

# Bundle Theory Made Relational? A Critique of Ontic Structural Realism

Philipp Blum\*

The Metaphysics of Science: Objects, Relations and Structure

Lausanne, October 12, 2012

This problem for structuralism has been pointed out as early as 1906, by the British idealist Joachim:

...we have made an assumption which we cannot justify; and yet, without it, we cannot maintain the correspondence-notion. For we have been forced to regard correspondence as identity of structure, and to attribute truth to my judgement because it repeats in its internal organization the inner structure of the 'real' factor, or of some subordinate whole within that. Now if there is *no* difference in the two factors, there clearly is no 'correspondence' – there is identity. But if there is a difference [...], how can there also be identity of structure? For 'structure' is a name for [a] scheme of inner relations, and relations which really relate different elements cannot be identical, i.e. cannot be identical if the differences of the elements are differences of them *qua* related. (Joachim 1906: 25–26)

## Ontic structural realism: relations without relata

“There are no objects”:

1. They argue for “the wholesale abandonment of the ...intuition that there must be something of which the world is made” (Ladyman and Ross 2007: 12).
2. “...what physics has taught us is that matter in the sense of extended stuff is an emergent phenomenon that has no counterpart in fundamental ontology” (Ladyman and Ross 2007: 20)
3. “The elements of fundamental physics are not basic proper parts of all, or indeed of any, objects. (Nor is there any motivation for supposing that the fundamental structures describe gunk.)” (Ladyman and Ross 2007: 44)
4. “we should not interpret science [...] as metaphysically committed to the existence of self-subsistent individuals” (Ladyman and Ross 2007: 119)

---

\*Département de Philosophie, Université de Genève, Switzerland,  
philipp.blum@philosophie.ch

5. “objects are pragmatic devices used by agents to orient themselves in regions of spacetime, and to construct approximate representations of the world” (Ladyman and Ross 2007: 130)
6. “there are objects in our metaphysics but they have been purged of their intrinsic natures, identity, and individuality, and they are not metaphysically fundamental” (Ladyman and Ross 2007: 131)
7. “Individual things are locally focused abstractions from modal structure. By modal structure we mean the relationships among phenomena (tracked or located [...] as things, properties, events, and processes) that pertain to necessity, possibility, potentiality, and probability.” (Ladyman and Ross 2007: 153–154)

Two independent claims:

**No-Objects** There are no objects.

**No-Properties** There are no (monadic, intrinsic) properties.

Do relations presuppose relata?

- Properties may exist uninstantiated in a world. (M. Tooley’s theory of universals)
- Properties may be fundamental, but bearers not. (Bundle theory of objects)
- Properties may be in some place but without any bearer at all. M. Johnston’s view on what is represented in hallucination.)

Problems for a monadistic bundle theory:

- Suppose Othello and Desdemona are both bundles of tropes.
- How do we distinguish the case where he unilaterally loves her from its converse?
- OSR can’t include relational tropes into the bundles.
- It appears that multiplying compresence relations is the only other way: one holding between each one of Othello’s monadic tropes and the relational loving trope, another one doing the same in Desdemona’s case.
- To link up a relation of  $n$  with one of  $m$  argument places, we need  $n \times m$  different compresence relations.

## There is only structure

“Everything is structure”:

1. “...‘structures’ are to be understood as mathematical models – sometimes constructed as axiomatized theories, sometimes represented in set theory – that elicit thinking in the formal mode” (Ladyman and Ross 2007: 119), which contain embedded data models representing relations among results of physical measurements (the “phenomena”).
2. “When we go on to deny that, strictly speaking, there are ‘things’, we will mean to deny that in the material world as represented by the currently accepted scientific structures, individual objects have any distinctive status. Some real patterns, we will argue, behave like things, traditionally conceived, while other behave like traditional instances of events and processes. In a

