Grounds and Structural Realism: A Possible Metaphysical Framework[1]

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Abstract: This article discusses the proposal of accommodating grounding theories and structural realism, with the aim to provide a metaphysical framework for structural realism (ST). Ontic structural realism (OSR), one of the most accepted metaphysical versions for structural realism, is taken into account here, with the intention of analyzing the framework in which GT and OSR are compatible, and to what extent.

Keywords: abstraction, grounding theories, metaphysics, structural realism, structure.

Introduction

Worrall (1989) introduces structural realism as the best version of scientific realism, a positive answer to the pessimistic meta-induction able to account for the 'realist' label enforced by the '(no) miracles argument.' Scientific realism is the view according to which we should commit ourselves to the existence of the non-observable entities posited by our scientific theories. Thus, the success of science would not appear to be a mere coincidence, but something to be expected, as scientific theories are at least approximately true descriptions of the world. Still, there is this phenomenon of theory change which casts doubt on the realism of our theories – in the history of science one may encounter many examples of theories once considered true, but then dismissed and replaced by other theories which had the same fate. Structural realism, then, is a commitment to the (mathematical) structure of our best theories, not to the unobservable entities they posit, and its roots can be traced back to Poincaré, as Worrall points out:

> There *was* an important element of continuity in the shift form 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

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> accumulation in the shift, but the continuity is one of *form* or *structure*, not of content. In fact, this claim was already made and defended by Poincaré. (Worrall 1989, 117)

Worrall's proposal to take into account a structuralist version of scientific realism, in which the main role is to be played by the relations among phenomena that our best (accepted) theories illustrate, would give, then, a glance at how, and not what, we can know. Following Ladyman (1998), in this paper I will call the version of structural realism that Worrall endorsed epistemic structural realism (ESR). Worrall points out that his proposal is no novelty:

> It cannot be said that this is reducing physical theories to simple practical recipes; these equations express relations, and if the equations remain true, it is because the relations preserve their reality. They teach us now, as they did then, that there is such and such a relation between this thing and that; only the something which we then called *motion* we now call *electric current*. But these are merely names of the images we substitute for the real objects which Nature will hide for ever form our eyes. The true relations between these real objects are the only reality we can attain... (Poincaré quoted in Worrall 1989, 118)

Worrall takes into account Hardin and Rosenberg's view according to which, in the case of theory change from Fresnel's to Maxwell's theory on the nature of light, the first one was actually referring to the same entity as the latter and also Boyd's account on theories as better approximation to the truth. His argument is that although the conclusions both parties arrived at are wrong, the intuitions lying behind them are correct – there is continuity in the shift from one theory to the other, not in content, but in form or structure.[2,3] The version of structuralism endorsed by Worrall is considered to be, mainly, an epistemological one, as Ladyman's (1998) analysis points out. Referring to Grover Maxwell and Russell's account, according to which only second order, descriptive, structural properties of objects can be known, Ladyman discusses the problems this form of epistemic structuralism eventually encounters:

> There are serious difficulties with this view, which were originally raised by Newman (1928) [...]. The basic problem is that structure is not sufficient to uniquely pick out any relation in the world. (Ladyman 1998, 412)

In Ladyman's view, Newman's problem could be given a solution in accordance to Benacerraf's observation that objects, in order to be properly named as such, should be treated as individuals in the structure, otherwise there is danger that, given the right setting, any 'object' could occupy the respective position. From this point of view, what structural realism tells us is not about the

[2] A detailed analysis of the equations from Fresnel and Maxwell's theories is to be found in Worrall 1989.

[3] Worrall in (1989, 122) also states that: "On the structuralist view what Newton really discovered are the relationships between phenomena expressed in the mathematical equations of his theory, the theoretical terms of which should be understood as primitives."

objects or their properties, but about the relations and the structure the world is made of (Ladyman 1998, 422).

The structural realist demands for a metaphysical framework, able to account for the relation between models and the world, one in which objects can be individuated, thus complying with Benacerraf's observation. The thesis of the present paper is motivated by this request, which I also corroborate with Psillos' critique on the strongly developed ontic structural realism, presented below.

Ontic Structural Realism

One of the most extensively discussed solution to the demand for a metaphysical framework is ontic structural realism (OSR), developed initially by French and Ladyman (2003). A detailed exposure is to be found in Ladyman and Ross (2007, chapter 3). I will briefly characterize it here as the commitment to the idea of the world having an objective modal structure, described by our best scientific theories and independent of our epistemic states. Ladyman and Ross advise the understanding of the term 'modal' as 'nomological,' in the case of fundamental physics,[4] which is at the center of their discussion, thus saving the no-miracles argument for realism in science. Objects are considered to be "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), whose identity and individuality is to be defined in terms of the world's structure. Moreover, as they specify,

> [...] This is the sense in which our view is eliminative; 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)

Structure becomes, thus, ontologically (more) fundamental, in comparison to objects which are to be identified, on the new terms, via group theoretic structure, following Weyl (Ladyman and Ross 2007, 145). Individuals become locally focused abstractions from modal structure – the relationships among phenomena to which modality can be ascribed to (necessity, possibility, potentiality and probability).

