

# What Analytic Metaphysics Can Do For Scientific Metaphysics\*

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## Abstract

The apparent chasm between two camps in metaphysics, analytic metaphysics and scientific metaphysics, is well recognized. I argue that the relationship between them is not necessarily a rivalry; a division of labour that resembles the relationship between pure mathematics and science is possible. As a case study, I look into the metaphysical underdetermination argument for ontic structural realism, a well-known position in scientific metaphysics, together with an argument for the position in analytic metaphysics known as ontological nihilism. I argue that we can ascribe the same schema to both arguments, which indicates that analytic metaphysics can offer an abstract model that scientific metaphysics may find useful.

## 1 Introduction

The emergence of research programmes under the title of ‘analytic metaphysics’ has well-established contemporary metaphysics in the analytic tradition; with the wane of logical positivism, *a priori* reasoning has once again become prominent in theorizing about the world.<sup>1</sup> But not everyone is happy with this revival, or at least, with this particular form of the revival. Ladyman and Ross famously argued in favour of ‘naturalistic metaphysics’, also known as ‘scientific metaphysics’, which is primarily driven by empirical findings in contemporary science. The relationship between these two approaches in metaphysics has been a subject of debate; some argue that analytic metaphysics should be completely discontinued and replaced by scientific metaphysics, while the opposite side argues that such a scientific critique is irrelevant to the gist of analytic metaphysics.<sup>2</sup>

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1 According to one version of the history, Quine’s (1948, 1951) ‘triumph’ over Carnap (1950) paved the way for contemporary analytic metaphysics. For a contrary account, see, e.g., Price (2009).

2 See, e.g., Dorr (2010), Callender (2011), French and McKenzie (2012, 2016), Ney (2012), Healey (2013), Ross (2016), Bryant (2020), Guay and Pradeu (2020), and Jaksland (2022) for various accounts of ‘analytic metaphysics’, ‘scientific metaphysics’, and the divide between them.

This paper provides a case for a relatively moderate claim about the relationship between analytic and scientific metaphysics: Analytic metaphysics can possibly be useful in understanding the world in collaboration with scientific metaphysics. This view is very close to what French and McKenzie (2012) refer to as the ‘Viking approach’ to metaphysics. The Viking approach takes the product of analytic metaphysics as a resource to be ‘plundered’ by scientific metaphysicians for their own purpose. For example, they argue that ontic structural realism (OSR), a position in scientific metaphysics famously espoused by Ladyman and Ross, can also benefit from plundering the concepts from analytic metaphysics (e.g., ontological dependence). They suggest that this relationship between analytic and scientific metaphysics resembles the relationship between pure mathematics and physics; just as Einstein found the theory of non-Euclidean geometry useful, scientific metaphysicians may find something useful in analytic metaphysics.

To support this view, I will provide a case study that compares OSR with a position in analytic metaphysics known as ‘ontological nihilism’ or ‘generalism’. While some ontological similarity between these two positions has been noted in the literature,<sup>3</sup> I argue that a more serious connection between them can be found in their supporting arguments. Just as an *a priori* theory in pure mathematics can be applied in scientific theorizing, I suggest that an *a priori* reasoning given in support of ontological nihilism bears a strong connection to a classic argument for OSR. The case study indicates that, just as pure mathematics and empirical science can work together, a division of labour between analytic and scientific metaphysics is possible. The chasm between these two camps need not run as deep as many consider.

First, I give a brief exposition of OSR and ontological nihilism (Section 2), and more importantly, two classic arguments given in support of each position, showing that we can ascribe the same argument schema to both (Section 3). This could be understood as a case where an argument in analytic metaphysics can offer an abstract model for an argument in scientific metaphysics, which resembles an interplay between pure mathematics and science (Section 4). Finally, I consider its general upshots (Section 5).

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<sup>3</sup> See French (2014, p. 114, 2018) for a structuralist’s view of generalism (cf. Glick, 2020) and Dasgupta (2017, p. 117) for a generalist’s view of OSR.