PNC-motivated metaphysics these distinctions lose all significance except purely practical, book-keeping, significance for human beings in certain sorts of special circumstances. From the metaphysical point of view, what exists are just real patterns.” (Ladyman and Ross 2007: 121)

3. “mathematical or structural” (Ladyman and Ross 2007: 93)
4. “those [three theories of ‘Newtonian gravity’ which are strongly empirically equivalent but differ with respect to their spacetime symmetries and their boundary conditions] have the same dynamical symmetries and so a structural realist who regards dynamical structure as what is physically real should regard them as different ways of describing the same structure” (Ladyman and Ross 2007: 83)
5. “Ontic Structural Realism (OSR) is the view that the world has an objective modal structure that is ontologically fundamental, in the sense of not supervening on the intrinsic properties of a set of individuals. According to OSR, even the identity and individuality of objects depends on the relational structure of the world. Hence, a first approximation to our metaphysics is: ‘There are no things. Structure is all there is.’” (Ladyman and Ross 2007: 130)
6. “Individual things are locally focused abstractions from modal structure. By modal structure we mean the relationships among phenomena (tracked or located [...] as things, properties, events, and processes) that pertain to necessity, possibility, potentiality, and probability.” (Ladyman and Ross 2007: 153–154)

Two interpretations:

**Relations-only** Fundamentally, there are just relations whose instantiation forms a pattern.

**Structure-only** Fundamentally, there is just structure.

Structure-only is significantly stronger than relations-only. Moreover, it is demonstrably false.

Structure-only implies the following supervenience claim: If  $x$  and  $y$  are isomorphic structures, they are indiscernible.

A successful mathematical description of some part of reality, however, does give us exactly this: an isomorphic structure. If there is a mathematical structure that is isomorphic to the physical world, then Structure-only is false. The ontic structuralist addresses this worry thus:

“Physical structure exists, but what is it? If it is just a description of the properties and relations of some underlying entities this leads us back to epistemic structural realism. What makes the structure physical and not mathematical? This is a question that we refuse to answer. In our view, there is nothing more to be said about this that doesn’t amount to empty words and venture beyond what the PNC allows. The ‘world-structure’ just is and exists independently of us and we represent it mathematico-physically via our theories.” (Ladyman and Ross 2007: 157)

There appear to be three possible answers to the question that Ladyman and Ross refuse to answer (what can distinguish two isomorphic structures?):

- The nodes of the structures make for the difference.
- The relations of the structures make for the difference.
- Both the nodes and the relations make for the difference.

Do relations have a “nature”?

- The identity and diversity of relations does not seem to be accounted for by their pattern of exemplification.
- Different relations having the same pattern of exemplification may differ in virtue of what they are. Hence their difference does not have to be brute.
- Analogy: a world wholly red is different from a world wholly blue.
- This does not carry a commitment to “quidditism”, the view that different relations can swap roles. (Unless “roles” are understood to be merely distribution patterns.)
- There is a good sense in which a mathematical relation cannot swap role with a physical relation (even if it might have the same distribution pattern).

What is the role of ‘structure’?

- $X$ -facts are fundamental.
- $X$ -facts are preserved through theory change. (successive mature theories do not disagree in what they say about  $X$ )
- $X$ -facts are substantive a posteriori discoveries. (not vulnerable to the Newman objection)
- $X$ -facts are verifiable. (they are entailed by science)
- $X$ -facts do not involve objects or intrinsic properties.
- $X$ -facts are characteristic of modern physics.

Could anything do all these things at once?

## **Back to relations? Primitive asymmetry**

Could we appeal to ‘thick’ relations to distinguish between isomorphic structures?

