On Progress in Metaphysics

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Abstract

In a recent paper, Kerry McKenzie identifies theory change in science as a source for doubts about the value of engaging in metaphysics of science before a final theory is at hand. According to McKenzie, the basic problem is that naturalized metaphysics lacks a concept of progress. More specifically, naturalized metaphysics lacks a concept of progress as approximation that can easily be taken to correspond to the scientific sources of naturalized metaphysical inquiry.

In this paper, we criticise the proposed concept of progress as approximation as too narrow a concept, notably, even in science, and propose an alternative notion of scientific progress that metaphysical investigations can and do latch on to, namely progress understood as exploring and constraining theory space. First, we motivate this notion of progress via an examination of progress in particle physics and propose that it can be applied to metaphysics as well. Second, we argue that this notion of progress leads to a convincing reply to McKenzie's argument. Third, we discuss how this notion of progress relates to the program of naturalized metaphysics and argue that it speaks in favor of a more lenient version of naturalistically-inclined metaphysics, namely inductive metaphysics.

1 Introduction

Here is a popular meta-metaphysical view: metaphysical theories should be firmly based on the natural sciences. By closely examining our best current physical theories, for example, we can gain valuable insight into the fundamental structure of the world. As our scientific knowledge grows, so does our metaphysical understanding of the world. We are now in a position to develop better metaphysical theories than we were 500 years ago, because we now have better scientific theories than we had 500 years ago. What is more, we will, hopefully, be in an even better position in 500 years from now, since certain errors of our current scientific theories will be eliminated by then. Progress in metaphysics goes hand in hand with progress in the natural sciences. Call this view *naturalistically-inclined metaphysics*.[1]

[1]Examples for naturalistically-inclined metaphysics (or "science-guided metaphysics" McKenzie (2021)) include naturalized or scientific metaphysics (e.g., Ladyman et al. (2007)

In a recent paper, Kerry McKenzie identifies theory change in science as a problem for this view. If metaphysical claims build on specific scientific theories, as naturalistically-inclined metaphysics has it, theory change in science will trigger theory change in metaphysics. However, McKenzie argues, while old scientific theories may still be viewed as approximations of their successor theories, such that a notion of *scientific* progress can be latched on to it, "canonical metaphysical claims ... cannot meaningfully be regarded as 'approximately true"', such that "the epistemic progress that science arguably enjoys through episodes of theory change cannot be expected to transfer to its metaphysics" (McKenzie, 2020, 1). In turn, this raises doubts on the value of engaging in *any* metaphysics of science before a final theory is at hand.

In this paper, we criticise progress as approximation as too narrow a concept, notably, even in science, and propose an alternative notion of scientific progress to which metaphysical investigations can and do latch on to, namely progress understood as *exploring and constraining theory space*. We argue that this notion of progress leads to a convincing reply to McKenzie's argument.

While we do not contest that there are cases in physics where scientific progress can be understood in accordance with McKenzie, there are many important cases where physics practice proceeds differently than McKenzie assumes. In general, progress in science is better understood as exploring theory space and then excluding which theories, i.e., which parts of theory space are compatible with the available empirical data. In particle physics, for example, theories of beyond standard model physics are tested – and eventually eliminated – by empirically constraining the parameters of a plethora of theories (e.g., Chall et al. (2021)).

This practice of physics and the scientific progress that comes with it cannot be accounted for in terms of approximation, since the theories that are eliminated as empirically inadequate will generally not be less accurate predecessors of the true theory (or predecessors that are special cases of the true theory). The true theory is what will survive this process of elimination, the other theories simply will not. On the other hand, McKenzie's approximation examples can be accounted for in terms of our notion of scientific progress. Whereas McKenzie offers a rather demanding notion of progress in physics – theory change brings about scientific progress, only if we can point to a specific (mathematical) relation of the theories under consideration – we propose a more lenient notion of progress in physics: excluding a theory is already about making scientific progress.

Equipped with this novel understanding of scientific progress, we then reevaluate McKenzie's verdict and argue that naturalistically-inclined metaphysics *can* make progress. Metaphysics is not doomed and engaging in metaphysics is a meaningful endeavour. Metaphysics can and does make progress.