## 2 Ontic Structural Realism vs. Ontological Nihilism: Ontology

OSR's slogan is 'that there are no 'things' and that structure is all there is' (Ladyman, 2016, sec. 4). Its modern form originated from Worrall's (1989) structural realism, which claimed that only the *structural* component of a scientific theory speaks to reality; the nature of the individual objects figuring in scientific theories need not concern scientific realists. The proponents of OSR take one step further by drawing an ontological conclusion: There are no individual objects whatsoever. For example, OSR claims that we need not posit photons as individual objects in a metaphysically robust sense in order to be a realist about modern theories of particle physics.<sup>4</sup>

Thus, OSR is a metaphysical position that emerged against the backdrop of philosophy of science, but a similar metaphysical position arose in analytic metaphysics as well. O'Leary-Hawthorne and Cortens (1995) advanced *ontological nihilism*, or 'nihilism' for short, arguing that 'the concept of an object has no place in a perspicuous characterization of reality' (O'Leary-Hawthorne & Cortens, 1995, p. 143). That is, the true ontology of reality is free of individual objects. Dasgupta's (2009, 2017) *generalism*, which claims that 'fundamentally speaking at least, there are no such things as material individuals' (2009, 35), is one of the recent analogues of nihilism in analytic metaphysics.

O'Leary-Hawthorne and Cortens argue that the nihilist account can be best expressed using Strawson's (1959) feature-placing language, which avoids existential statements involving individual objects.<sup>5</sup> Nonetheless, it remains a burden for nihilists to reject all everyday platitudes involving individual objects. The authors suggest that nihilists need not reject everyday platitudes for being false, but just maintain that they fail to represent reality *perspicuously*; nihilists can assent to ordinary existential claims without treating them as a perspicuous way of representing reality.<sup>6</sup>

The use of perspicuous language is not exclusive to nihilists. The proponents of OSR have employed a similar strategy of adopting 'individual objects' in a non-perspicuous manner as well.

we regard the ontic form of SR as offering a reconceptualisation of ontology, at the most basic metaphysical level, which effects a shift from objects to structures. [...] Let us be clear: we are not 'anti-ontology' in the sense of urging a move away from electrons,

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4 See Frigg and Votsis (2011) and Ladyman (2016) for general surveys of structural realism.

5 Similarly, Dasgupta (2009) adopts the formal language *G*, which is equivalent to Quine's (1976a) predicate functor language, as his preferred language for generalism.

6 One possible way of characterizing the 'perspicuous representation' is that it shows 'the form or structure of the fact it conveys' (O'Leary-Hawthorne & Cortens, 1995, p. 155). See, e.g., North (2021) for a recent work that employs a similar notion of 'perspicuous'. In the present context, we can maintain that 'perspicuous' more-or-less corresponds to 'fundamental', while I argue elsewhere that this is not necessarily the case.

elementary particles etc. and towards ‘observable structures’ or the S-matrix or whatever; rather, we urge the reconceptualization of electrons, elementary particles and so forth in structural instead of individualistic terms. (French & Ladyman, 2003, p. 37)

OSR need not reject individual objects outright; it still allows talking about elementary particles as individual objects. Nevertheless, talks about particles as individual objects are true in a non-perspicuous sense at best. That is, ‘at the most basic metaphysical level’, talks about particles can be formulated more perspicuously using structural terms, not involving individual objects.<sup>7</sup>

The juxtaposition of OSR and nihilism shows that both uphold an object-free ontology. This suggests that OSR and nihilism at least partly agree in their *negative* claims about ontology,<sup>8</sup> i.e., what does *not* exist. Such an agreement in ontology, however, is not our primary interest since our interest lies in the *methodological* aspects of analytic and scientific metaphysics. In the next section, I consider the connection between OSR and nihilism from this methodological point of view.