Such thick relations will have converses:

“A relational proposition may be symbolized by  $aRb$ , where  $R$  is the relation and  $a$  and  $b$  are terms; and  $aRb$  will then always, provided  $a$  and  $b$  are not identical, denote a different proposition from  $bRa$ . That is to say, it is characteristic of a relation of two terms that it proceeds, so to speak, *from one to the other*. [...] It must be held as an axiom that  $aRb$  implies and is implied by a relational proposition  $bR'a$ , in which the relation  $R'$  proceeds from  $b$  to  $a$ , and may or may not be the same relation as  $R$ . But even when  $aRb$  implies and is implied by  $bRa$ , it must be strictly maintained that these are different propositions.” (Russell 1903: 95–95, §94)

Russell seems to think of the relational complexes  $aRb$  and  $bRa$  as consisting of *four* constituents:  $a$ ,  $b$ , the relation  $R$  and its ‘sense’. But what could this ‘sense’

possibly be?

We face a double dilemma, for both symmetric and asymmetric relations: If  $R$  and  $\dot{R}$  are different if they have different senses, then the relational fact  $aRb$  is different from the relational fact  $bRa$  even if  $R$  is necessarily symmetric. If they can be identical, even if their senses are different, then what distinguishes  $aRb$  from  $bRa$  for asymmetric relations  $R$ ? If the 'sense' of a relation is something over and above the order of its constituents, then how can we identify  $aRb$  with  $a\dot{R}b$  for necessarily symmetric  $R$ ? If it just consists in this order, how can we distinguish  $a\dot{R}b$  from  $aRb$  for asymmetric relations? It just does not seem possible to hold both  $a\dot{R}b = aRb = bRa$  for symmetric relations and  $a\dot{R}b \neq aRb \neq bRa$  for asymmetric relations.

This ontological worry is as old as the rehabilitation of relations. How can it be, Ramsey (1925: 14, 406) asked in the spirit of Leibniz's quote above, that  $(\lambda x(aRx))b$ ,  $(\lambda y(yRb))a$  and  $(\lambda x, y(xRy))(a, b)$  represent (are logical forms of) the same proposition, given that they have different components? If they represent the same proposition, and stand for the same fact, however, what are their constituents? If relations are different from their converses, what could give us a reason to take one, but not the other, to be a constituent of a relational fact? In his seminal paper "Neutral Relations", Kit Fine puts this worry the following way:

...it is hard to see how the state  $s$  might consist *both* of the relation *on top of* in combination with the given relata and of the relation *beneath* in combination with those relata. Surely if the state is a genuine relational complex, there must be a *single* relation that can be correctly said to figure in the complex in combination with the given relata. (2000: 4)

## Back to particulars? Relata without intrinsic properties

There might be objects without intrinsic properties : nodes in a graph, Armstrong's thin, Bergmann's bare particulars.

Some may even be weakly or relatively discernible:

- Saunders 2003: relationalist space-time points
- Ladyman 2005:  $i$  and  $-i$
- Saunders 2006: quantum particles

"No intrinsic nature" – what does this mean?

1. **external relations:** "By *relational holism* I will mean the claim that objects which in at least some circumstances we can identify as separate individuals have inherent relations, that is, relations which do not supervene on the non-relational properties of the distinct individuals. Relational holism is free of the incoherence which threatens less clearly stated forms of holism. It is sufficient for an object to be a distinct individual that it have a non-relational property." (Teller 1986: 73)
2. **no need:** "...if there are space-time points, one can maintain that all the qualitative properties of any space-time point consist in relations to other

space-time points. There is no need for an intrinsic nature of space-time points. (The same is arguably true of numbers). Imagine a world in which all physical properties are realized as geometrical properties of space-time points. In such a world, we can in principle know all the types of physical properties, they are all relational, and there is no need for intrinsic properties, because the relata are space-time points.” (Esfeld 2001: 401)

3. **non-existence:** “a metaphysics of relations merely has to reject the second part of this claim: one can maintain that (a) relations require relata, that is, things which stand in the relations, but that (not b) these things do not have any intrinsic properties that underlie the relations in which they stand.” (Esfeld 2004: 602)
4. **full dependence:** “as far as the physical world is concerned, there is a mutual ontological as well as conceptual dependence between objects and structure (relations): objects can neither exist nor be conceived without relations in which they stand, and relations can neither exist in the physical world nor be conceived as the structure of the physical world without objects that stand in the relations.” (Esfeld and Lam 2008: 32)

Crucial claim: mutual dependence between objects and relations.