We will proceed as follows: first, we present and discuss McKenzie's argument. We then briefly criticise a recent reply by Nicholas Emmerson, before we

and Chakravartty (2017)) and the recent proposal of inductive metaphysics (see Engelhard et al. (2021)).

turn to the case of particle physics and defend a concept of *scientific* progress in terms of exploring and constraining theory space. In section 5 this is generalised to a concept of metaphysical progress. As a final side-note, we argue in section 6 that our understanding of metaphysical progress suggests that a specific non-standard form of naturalistically-inclined metaphysics, dubbed inductive metaphysics, is the preferred way of doing metaphysics. Before we conclude, we discuss a few potential objections.

2 McKenzie's argument

There are two ways to frame McKenzie's challenge. We can say that it is about the claim that we need a *final* scientific theory to meaningfully engage in metaphysics[2] or we can say that it is about the claim that standard versions of naturalistically-inclined metaphysics, e.g., naturalized metaphysics, lack a concept of *progress* (as approximation) – which, in turn, renders naturalistically-inclined metaphysics meaningless. In our view, the second framing is more to the point. In fact, McKenzie herself has dubbed the issue recently as "the *progress problem*" (McKenzie, 2021, 436),

> which focuses on the fact that the science upon which contemporary SGM [science-guided metaphysics] relies is overwhelmingly likely to be false, meaning that a metaphysics based on it is likely to be false also. Given that – unlike in science itself – there is also no clear sense in which metaphysical claims can at least be said to be 'making progress', the epistemic value of a present-day metaphysics that is based in current science becomes very difficult to discern" (McKenzie, 2021, 436).

There is a sense in which lacking a final theory is unproblematic, namely if our metaphysical endeavours do at least make some kind of progress – similar to the situation in science. For, say, physics, the fact that we do not have a final theory yet is unproblematic because physics does make progress. In particular, false physical theories often stand in approximation relations to their not-yet-refuted successor theories: a 'new' theory T_{new} approximates an 'old' theory T_{old}, if T_{new} 'contains' T_{old} in some (mathematical) limit. For example, Newtonian mechanics is a limit of general relativity, which is expected to be an approximation of some theory of quantum gravity, which, again, is probably an approximation of some unknown final (or true) theory. For McKenzie, the (mathematical) approximation relations between subsequent theories are key for physics' ability to make progress. Hence, according to McKenzie, saving a notion of metaphysical progress means pointing out that also metaphysical theories approximate their successors.[3]

[2] Linnemann and Martens (2022) take this perspective.

[3] So, arguably, McKenzie assumes a semantic account of progress (see Bird (2007)) for both science and metaphysics.

This prompts a severe problem for naturalistically-inclined metaphysics, since the approximation notion of progress simply does not carry over to metaphysics, as McKenzies observes. Typically, metaphysical theories do not stand in approximation relations – already due to the fact that metaphysical theories do not have mathematical representations. So the question arises how to make sense of progress in metaphysics.

Here is a more careful reconstruction of McKenzie's central argument.

(A.1) (Naturalistically-inclined) Metaphysics is valuable only if it makes progress.

(A.2) (Naturalistically-inclined) Metaphysics makes progress only if it approximates truth.

(A.3) (Naturalistically-inclined) Metaphysics approximates truth only if its central claims can be approximated.

(A.4) The central claims of (naturalistically-inclined) metaphysics cannot be approximated.

(A.5) Therefore, (naturalistically-inclined) metaphysics is not valuable.

In addition, one can give the following argument to support premise (A.4):

(B.1) The central claims of (naturalistically-inclined) metaphysics can be approximated only if (i) they are true about approximately everything or (ii) they are approximately true about everything or (iii) they can be expressed mathematically (just as the relevant physical claims).

(B.2) The central claims of (naturalistically-inclined) metaphysics are neither of these.

(B.3) Therefore, the central claims of metaphysics cannot be approximated.

