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Panpsychism and Structural Realism¹

The Problem

Structural realism is a popular view among philosophers of science. Definitely with the late David Lewis' paper on "Ramseyan Humility" (Lewis 2009), if not earlier, it has become widely discussed among analytic metaphysicians as well. It promises to avoid the pitfalls of both classical scientific realism and scientific anti-realism by restricting realism to the structural features of the world only. In the tradition of Whiteheadian process philosophy, any form of structural realism, however, commits the fallacy of misplaced concreteness. Structure alone will never suffice to ground the existence of a concrete entity. Intrinsic properties that carry the relational structure are needed. This line of argument lends support to a kind of panpsychism if the grounding realizers of the structural and relational properties are conceived to be intrinsic properties analogous to the properties of the phenomenal mind. To the structural realist, it is by no means obvious that he is committing a fallacy of misplaced concreteness. On the contrary, the need for unobservable realizers of the mathematical structures described by science is often flatly denied. If – by assumption – all there is to matter is its relational or structural properties, then the impetus to seek an intrinsic 'background' that underpins them obviously evaporates completely. For the panpsychist in the tradition of process philosophy, it is thus a pressing task to carefully and critically scrutinize the prospects for structural realist metaphysics. Things are complicated by the fact that there are many forms of structural realism. In what follows some general features of the most important subdistinctions of structural realism will be discussed.

What is Structural Realism?

Classical realism affirms that the nature of unobservable objects is at least in approximation correctly described by our best scientific theories. Anti-realism holds that truth is to be understood in epistemic terms either as ideal rational acceptability or as maximal coherence; thereby any claim about the correspondence between our theories and the mind-independent world is avoided. Structural realism takes a middle position by maintaining that we should commit ourselves to the structural and mathematical content of our theories only. The standard example is the transition

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from Fresnel's ether to Maxwell's electromagnetic theory of optics. What was carried over in this theory shift was not the full theoretical content; there was rather a continuity of form or structure. (Worall 1989, 117.)

The best way to characterize structural realism is the standard Ramsey method of eliminating theoretical terms. Each referring term in a given theory is replaced by an existentially bound variable. The result is a claim of the following general structure: There exist certain entities (represented by variables only) that are configured structurally in a certain way. It is still maintained that the theoretical entities exist; however, the theory does not refer to them directly but rather by means of bound variables and the relational structure that is (supposedly) known by observation. In one reading of structural realism, the theoretical entities "in themselves" remain unknown; only their structural interdependence is knowable. Structural realism thus understood combines a Kantian anti-realist view about the nature of things in themselves with a realist view about the relational structure. More austere forms of structural realism embrace radical eliminativism about anything non-relational. Before these different positions will be discussed in greater detail, the most powerful and general challenge to structural realism by the panpsychist will be presented: the hard problem of consciousness. This problem serves as a backdrop for the entire discussion presented here. Only then will the analysis of the various strands of structural realism highlight the problems that the respective structural realists have to face in a more fine-grained way. In conclusion I will argue that the challenge of structural realism to panpsychism is real but that it poses no serious threat to the viability of a panpsychist view.

The Incompleteness of Structure: A "Chalmersian" Presentation of the "Hard Problem of Consciousness"

The key argument against any form of structural realism is that within it the hard problem of consciousness arises in its toughest form: there is a deep epistemological and ontological gap between relational structure and phenomenal consciousness.

Following upon recent research in the philosophy of mind, the discussion of the "hard problem of consciousness" has resulted in a widespread acceptance of the thesis that the qualitative mental properties of phenomenal experience cannot be fully reduced to relational or structural properties. It is the intrinsic qualitative aspect of the mental that cannot be captured by the causal and functional concepts of the physical sciences. Because of their intrinsic nature, qualitative mental states cannot be captured by scientific analysis. The properties that science finds are all dispositional. Dispositions require a categorical (non-dispositional) basis on which they supervene. For present purposes, "intrinsic properties" will refer to those properties that a thing has in itself, independently