How is the dependence of things on relations to be spelled out?

Version 1: Particulars as bundles of relational properties. Relational properties are problematic, however:

- **Conceptual and ontological posteriority:** Relational properties do not give us expressive power enough to state even their own identity conditions (Hochberg 1988: 196). To say that, generally and as a matter of logical truth, if  $a = b$ , then  $\lambda x(aRx) = \lambda x(bRx)$ , we need to quantify over relations. The point is, I think, best put in terms of explanatory priority: The reason why loving-Superman and loving-Clark-Kent is one and the same property (and Lois Lane, as a matter of logic, exemplifies one iff she exemplifies the other), is that Superman is Clark Kent; therefore, the properties are not atomic, but derelativisations of the prior relation of loving.
- **Regress:** “The supposed adjective of  $L$  [“greater than  $M$ ”] involves some reference to  $M$ ; but what can be meant by a reference the theory leaves unintelligible. An adjective involving a reference to  $M$  is plainly an adjective which is relative to  $M$ , and this is merely a cumbrous way of describing a relation. [...] Apart from  $M$ , nothing appears in the analysis of  $L$  to differentiate it from  $M$ ; and yet, on the theory of relations in question,  $L$  should differ intrinsically from  $M$ . Thus we should be forced, in all cases of asymmetrical relations, to admit a specific difference between the related terms, although no analysis of either singly will reveal any relevant property which it possesses and the other lacks.” (Russell 1903: 222–223, §214) The proposed analysis of “ $aRb$ ” as “ $Fa \wedge Gb$ ” is incomplete and in need of another conjunct, “ $F'R'G$ ”, where  $R'$  is another asymmetric relation. Without such a relation funding the difference of the foundations or relational properties, we have “a conception of difference without a difference of conception” (Russell 1901: 40) – a difference without difference-maker, in other words.

- **External relations:** Necessarily, whenever a dyadic relation  $R$  is exemplified, say by  $a$  and  $b$ , two relational properties, *having  $R$  to  $a$*  and *having  $R$  to  $b$* , are exemplified too, by  $b$  and  $a$  respectively. In the case of internal relations, these relational properties are themselves intrinsic to their respective bearers: they are shared by their (respective) duplicates, are not (too much) disjunctive, and compatible with both loneliness and accompaniment (Lewis and Langton 1998). Whenever  $R$  is internal, the intrinsic property of being internally  $R$ -related, exemplified by the fusion of  $a \oplus b$ , the whole formed out of  $a$  and  $b$ , is factorisable into two intrinsic properties of the parts. For the relational properties *having  $R$  to  $b$*  to be an intrinsic property of  $a$ , its exemplification may depend only on intrinsic properties of  $b$ . Call “external” those relations that do not supervene on the intrinsic properties of their relata, but on the intrinsic properties of the  $n$ -tuples of their relata (or, equivalently, of the fusion of their relata). Relational properties ‘stemming from’ external relations are extrinsic.

Version 2: ontological holism – the whole is ontologically prior to its parts:

One can conceive the joint state of a quantum whole as including intrinsic properties of the whole, that is, intrinsic properties which do not supervene on intrinsic properties of the parts. These intrinsic properties of the whole, however, do not speak in favour of a metaphysics of relations: Any relation between two or more systems can be conceived as an intrinsic property of the whole of the systems in question. (Esfeld 2004: 610)

This is just the acceptance of external relations – nothing particularly structuralist about this.

Version 3: Relations are essential to the particulars. But this does not make the latter dependent on the former – you may hold that Socrates is essential human without being committed that Socrates essentially depends on properties (and thus is a less-than-fullblooded individual).