For clarification consider the following example, also used by McKenzie (McKenzie, 2020, 19–20): 'Structural realism understood as the claim that all properties are extrinsic is approximately true.' Then the different options in (B.1) read as follows: First, structural realism is true about approximately everything, *if* approximately all properties are extrinsic – but, argues McKenzies, there being also intrinsic properties arguably will not be accepted as support for structural realism being approximately true, but rather as support for its refutation. Second, it is approximately true about everything, *if* all properties are approximately extrinsic – but by "saying that the property is 'approximately extrinsic', we transpose it into exactly that which the structuralist needs to avoid" (McKenzie, 2020, 20), namely an *intrinsic* property. Lastly, note that the third option is out of the picture as 'all properties are extrinsic' is not something that can be represented mathematically.

Now, a potential reply to McKenzie could note that one can object to premise (A.3), i.e., '(naturalized) metaphysics approximates truth only if its central claims can be approximated', by distinguishing between metaphysical *theories*

and metaphysical *claims*. Even if metaphysical claims (like 'all properties are extrinsic') cannot be approximately true, there remains a sense in which metaphysical theories, which essentially are sets of such claims, can still be approximately true: a metaphysical theory is approximately true, if most of its claims are true.[4]

More importantly, however, there is a a sense in which metaphysics can make progress without approximating truth in McKenzie's sense. In particular, there is a (modal) sense in which metaphysics approximates truth. The crucial problem, as we see it, is that all options of (B.1) concern *direct* (truth) approximation relations holding between subsequent theories (or claims): for McKenzie, truth approximation in metaphysics means to be a candidate for a true theory *and* to stand in approximation relations to previous and subsequent candidate theories. Instead, the proposal we argue for in the second part of this paper essentially pushes the concept of (truth) approximation to a meta level. Instead of having truth being approximated by a chain of theories which *stand in approximation relations themselves*, we propose to relax the latter requirement: the various theories do not need to have anything to do with each other. Truth approximation is detached from considering approximations between different candidate theories and rather taken to be about the exclusion of candidate theories as such: excluding candidate theories narrows down the list of candidate theories and thereby encircles the true theory. Relations between theories are not entirely irrelevant, though: they help to order the candidate theories which again helps to encircle the true theory more efficiently (see below). Moreover, progress is detached from formulating truer and truer theories (in the sense of a chain of theories that stand in truth approximation relations themselves). As we shall argue below, this option is, in fact, inspired by physics, better meets what we observe as common practice in other sciences apart from physics, *and* is transferable to metaphysics.

But first, let us be clear that we do not doubt that there are cases in physics where scientific progress can be understood in accordance with McKenzie. For example, some theory like Newtonian mechanics is approximately true indeed, namely in the sense that the theory is a limit of an empirically more adequate successor theory, i.e., general relativity, which is standardly expected to be an approximation of some theory of quantum gravity (e.g., Huggett and Wüthrich (2013)), which, again, is probably an approximation of some unknown final (or true) theory in this very sense. Progress understood as such does lend itself to a specific, arguably linear order of physical theories. What we criticise is that this is demanding too much – already for progress in physics. That a 'new' theory T_{new} is shown to 'contain' an 'old' theory T_{old} in some limit is not what signifies large parts of what can legitimately be called *progress* in science. That some approximation relation holds between two successive theories may be a sufficient condition for progress,[5] but it certainly is not necessary. There are many important cases where physics practice proceeds differently than such

[4] This account of progress is still semantic, but employs some kind of verisimilitude account (see also Bird (2007)).

[5] Arguably, this can be questioned.

examples like the Newton–Einstein case suggest. Hence, we shall argue that the most general characterisation of scientific practice that incorporates the different examples of scientific progress – in physics, but, notably, in other sciences as well – is that science explores and then excludes which theories, i.e., which parts of theory space are compatible with the available empirical data.

3 Emmerson's Reply to McKenzie

But before we elaborate our view further, let us briefly comment on a proposal by Nicholas Emmerson, who has – as we have recently become aware of – presented a reply to McKenzie in terms of deepening explanation.