### 3 Ontic Structural Realism vs. Ontological Nihilism: Arguments

We considered the overlap in ontology between OSR and nihilism, but the more pressing question is on what basis we are justified to accept such an ontology. In this section, I will look into the arguments for OSR and nihilism, which are given in support of the ontological claims discussed in Section 2. We will see that both arguments can be interpreted as embedding the same argument schema given their common approach to the underdetermination of individual objects.

For OSR, let us consider a classic argument from the findings of quantum mechanics (QM) (French, 1989, 2014, sec. 2.7). Consider two intrinsically indistinguishable particles  $a$  and  $b$ , which can be in state 1 or state 2. According to classical statistical mechanics, there are four possible ways for these particles to be arranged: both  $a$  and  $b$  in 1,  $a$  in 1 but  $b$  in 2,  $a$  in 2 but  $b$  in 1, and both  $a$  and  $b$  in 2. In QM, however, only three equipossible arrangements are available: both  $a$  and  $b$  in 1, both  $a$  and  $b$  in 2, and one in  $a$  and one in  $b$ . Their difference lies in whether the permutation of particles counts as a distinct arrangement; while swapping  $a$  and  $b$  counts as a different case in the classical picture, they no longer count as being physically distinct according to QM. This feature of QM, *permutation*

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7 This version of OSR has been referred to as ‘reductive’ or ‘priority-based’ OSR in the literature (see Brading & Skiles, 2012, sec. 5.5; McKenzie, 2017, sec. 3.2).

8 It can be argued on an independent basis that nihilism can converge with OSR in ‘positive’ ontological claims as well. That is, if nihilists embrace physicalism and choose to accept only the fundamental kind properties recognized by structuralists (see McKenzie, 2017, sec. 3.2), then the ‘positive’ ontology of nihilism and OSR will overlap.

*invariance*, suggests that *a* and *b* are indistinguishable even with respect to extrinsic properties (e.g., spatial properties). It implies, even according to the strong version of the Principle of the Identity of Indiscernibles (PII), that *a* and *b* are numerically identical, but this is absurd.<sup>9</sup>

It led some physicists and philosophers to believe that quantum particles are not individual objects, which some refer to as the ‘received view’ on quantum particles (see Arenhart, 2017). It has also been argued, however, that this is not the only available account. For example, you can posit mutually inaccessible ‘irreducible sub-spaces’ occupied by particles, which explains the behaviour of quantum particles just as well; we can still maintain that quantum particles are individual objects (see French & Redhead, 1988).

Thus we have two rivalling metaphysical options; we can either accept the received view, i.e., the ‘particles-as-non-individuals’ account, or the contrary view, i.e., the ‘particles-as-individuals’ account. Physics does not seem to favour one account over another. Therefore, physics *underdetermines* metaphysics, which is taken to imply the following:

We need to recognise the failure of our best theories to determine even the most fundamental ontological characteristic of the purported entities they feature. It is an *ersatz* form of realism that recommends belief in the existence of entities that have such ambiguous metaphysical status. What is required is a shift to a different ontological basis altogether, one for which questions of individuality simply do not arise. Perhaps we should view the individuals and nonindividuals packages, like particle and field pictures, as different *representations* of the same structure. (Ladyman, 1998, pp. 419–420)

As QM lends equal support to the two rivalling accounts on the nature of individual objects, it gives us a reason to question the very notion of individual objects; we take QM to be tracking the reality, but it does not seem to decide the metaphysical questions about individuality. The reality seems to be indifferent to these questions. Ladyman observes that accepting OSR, which dispenses with the category of individual objects, can resolve this problem; the questions about individuality will not arise at all if the category of individual objects is discarded altogether. OSR thereby resolves the underdetermination of the metaphysics of quantum particles.

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9 It has been debated whether all entangled quantum particles are indeed indiscernible, e.g., Saunders (2006) argued that fermions can still be *weakly indiscernible* (cf. Muller & Saunders, 2008; Quine, 1976b). See Leitgeb and Ladyman (2007), Ladyman and Bigaj (2010), and French (2020) for structuralist responses.