of its relations to other things: the properties it could have even if it were the only thing in the universe. The mental properties of the Cartesian thinking thing are intrinsic in this sense because it can be conceived that all of its mental states could exist even without a material external world. The richness of its intrinsic properties is thus in principle independent of external relations (maybe with the exception of God). In contemporary philosophy of mind, functionalism has been criticized as capturing only the relational aspects of mind, and as missing the intrinsic, qualitative mental properties. Can physical properties be intrinsic in this sense? That is a difficult question. Mass is considered by some to be an intrinsic property. But then, having a mass of m is a property such that something that has that property will play a certain functional role defined by a relation of force and acceleration: $m=F/a$. What about rest mass? It is a consequence of general relativity that only an isolated system would have a coordinate-independent mass. Since a non-isolated system is constantly exchanging energy-momentum with its environment, the mass at a certain point in time would depend on the simultaneity determinations of the observer. In quantum mechanics, mass is ultimately explained by the Higgs mechanism, which is clearly a functional concept. It seems as though, if only we dig deep enough, even physical concepts that looked *prima facie* like non-relational intrinsic properties, turn out to be defined relationally. It is thus reasonable to ask: What is the intrinsic categorical nature of those entities that are relationally defined by physics?

Many arguments have been advanced to show that facts about qualia are not implied by physical facts. I will focus here on David Chalmers' famous "zombie argument" because it helps to clearly indicate where in the logical structure of the debate the physicalist is possibly forced to draw panpsychist conclusions. The general form of the argument is this (Chalmers 2002, 249):

Let P be the conjunction of all micro-physical truths about the universe, and let Q be an arbitrary phenomenal truth about the universe.

- (1) $P \& \sim Q$ is conceivable.
- (2) If $P \& \sim Q$ is conceivable, $P \& \sim Q$ is metaphysically possible.
- (3) If $P \& \sim Q$ is metaphysically possible, materialism is false.
- (4) Materialism is false.

But, says the standard scientific essentialist (type-B materialist), $P \& \sim Q$ is only conceivable but not metaphysically possible. The mistake, according to the type-B materialist, is that we are working with primary intensions when dealing with epistemic possibility (conceivability), and with secondary intensions when dealing with metaphysical possibility. In the first case, we consider a world as actual; in the latter case we consider a world as counterfactual (how things might have been but are not). If we consider Putnam's XYZ-world as actual, then "water is not H_2O " is true.

This is an instance of an epistemic possibility. If we rigidly hold the meaning of “water”, as fixed by the actual world, and counterfactually consider the XYZ-world, then “water is not H₂O” turns out to be false. Then “water is H₂O” expresses a Kripkean necessary truth. Let us call possibility associated with primary intensions “1-possibility,” and possibility associated with secondary intensions “2-possibility.” In order for Chalmers' argument to meet the challenge of type B-materialism, it should rather look like this (Chalmers 2010):

- (1) P&~Q is conceivable.
- (2) If P&~Q is conceivable, P&~Q is 1-possible.
- (3) If P&~Q is 1-possible, P&~Q is 2-possible.
- (4) If P&~Q is 2-possible, materialism is false.
- (5) Materialism is false.

Here, the truth of (3) requires that both P and Q have primary and secondary intensions that coincide. In the case of Q, this seems unproblematic. If something feels like pain, it is pain. If something feels like consciousness, it is consciousness. In the case of P, however, the issue becomes much more problematic. Physical properties are functionally defined. We can say that the primary intension of “mass” picks out whatever plays the mass role in a given world. We can also say that the secondary intension of “mass” is tied to the property playing that role in our world in such a way that in a world where something else plays the mass role, this role filler is not mass. Premise (3) can be rejected on these grounds. But what does that mean? In that case there would be possible worlds that verify the structural description of our world in physical terms without being an exact duplicate of our world. The physical structure of those other worlds would be indistinguishable from our world, but the intrinsic natures carrying those relations would be different. The most interesting case would be worlds verifying P&~Q.

This leads to an interesting metaphysical picture: the structural properties of physics in our world do not necessitate the Q-properties (phenomenal properties); the Q-properties do not supervene logically on the structural properties. However, the structural properties of physics together with additional intrinsic properties necessitate the emergence of phenomenal consciousness. This metaphysical picture has been eloquently expressed by Astronomer Sir Arthur Eddington in his work “Space, Time, and Gravitation”: “Physics is the knowledge of structural form, and not knowledge of content. All through the physical world runs that unknown content, which must surely be the stuff of our consciousness” (Eddington 1920, 200). Russell's “neutral monism” was based on similar intuitions: “As regards the world in general, both physical and mental, everything we know of its intrinsic character is derived from the mental side, and almost everything we know of its

causal laws is derived from the physical side” (Russell 1927, 402). The structure of Chalmers' argument thus comes finally down to this (Chalmers 2002):

- (1) $P \& \sim Q$ is conceivable.
- (2) If $P \& \sim Q$ is conceivable, then $P \& \sim Q$ is 1-possible.
- (3) If $P \& \sim Q$ is 1-possible, then $P \& \sim Q$ is 2-possible or Russellian monism is true.
- (4) If $P \& \sim Q$ is 2-possible, materialism is false.
- (5) Materialism is false or Russellian monism is true.