Also Emmerson (2022) reads McKenzie as challenging the capability of metaphysics – tacitly understood as 'naturalized metaphysics' by Emmerson – to make progress. Emmerson points out that what most philosophers of science take to define *scientific* progress, namely providing better approximations to the truth, "cannot be meaningfully applied to metaphysical theses" (Emmerson, 2022, 2), according to McKenzie. Emmerson is more optimistic. Essentially, his own account draws on an analysis of scientific progress in terms of understanding. According to his view, we make progress in science and metaphysics, if we "grasp explanations of increasing depth, where the depth of an explanation is measured with respect to the range of interventions under which it is invariant" (Emmerson, 2022, 1). Emmerson illustrates his proposal by help of Saunders' weak discernibility view in the context of similar quantum particles, which he deems progressive as it expands on the range of applicability of the previously dominant qualitative properties proposal. Importantly, also a notion of approximation lends itself: "since this wider range contains the range of interventions under which the qualitative properties proposal is invariant, these metaphysical theories can meaningfully be said to correspond" (Emmerson, 2022, 1).

First, one may criticise that conceptions of progress that rely on understanding and explanation are building on rather controversial notions. Second, one may object that 'being invariant under a wider range of testing interventions' is a rather non-standard notion of progress. Third and more importantly, however, the idea of progressing by 'deepening explanation' is in danger of still demanding too much. Neither in science, nor in metaphysics do we make progress only when something 'explains' – and further restrictions ('explains more deeply') only make it worse. Essentially, our criticism is that Emmerson's proposal resembles McKenzie's too closely: the deepening explanation account still centrally involves a rather immediate notion of approximation: some successor theory is directly related to some predecessor via some kind of direct approximation relation. The only difference is that one is not restricted to specific mathematical approximation relations anymore. Rather, approximations in terms of explanatory scope are sanctioned as well. Against this, we hold that already many cases of scientific progress often do not meet this strong criterion, as we shall now argue in more detail.

4 The case of particle physics

Consider the case of particle physics, for example: here, theories (or models[6]) of beyond standard model physics are tested – and eventually eliminated – by empirically constraining the parameters of a plethora of theories at the same time (as opposed to probing specific theories one after the other). In particular, the theories of particle physics vary with respect to their particle content, the particles' masses, coupling constants, and other empirically testable parameters. Thus, whether some theory is empirically adequate can be determined by measuring the values of such parameters. The theories are sensitive to the empirically determined values of such parameters. For example, if certain collider experiments constrain the mass of the Higgs boson to $m_h = 125.10 \pm 0.14$ GeV, the many theories which predict a Higgs mass of $m_h \leq 115$ GeV are empirically excluded.[7] Already prior to discovery, the Higgs exclusion charts with the Tevatron, LEP, and later ATLAS and CMS exclusion bands were important resources for model building. So, new experimental results for such parameters help to constrain which theories are still compatible with the growing body of empirical data.

Say we have to consider N such parameters. The N parameters span an N-dimensional theory space. Each point in this theory space corresponds to a specific theory with specific values for each parameter. What is arguably more relevant in practice: some region in this theory space corresponds to a set of theories with a certain range for the values for each parameter. Empirically constraining some or all of the parameters constrains which regions of the theory space are still empirically viable and which are already ruled out. In this way, the set of candidates for a final (or true) theory (including the final theory itself) is encircled and narrowed down step by step.

Notably, N is always finite by stipulation for any given theory, since otherwise the theories under consideration would not be predictable, i.e., would not be viable candidates in the first place. Still, the (most general) theory space itself may in principle be infinitely dimensional, since different theories (for different domains, i.e., aspects of the world) will usually have non-congruent sets of parameters. Moreover, there will typically be 'qualitative' dimensions as well: dimensions that order theories with respect to their posits or their 'type' (e.g., whether they are classical or quantum field theories, local or non-local theories etc.).

Note also, that considering theory space employs a richer structure than simply considering a list of all the candidate theories. The theory space view is a way to *order* the plethora of theories on the list by exploiting information about the parameters that individuate them – or, more generally (also with an

[6] We do not distinguish between 'theory' and 'model (of a theory)' here. For example, the Standard Model of Particle Physics is a theory or model formulated in the theoretical framework of quantum field theory, and so are the various supersymmetric 'models' and other 'theories' of beyond standard model physics.

