A case for conservative ontology development in scientific metaphysics

Sahana V. Rajan

Abstract: Over the past decade, in contrast to the traditional analytic version of metaphysics, a brand of metaphysics that prioritizes collaboration and corroboration with sciences has emerged in the form of scientific metaphysics. While there has been a shift from the methodological dependence of analytic metaphysis on intuition, and conceptual analysis to the methodological preference for empirically-motivated metaphysical insights in scientific metaphysics, such a shift has not penetrated the foundational aims. Scientific metaphysics continues to probe the nature and structure of reality, much like its analytic counterpart and in this process, develops ontologies. Broadly two kinds of ontologies are furnished - global metaphysical ontologies and local scientific ontologies. In this paper, I highlight the challenges with developing such ontologies in scientific metaphysics. With Ladyman-Ross' Information Theoretic Structural Realism as a case in point, I contest that the former suffers from representational indeterminacy and redundancy. Further, I note the possibility that eventually, local scientific ontologies might be replaced by scientific theories and in such a scenario, the former are best conceived as interim metaphysical supports for the latter.

Keywords: scientific metaphysics; ontologies; representation; redundancy.

> A metaphysical philosophy, in the sense of that which is to be definitively accepted in advance of scientific inquiry, is, or should be, a system of pigeon holes in which facts are to be filed away. Its first merit is to give a place to every possible fact. Whatever could conceivably be settled by experiment, metaphysics should abstain from settling in advance.
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> (Peirce 1975: 201)

1. *Introduction*

The pigeon holes are ready. A hundred ontological systems, and a thousand eager metaphysicians await. Where are the scientific facts? Last few centuries,

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many scientific facts arrived (think of phlogiston theory, caloric theory, or Newtonian physics) and were safely filed away in the pigeon holes. But soon after, these 'facts' retired to the overcrowded hall with other superseded scientific theories and the pigeon holes were emptied. The latest facts (think of Quantum Field Theory, Modern Evolutionary Synthesis) to occupy these pigeon holes have survived a great many tests- how long will the current tenants last[1]?

Metaphysicians in the enterprise of gathering and filing away scientific facts into ontological pigeon holes should be ubiquitously aware of the possibility that such facts are always prone to eviction by the next drove of facts. The acceptance of scientific theories is to be solemnly accepted with the possibility of their future retirement. Such possibilities have invoked a cautious optimism in scientific realists and pessimism in scientific anti-realists about the status of scientific theories. Scientific realists defend their optimism by citing the explanatory and predictive successes of the retired theories, in form of the no-miracles argument (Brock and Mares 2007; Devitt 2008; Park 2019). For now, in the course of this paper, I side with the hesitant optimism of a scientific realist, supported by empirical evidence which indicates that scientific theories can latch onto and mathematically specify the structures of our reality (Worrall 1989; Ladyman 1998; Arenhart and Bueno 2015). However, ontologies have not always been built, in the history of metaphysics, in such strict corroboration with scientific theories. The coming together of science and metaphysics is, in many ways, a recent phenomenon. The traditional manners of building ontologies often relied on *a priori* methodologies, including intuition and conceptual analysis. Such ontologies have been critiqued for misrepresenting, or in Ladyman's terms, domesticating science to advance their metaphysical points (Ladyman *et al* 2007: 4-8)[2]. In contrast to the reliance on

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[2] The representation of analytic metaphysics by James Ladyman, Don Ross, David Spurrett and others (hereon, RLS) has been severely challenged over the past decade. The dangers of sweeping generalizations, possible misrepresentation and the absence of in-depth examination of neo-Scholastic metaphysical positions as well as doubts about unified worldview and nature of a scientistic metaphysics were brought forth by P. Kyle Sanford, Katherine Hawley, Paul Humphreys, Cian Dorr among others (Stanford *et al.* 2010; Dorr 2010). Although the discussion of these challenges is crucial, it is unfortunately beyond the scope of my paper. While receiving RLS's comments on analytic metaphysics, the reader should note the limitations of their accounts and also note the extensive ongoing debates on methodologies in metaphysics (Thomasson 2007; 2012; Nolan 2016; Lee 2017).

a priori methodologies, over the past decade, there has been a concerted effort to develop Scientific Metaphysics[3] that endorses an empirically-motivated form of metaphysical theorising in collaboration and corroboration with scientific theories (Ross *et al.* 2013; Soto 2015).