Russell's intuition was that we lack information about the intrinsic nature of the physical world, in virtue of which (plus the relevant laws) the emergence of conscious mind can be explained. This is, of course, just a conjecture, but it is certainly a possibility that knowledge of the intrinsic properties of matter would help to overcome the puzzle of emergence. In Russell's words: “The physical world is only known as regards certain abstract features of its space-time structure – features which, because of their abstractness, do not suffice to show whether the world is, or is not, different in intrinsic character from the world of mind” (Russell 1948, 240). To use Whitehead's term, the modern notion of matter presents us with “vacuous” entities whose intrinsic nature is unknown (Whitehead 1929, 29). Inspired by Humean arguments, Peter Unger has recently presented a visually compelling picture of this problem. Let us define two worlds in purely structural terms, not assuming any intrinsic qualitative properties. The first world is a classical Newtonian world of particles moving about in empty space according to the laws of physics. Call this the “particulate world.” In the second world there is a continuous material plenum (a continuous field of matter) in which there are little, perfectly empty spaces, or absolute vacua, or simply “bubbles.” Call this the “plenumate world.” Now let us assume that the two worlds stand in an isomorphic relation in such a way that for each particle in the particulate world there is a corresponding bubble in the plenumate world (in the same location, governed by the same laws). It is Unger's contention that these two worlds are functionally equivalent (Unger 2006, 21-31). A structural description would be unable to capture the differences between these two worlds. The structural realist might regard it as a theoretical advantage that his/her account abstracts away from the underlying differences and concentrates on the isomorphic structure only. But, as this simple example makes quite clear, the intuition that the structural description misses something of great importance is powerful.

An alternative metaphysics would thus have to assume more than just structure. One way of spelling this out could be a dual aspect theory: The relational properties account for the structural form, but the absolutely intrinsic properties account for the ultimate realizers of the relational structure. One might even think of some kind of “hylomorphism” of the relational and the intrinsic;

both aspects together constitute a concrete entity. Thus the relational and the intrinsic aspects of reality have basic ontological status, without one having clear priority over the other. Alternatively, a neutral monism can also serve as the metaphysical framework. In this case, the basic properties of the world are neither physical nor phenomenal; rather, the phenomenal and the physical are constructed out of them. “From their intrinsic natures in combination, the phenomenal is constructed; and from their extrinsic relations, the physical is constructed” (Chalmers 1996, 156). In any case, this ontology implies that something mental or proto-mental is a fundamental feature of the world.

Now, if the analysis sketched above is correct, then any form of structural realism is misguided. It cannot be a complete realistic view of the world. The panpsychist could stop right here and consider her case closed. But this would seem to be rushing things. After all, there is no widely accepted solution to the hard problem of consciousness. In not providing a satisfactory solution to the hard problem of consciousness, structural realism stands by no means alone. One can thus reasonably ask: Can the panpsychist offer more than just this argument from the hard problem of consciousness? Are there internal problems of structural realism that the panpsychist might exploit to bolster her case? The panpsychist is thus well advised to attempt a critical analysis of the different versions of structural realism. For this purpose, I will distinguish epistemological from ontological structural realism. Within ontological structural realism there is the further sub-distinction of moderate and eliminative ontological structural realism. (Cf. Ladyman 1998.)

Epistemic Structural Realism

Epistemic structural realism remains agnostic about any properties of the unobservable realm that are not structural. The Russell of “The Analysis of Matter” (1927) is a good example of this view. Russell argued for an agnosticism concerning the physical world with the exception of its purely formal and mathematical properties. The higher order properties of physical theories can only be expressed in mathematical terms. Epistemological structural realism limits the scope of scientific realism to exactly these properties. But according to the epistemic structural realist there is an objective world out there that contains unobservable objects. We can, however, only know the relational properties of these objects. Thus we only know the structure, ultimately only the formal structure, of the world.

It is immediately obvious that the panpsychist is not threatened by this argument because she makes exactly this point, that the intrinsic nature of objects “in themselves” is not known to us, except in the case of our own consciousness. The panpsychist is thus not an agnostic about the ultimate intrinsic nature of things. That puts her at a distinct advantage over the epistemic structural realist in

explaining the emergence of consciousness. But the panpsychist's view does not contradict the account of the epistemological structural realist who is simply silent on the intrinsic nature of unobservable entities.