This argument for OSR, which is dubbed the ‘*metaphysical underdetermination argument*’ (MUA), has been widely discussed in the literature. In some sense, MUA parallels O’Leary-Hawthorne and Cortens’ argument for nihilism, which I will refer to as the ‘*nihilist argument*’ (NA):

There is also a deeper sort of motivation for ontological nihilism, however. That view has the consequence that many metaphysical disputes - concerning, *inter alia*, identity, composition or alternate ontologies - are somehow perverse. Such is the widespread impatience with those disputes that this consequence will inevitably be seen as a selling point of a nihilistic approach to ontology. (O’Leary-Hawthorne & Cortens, 1995, p. 160)

Consider the special composition question (Van Inwagen, 1990), which asks under which conditions multiple objects compose another object, i.e., their mereological sum. Two major competitors are mereological universalism (Lewis, 1986) and mereological nihilism (cf. Van Inwagen, 1990). Unfortunately, many suspect that the standoff between these accounts, which are based on conflicting intuitions over bizarre cases (e.g., is there a mereological sum of the Eiffel Tower and the nose of Napoleon?), will not be settled ever; the special composition question is underdetermined.<sup>10</sup> Given this underdetermination, nihilism offers a solution that explains away the problem.

It is clear enough what the ontological nihilist will say here. On her account, ‘There is a table here’ and ‘There are little bits arranged tablewise here’ express just the same fact, one that can all the more perspicuously be described by ‘It is tabling here’. (O’Leary-Hawthorne & Cortens, 1995, p. 160)

According to NA, the disagreement between mereological universalism and mereological nihilism arises only because both sides agree that there is the category of individual objects. If nihilism is true, the disagreement evaporates; both ‘There is a table’ and ‘There are little bits arranged tablewise’ will turn out to be non-perspicuous ways to represent the same fundamental fact. Hence, nihilism can resolve the special composition question, which makes it ‘a selling point’ for nihilism.

What do MUA and NA have in common? I argue that MUA and NA follow the same philosophical strategy: For both arguments, the problem stems from the apparent underdetermination of the metaphysics of individual objects. Their common solution is to reject the category of individual

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<sup>10</sup> This underdetermination has also been interpreted as undermining the ‘realist’ approach to the mereological discourses altogether (Chalmers, 2009; Hirsch, 2011; Thomasson, 2015). This view stands, in some sense, in direct opposition to NA since nihilism aims to provide a ‘realist’ account of mind-independent reality (O’Leary-Hawthorne & Cortens, 1995, pp. 161–162).

objects, which thereby resolves the underdetermination. This common strategy can be schematized as follows:

- **Individual-Underdetermination (I-U) Schema**

1. Metaphysical accounts  $M_1$  and  $M_2$  disagree over a metaphysical question  $Q$ .
2.  $Q$  embeds the ontological category of individual objects as its central component; if the category of individual objects is rejected from metaphysics, then  $Q$  will not arise.
3.  $Q$  is in principle unsolvable between  $M_1$  and  $M_2$ .
4. Given 2),  $Q$  can be resolved by rejecting the category of individual objects from metaphysics.
5. Other things being equal, (re)solving a metaphysical question is epistemically virtuous.
6. Given 3), 4), and 5), you are justified to reject the category of individual objects from metaphysics.

We can run through both MUA and NA to check whether they conform to the I-U schema: First, both arguments involve a pair of metaphysical accounts in a disagreement; MUA concerns the particles-as-non-individuals and the particles-as-individuals accounts, while NA concerns mereological universalism and nihilism. They disagree on the metaphysical question of whether the given anomalous entities (i.e., quantum particles in MUA and bizarre mereological cases in NA) count as individual objects. In both cases, the category of individual objects is the central component of the question. Had the metaphysical question been solvable between the rivalling accounts, we would not have had to resolve the question. Unfortunately, the question is taken to be unsolvable in principle; it seems underdetermined in both the contexts of QM and mereology. The remaining option is to resolve the question by rejecting the notion of individual objects from metaphysics. We thereby yield OSR and nihilism as the conclusion of MUA and NA respectively. Thus, we can see that the major arguments for the ontology, i.e., MUA and NA, follow the same I-U schema.<sup>11</sup>