While developing ontologies in analytic metaphysics, agreement with scientific facts is an optional feature. This has often resulted in metaphysical hypotheses that are divorced from scientific findings about the world and have been the target of glaring critique by many metaphysicians (Ladyman and Ross 2007: ch. 1; Maclaurin *et al.* 2012; Byrant 2020). In contrast, such an agreement is a necessary (though, not sufficient) condition for theories to qualify as naturalised or scientific, in case of naturalised or scientific metaphysics. Under such an agreement to scientific theories, scientific metaphysics can develop, I propose, two broad kinds of ontologies, global metaphysical ontologies and local scientific ontologies. I contest that the former suffer from representational indeterminacy and redundancy. With Information Theoretic Structural Realism (ITSR) of RLS[4] as a case in point, I suggest that it would be a wise move to eliminate global ontologies. Further, as scientific theories develop, the underdetermination of metaphysical claims and local ontologies could be gently addressed. In the end, I note the possibility that eventually, local scientific ontologies might be replaced by scientific theories and in such a scenario, the former are best conceived as interim metaphysical supports for the latter.

To this end, here is a roadmap of what follows: I begin by introducing The Reader's House which eases us into distinction between local scientific ontologies and global metaphysical ontologies in Section 2. The elimination of global ontologies is proposed with ITSR as a case in point in Section 3. Further, the underdetermination of local scientific ontologies by scientific theories is discussed in Section 4, highlighting the possibility of the elimination of those ontologies that do not accommodate scientific developments and also, the eventual collapse of the surviving local scientific ontology onto scientific theories. In the end, I briefly note the profit of a conservative ontology development for scientific metaphysics (Section 5).

[3] Scientific metaphysics differs from metaphysics of science in some crucial ways. Scientific Metaphysics is a specific form of metaphysical theorising committed to collaboration and corroboration with scientific theories; it is a counteraction to the dominance of *a priori* methodologies in traditional analytic metaphysics. Metaphysics of science involves (but is not exclusive to) debates relating to metaphysical aspects of various scientific domains (physics, chemistry, biology, psychology, economics and others). There can be both analytic and scientific metaphysics of science. In case of the former, *a priori* methodologies can be utilized to infer metaphysical claims based on scientific theories. However, scientific metaphysics prioritizes scientifically-informed metaphysical claims.

[4] This is a short form for "Don Ross, James Ladyman, David Spurrett" and is borrowed from Melnyk 2013.

2. *Conservative ontology development: a starter's kit*

2.1. The reader's house

Imagine a metaphysical theory called "The Reader's House" which maps the ontology of your house. You are the metaphysician developing this comprehensive inventory. As you walk through your house, you make a numbered list: you write down the name of every item in your house starting with the doorbell and name plate to the fence in your backyard. Through this process, depending on your preference for detail, you might want to go a little deeper and even add the length of wires used in the electrical apparatus running in your house; perhaps, you feel a little adventurous and also put down the screws, nuts and bolts. Right now, you have a numbered list of all items in your house. As you go through this giant list, you realize that you have left a precious load of items: what about everything that *constitutes* all of these things in your house? You wonder: What about the quarks, the electrons, the atoms, the molecules and everything between and within? And this triggers another rabbit hole of ontological meditations: what about your dogs? What about your partner and the kids? And then: What about the ways in which each of them relates to each of the other and also, how each of us relate to the humongous list of items you jotted down? Unless you pin down all of this, you would be missing out on accurately representing the ontology of your house. This leads to an inventory which takes the form of an infinitely cross-referenced complex network. This entire enterprise assumes you have collaboration *par excellence* with physicists, chemists, psychologists, sociologists and others who enable you to correctly classify everything.

You sit with the colossal colour-highlighted, neatly bound database and think: "Something must be missing!", a feeling that haunts most metaphysicians even after stuffing their ontologies as much as possible. You rest a bit, watching your dog, Maya. Looking at her, imagining so many ways in which we all are common, you wonder: "Could there just be one broad category, to which all of us could belong? Could I headline the inventory such that everything falls under it?". You think through the options: there could be that-which-is, material beings or physical entities, perhaps?