Newman's Argument

The classic critique of epistemological structural realism is “Newman's Argument” (Newman 1928), which was initially directed against Russell. Newman's Argument is best understood as a *reductio* aimed at epistemological structural realism, showing that it ultimately collapses into anti-realism.

Two claims by Russell are relevant here; he argued:

1. “... it would seem that wherever we infer from perceptions it is only structure that we can validly infer; and structure is what can be expressed by mathematical logic” (Russell 1927, 254)
2. “The only legitimate attitude about the physical world seems to be one of complete agnosticism as regards all but its mathematical properties” (Russell 1927, 270)

Newman argues that the existence of a mathematical structure is trivially true of a set of objects. He gives the following example (Newman, 1928, 139f.):

What does it mean to say that “two systems of relations have the same structure”? Assume, set A is a random collection of people, and R the two-termed relation of “being acquainted”. A map of A can be made by making a dot on a piece of paper to represent each person and then those pairs of dots which represent acquainted persons are joined by a line. Such a map is itself a structured system. This new system B has the same structure as A. The structure-generating relation, S, is in this case “joined by a line”. The important aspect of this example is that it is not at all necessary for the objects composing A and B, nor the relations R and S, to be qualitatively similar. “In fact to discuss the structure of the system A it is only necessary to know the incidence of R; its intrinsic qualities are irrelevant. The existence of a structure is trivially true of a set of objects” (Newman 1928, 139f.). According to Newman, a statement describing a certain structure with regard to a number of objects is a trivial statement. Why is the existence of a structure trivially true of a set of objects? Because, for Newman, a structure is purely formal and mathematical and furthermore it is independent of the intrinsic qualities of the objects. If only the structure is known, then besides what is logically deducible from the properties of the structure, it is only the number of constituting objects that can be known. But if all we know about the objects is their cardinality, if we do not know any properties of the objects that ground certain relations and exclude others, then – mathematically – any system of relations over these objects is as good as any other; all of them are instantiated. Relations are simply sets of ordered sequences of entities. Given the entities, all of those ordered sequences will exist, as a matter of pure mathematics. There is only the structural reality consisting of relations,

and individual objects are points defined by their place in the overall relational system. Another illustration for this idea is mathematical graph theory. One could say that nature is like a mathematical graph, in which relations obtain between point-like nodes (Cf. Dipert 1997). There are no non-relational properties. Unless there is something, as Newman says, “qualitative” (involving intrinsic properties) about the *relata* that determines the nature of the relations, the relations, of which the structure is supposed to be a formal abstraction, are in no way determined. Without knowing what exactly is related, one does not know what the nature of the relation is, except for its purely formal characteristics.

The very idea of realism, describing nature as it exists independent of the mind, is thus undermined. Epistemological structural realism is meant to vindicate and not to revise the ontological commitments of scientific realism. On this view the objective world is composed of unobservable objects between which certain properties and relations obtain. But we can only know the properties and relations of these properties and relations, that is, the structure of the objective world. The problem gets even worse: If Newman's argument is correct, we do not even know the objective structure of the world in any realist sense of “objectivity”. Scientific realism collapses into anti-realism. The same point can be made by referring to Putnam's famous modeltheoretic argument (Putnam 1980). As argued by Newman, given a number of objects, any relational structure configuring them is already given. If we picture objects as mere nodes in a relational graph with no intrinsic nature, then for each structure there are many different relations between the objects that make the propositions describing the structure true. What is the intended model of the structure? Which one is the *real* relational structure of the mind-independent world? There are too many ontological interpretations (models) of our theories. Our scientific descriptions of the world are unable to single out the intended model, i.e., the real world. Since science deals only with mathematical structure, and not with real relations between objects (which are determined by the qualitative intrinsic natures of the objects), we can never know the one true story about the world in a metaphysical-realist way. We have too many “truths.”