The present conclusion should be distinguished from other bolder claims: First, I do *not* argue that OSR and nihilism are the same position. Second, I do *not* defend the validity of MUA and NA; the

11 Strictly speaking, I do not claim that the I-U schema captures the entire dialectic involving MUA and NA. For example, OSR can also be interpreted as ascribing the same structure to the rival accounts of quantum particles, but it is unclear whether the premises of the I-U schema guarantee this (cf. Norton, 2008; Lee, 2022). Nonetheless, I still find the I-U schema good enough for the purpose of this paper.

given conclusion only tells us that, insofar as the I-U schema is concerned, MUA and NA either stand or fall together. Third, I have *not yet* drawn any epistemological upshot from this connection between MUA and NA; NA may share the same structure with MUA, but this fact alone does not epistemically justify NA, let alone analytic metaphysics in general. A more serious account of this connection between MUA and NA will be provided in the next section, which entails a more general account of the relationship between scientific and analytic metaphysics as well.

#### **4 Analytic Metaphysics Giving an Abstract Model for Scientific Metaphysics**

Analytic metaphysics is often criticized for being *a priori* metaphysics; *a priori* inquiries about the world have a bad track record in finding truths, so there is little reason to believe in the reliability of analytic metaphysics insofar as it relies on *a priori* methods (Ladyman & Ross, 2007, sec. 1.2.2). Granted, I argue that the *a priori* nature of analytic metaphysics is not to be blamed. To the contrary, I argue that analytic metaphysics can contribute to finding truths about the world *precisely when it is a priori* in the sense that pure mathematics is. This way, the previous example of MUA and NA can be well accounted for, which lends support to the view that analytic metaphysics can possibly help scientific metaphysics.

First, we need to fix the sense of ‘*a priori*’. What makes analytic metaphysics *a priori*? One possible answer is its extensive use of *metaphysical intuitions*, which are taken to provide a non-scientific evidential basis for metaphysical claims. For instance, NA, an argument for nihilism, involves metaphysical intuitions about mereological puzzles.

As Bryant (2020) points out, however, metaphysical intuitions are not *a priori* in a relevant sense. Instead, they are empirical judgments informed by our folk theories about the world. For instance, the intuitions about everyday observables involved in mereological puzzles might have stemmed from the innate folk theory we inherited from our ancestors. The history of science has shown, however, that such folk intuitions tend to be unreliable, especially when the deep underlying structure of reality is concerned. Hence, the extensive use of metaphysical intuitions in analytic metaphysics can be problematic, but this has little to do with *a priori*. The problem with analytic metaphysics instead comes from the ‘empirical’ folk theory that implicitly informs metaphysical intuitions.



When intuitions are set aside, is there anything left of analytic metaphysics that can be deemed *a priori*? I argue that there remain at least two *a priori* roles. First, even after being stripped of intuitions, analytic metaphysics leaves us with *rigorously characterized* concepts of metaphysical categories, e.g., the concept of individual objects. We have *prima facie* inherited the concept of individual objects along with our metaphysical intuitions, but metaphysical intuitions themselves do not automatically tell us how to characterize it rigorously. For example, even when we ‘intuit’ that an apple and a table are both individual objects, we may have to reflect on the question of what precisely *makes* them individual objects. Metaphysical reflection can possibly tell us how we ought to characterize the metaphysical concept. The reflection on apples and tables, for example, could have convinced some metaphysicians to believe that both are governed by a principle such that they are numerically identical if indiscernible, i.e., PII.<sup>12</sup>

This reflective process leading to PII is arguably *a priori*; we might have acquired the concept of individual objects empirically, but we need not rely on extra empirical input to abstract a characterizing principle such as PII from the given concept. This is comparable to how a mathematical concept, informally acquired, goes through ‘conceptual clarification’ (Feferman, 1998). For example, while the notion of continuity in mathematical analysis might have first appeared due to mathematical intuitions or findings in physics, Dedekind’s (1872/1963) formal characterization of continuity is arguably *a priori par excellence*. The same can be said of PII as a characterization of the concept of individual objects; analytic metaphysics can rigorously characterize a metaphysical concept *a priori*.