This movement marks a paradigmatic shift. You are not talking about specific kinds of things anymore, which are studied by scientific theories- you are moving to make general claims about everything, all that is. This is the jump from ontological claims which can be strictly warranted by your squad of scientific experts to metaphysical claims which do not fall under any of their specialisations. You are the creator here. This is where you, the metaphysician, run the risk of indulging in the excesses of the *a priori*.

If you have so far been committed to scientific metaphysics in developing The Reader's House, I imagine that you corroborated your claims with your group of scientific experts. However, as you distance and intend to widen the scope of your claims, you take on the perspective of a vantage point which no singular science could offer you. Till this point, you depend on the rigor that the individual scientific theories supply to your inventory- hereon, you are on your own, building a panoptic perspective. In the coming section, I introduce the notions of local and global ontologies to talk about this movement from ontologies supported by scientific theories to ontologies which move over and beyond them.

2.2. Local scientific ontologies and global metaphysical ontology

As you gradually extended The Reader's House inventory, at some point, a pragmatically motivated project of developing a list of items in the house turned into a larger metaphysical project, intended to capture all-there-is. In both of these projects, the larger goal is to represent the world around you. While developing an inventory of list of items in the house, you represent a specific set of phenomena. In corroboration with the relevant scientific theories, you jot down the entities and processes which are empirically supported. Ignoring, for now, the deeper details about the timeline and order in which you noted the items, you covered the following phenomena amongst many others. There are the quantum phenomena, then there is virus, chromosomes, red blood cells and then come the pollens. Then came amoeba, ticks, dust mites so on and on until you reached apples, a mouse, a soccer ball and your dog Maya and eventually, you measured the house itself. In each of these cases, a specific set of phenomena is investigated, and you depend upon the relevant scientific theory to offer empirically supported information about their nature or structure and their behaviour. Metaphysical claims and ontologies specific to these set of phenomena can be proposed, in collaboration with the scientific theories. Local scientific ontologies are those ontologies that are developed and based on particular theories, and are restricted to a scientific domain; they are theory and domain restrictive. Consider neuroscience which broadly studies the nervous system, more specifically the brain and its structure and development, its effect on our cognitive functions and behaviour. Based on the findings and developments in neuroscience, we can arrive at a multitude of local scientific ontologies (like Integrated Information Theory, Global Workspace Theory, Recurrent Processing Theory) which attempt to metaphysically capture the behaviour of certain kinds of organisms. In these local scientific ontologies, any metaphysical claim receives its confirmation or falsification from the findings and developments in neuroscience. This is, however, not the case with building an ontology that fits reality or the world. Global metaphysical ontologies are those ontologies developed to represent any phenomena whatsoever. Such ontologies are not based on particular scientific theories or on empirical information pertaining to a scientific domain; they are domain and theory neutral. In the coming section, I suggest that global ontologies suffer from representational indeterminacy and redundancy, which motivates their elimination in scientific metaphysics[5].

3. *Decluttering the reader's house: elimination of indeterminate and redundant global ontologies*

In scientific metaphysics, a global ontology posits entities and processes (like properties, universals, hunks of matter or real patterns) that underlie or are presupposed by scientific theories. The world is believed to possess a fundamental nature or fundamental structure, constituted by such entities and processes. Existence claims of global ontology take forms such as, "It is real patterns all the way down." (Ladyman and Ross 2007: 228) or for analytic metaphysics, "I propose that a physical object is not an enduring spatial hunk of matter, but is, rather, a spatiotemporal hunk of matter." (Heller 2001: 331). Such global ontologies which aim to represent 'world' or 'reality' suffer from representational indeterminacy.