The panpsychist can thus argue that epistemological structural realism fails in the attempt to provide a genuine alternative between classical scientific realism and anti-realism. It is rather a form of anti-realism. As such it remains agnostic about the intrinsic nature of “things in themselves”, and is thus no threat to panpsychism. A nice illustration for this is provided by Kant. Even though Kant defended a version of epistemological structural realism, he was still on a metaphysical level sympathetic to panpsychism because “thinking” or something “analogous to thinking” was for him the only reasonable candidate for the intrinsic nature of substances in space. For Kant it was obvious that the only absolutely intrinsic properties we can conceive of are taken from the mental realm. It is worthwhile to quote him at length:

“It is quite otherwise with a substantia phenomenon in space; its inner determinations are nothing but relations, and it itself is entirely made up of mere relations. We are acquainted with substance in space only through forces which are active in this and that space, either bringing other objects to it (attraction), or preventing them penetrating into it (repulsion and impenetrability). We are not acquainted with any other properties constituting the concept of the substance which appears in space and which we call matter. As object of pure understanding, on the other hand, every substance must have inner determinations and powers which pertain to its inner reality. But what inner accidents can I entertain in thought, save only those which my inner sense presents to me? They must be something which is either itself a thinking or analogous to thinking” (CPR B321, transl. Norman Kemp Smith).

Kantian empirical agnosticism in regards to the intrinsic nature of unobservable objects (as opposed the mere phenomena) is compatible with metaphysical leanings towards panpsychism. The only alternative for the epistemic structural realist might be to expand her notion of the observable object, giving it more than just structural content. Thus it might be possible to escape Newman's and Putnam's argument. But then epistemic structural realism collapses into classical realism, which naively assumes that the nature of things is directly discoverable by science.

Ontological Structural Realism

It should thus not come as a surprise that the “real” adversary of panpsychism is ontological structural realism. An initial, and a still somewhat superficial, reading of ontological structural realism asserts simply that there is nothing more to the entities than their place within the relational system. Below we will call this version “moderate ontological structural realism”: According to this view, the Ramseyfication has to be interpreted ontologically. The bound variables in the Ramsey sentence refer to objects that have no intrinsic nature. In other terms, it is not only our description of the world that becomes like a mathematical graph, but furthermore the nature of mind-independent entities is reduced to point-like places within the structure. In the formalism of contemporary particle physics, the ultimate units of matter are described as point-like. In quantum mechanics individual particles have no clear identity conditions, no intrinsic natures. Ontological structural realists argue that the nature of physical reality as presented by contemporary physics is incoherent with standard metaphysical views about the ontological relationship between relations, individual objects, and intrinsic properties. Instead of reformulating classical substance theory in a dynamic, process-oriented way as Whitehead proposed, ontological structural realists argue that the best interpretation of contemporary physics is that there is ultimately only structure and all particular objects, if they are to be considered at all, are point-like and void of any intrinsic properties. The Newman/Putnam argument seems ineffective against ontological structural realism. The objective mind-independent world is, according to ontological structural realism, a complex structure. The *epistemological* question, whether our theories correctly represent this structure, is irrelevant. The relational world-structure is, so it seems, something concrete, not an abstract

mathematical object to which Newman's argument would apply. It cannot be said that every possible relation between objects is instantiated, only one particular set of relationals is concretely realized in this world. But how is this possible within ontological structuralism? Ontological structural realism might initially look like functionalism, but there is supposedly a big difference. Functionalism requires that the system of relations it specifies be implemented or realized by some appropriately organized system of entities whose own properties permit them to ground the functional specification of the system. Ontological structural realism dispenses with the realization requirement: the system of relations all by itself is enough to underpin the reality of the entities at issue.

The Carrier Problem

It is precisely this idea that the panpsychist needs to question. In his paper "Pattern and Being", John Haugeland assumes the traditional view that a substance needs properties, which it has regardless of anything else. He then considers the ontological status of the pieces in a chess game – say a rook or a pawn – and claims that their very nature is determined entirely by how they move about in the chess game in relation to other pieces. A chess game is a perfect example for a small structural world. Haugeland writes: "No rook is a substance. ... Nothing about a rook is determinate, not even its 'rookness,' apart from its participation in a chess game" (Haugeland 1993, 63). The situation is even more complicated. The formal definition of a type in a chess game is circular. The nature of each type is completely determined by the set of allowable moves it makes within the game as a whole. The chess game as a whole, however, is defined by the interdependent set of types that play functional roles in it. Each part of the game presupposes the existence of the whole game, and the game presupposes the existence of its parts. Why isn't this circularity of chess categories vicious (Cf. Rosenberg 2004, 234)? How can chess games actually and concretely exist? Rosenberg claims that there must be something distinct from the formal structure that actually grounds the game in concrete reality. In the case of a chess game we have physically distinct objects that serve as stand-ins, or realizers, of the relevant types, thus allowing for the existence of concrete tokens of those types. Of course, there is much more to consider here, such as the concrete chessboard or the physical position of the players in space. Without such "carriers" of the formal structure, the game would remain too incomplete and abstract to exist concretely. Rosenberg extends this thought to other, more complex, conceptual systems such as those constructed by scientific theories which are also merely abstract and circularly defined. Consider cellular automata in computer science. Each cell is defined by its role in the entire system, and the entire system is defined by the cells. Cellular automata may exist as computational systems because there is something external to the formal system that realizes or carries the computational system. The physical states of the hardware are the