Such an *a priori* characterization of a metaphysical concept can persist even when we dismiss metaphysical intuitions. That is, even when we no longer count on metaphysical intuitions involving apples and tables, the concept of individual objects characterized by PII can remain and apply to scientific metaphysics. For example, recall that PII played a critical role in MUA; we could derive a metaphysically absurd conclusion from permutation invariance thanks to PII (see Section 3). As such, the product of *a priori* metaphysical reflection can remain useful in scientific metaphysics.

The second *a priori* role of analytic metaphysics is to provide us with an *abstract model* for metaphysical reasoning. For example, in the case of NA, we can yield the I-U schema as an abstract model by stripping mereological intuitions off of NA; we abstract away the specific details such as

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12 Is ‘rigorous characterization’ meant to *uncover* what is embedded in the concept or *improve* the concept? For example, is PII the product of discovery or refinement? This is related to the question of the divide between ‘conceptual analysis’ and ‘conceptual engineering’ (see Isaac et al., 2022). The term ‘characterization’ is meant to be neutral about this question; either option is compatible with the objective of the present paper.

‘special composition question’, ‘mereological universalism’, ‘mereological nihilism’ and replace them with placeholders ‘ $Q$ ’, ‘ $M_1$ ’, and ‘ $M_2$ ’. At the same time, the model should not be *too* abstract; it should be specific enough to capture the substantial aspect of both MUA and NA. For instance, it needs to ensure that both MUA and NA mean the same ontological category by ‘individual objects’; otherwise, we cannot preclude the possibility that MUA and NA merely talk past each other when talking about ‘individual objects’. This is where the first *a priori* role of analytic metaphysics, i.e., rigorous characterization of metaphysical concepts, comes in handy. As described above, PII remains consistent in characterizing the concept of individual objects whether metaphysical intuitions are dismissed or not. This common characterization strongly suggests that MUA and NA mean the same metaphysical category by ‘individual objects’. The two *a priori* roles of analytic metaphysics go hand in hand.

As an abstract model, the I-U schema is arguably *a priori* for the following reasons: First, as argued above, rigorous characterization of the notion of individual objects is *a priori*. Second, it appears that we need not consult empirical data (including intuitions) to be convinced of the validity of the I-U schema, at least when the category of individual objects is concerned.<sup>13</sup> Hence, analytic metaphysics can offer an abstract model *a priori*.

I argued that a scientific metaphysician’s justified worry about metaphysical intuitions has little to do with *a priori*. Then what about the use of an abstract model, which is *a priori* in a proper sense? A scientific metaphysician has to concede that, insofar as MUA is taken to be acceptable, the use of an abstract model such as the I-U schema should be acceptable as well: As explained in Section 3, MUA conforms to the I-U schema; you can yield MUA from the I-U schema by replacing the placeholders ‘ $Q$ ’, ‘ $M_1$ ’, and ‘ $M_2$ ’ with the relevant notions from QM, while the ontological category referred to by ‘individual objects’ remains the same. Hence, a scientific metaphysician who espouses MUA implicitly relies on the I-U schema. The validity of the I-U schema itself, nonetheless, seems justified *a priori*; while the source of underdetermination in MUA is informed by empirical findings in QM, the abstract reasoning from underdetermination to the rejection of individual objects is not sanctioned by the empirical findings themselves. This shows that an argument in scientific metaphysics may follow an abstract model, which can also be yielded *a priori* through analytic metaphysics.