3.1. The problem of representational indeterminacy

Consider a global ontology $O_{G.1}$ which declares that the world is constituted by substances possessing essential and accidental properties as well as internal and external relations. To the question, "What phenomena does $O_{G.1}$ represent?", we could expect the response, "*Everything* around us.". If pushed further, "What is *everything*?", $O_{G.1}$ could come back with, "You can pick

[5] The proposed distinction between global metaphysical and local scientific ontologies should be differentiated from the classification of globally applied and locally applied naturalistic metaphysics suggested by Soto 2017. Soto considers globally applied naturalistic metaphysics to be a component of metaphysical practice that investigates ontological issues relating to fundamental structure of reality (i.e. those features of our physical world that can be instantiated everywhere in the world). These would include questions about whether space and time are relational or substantival or whether reality has a natural-kind structure. Also, locally applied naturalistic metaphysic are specific debates which arise pertaining to the role of unobservable posits within particular theories of scientific ontology. He illustrates this through the case of dark matter. In my proposal, global metaphysical ontologies make claims about the 'world' or 'reality' and I suggest their elimination due to indeterminacy and redundancy. Specifically, questions about fundamental structure or nature, a natural-kind structure, or the role of unobservables sans the context of specific sciences would be treated with sceptical hesitation and might face elimination eventually. Local scientific ontologies, in my proposal, are those ontologies which are based on scientific theories and are underdetermined by the latter.

up *anything* that is happening *anywhere*." In reply, a complaint to the effect, "That is vague. What are the specific phenomena that $O_{G.1}$ attempt to capture?" might extort a mildly concrete response, "The ontology can offer the metaphysical nature of, say, this mountain, that ball or even your dog.". Global ontologies suffer from representational indeterminacy, the lack of targets of representation and require probing to clarify the determinate targets. Once such targets are identified, scientific metaphysicians can refer to relevant sciences which would provide empirical information and form the context within which the metaphysical claims and entities and processes posited by $O_{G.1}$ can be construed. In the above case, a scientific metaphysician could cite mountain geography to learn about the mountain, physics to study more about the ball and evolutionary biology and zoology to find out more about my dog. It might be fitting to imagine $O_{G.1}$ as an abstract world of Platonic forms which awaits its instantiation in the sciences. Such abstract worlds, characterised by representational indeterminacy, are neither empirically-motivated nor scientifically-informed and should be eliminated.

Some metaphysicians of science might remind us that it is not possible to completely cleanse a scientific theory of *a priori* claims, since theories inevitably *presuppose* metaphysical details (Chakravartty 2010; 2013, Mumford and Tugby 2013). However, such metaphysical matters can be fruitfully analysed within the bounds of scientific theories and need not be generalized to the degree of indeterminacy. Ladyman also seems to support such restriction of metaphysical theorising within scientific contexts, when he emphasises that the assumption of a general composition relation, beyond "the particular kinds of composition relevant to their respective domains" is symptomatic of nothing more than "an entrenched philosophical fetish" (Ladyman and Ross 2007: 21, Ladyman 2012). In the coming section, I highlight that scientifically-informed global ontologies, in addition to representational indeterminacy, also suffer from redundancy.

3.2. The Redundancy Dilemma

The Redundancy Dilemma applies to those global ontologies, that offer an inventory of entities and processes for the 'world', based on scientific theories. Here is a prototype: Suppose a global ontology $O_{G.2}$ that says that the world is constituted by structures, that further consist of relations between phenomena. $O_{G.2}$ is based a scientific theory T_S at time *t*. T_S gradually develops over decades. Assuming that it is not proven false or superseded, imagine time $t+_{n,}$ when T_S can reductively or non-reductively represent a range of phenomena (including non-physical). On such an exciting and promising day, T_S would represent the world in terms of entities and processes that empirically constitute its theory.

An example could be the case of Quantum Field Theory which mathematically represents the world in terms of quantum fields, particles, waves (Kuhlmann *et al.* 2002, Baker 2016). In a more developed form, QFT would continue to represent the world in terms of these ontological categories. In such a scenario, $O_{G.2}$ would be redundant. The categories of structures and relations could be powerful conceptual instruments *in* scientific theories. However, there is no good reason to assume there ought to be something to represent beyond the determinate representational targets of scientific theories. More importantly, reiterating the point that Ladyman raised earlier, global ontologies forgo intricate representational details of scientific theories. In practice, representation of each phenomenon is a complex function of the pre-existent scientific discourse on the phenomena, the pragmatics of technological scope and limitations and other factors (Coopmans *et al* 2014). The Big Picture, the grand narrative of the 'world' or 'reality', goes beyond the determinate targets of representation, and there seems to be no good reason to believe in such a narrative.

