, this would suffice to eliminate objects. Suppose essentialism about origins is right, in which case me being who I am depends upon my parents existing, and standing in a particular relationship to me. Even if essentialism about origins were true it would not follow that I do not exist, nor that there is not more to me than the fact that I am my parents' child. The necessitation involved in dependence relations is quite unproblematic for the dependent entity, provided that the dependee exists. Accordingly I don't quite see how French's next claim is supposed to follow from or be illuminated by this notion of essential dependence. "Our putative objects only exist if the relevant structure exists and the

dependence is such that there is nothing to them—intrinsic properties, identity, constitution, whatever—that is not cashed out, metaphysically speaking, in terms of this structure. This yields eliminativist OSR: there are no objects, thick or thin, and no identity, contextual or otherwise"[French, 2014, 182].

Essential dependence alone does not yield this result, so perhaps the dependence invoked here is once again a species of explanatory dependence. In that case, it seems French is here facing the same difficulties as earlier. What he needs is a non-vindicatory explanation of why particles sometimes appear object-like. As stated, however, the explanation seems vindicatory. The putative objects only exist if the structure exists. Well, since the ontic structural realist presumably thinks that the structure does exist, he should hence have no problem allowing the objects to exist as well. Indeed, it seems that those who insist on 'thin' objects, or objects with contextual identities, are embracing this vindicatory result. The reason we are permitted to think that there are 'thin' objects, is precisely that everything about them can be cashed out in terms of structure. If particles in quantum mechanics only have an identity if certain structures exist, that is, if they have their identity in virtue of standing in certain relations, then we should be perfectly happy to attribute existence and identity to them if those relations or structures are in fact in place. It seems, then, that considerations from quantum mechanics do not give us good reasons to favour eliminativism over re-conceptualized quantum mechanical objects.

French could try to block this vindicatory interpretation, by insisting that quantum theory shows that particles are not objects. The type of dependence argument French really needs for his eliminativism is the following: objects depend (existentially or essentially) on something B, and quantum mechanics gives us reason to believe that B does *not* exist. If quantum mechanics gives us reason to believe that particles exist, then they cannot be objects. To give such an argument, French would need to present a suitable B. B would have to be an entity, feature, or relation plausibly required for objects to exist (or for objects to have an identity), yet it would also have be something definitively ruled out by quantum mechanics. French's own underdetermination arguments make it unlikely that such a B can be found.

Even if one does not accept the underdetermination argument, one might worry, as Brading and Skiles [2012] do, that it is too much to require an 'identity profile' of objects for them to count as objects. More generally, an eliminativist has to show both, that objects must have a certain kind of feature to count as objects, and then secondly, that quantum mechanics rules out that quantum particles have this feature. Quantum particles lack many features we commonly attribute to ordinary objects, like solidity. On the other hand, we do at times attribute very object-like features, like cardinality, to collections of quantum particles. The difficult question, it seems to me, is whether we can make sense of these attributions outside the ordinary context in which we normally use them.

4 Conclusion

Let me conclude with a brief summary. I've focused on one aspect of French's articulation of OSR, his eliminativism about objects. I considered three sources of problems for this view: objects might be needed for the articulation of structural realism, objects are all around us, and quantum particles might be objects. I suggested in response to the first, that French's *Poincaré Manoeuvre* needs a little more footwork, and in response to the latter two that dependence relations do not get rid of objects. In particular I suggested that dependence relations are in fact too strong for the intended conclusion, that the explanatory dependence relations seem vindicatory rather than undermining, and that existential or essential dependence relations only eliminate dependent entities if no suitable dependee can be found.

Instead I've suggested that we should take ontic structural realism to be committed to the (widely shared) first-order metaphysical thesis that ordinary objects are not fundamental. This widely held view, together with the view that the entities of fundamental physics are not (ordinary) objects and the commitment to a physics-based metaphysics yields the meta-metaphysical thesis that our metaphysics should not be 'object-oriented', that is, we should resist the temptation to attribute features of objects to the elements of our fundamental ontology. We can reject object oriented metaphysics even without eliminativism about objects, provided the only objects we recognize are non-fundamental. So, why be an eliminativist?

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