From this perspective, analytic metaphysics, or the *a priori* components thereof, is not necessarily in conflict with scientific metaphysics. Even a division of labour may be possible. Consider

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<sup>13</sup> I appreciate an anonymous reviewer for pointing out that the I-U schema need not be ‘universally valid’; we only need that the I-U schema is truth-preserving when the category of individual objects is concerned.

the following scenario: Based on mereological intuitions, an analytic metaphysician develops NA, therefore rejecting the category of individual objects. After a while, NA comes to be challenged by empirical findings against the reliability of metaphysical intuitions. Nonetheless, a scientific metaphysician finds that NA has redeeming features; once the mereological intuitions are abstracted away, NA is left with the I-U schema. She realizes that the I-U schema is applicable to the finding in QM. By filling in the placeholders with the QM-equivalents, she yields MUA, which concludes that the category of individual objects is to be rejected. Given that ‘the world is actually quantum in nature’ (French & Krause, 2006, p. 145), she is convinced that this is a metaphysical truth.<sup>14</sup>

There is no reason to believe that MUA was actually inspired by NA. Nonetheless, the scenario illustrates how a division of labour *could have* taken place; a work in analytic metaphysics could have led to an abstract model that a scientific metaphysician might find useful. The *a priori* nature of the abstract model does not seem to cause a problem for the scientific metaphysician; she will employ the model only after carefully checking whether the model conforms to the scientific truths. Scientific metaphysicians can thereby ‘plunder’ an *a priori* model from analytic metaphysicians.

This reinforces the analogy between the role of analytic metaphysics in scientific metaphysics and the role of pure mathematics in science. Pure mathematics is *a priori* in the sense that an abstract model from analytic metaphysics can be *a priori*. Just as a mathematical theorem may have an unexpected application in science, a scientific metaphysician may find an abstract model useful for drawing a metaphysical conclusion informed by science.

Of course, scientific metaphysicians need not wait for analytic metaphysicians to come up with an abstract model; scientific metaphysicians can develop an abstract model on their own, which is analogous to the fact that theoretical scientists can prove mathematical theorems themselves. Nonetheless, the fact that scientific metaphysicians or scientists can do such *a priori* works on their own does not prevent them from outsourcing such work when available.

Thus, I argue that the case of MUA and NA supports the thesis that analytic metaphysics can possibly help scientific metaphysicians by finding an abstract model. The ‘Viking’ approach to metaphysics, however, is not without controversy. For instance, Ross (2016) argued that a scientific

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<sup>14</sup> Note that MUA only concerns non-relativistic QM, which some take to be worrisome for metaphysics (e.g., Wallace, 2020, p. 94) This worry is largely orthogonal to the present paper since we only approach MUA as a case study, not defending its soundness (cf. Ladyman & Ross, 2007, pp. 138–139).

metaphysician should actively avoid adopting any resources from analytic metaphysicians; they are error-prone in nature. An abstract model from analytic metaphysics cannot be an exception either.

Such sceptics may object to the analogy between the role of analytic metaphysics and the role of pure mathematics; analytic metaphysics is not comparable to pure mathematics (cf. Bryant, 2020, n. 4). First, some may argue that scientific metaphysicians simply do not find analytic metaphysics useful, which makes it starkly different from ‘the unreasonable effectiveness of mathematics’ in science. This is an empirical claim, which I cannot answer from the armchair. I will give more contrary examples in Section 5, but for now, I can grant this objection; I do not claim that analytic metaphysics is as helpful as pure mathematics is. For example, whereas scientists may have to outsource mathematical proof to mathematicians due to its complexity, scientific metaphysicians may develop an abstract model with ease. This is fully consistent with my thesis. Through the earlier example of MUA and NA, I only aimed to illustrate the way an abstract model from analytic metaphysics can *in principle* be applied in scientific metaphysics. We need not preclude the possibility that scientific metaphysicians can outsource some work to an analytic metaphysician.