Modal commitment thus proves to be one of the most important features of scientific realism; in the case of ontic structural realism, natural necessity must be taken into consideration. Psillos criticizes this account, in which modality generates structure, all being reflected in the retainment of the mathematical structure of our best accepted theories, and notes that mathematical structure is abstract, and abstractions do not have causal powers. Should structural realism be abstract enough to enable discussion of structure, and also concrete enough to be instantiated by physical systems, as French

[4] For special physics, as they mention, causal structuralism could be the best available option.

requires, Psillos asks the question of priority – to whom are structures prior to, if they are all that there is? The positive side of Psillos's critique is built on the assessment of a version of OSR, M-OSR, due to Michael Esfeld, which incorporates Causal (hypo)Structuralism and leads the way in bringing into attention properties *qua* universals. According to M-OSR, physical structures consist in concrete relations among objects whose identity is given by the relations they engage into, CS' contribution denying *quiddities* to properties – that is, properties ought to be identified only *via* their causal profile. One of the problems of CS is that it replaces *quiddity* with *totalitas*:

> All it will succeed in identifying is the whole network of properties [that satisfy the Ramsified lawbook], without identifying any of them in particular. Here, at best, we get a *totalitas* (the Ramsified lawbook) and a specification of properties in relation to it. [...] this relative specification will leave us in the dark as to what property is what. (Psillos 2012, 175)

The solution to this puzzle is that some of the properties get their identification by some other process, and this leads straight to causal hypostructuralism, where causality itself has to be identified *via* something independent of its function in the web. However the path of causal (hypo)structuralism might seem misleading, CS seems to promise to ground the idea that physical structures are "genuinely causal, their essence being their power to produce certain effects." (Psillos 2012, 176) Psillos advocates for a version of structural universals admitting spatial universals able to account for both features that structures seem to require for OSR: abstraction, as they are repeatable and shareable, and modality – bearing the force to produce effects in the phenomenal world (Psillos 2012, 184).

OSR possesses the feature of a very promising account for our scientific theories – it is able to sustain the no-miracles argument and to defend realism against pessimistic meta-induction; it also has metaphysical implications. However, the last dimension remains to be explored – as we have seen, this view has to explain how structures, though abstract, can have modal, physical effects. In what follows, I offer another interpretation for this matter, one in which the starting point is the object, not the structure. I describe another way of reaching structures, *via* objects, and discuss some of the contributions this account can bring to (O)SR.

Theories of Ground

The theory of ground I will refer to is the one advocated by Kit Fine, according to which the notion of ground is the metaphysical counterpart of 'essence.' One important aspect in the family of ground is related to ontological dependence, one of the virtues acquired by adopting Fine's view on essence.

Ancestors of Ground: A Finean Account on Essence

Traditionally, the pair necessity-essence was given the form of reduction of the latter to the former. This relation is expressed, in (philosophical) logic, by using *de re* statements and the necessity operator, such that in assessing the sentence's truth value, one should be committed to the necessary attribution of a given property in all the possible worlds the object we are referring to exists. According to this view, an essential property is a property the object has in all the possible worlds – in other words, there is no way we can conceive of the object not having that very property. Conditions have been imposed on the type of property discussed here – it should not be a trivial one (such as self-identity or existence), it should not be possessed in virtue of some other property, belonging to another category (for instance, Socrates' humanity is not essential in virtue of the identity between 2 and 2) and so on.

However, difficulties arise from this account. The most prominent criticist of *de re* statements is Quine, who dismisses the analogy in treatment of modal and temporal logic, arguing that although they seem similar, preservation of identity across possible worlds or by continuity in time, in the same world, are different matters (Quine 1976). In fact, only the latter is plausible, – for the transworld identity, we have no warrants, as the objects' *quiddities,* should they exist, are not accessible to us. Admitting *de re* statements is committing oneself to the "jungle of Aristotelian essentialism" (Quine 1953), and it should be avoided, even if the price is to give up this kind of statements.[5]

Another challenge was raised by Roderick Chisholm (1967): suppose we have a set of possible worlds W and the actual world is 'w*.' Some of our objects are Adam and Noah. We can exchange their properties, one by one, slightly, such that in consecutive worlds, no differences can be observed. In the final world, let's call it 'u,' the role played by Adam will belong to a person presenting all of Noah's [w*] properties and vice versa. It is also important to note that adjustments are to be made also to the other objects whose properties are related to Adam and Noah. The puzzle then arises: by transitivity of identity, Adam [w*] and Adam [u] are identical. Still, the properties of Adam [w*] correspond to those of Noah [u] and, and Adam [u] has all and only the properties of Noah [w*]. This example shows us that we do not have a means by which to determine the objects' *quiddities*. Also, there seems to be a problem with *de re* statements, which actually imply we can talk about essential properties, in terms of necessity.