carriers of the cellular automata. Biology, as an abstract conceptual system, is carried by the mechanics of molecular biochemistry, psychology by the dynamical properties of the neural system, and economics by the needs and desires of individuals. The crucial question is, however: What carries the most basic physical level? Physics presents us a world of interdependently defined functional roles. Are there any properties that can give this circularly defined conceptual system a foothold in concrete reality? This is a puzzling question. Let us call it the “ultimate carrier problem.” The ontological structural realist will have to argue that there is in fact no carrier problem. However, Leibniz argued that all extrinsic, relational properties have to be grounded in intrinsic properties. Relations have to relate to something. This idea has strong intuitive force. How could it possibly be that all relational properties of material objects be grounded in intrinsic properties? If grounding means that the intrinsic properties are the constituting base of the relational extrinsic properties, then we have a metaphysical system in which certain fundamental entities with absolutely intrinsic properties constitute the entire remainder of reality – a view that Leibniz famously argued for in his *Monadology*. The key was to replace “mutual causal influence” with “mutual information” (Seager 2006, 4). The whole of physical space was constructed by giving each monad a spatial viewpoint, from which space was constituted as experienced space. The idea of ultimate carriers can lead directly to panpsychism. It is for this reason that the denial of the need for ultimate carriers in ontological structural realism is a direct threat to panpsychism. But the structural realist encounters a serious problem here. If the ultimate relational system is not carried in any way, then it is a purely mathematical abstract object. If this is the case, then Newman's argument applies to the this relational ontology after all: If there are no intrinsic properties of the objects that ground certain relations and exclude others, then – mathematically speaking– any system of relations over these objects is as good as any other. All of them are instantiated. Relations are simply sets of ordered sequences of entities. Given the entities, all of those ordered sequences will exist, as a matter of pure mathematics. Thus Newman's argument gets ontologized. It is no longer the epistemological question, whether we know how a formal structure is realized in the mind-independent world. The question at this point becomes, how does a mind-independent world, which consists entirely of mathematical point-like objects and where all formal relations between objects are trivially given, singles out the appropriate relations, so as to constitute the concrete world in which we live? This seems to be a case of the utterly unintelligible emergence of the concrete from the abstract. So Newman's argument re-emerges in an ontological reading. The only way to avoid this situation would be to eliminate individual objects altogether.

At this point an important distinction needs to be made. The brand of ontological structural realism which we have discussed up until this point, was mostly moderate ontological structural realism. It has to be distinguished from its more radical cousin, eliminative ontological structural realism. The

difference can easily be stated:

Moderate ontological structural realism defends a two-category ontology: objects, relation. However, objects are bare of intrinsic properties.

Eliminative ontological structural realism adopts a parsimonious, one-category ontology: there are only relations.

Both versions of ontological structural realism will now have to be interpreted separately.

Moderate Ontological Relationalism

This position tries to occupy space between two extremes. The first extreme is the view that all relations have to be grounded in the intrinsic properties of objects, thus granting ontological primacy to the objects. The other extreme is the outright denial of the existence of anything other than structure. The moderate ontological realist, however, places relations and objects on equal footing. Both ontological categories are interdependent. The relations unite the relata. The relata are the meeting points of the relations. Relations require relata. One presupposes the other; they are circularly defined (Cf. Eddington 1928). Objects are bundles of relations, and relations are connections between objects (Cf. Esfeld 2008). The challenge is to make sense of this initially appealing idea. If relations and objects are circularly defined, why is this circularity not vicious or even “deadly”? As we have seen, according to Rosenberg, such circularly-defined differences are harmless because their existence is grounded in something that carries those contrasts. Properties that are functionally defined within a system are relative to this system and cannot carry the relational structure of the system. Something external to the system is needed (Cf. Rosenberg 2004, 237). In order to avoid an infinite regress of ever more fine-grained systems, where each lower structure is serving as the carrier of the next higher one, a stopper is required. There are good scientific reasons to assume that nature has a lower size limit (Planck size scale). Only a property that is intrinsic *tout court* and not relative to a system could bring this about and serve as an ultimate carrier. Are there properties that are not intrinsic to any system, but at least partly intrinsic to themselves? The only candidates we know of are phenomenal qualities. One cannot understand the nature of phenomenal qualities by knowledge of their contextual relations alone. This radical intrinsicness is the very nature of phenomenal qualia. Whatever grounds the structural-relational properties of the world must have this radical intrinsicness. It might well be that our own consciousness is the closest analogue we get to this underlying reality. Now if objects and relations form such an interdependent system, the carrier must be external to this system. Rather than the intrinsic properties of the objects - whose existence the moderate ontological structural realist denies - there must be something else, out of which objects and relations arise. And this ultimate reality had better have the radical intrinsicness that stops the regress. This line of reasoning opens