The second objection concerns what analytic metaphysics is about. Pure mathematics, one may argue, is *formal* by nature; its subject matter is not meant to be about the natural world, so it cannot conflict with natural science. In contrast, analytic metaphysics is meant to be about the real world, which is the subject matter of scientific metaphysics. As the claims in analytic metaphysics are inseparable from claims about the real world, you cannot expect to isolate an *a priori* abstract model from the rest of analytic metaphysics. The model from analytic metaphysics will inadvertently retain errors from its origin in analytic metaphysics.

My response is that the objection relies on an anachronistic conception of ‘pure mathematics’. The emphasis on the formal axiomatization of mathematical knowledge is largely a product of the nineteenth-century mathematics, which is a pretty recent phenomenon in the history of mathematics. For example, a wealth of knowledge in number theory far predates the Dedekind-Peano axioms of arithmetic. Furthermore, Maddy (2008, 2011, Chapter 1) stresses that the very notion of ‘pure mathematics’ is more-or-less a modern invention; the theories we now identify as ‘pure mathematics’ have long been considered theories about the natural world. For example, none other than Euclidean geometry had been considered the theory of physical space; only after the confirmation of general

relativity did Euclidean geometry have to be construed as an abstract theory in ‘pure mathematics’.<sup>15</sup> Hence, if the problem with analytic metaphysics lies in the fact it was originally meant to be about the real world, then pure mathematics should have the same problem as well. We need not be overly sceptical about extracting an abstract model from analytic metaphysics.

In sum, I argued that a division of labour can take place between analytic and scientific metaphysics; just as pure mathematics can help science, analytic metaphysics can offer an abstract model that can possibly help scientific metaphysics. This perspective allows us to see, e.g., the interesting connection between NA and MUA.

## 5 Concluding Remarks

Is the rivalry between analytic and scientific metaphysics necessary? This paper attempted to show that analytic metaphysics can possibly help scientific metaphysics using a case study on OSR and nihilism, or more specifically, their supporting arguments MUA and NA. The case study suggests that analytic metaphysics can offer (i) *a priori* characterization of metaphysical concepts and (ii) *a priori* abstract models that might be of use for scientific metaphysics, which resemble the way pure mathematics can help science.

As mentioned in Section 4, the sceptic might point out that the track record of analytic metaphysics is far less impressive than what pure mathematics has offered in service of science. I agree that it might have been the case so far, but the chasm between analytic and scientific metaphysics seems to be getting thinner. For example, many recent studies on quantum indeterminacy by scientific metaphysicians openly consider borrowing apparatuses from the analytic works on metaphysical indeterminacy.<sup>16</sup> Conversely, just as many mathematicians choose their research topics based on their relevance to the mathematical structures found in sciences, scientific metaphysics can motivate analytic metaphysicians to study abstract models which are scientifically relevant. This growing trend suggests that an outright scepticism about the interplay between analytic and scientific metaphysics is unwarranted.

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15 In other words, the confirmation of general relativity is taken to have decisively shown that Euclidean geometry needs to be construed as an abstract theory. It is *not* the case that (i) Euclidean geometry has never been considered an abstract theory beforehand nor (ii) non-Euclidean geometry has never been considered to be a theory of physical space before general relativity (cf. Blanchette, 2017).

16 See, e.g., Darby (2010), Skow (2010), Glick (2017), and Calosi and Wilson (2019) for works in scientific metaphysics that engage with the analytic accounts of metaphysical indeterminacy (Barnes & Williams, 2011; Wilson, 2013).

The present thesis generates some new questions as well. For instance, given the analogy between analytic metaphysics and pure mathematics, one may ask whether this analogy compels us to rethink what the subject matter of analytic metaphysics is: As explained in Section 4, the development of modern mathematics arguably redefined the nature of ‘pure mathematics’. Does it imply that, by analogy, the nature of analytic metaphysics should be redefined as well? This is a hard question given the absence of a consensus on the nature of pure mathematics; the question about analytic metaphysics may depend on what we take to be the correct account of mathematics, which can be further investigated in future works.

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