However, Kit Fine objects, in a series of articles, to this traditional account on essence and suggests that instead we should treat necessity in terms of essence[6]. Should we have a property F, and a statement A, then $\Box_F A$, read "A is

[5] According to Quine, should modal logic contain only *de dicto* statements, there would be no concern about its legitimacy.

[6] For more details, see Fine 1994.

true *in virtue of* the nature of the objects which F."[7] The statement is obtained by prefixing A with the essentialist operator $\Box_F$, 'in virtue of the objects that F,' which has been formed by specifying the property F to the essentialist operator. The logic thus developed, $E5^{(+)}$ incorporates S5, the standard modal logic system and some other axioms that describe its characteristics. In what follows, its metaphysical implications will be taken into account. The statement A, in the above example, attributes essential properties to an object; its truth-value is determined in relation with a class of objects sharing a certain property – F. How was this class obtained? Fine's answer would be: by using the λ-abstraction on the property F – thus creating a cloud containing all the objects that F. The nature of the objects that F is in question here, and this very nature establishes the truth of statement A.

Reformulating the issues raised by CP can bring us one step closer to the issues that the finean account on essence aims to solve. CP questions our common intuitions on the relation between objects and properties – who is identical to whom, in the above-mentioned example? Is Adam [w*] identical with Adam [u] in virtue of the role they play in the 'structure' of the respective possible worlds, or the former is identical to Noah [u] because of the properties they share? Is it essential for one object to stand in the relations it stands, or its properties are the ones that help us identify it? The core of this problem seems to be the notion of ontological dependence between objects and properties: objects are given to us fully loaded with their properties and the relations they stand in – objects are ontologically dependent of the properties they have, and the properties are also dependent on the objects instantiating them. The finean notion of essence promises to be free of ontological dependence: a property F is abstracted from an object and the class of all objects that have this property is then obtained. Then, in virtue of the nature of that cloud of objects, statements receive their evaluation. The dependence chain is broken once through λ-abstraction and then by the instantiation of the property in some object, about which the statement is about.

Grounds in Metaphysics

> *Ground, if you like, stands to philosophy as cause stands to science*. (Fine 2012)

A similar relation to that between essence and necessity is the one between grounds and explanation. Ground is considered to be the ultimate, fundamental form of explanation; it belongs to the metaphysical level and it links entities of the same kind: facts or statements. It borrows a traditional form and consists of grounding and grounded entities, and presents many varieties, according to the criteria taken into consideration. Thus, it can be (non)/factive, plural or singular, full or partial, (im)/mediate, weak or strict, (non)/distributive.

[7] See Fine 1995, 241-242.

For example, we can talk about a fact C grounded in the fact A and some other ground B, which is not factive[8]. Let us consider B to be a moral judgment; then, C is non-factively (because of B), plurally (because of A and B grounding together C) grounded. On the other side, A and B are each partial (non-distributive) grounds for C.

The image I try to picture about grounds goes as follows: they belong, in a theoretical account, to the species of explanation. In the world, they are facts that produce effects. They cannot replicate (they are non-reflexive), but support transitivity (because of the mediate type allowed) and are not symmetrical (because of non-reflexivity and in order to avoid circularity – a grounded fact cannot ground its ground(s)). They can be encountered at all levels of the physical world, up to the fundamental one, where we should or could be talking about the ungrounded. A grounding fact can thus have its own grounds, as long as it is not circular; also, there is a limit where the chain ends.[9]

Grounds also prove to be a strong and useful resource for realism – they are is, as Fine advocates, the starting point for a discussion about what is real:

> I come to two main conclusions: first, that there is a primitive metaphysical concept of reality, one that cannot be understood in fundamentally different terms; and second, that questions of what is real are to be settled upon the basis of considerations of *ground*. (Fine 2001, 1)

Fine argues that determining which propositions are factual requires an inquiry on the grounds of the entities in question, as real/fundamental propositions are factual, and propositions grounded in the real are factual (Fine 2001, 28). The approach he favors consists in a continuous search of grounds for propositions, until we reach to what is (grounded in the) real, as "any basic *factual* proposition will be real. For any true factual proposition is real or grounded in what is real; and so the proposition, if basic, will be real." (Fine 1002, 26). If such a point is reached, then another real/existing fact/entity has been determined. Realism, then, starts gaining force.

