What Ontic Structural Realism Could Be

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my brief

- “more about your ideas about the foundations of the metaphysics of relations”
- “more about how to precisely formulate the thesis of structural realism”
- Mark Johnston: “how deeply have you thought about what reduction is?”

plan

1. What is structural realism?
   1.1 The threat to realism from the history of science
   1.2 Not ESR
   1.3 The Abstraction of Nature
   1.4 OSR
2. Individuals, Objects and Structure
3. The positive metaphysics of ETMG: Rainforest Realism
4. Levels and Scales, Reduction and Emergence

1. The Scientific Realism Debate

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- Theories explain as well as predict by tracking the causal/nomological structure of the world.

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- The Argument from Theory Change – Counterexamples to the No-Miracles Argument

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- Also the approximate truth of deep ontological claims is not plausible even when we do have continuity of reference e.g. space and time, gravity, mass, electromagnetic field,…
- Abandoned theoretical terms are not the only issue e.g. ‘atom’

What is preserved on theory change?

- It is not just the empirical content or phenomenological laws of past theories that is retained.
- Heinz Post on the General Correspondence Principle

Structural Realism

- Worrall 1988: The Best of Both Worlds viz. no-miracles argument and problem of theory change

There was an important element of continuity in the shift from Fresnel to Maxwell – and this was much more than a simple question of carrying over the successful empirical content into the new theory. At the same time it was rather less than a carrying over of the full theoretical content or full theoretical mechanisms (even in approximate form) ... There was continuity or accumulation in the shift, but the continuity is one of form or structure, not of content (1989, 117).

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- A purely epistemological modification of traditional scientific realism cannot solve an ontological problem.
- The Ramsey sentence of a theory refers to exactly the same entities as the original theory so if there was an ontological problem it is left unaddressed.

1.3 The Abstraction of Nature

[T]he structure of this physical world consistently moved farther and farther away from the world of sense and lost its former anthropomorphic character [...] Thus the physical world has become progressively more and more abstract; purely formal mathematical operations play a growing part. (Planck 1996, p. 41)

1.3 The Abstraction of Nature

- The founders of quantum mechanics abstracted from wave mechanics and matrix mechanics and took the mathematical structure exhibited by both to be what truly represented the world.

1.4 OSR Scientific Realism and the philosophy of physics

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- Steve French on metaphysical underdetermination of the nature of quantum particles and spacetime points
- Ladyman 1998 proposes primitive ontology of structure and relations and elimination or reduction of individuals.
- OSR slogans – ‘structure is all there is’, ‘there are no individual objects’, ‘every thing must go’, ‘relations all the way down’,…

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- However, there seem to be relations that do not supervene on the intrinsic properties of their relata (even with their spatial relations).

Non-Supervenient Relations in Physics

- entanglement in quantum mechanics
- relative phase relations in quantum mechanics
- the Aharanov-Bohm effect
- metrical relations in General Relativity

Ontic Structural Realism - three issues

1. ‘Structure’ is retained on theory change.
2. non-supervenient relations
3. Structuralism about a domain involves the idea that the entities in the domain are mutually dependent on each other for their existence/individuation: the identity and individuality of quantum particles and spacetime points

Thanks Kyle…

- But do the above have anything to do with each other?
- …even the modest claim that structural realism is supported by the historical record seems to trade on the inherent vagueness and ambiguity in what we are prepared to describe as "structural", while Ladyman and Ross' claim that their Ontic Structural Realism is supported by a consilience of many different sources of evidence…threatens simply to turn the case for structural realism into a bad pun.

  Kyle Stanford (2010), *Metascience*

Objection: Structure is lost on theory change too

- Agreed but structural relations between successive theories can be precisely described and show the continuity between theories that differ greatly in respect of what they say about the nature of things.

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- Case Study: Phlogiston

What is OSR?

- “Structural realists (James Ladyman, Don Ross, Steven French, Kerry McKenzie, among others) reject the traditional answer. They argue…that there are no “objects” (or at any rate that we should not believe in “objects”) and that there is only “structure.”