Global ontologies are representationally indeterminate and redundant. Their elimination would regulate the conceptual gymnastics performed in scientific metaphysics based on purely *a priori* methodologies. In the next section, I illustrate the case for their elimination through Information-Theoretic Structural Realism of James Ladyman, Don Ross, David Spurrett and others.

3.3. Information Theoretic Structural Realism of Ladyman, Ross and Spurrett

In the previous section, I questioned The Big Picture generally presupposed by a global ontology. An instance of such a global ontology is Information Theoretic Structural Realism (ITSR).

From a scientistic stance (synthesis of empiricist and materialist commitments), RLS adopt the Dennettian theory of real patterns and redevelop it into Information Theoretic Structural Realism (ITSR). This is a global ontology for a non-reductive unified worldview, which proposes that our world is constituted by representational and extra-representational or universal real patterns (Dennett 1991).

RLS define real patterns in the following way:

> A pattern P is real iff
> (i) it is projectible; and
> (ii) it has a model that carries information about at least one pattern D in an encoding that has logical depth less than the bit-map encoding of D, and where D is not projectible by a physically possible device computing information about another real pattern of lower logical depth than P. (Ladyman and Ross 2007: 233)

Essentially, a pattern is a regularity in data (which can be understood, roughly, as that which is observed or is observable). Some such regularities in data can be compressed through relevant algorithms. Depending on its computational capacities, an observer compresses continuous flow of such data and produces a model which offers a better-than-chance prediction of future events. These processes, of observation (in relation to capacities of the physically possible machine), compression and processing of data as well as the production of predictive models constitutes a real pattern (Ladyman and Ross 2013). There are largely two kinds of real patterns, representational real patterns and extra-representational or universal real patterns.

On one hand, representational real patterns are: (i) Predictive models produced by compression of observed data, relative to the computational capacities of the observers; (ii) Such models are expressed through natural or ordinary language (employing notional-world concepts like causation and cohesion). Such predictive models capture ontologies, relative to specific scales of measurement, at which observation occurs. RLS suggest that special sciences (like non-fundamental branches of physics, chemistry, biology, economics, sociology) trade in such representational real patterns. Metaphysical claims of special sciences are largely epistemological products which enable measurement conducive to the computational convenience of observers of a certain kind; a case in point is the category of individuals which is considered to be an epistemological book-keeping device.

On the other hand, extra-representational or universal real patterns are those predictive models, mathematically specified by fundamental physics, which capture the entire physical complexity of the phenomenon. In such patterns, there is lossless compression of observed data. Fundamental physics generates such patterns and represents the objective modal structure of our world. Such structures can be measured at any scale of measurement (i.e. they are scale-neutral and thus, are "universal" real patterns). RLS admit that the goal of scale-neutral real patterns capturing the complexity of the world in its entirety is a limiting ideal, an aspiration which perhaps, we would never reach[6].

[6] The claim that we might never reach such an ideal is insufficient to insulate ITSR from the redundancy dilemma. If we might never reach such an ideal, what purpose does it effectively serve for scientific metaphysics? The two regulative principles proposed by RLS, namely, Principle of Naturalistic Closure (PNC) and Primacy of Physics Constraint (PPC) can limit and moderate metaphysical claims in Ontic Structural Realism (Ladyman *et al.* 2007: 37-38). The aspiration for a completed fundamental physics might be reflective of the subjective preferences of the theorists. Such preferences are undeniably an important aspect of the epistemic factors which govern the development of scientific theories and the derivative local ontologies. However, when taken out of the context of scientific theories and local ontologies, such aspirations are often symptomatic of, in Ladyman's terms, "an entrenched philosophical fetish" for The Big Picture.

Illustrating through Eddington's famous instance of two tables, RLS explicate the relation between universal real patterns of fundamental physics and representational real patterns of special sciences (Ladyman 2018). The table of everyday life is a real pattern projectible from a specific macroscopic scale. However, at a fundamentally physical scale, the table is a pattern of molecules which are attached together by electromagnetic potentials. We can, at best, correlate the everyday-life-table as a representational real pattern to the fundamentally-physical bound state of particles which composes it[7].