[7] Obviously – just consider the well-understood difficulties regarding such 'naive' falsifications – this is a simplification. In general, only measuring the values of various parameters will at some point lead to excluding respective theories as empirically not adequate.

eye on further generalisations with respect to metaphysics), information about similarities and differences between the theories (e.g., whether different theories share certain characteristics according to the qualitative dimensions of theory space). Accordingly, relations between theories *are relevant* as they help to order the theories and then, potentially, exclude many of them simultaneously.

Importantly, the theories that are tested in this manner are often formulated explicitly with that theory space of infinitely many theories in mind – physicists *explore* the theory space, i.e., try to come up with new theories that are located in the non-excluded parts of theory space. The particle physics' notion 'model building' captures that perfectly. For example, if some experiment fails to exclude a certain region in theory space, this typically triggers an increased interest in coming up with theories (or models) that sit in that region (for example, we had periods of increased interest in grand unified theories, various light Higgs or heavy Higgs models, or split SUSY models etc.). Maybe this exploratory mode is exemplified best by cases of 'false alarm', in which preliminary experimental 'results' that later turn out wrong trigger investigations into regions of theory space that would have been preferred had these 'results' been confirmed; reports on superluminal neutrinos by the OPERA collaboration in 2011, or reports on primordial gravitational waves by the BICEP2 collaboration are recent examples of this. This exploratory research mode can appear as either within a given theoretical framework, like supersymmetry or quantum field theory, or in terms of what have been dubbed model-independent searches (see Steinle (1997); Franklin (2005); Karaca (2017)), which explore the theory space independently of specific theoretical background assumptions (and are therefore sometimes also called exploratory searches).

This type of scientific progress can be captured via a philosophical theory of progress that emphasizes the practice of exploring and constraining theory space. Progress is not necessarily achieved by formulating theories that are closer to the truth than their predecessors (or provide increasingly deeper explanations), i.e., by reference to direct approximation relations between subsequent theories. Rather, an important way of achieving progress is by plumbing the depths of theory space and identifying which regions of theory space constitute a serious possibility.[8]

This practice of physics and the scientific progress that comes with it cannot be accounted for in terms of direct approximation (neither in its mathematical, nor in its explanation-based version), since the candidate theories will generally not be less accurate or less general predecessors of the true theory (or predecessors that are special cases of the true theory). Still, narrowing down the set of candidate theories further and further should be considered making progress

[8] As mentioned earlier, one could therefore categorise our proposal as a *modal* account of progress. In particular, we remain neutral to Bird's (2007) distinction between semantic, epistemic, and functional-intrinsic accounts of progress. There is a sense in which our proposal may be read either semantically (concerning truth) or epistemically (concerning knowledge), but strictly speaking our proposal is neither semantic (truth reference is developed differently), nor epistemic (which basically adds further criteria, ending up with a version of 'reliably formed justified true believe'), nor intrinsic-functional in Bird's sense.

– especially, since it is not simply about excluding candidate theories from an unordered list of theories. Developing and eliminating candidate theories constitutes progress in physics, as does the transition between two theories that are in an approximation relation. In fact, cases that are usually discussed with respect to the approximation sense of progress are easily incorporated into the constraining theory space sense of progress – e.g., Newton's theory is empirically ruled out, while general relativity is not (yet). And, importantly, not only are these specific theories ruled out (or not ruled out yet), but – given further assumptions – whole regions of theory space, i.e., sets or classes of theories, are excluded (or still viable): for example, action at a distance theories, like Newton's, are ruled out, while local theories, like general relativity, are not.

Whereas McKenzie offers a rather demanding notion of progress in physics – theory change brings about scientific progress, only if we can point to a specific (mathematical) relation of the theories under consideration – we propose a more lenient notion of progress in physics: excluding a theory is already about making scientific progress and, furthermore, exploring theory space is as well.