Varieties of OSR

- French: eliminativist about individuals, ontological priority to relational structure
- Esfeld and Lam: non-eliminativist about individuals and relations – mutual dependence
- Muller and Saunders: relational individuation of non-individual objects
- Ladyman and Ross: non-eliminativist about (metaphysically) thin individuals, ontological priority to relational structure

versus

- Schaffer: eliminativist about relations, ontological priority to one object and intrinsic properties
- Lowe and Simons: eliminativist about relations, ontological priority to individuals and intrinsic properties

2. Individuals, Objects and Structures

“One problem that structuralists face at this point is that “mainstream metaphysicians” are likely to draw a blank if asked to state what this presumed orthodoxy amounts to. Nor do I know of any very clear outline of it anywhere in the structuralist literature.” McKenzie 2016, p. 3

Quantum Particles

Schrödinger: “particles are energy quanta without individuality” (Statistical Thermodynamics, p.43

Weyl: “neither to the photon nor to the (positive and negative) electron can one ascribe individuality” (*Philosophy of Mathematics and Natural Science*, p. 247)

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- French and Krause propose an ontology of non-individual objects taking indistinguishability to be incompatible with individuality.
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- The real metaphysical issue is structuralism versus atomism, and the former need not imply eliminativism about individuals and is compatible with requiring weak discernibility only or even with primitive distinctness.

Individuation

	Intrinsic	Contextual
Primitive	Haecceity	Primitive Contextual Individuation
Grounded	Bundle of Properties	Bundle of Qualitative Relations

What are the relations between notions of *entity*, *object*, *individual*, and *substance*?

A standard view is that objects are the values of first order variables.

It is common to regard the notion of an object as weaker than that of an individual and so to require of individuals something extra:

(1) persistence (French and Redhead 1988)

(2) transworld identity

(3) laws of identity perhaps including PII

(4) absolute discernibility (French and Krause 2006, Muller and Saunders 2006, Butterfield and Caulton) ('relationals' – misnomer?)

(5) countability and determinate identity (Lowe)

It is not at all clear what if anything any of these have to do with each other.

The relation between Common Sense Realism and Scientific Realism

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- Selective scepticism: van Fraassen and induction

- Scientific realism as such has no account of the relationship between ontologies at different levels in different sciences.

- Eddington's famous two tables example poses the problem of reconciling the ontologies of atomic physics and everyday material objects.

The Positive Metaphysics of ETMG

- Metaphysics should be naturalized and draw upon science.
- Science is integrated to a very great extent pace Nancy Cartwright, John Dupre and others.
- There is a distinctive conception of naturalized metaphysics that involves the unification of science.

The Positive Metaphysics of ETMG

- There is not for all we know a fundamental level of reality (though there might be), and accordingly our metaphysics should not presuppose that there is.
- Accordingly, physics is not defined in terms of fundamental building blocks of reality but as follows:

  Physics is to be characterized as the science that holds at the widest range of scales and across all of space and time.
- Reductionism involving either type-type or token-token identity is not in general plausible though it may be in specific cases.

However, in the absence of reductionism, selective eliminativism is contrary to naturalism so this motivates rainforest realism (following Ross 2000):

Science offers us ontologies at many different levels. The ontological commitments of the special sciences should be taken as metaphysically on a par with those of physics. For example, there are atoms, cells, organisms, agents, social structures and indeed tables.

The Positive Metaphysics of ETMG

Ontology is scale relative in respect of both space and time.

The Positive Metaphysics of ETMG

Composition is a real feature of the world and is in general diachronic, dynamical and domain specific since it depends on the relevant kinds of interaction among parts.

The Positive Metaphysics of ETMG

Ladyman and Ross argue on the basis of consilience in respect of the following induction, the no-miracles argument, novel prediction, probability, information processing and computation that objective modal structure is represented by science. Indeed, real patterns are defined modally. They are there to be discovered. Hence:

The world has an objective modal structure that is represented by causal claims and laws in the special sciences.

Reduction

"In particular why think that identifications could be reductions, despite the obvious logical worries? You suggest that the relevant identities fail, both token and type, but suppose they succeeded. Then what would be reduced to what? Samuel Clemens = Mark Twain is no reduction, and no numerical identity is ever *in itself* one. So in rejecting reduction what exactly is being rejected?"

Complexity

- The special sciences are possible because the world is to some extent algorithmically compressible. At certain levels of description it is possible to use much less information to predict the behaviour of systems described in an approximate and probabilistic way, than would be needed to describe their microstates.
- For example, Kepler's laws, the ideal gas laws, the Hardy–Weinberg law,… In fact all laws in the special sciences are like this. The special sciences rely upon reduction in the degrees of freedom of the system.
- There are real patterns in the world that are only visible at the right scales of resolution and degrees of approximation. If you don't see them you are missing something about reality and that is good enough to allow us to say that the objects, properties and processes described by the special sciences are real.

Real Patterns

It is argued that rainforest realism and ontic structural realism are unified by the idea that:

Existence should be explicated in terms of the theory of real patterns.