ITSR is a global ontology of real patterns for a unified non-reductionistic worldview. This unity is specified in the mathematical structures of fundamental physics, which captures the objective modal structure of the world. In the next section, I show the redundancy of such an ontology and suggest its elimination.

3.4. ITSR: eliminating The Big Picture

Suppose that today is the day that fundamental physics can universally measure real patterns and reductively or non-reductively represent different kinds of phenomena. In such a scenario, those entities and processes that empirically constitute the fundamentally physical theory are measured and represented. To illustrate, say, QFT takes the form of such a fundamental physics, then we would measure and represent determinate targets including particles, waves, fields. The ontological categories of representational or universal real patterns would neither play any role nor add no metaphysical value to the scientific theory. In other words, ITSR would be redundant.

While we wait for fundamental physics to develop further, we could take inspiration from RLS who say the following of scientists pursuing ultimate answers to big metaphysical questions: "Scientists who rush to pronounce on such questions in the light of the latest theories go beyond the evidence." (Ladyman and Ross 2013: 131). ITSR is an instance of "...going beyond the evidence" and while theories develop, it might be advisable to avoid rushing to global ontologies.

A disunity of science zealot or an admirer of promiscuous realism might regard the suggestion for contextualisation of metaphysical claims within diverse sciences as an affirmative for a disunified worldview. However, the thesis

[7] The two tables cannot be identified with one another because they possess different persistence and modal properties. While the table could exist even after some of its relevant particles did not, this does not stand for the bound state which would alter with the change of these particles. Also, though the table could have a leg replaced, the bound state would not survive such a shift. For a detailed examination of ITSRist relationship between fundamental physics and special sciences, see Ladyman 2009.

of disunity of sciences is as excessive as the thesis of unity of sciences. Both assume a substantive notion of a metaphysical reality, so to say, The Big Picture of our world that is either one or broken, which is either unitary or fragmented. The recommendation of global ontology eliminativism declares that there is no Big Picture of the world. The theses of unified and disunified world-views are equally at fault for assuming there is such a picture, a world beyond the determinate targets of representation.

In this section, the eliminativist stance towards global ontologies has been discussed. Based on the instance of ITSR, I have emphasized that a developed form of fundamental physics could render ITSR redundant. In the next section, I consider underdetermination of local ontologies derived from or based on scientific theories. Such local ontologies would face elimination as scientific theories develop. Those ontologies that can accommodate scientific developments would survive while the ones which fail to account for them would perish.

4. *Local scientific ontologies*

4.1. Indeterminacy of general metaphysical notions

Let's go back to the pigeon holes of metaphysics. A local scientific ontology constitutes pigeon holes to stack away the facts of a domain-specific current best scientific theory. Say, to accommodate QFT of fundamental physics, Ontic Structural Realism suggests the pigeon holes of structures, relations and interactions. Consider Integrated Information Theory that suggests the pigeon holes of systems with parts involved in cause-effect feedback loops for accommodating findings of affective, cognitive and computational neurosciences. The previous argument against global ontology underscored that there is no reason to assume that there is a general set of pigeon holes which can accommodate all scientific theories. Unfortunately, a general set of pigeon holes cannot even be cashed out for a domain-specific scientific theory. From a scientific theory, a multitude of local scientific ontologies can be derived. Global Workspace Theory, Integrated Information Theory, and Recurrent Processing Theory are some of the local scientific ontologies based on neuroscience. From Quantum Field Theory of fundamental physics, we can derive the traditional substance-attribute metaphysic, ontology of individuals and sets, ontologies of facts, Whiteheadian process ontology, ontology of tropes and trope bundles as well as field and structuralist ontologies (Kuhlmann *et al.* 2002). To this morass of ontologies is also added another can of worms, metaphysical claims that hint at seemingly opposing views. A recent example is the debate on quantum objects as individuals and as non-individuals (French and Krause 2006:

Chapter 4, Caulton 2015, Arenhart 2015). This signals the underdetermination of local ontologies and metaphysical claims by scientific theories (Laudan and Leplin 1991, Stanford 2001, Norton 2008, Magnus 2010, Werndl 2013). The Big Picture is, then, this: A rainforest of local ontologies flooded with often-incompatible metaphysical claims.