Now, one might object that we loose a great deal of information about what some progress is precisely progress about when switching from the approximation view to the theory space view. The approximation relations between subsequent theories inform us about the precise sense in which adopting the new theory is making progress, they provide a measure of progress by making explicit where the truth approximation is taken to be improved. However, this is arguably sufficiently similar in our view. First of all, the theory space view is still perfectly able to make sense of what it means that a theory is true (and this is arguably central to McKenzie with respect to her points about metaphysics): the true theory is the theory that will survive the process of elimination. In a sense, excluding false theories in theory space and thereby encircling the true theory is an *indirect approximation* of the true theory. When it comes to generalisations to metaphysics, this indirect approximation of the true theory avoids the problems of direct approximation accounts like the ones put forward by McKenzie and Emmerson.

Secondly, relations between different theories *are* taken into account and used: theory space *orders* the theories. Hence, we are able to extract information about why certain theories that share certain features are (probably) closer to the true theory than theories that share other features (e.g., quantum field theories will be better candidates than theories of Aristotelian dynamics). The theory space view is not about all or nothing, since it is not merely about writing theories on and deleting them from some shopping list.

5 Understanding metaphysical progress

The above concept of scientific progress can be utilised for metaphysics: also the practice of metaphysics is not about straightforwardly approximating a true theory (insofar we agree with McKenzie), but primarily about exploring and constraining (metaphysical) theory space. It is then plausible that metaphysics

makes progress and that metaphysical progress goes hand in hand with scientific progress.

Also for metaphysics we can construct an abstract space of possible metaphysical theories, meaning that we can order the various metaphysical candidate theories with respect to their content, just as we can order scientific theories.[9] Then, progress in metaphysics is achieved by both exploring and constraining this theory space. By working out the various candidate theories, coming up with new candidates that have not been considered before, refining and defending them against objections, and investigating relations between candidates (including whether two candidate theories are identical, isomorphic, dual etc.) metaphysics explores theory space: exploratory metaphysical investigations help to get a grip on what the different dimensions of theory space are and where the various candidate theories are situated. By assessing candidate theories especially with respect to internal (logical) consistency and external compatibility with scientific evidence, metaphysics constrains theory space: exclusionary metaphysical investigations help to determine what the serious candidate theories currently are; this may be understood as an indirect approximation ('encircling') of the true theory.

Thus, metaphysics is automatically and fruitfully tied to science and its progress, because metaphysics is continuously tested by the currently best available scientific evidence (including experimental as well as theoretical results). First, metaphysical claims that directly follow from a scientific theory in a one-to-one correspondence are eliminated when the respective scientific theory is eliminated. So, in this case, scientific progress is tantamount to metaphysical progress. Second, more general metaphysical claims (such as the claim that every property is extrinsic) are not directly eliminated in this way, as they are typically compatible with many possible scientific theories. However, just like in physics, progress can still be made by formulating and then probing candidate theories in order to explore and ultimately constrain the theory space of metaphysics. Thus, metaphysics is automatically tied to science in two ways: (1) via the exclusion-part of testing metaphysical theories, and (2) via exploration – scientific theories may inspire metaphysical theories. Hence, our science-inspired account of metaphysical progress shows how and why metaphysical progress goes hand in hand with scientific progress.

Here are three concrete ways in which scientific progress can bring about metaphysical progress: First, scientific progress can inspire the formulation of novel candidate theories in metaphysics. For example, theories of quantum gravity may inspire metaphysical positions like spacetime eliminativism. Second, scientific progress can boost the development of existing candidates by showing how to fill in the details. Scientific progress can raise new problems for metaphysics (e.g., the issue of indiscernibility in quantum mechanics) and prompt refinement of extant metaphysical theories (e.g. entanglement as world-

[9] Arguably, complexity increases in metaphysics. For example, the notion of 'parameter' used to characterise the dimensions of theory space in physics needs to be relaxed further. Still, note that even in physics not all parameters are quantifiable (e.g., one dimension of physical theory space merely groups the theories in, say, local and non-local theories).

making relation for Lewisian metaphysics; see Jaksland (2021)). Third, it can lead to novel arguments for and against existing candidates (e.g., quantum mechanics and structural realism). Specifically, scientific progress can eliminate metaphysical claims that are in conflict with the remaining theoretical possibilities in physics (or other sciences). Scientific theories may help to develop new arguments against extant theories (e.g., quantum mechanics and classical Humeanism).