up an argument for proto-mental properties in this underlying reality.

Another problem with moderate ontological realism is the idea of objects that lack intrinsic properties. How can this notion of an object be spelled out? A thing, that has no nature that makes it what it is, is indeed an utterly mysterious thing. Even an omnipotent creator could not create a world in which this thing existed just by itself. With regard to numbers, Russell made this often quoted point in the “Principles of Mathematics”, which can be extended to other individual objects as well:

“It is impossible that the ordinals should be, as Dedekind suggests, nothing but the terms of such relations as constitute progressions. If they are to be anything at all, they must be intrinsically something; they must differ from other entities as points from instants, or colors from sounds... Dedekind does not show us what it is that all progressions have in common, nor give any reason for supposing it to be the ordinal numbers, except that all progressions obey the same laws as ordinals do, which would prove equally that any assigned progression is what all progressions have in common. ... His demonstrations nowhere – not even when he comes to cardinals – involve any property distinguishing numbers from other progressions. (Russell 1903, 249)

To be an individual object implies having intrinsic properties. Esfeld's contention that objects are bundles of relations gives rise to similar worries. How is such a bundle unified as an individual? Esfeld inherits all the problems of the bundle theory of concrete particulars. There are far too many bundles of relations co-present at any given point in time. What distinguishes the true individual object from a random bundle of relations? Esfeld cannot refer to a “haecceitas” or “thisness” as the individuating property since this would obviously be an intrinsic property of the object. It is not sufficient to attribute invariance under certain symmetric transformations in the mathematical formalism of physics to individuate things. Transformation invariance is an entirely structural property, which is utterly silent on and has nothing to say about what is invariant during transformation. What constitutes the nature of the entity that endures during these transformations? Moderate ontological structuralism does not provide an answer to this question.

Eliminative Ontological Structural Realism

The most promising strategy for the structural realist might then be to eliminate individual objects altogether. There is nothing but structure. Newman's original argument against epistemological structural realism is clearly not effective here. It is an epistemological argument and it builds on the assumption that the number of objects is given. Also, an ontological reading of Newman's argument is without force. If there are no individuals, then arguments based on the requirement of intrinsic natures have no target at which they can aim. It is futile to argue about the necessary properties of individual objects if the theory denies their very existence.

However, there are other difficult challenges for the eliminative ontological structural realist. The first one is grounded in a simple conceptual analysis. Does the very notion of a relation make sense if there are no relata? Formally speaking, relations are construed as n-place predicates. It seems to be a conceptual truth that relations relate something. On the metaphysical side even deeper problems arise. The eliminative ontological structural realist has to deny the need for carriers of structures; otherwise the carrier problem and the question of intrinsic properties carrying the relational structure re-emerges. But if there are no carriers, then the formal, mathematical structure is the ultimate reality. The eliminativist ontological structural realist cannot give an account why the world is physical rather than mathematical. (Cf. Ladyman/Ross 2007.) The original motivation for structural realism was to abstract away from the unknown physical reality and work only with the second-order structural description given by mathematical physics. Thus there was a clear distinction between structure on the one hand and what is being structured on the other. But according to the eliminative version of structural realism, there is nothing but structure. The contrast between structure and non-structure has been lost (Cf. van Fraassen 2006). The distinction between classical scientific realism and structural realism has collapsed. Eliminative ontological structural realism is a classical metaphysical realism, which claims that the entire universe is a complex mathematical structure of relations. The resulting picture is Pythagorean in spirit. The entire universe emerges from formal structures. Very few eliminativist ontological structural realists embrace this Pythagorean view wholeheartedly (for example: Tegmark 2007), but this consequence seems all but inevitable if one thinks the position through. How the concrete physical world as we know it emerges from this mathematical structure is a case of mysterious inter-attribute emergence, in this case the emergence of *concrete* physical objects from *abstract* mathematical structures. We began this paper with a Chalmersian argument for the incompleteness of physics: The functionally defined physical facts alone cannot account for the emergence of qualitative phenomenal facts. This problem gets aggravated if the physical facts are ultimately nothing but mathematical facts. Some structural realists have clearly acknowledged this problem, Dipert even hinted at panpsychism as a solution:

“There might at first seem to be no place in these cold graphs for minds, consciousness, and other mental phenomena – unless, that is, everything is mental. Although within the dialectic of this essay it is wild and possibly irresponsible speculation, we should perhaps consider seriously the possibility that something like the pan-psychism of Spinoza, Leibniz, or Peirce is true, and that vertices are pure feelings (Peircean 'firstnesses'), constituting a distinct thought or object only when connected to other such entities” (Dipert 1997, 358).

The question then is whether eliminative ontological structural realism is capable of providing a realistic metaphysics of the nature. Galen Strawson has in recent years mounted a critique of classical physicalism that can *a fortiori* be raised against the Pythagorean metaphysics, to which the eliminative ontological structural realist is committed (Strawson 2006). It is based on a venerable

argument for panpsychism, the “genetic argument.” It rests on a claim concerning the intelligibility of radical inter-attribute emergence, as opposed to weaker intra-attribute emergence. In his paper, “Panpsychism” Thomas Nagel had argued that uniform psycho-physical correlations could not account for the emergence of mental properties from the physical components of a system:

“Instead, intrinsic properties of the components must be discovered from which the mental properties of the system follow necessarily. This may be unattainable, but if mental phenomena have a causal explanation such properties must exist, and they will not be physical” (Nagel 1979, 187).

Emergence cannot be brute in the sense of there being nothing in the emergence base in virtue of which the emergent phenomenon emerges: *ex nihilo nihil fit*. Nothing can give what it does not possess. In order to make sense of the emergence of consciousness, the evolution of the phenomenal mind must be smooth. Consciousness in some form must be present “at the very origin of things” (James 1890, 149). Inter-attribute emergence is to be avoided. Otherwise even a Cartesian soul could mysteriously emerge from a Cartesian physical body (or, as in the case of eliminative ontological structural realism, the emergence of a concrete physical object from a configuration of abstract mathematical objects). If such inter-attribute emergence is considered intelligible, then one will inevitably end up with a radical Humean view of causal powers in which “any thing may produce any thing” (Treatise III, xv), and any reasonable prospect for a substantive metaphysical account of the mind-body relation will have vanished. If emergence is construed as an intra-attribute relation, however, then one has to give up the standard physicalist principle that there are no (proto-)mental properties at the ontological base levels. Strawson calls this dogma of contemporary physicalism the “NE principle”: “physical stuff is, in itself, in its fundamental nature, something wholly and utterly non-experiential” (Strawson 2006, 11). The intuition, that a system that is only structurally defined cannot give rise to qualitative experience, is more than just an epistemic problem of cognitive upward opacity that might be overcome by more empirical research; it is a deep metaphysical puzzle. This problem becomes even more serious if the relational structure that is supposedly generating consciousness is conceived of in Pythagorean terms.

Conclusion

We have come full circle. We started with the hard problem of consciousness and returned to it at the end. As it turns out, the hard problem of consciousness is the major stumbling block for any ontological structural realism. The panpsychist claims to have a better answer to the hard problem of consciousness because no miraculously strong emergence is required. Epistemological structural realism is another matter, however. Since it is silent on the intrinsic properties of matter, it is compatible with a panpsychist metaphysics. Indeed, someone who endorses structural realism for epistemological reasons only, can have “secret” panpsychistic inclinations at a metaphysical level.

As was shown, Kant is certainly a case in point.

We have argued that moderate ontological structural realism provides no conceptual means to account for the individuation of objects without intrinsic properties. Also, if relations and objects are interdependent and circularly defined, a grounding problem for the circular structures arises. For those reasons, moderate ontological structural realism seems to be a conceptually unstable theory. Eliminative ontological structural realism is conceptually more coherent. But it has problems of its own, the most important one being the collapse of the distinction between the physical and the mathematical. The Pythagorean metaphysics implied in this account is the source of a plethora of metaphysical problems, not the least of them being the emergence of consciousness.

Thus, the panpsychist can endorse epistemological structural realism as an epistemological interpretation of the scientific endeavor. For the reasons given above, the panpsychist will reject structuralist metaphysics in both forms: moderate and eliminative.

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