The definition of real patterns (Ladyman and Ross, 2007, chapter 3) is as follows:

To be is to be a real pattern; and a pattern is real iff

it is projectible under at least one physically possible perspective; and,

it encodes information about at least one structure of events or entities S where that encoding is more efficient, in information-theoretic terms, than the bit-map encoding of S, and where for at least one of the physically possible perspectives under which the pattern is projectible, there exists an aspect of S that cannot be tracked unless the encoding is recovered from the perspective in question.

Real Patterns

- Daniel Dennett's notion of 'real pattern' is a computational one.
- The idea is based on the compression of data and the reduction of information processing made possible by a high level description of a system that could in principle be described at a fine-grained level but at a much greater computational cost.

The account of real patterns in Dennett, Ross and ETMG is articulated in information theoretic terms as above. However, Ladyman and Ross (2013) argue that another way to understand it is in terms of statistical structures. Real patterns theory can also be developed in terms of the dynamics of phase spaces (as Jenann Ismael suggested in conversation). Hence:

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Many real patterns in science are such that the compression of the information allows only probabilistic recovery of the underlying system. Real patterns are lossy but if one ignores them one misses out on a real feature of the world. (Consider the Carnot cycle as a real pattern with respect to the underlying statistical mechanics.) Hence, there is not even token-token identity between levels.

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- This is why we should say, pace mereological nihilists, that ordinary objects such as tables exist, and why we should deny, pace defenders of unrestricted composition, that arbitrary sums of ordinary objects exist. On this view, there are no real things that do not figure in projectible generalisations/causal laws.

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- It is a fact about the world (for all we know a contingent one) that it is ordered on many levels.
- Science includes theories that link the levels but in almost all cases the higher-level description is coarse-grained, approximate and aggregative with respect to the underlying levels so reduction is not plausible.

- Real patterns are preserved on theory change - cf. Butterfield on the Krebs cycle.

- Real patterns are defined modally.
- They are there to be discovered.

- Dennett's paper is notoriously unclear about whether 'real patterns' should be regarded as real or as useful fictions.
- realism versus pragmatism - metaphysics versus epistemology

Emergence

“The term "emergence" is often used in ontology and in the philosophy of the non-basic sciences as the appearance at the "higher-level" of something novel due to bridge laws. I take it you do not mean that by "emergence". And you do not mean just that the different "scale" of the system invites a new vocabulary and new methods of investigation. (I take it.) “

- strong emergence - emergent entities have full ontological status
- weak emergence - emergent entities are epistemologically and semantically irreducible (but may not have full ontological status)
- ontological reductionism - everything is ultimately physical so only the entities of fundamental physics have full ontological status
- theory reductionism - emergent entities can be derived from more fundamental theories

- Conservative metaphysicians would complain, the eater is a redundant causal factor, since the program underlying Life, which in its declarative representation quantifies only over cells, is strictly deterministic. We are reminded that an eater or a glider is, at any given time, 'made of' cells and nothing else. Then we are invited to agree that a thing cannot have causal efficacy over and above the summed causal capacities of the parts with which it is allegedly identical. The result is supposed to be reductionism, and instrumentalism about gliders and eaters.

(The above paragraph is from Ladyman and Ross (2007), chapter 4.)

- David Wallace advocates what he calls a functionalist account of ontology based on the notion of real patterns in his elucidation of the Everettian interpretation of quantum mechanics.
- His ontology is two-tier in that only higher-order entities such as cats and tables are understood in terms of real patterns, whereas the wavefunction or whatever else proves to be fundamental in physics is understood in categorical rather than functional terms.

- On the other hand, James Ladyman and Don Ross (2007) advocate a real patterns account of ontology across the board.
- All real patterns are real but there is an asymmetric relation among them.
- The relation is not composition since emergent structure is not reducible to the sum of the parts - no building blocks

- The problems of vagueness of composition and identity over time as well as generation and corruption all apply to both special science objects and everyday ones. The real patterns account of ontology solves both in the same way.
- Real patterns account provides a unified account of everyday and special science ontology.

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- A further question. The obvious worry about your "scientism" is that it requires *the forgetting of the original forgetting*, i.e. the methodological setting aside of mathematically intractible features of reality. That forgetting or prescinding was entirely natural and justified *given the ambitions of mathematical physics*. But then to go on to think that mathematical physics is well-placed to deal with, say, the category of quality -- colors, tones, odors (not qualia understood as mental, nor *properties* like being red, but the *qualities* themselves) -- is just an unfortunate repression of the history of science, no? In raising the issue about quality versus quantity, you may think I am merely rehearsing your despised "Neo-Scholastic" points, but I am prepared to follow the issue through with real detail from from color science, psycho-physics and the psychology of perception. Is the qualitative supposed to *emerge from* the quantitative? How exactly do you suppose that these sciences underwrite that thought?