This is one of the applications of the theories of ground. Another step, closer to the philosophy of science, has been made by Shamik Dasgupta. His works on grounds and structural realism seem to support my intuition that the former can play an important role in providing the metaphysical framework that philosophers of science require from structuralism. According to Dasgupta (2014), the logical structure of grounds allows for structuralist hypotheses and ground is irreducibly plural. The plurality, symbolized by Γ, is a list, not a conjunction of grounds, and this is also the form of the grounded, let us say Δ. Grounds metaphysically necessitate the grounded and each member of Γ has to be relevant with respect to Δ, they can be transitive (derivative ground), certain

[8] That is, itself a fact.

[9] For a detailed presentation of the types of ground and the interaction between the members of this relation, see Fine 2012.

conditions being met. The qualitativist view of the world Dasgupta adheres to is an explanatory relation; hence the challenge of showing that the *explanantia* are sufficient for the *explanans*, to whom he argues that it can be met if one adopts plural grounds. Structuralism is a version of qualitativism and the plural requirement that accompanies it leads us to the idea that, since the world is made of purely qualitative facts, then the individualistic ones are to be explained only following the plural grounds schema – that is, when they are explained simultaneously (Dasgupta 2014).[10]

For example, let us consider a unity of measurement – Dasgupta's choice is for quantity. The manner in which the reference unit is established is more or less arbitrary, but subsequently, quantities are to be determined by reference to this unit. The relations established among objects possessing the property of having mass are structural – they cannot account for how bodies in the actual world can be related to others in some other possible world (given the arbitrariness of the reference unit choice). Our most plausible account on the given, real world is then a qualitativist, structural, comparativist and plurally grounded one.

Grounds and Structures. Possible Metaphysical Frameworks

In philosophy of science, structural realism has two main branches: the epistemological one, which gives an account on how and why we get our scientific theories, and the metaphysical one, which is supposed to shed light on the 'furniture of the world.' One of the most viable candidates to the latter proves to be OSR, which nonetheless encounters difficulties, one of them being that is has to be abstract enough as to enable talking about structures, but also concrete enough to explain instantiation by the physical systems.

My proposal is to take into consideration the grounding theories. As we have seen, steps towards giving an account of structuralism and realism in terms of grounds have been made (Fine 2001), (Dasgupta 2013 and 2014). However, the possibility that they could positively contribute to OSR's difficulties seems unexplored, and my suggestion is to draw attention to that direction. Should we take into consideration a finean ancestry of the notion, we could consider these relations as being able to account for both of Psillos' requirements. If necessity and essence stand in the same type of relation as the pair causation-ground, we can then discuss about causation as expressible/reducible to a certain type of ground.

Is the theory of ground, as presented above, compatible with OSR? I am inclined to answer affirmatively – in my view, the *Weltanschauung* grounds offer has modal powers, because they allow discussion about necessity, possibility and face similar difficulties with OSR. What would then be the benefits of adopting it?

[10] It could be interesting to compare this result to the *totalitas* objection formulated by Psillos (see above).

The strongest point I can find is that it can be an answer to the challenge of explaining how a structure that is abstract in nature can have concrete, physical influences. Should we follow Fine's advice, then grounds and causation stand in the same relation as essence and necessity – the second can be, and is expressed by means of the former. Moreover, grounds are the fundamental form of explanation, located at the metaphysical level. Causation, instead, belongs to the reign of phenomena; we are thus able to offer a metaphysical explanation of a concrete, more or less observable relation.

Conclusions

In the light of this argumentation, then, we can conceive of the theory of ground as being a meta-metaphysical[11] theory with respect to structural realism or, particularly, OSR, with which I have not identified, for the moment, any incompatibility. Grounding should not be, in my view, a replacement for OSR; instead, since OSR concerns a part of the world, namely our scientific theories of fundamental research, and the grounding theory could be thought of as accounting for the world as a totality, perhaps the natural move is to consider OSR to be under ground's range, explaining thus why I advance it as a meta-metaphysical theory (with respect to OSR which already has been included in the kingdom of metaphysics).

However, it would be interesting to compare the issues both theories encounter with respect to individuation and identity. And also, to my mind, the relation between abstract and modal/concrete could be subject to further investigation.

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[11] I chose to propose grounds as a meta-theory because they are able to account for more than phenomena/ facts of interest to science; there is nothing counterintuitive in an attempt to ground moral statements, for example.

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