Version 4: Relations provide the identity conditions for particulars. Either, this just means that there are particulars which are indiscernible with respect to non-relational properties. But this is universally acknowledged and does not provide for dependence. So ‘providing identity conditions’ must be stronger, strong enough to rule out Humean supervenience. Objects are somehow ‘relationally constituted’. But don’t the relations have to be ‘thick’ to achieve this feat? Esfeld and Lam (2008: 33): No, we may accept numerical diversity as primitive. But then there is no dependence: the relations do not provide the identity conditions for particulars, because the particulars do not have identity conditions.

Version 5: The distinction between particulars and relations is a merely conceptual one:

“The question of the ontological relationship between objects and relations is ill-posed. We predicate properties, including relations, of something, we quantify over objects, and we define a structure on a

domain of objects by indicating how these objects are related to each other. However, this is the way in which we represent the world...[...]. It does not match a real distinction in the world. Consequently, there is no point in enquiring into the relationship between objects and properties, including relations or structures, and, in particular, to talk in terms of a mutual ontological dependence between objects and properties, including relations or structures, or an ontological priority of the one over the others. There are not two types of entities, objects and properties including relations or structures, that entertain a certain relationship of ontological dependence. The dependence is only conceptual.

There is no ontological distinction between objects and their properties in the sense of modes: the modes are the way in which the objects exist. Objects do not have any existence in distinction to their ways of existence, and their ways of existence do not have any existence in distinction to the objects. One can draw a conceptual distinction between objects and their ways of existence, but not an ontological one, applying to reality. In reality, there is only one type of entity, namely objects that exist in particular ways.” (Esfeld and Lam 2011: §8.3)

We do not predicate properties, and we do not define structures.

But why is this not just the standard Aristotelian conception of universals as immanent?

## References

- Esfeld, Michael, 2001. Review of ?. *Erkenntnis* 54: 399–403
- Esfeld, Michael, 2004. Quantum Entanglement and a Metaphysics of Relations. *Studies in History and Philosophy of Science Part B: Studies in History and Philosophy of Modern Physics* 35: 601–617
- Esfeld, Michael and Lam, Vincent, 2008. Moderate Structural Realism About Space-Time. *Synthese* 160: 27–46
- Esfeld, Michael and Lam, Vincent, 2011. Ontic Structural Realism as a Metaphysics of Objects. In Bokulich, Alisa and Bokulich, Peter, editors, *Scientific Structuralism*, number 281 in Boston Studies in the Philosophy of Science, pp. 143–160. New York: Springer Verlag
- Fine, Kit, 2000. Neutral Relations. *The Philosophical Review* 109: 1–33
- Hochberg, Herbert, 1988. A Refutation of Moderate Nominalism. *Australasian Journal of Philosophy* 66: 188–207. Elaborated into ?
- Joachim, Harold Henry, 1906. *The Nature of Truth*. Oxford: Clarendon Press
- Ladyman, James and Ross, Don, 2007. *Every Thing Must Go. Metaphysics Naturalized*. Oxford: Oxford University Press. With David Spurrett and John Collier
- Lewis, David K. and Langton, Rae, 1998. Defining “intrinsic”. *Philosophy and Phenomenological Research* 58: 333–345. Reprinted in ?: 116–132
- Ramsey, Frank Plumpton, 1925. Universals. *Mind* 34: 401–417. Reprinted in ?: 112–137; cited after reprint in ?



- Russell, Bertrand Arthur William, 1901. On the Notion of Order. *Mind* 10: 30–51. Reprinted in ? : 291–309
- Russell, Bertrand Arthur William, 1903. *The Principles of Mathematics*. Cambridge: Cambridge University Press. 2nd edition: ?
- Teller, Paul, 1986. Relational Holism and Quantum Mechanics. *The British Journal for the Philosophy of Science* 37: 71–81