A surveyor of this rainforest might observe common categories (like structures, substances, individuals, properties) and intuitively infer a global ontology constituted by these categories. However, this would be an unwarranted jump. There are significant scientific details in a theory which support the choice of an ontological category within local ontologies and a generalisation to the effect that structures (or any other ontological category) constitute our world turns a blind eye to important aspects of the scientific theories within which the notion of structure figures. In QFT, the non-individuality of particles motivates the category of structures. In neuroscience, an evolutionary trajectory of the brain as an organ and specifically, the circuitry of brain regions and activation of neural networks might motivate the category of complex systems or structures. In each of these cases, there are crucial differences in the scientific details that underlie the choice of category. The way in which neural activations occur and form dynamic brain networks is significantly different from the way in which particles behave at a subatomic level. There is no reason to assume a substantive notion of structure to denote the phenomena across domains or theories. A safer bet to acknowledge such commonalities across ontologies could be to suggest that there are Suárezian surface features to the notion of structure, which characterises its use in diverse scientific theories (Suárez 2010; 2015). That a structure is constituted by relations between phenomena could be its surface feature, capturing the most general feature that marks its use across theories. However, the utility of general notions and surface features for scientific theories is negligible. To put such notions to use, the metaphysician ought to engage with un-domesticated versions of scientific theories and recognize the relevant instantiations of structures and relations within the theory. If the use of a metaphysical claim or ontological category requires acquaintance with the relevant scientific theories, then what could be the role of general notions? Here, the Redundancy Dilemma resurfaces.

4.2. The end fame for local scientific ontologies: victorious replacement by scientific theories

As scientific theories develop, the underdetermination of local scientific ontologies could gradually resolve. Lesser and lesser number of local ontologies would continue to accommodate the latest developments in scientific theories. As neuroscience developed, Cartesian Dualism, a local ontology based on anatomical and physiological studies undertaken by Descartes, was abandoned and replaced by other theories of mind or consciousness (such as Identity Theory, Functionalism, Behaviourism, Eliminative Materialism) that acknowledge the role of the brain in the identity or emergence of mental states.

With gradual elimination of local ontologies, scientific metaphysicians might realise that the ultimate victory for a local scientific ontology is to collapse onto a scientific theory. In neuroscience, Eliminative Materialism is a local ontology that predicts that the endgame for theories of mind and consciousness is their elimination and replacement by a complete neuroscience (Churchland 1981). Scientific metaphysicians ought to seriously consider the possibility that local scientific ontologies might be, at best, interim metaphysical devices that serve to advance scientific theories and whose success is the extent to which they can collapse onto developed versions of the theories.

5. *The case for conservative ontology development*

Scientific metaphysics began as an attempt to regulate metaphysical theorising, previously governed solely by intuition and conceptual analysis. This regulation was carried out by committing to rigorous engagement with scientific theories. Over the past decade, in metaphysical debates that value collaboration and corroboration with scientific theories, there have been signs that intuition and conceptual analysis could override the strict boundaries drawn by the latter; this is exemplified by the case of global ontologies. Global ontologies are representationally indeterminate and redundant and should be eliminated. As a metaphysically healthy alternative, we can develop a range of local ontologies based on scientific theories. Of these local ontologies, only those which accommodate scientific developments would continue to be relevant and eventually, might face a collapse onto developed versions of scientific theories.

To conclude, I restate the case for Conservative Ontology Development: first of all, global ontologies that declare an ontology for all-there-is, world, or reality suffer from representational indeterminacy and redundancy and should be eliminated, and second, the relevance of local scientific ontologies is determined by the extent to which they can accommodate the latest scientific developments. With such conservative ontology development, scientific metaphysics can avoid excessive dependence on *a priori* and can channelize its theoretical resources towards serving scientific theories to reach more developed forms.

Sahana V Rajan
Jindal Global Business School, O P Jindal Global University
svrajan@jgu.edu.in

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