Borrowing a metaphor from Dellsén et al. (2021), it is just helpful to know the whole haystack and even better to have to search only a part of it. In a sense, the thesis of this paper is that we make scientific and metaphysical progress by formulating false theories.

6 Inductive metaphysics

As a side note, we want to stress that this suggests that even a priori elements may come into play.[10] If metaphysical progress is about exploring and then excluding metaphysical theories, part of this progress consists in actually constructing the plethora of metaphysical theories. Arguably, this is in conflict with the program of naturalized metaphysics as explicitly stated by Ladyman (2017). Accordingly, we see a preference for what has been called inductive metaphysics (see Engelhard et al. (2021)) over standard naturalized metaphysics.

Inductive metaphysics is a promising alternative to naturalized metaphysics that captures the main idea of naturalistically-inclined metaphysics while avoiding the more radical conclusions of naturalized metaphysics. As naturalized metaphysics, inductive metaphysics takes the sciences seriously, both as a source for metaphysical knowledge and as a source for methodological tools in metaphysics. But at the same time and unlike naturalized metaphysics, inductive metaphysics also allows for more 'traditional' sources of metaphysical knowledge and methods. In this way, inductive metaphysics can be regarded as a reconciliation between naturalistic metaphysics and a priori metaphysics.

Recall that naturalized metaphysicians claim that metaphysical theories must be firmly based on the natural sciences, and especially physics, in order to be at all valuable. This is what McKenzie calls the 'negative claim' of naturalized metaphysics: metaphysical theorizing that does not pay heed to current scientific theories is not worth doing. But naturalized metaphysicians do not give up on metaphysics entirely. Instead, they claim that we can gain substantive metaphysical insight by closely studying our best scientific theories. This is what McKenzie calls the 'positive claim' of naturalized metaphysics: metaphysical theorizing that is based on current scientific theories is worth doing. Both the negative and the positive claim can be interpreted in various ways, depending on what it means to be 'based on' a scientific theory. Weak interpretations might spell out the notion that a metaphysical theory is based on a scientific theory in terms of mere compatibility, for example. This will render the negative claim uncontentiously true and the positive claim dependent on the

[10] This is arguably the case in physics as well (e.g., checks for consistency).

worth of classic a priori metaphysics. Strong interpretations, on the other hand, might spell out the notion that a metaphysical theory is based on a scientific theory in terms of direct ontological commitments of specific scientific theories. In this case, the negative claim will be much more controversial, as it would plausibly ban any reasoning that is not the result of a thorough investigation of specific theories from the metaphysician's toolbox.

We do not defend the negative claim. On the contrary, we think that valuable inquiry of the furniture of the world can be done without reference to the sciences at least in some areas of inquiry. (For example, we do not think that theories of free will, of responsibility or of the metaphysics of morality in any strong sense need to be based on scientific theories in order to be at all valuable. This, of course, does not mean that such theories cannot still profit from engagement with the sciences.)

However, we do defend the positive claim: We hold that science-based metaphysics is worth doing. As we have argued above, this is compatible with scientific theory change. What is more, from the perspective of inductive metaphysics, scientific theory change or situations where science has not settled for one out of several candidate theories (yet), like it is currently the case for quantum gravity research, can actually be put to use in metaphysics by investigating whether the different theories suggest any common core. *Prima facie*, all theories and all tenable interpretations of theories that are not ruled out yet are relevant for inductive metaphysical inferences. For example, the relevant theories of spacetime include the various theories of quantum gravity and also general relativity in its different interpretations. In this context, inductive metaphysical inquiry consists in, among other things, working out what is the common core constraint of all these vastly different sources for a metaphysics of spacetime.[11]

On the contrary, for Ladyman and Ross, the only way to properly argue for a metaphysical thesis like structural realism is by arguing that our best current physical theories suggest that it is true. The central objective of naturalized metaphysics is to make metaphysics a part of science. According to (Kincaid, 2013, 3), naturalized metaphysics proceeds "only by means of scientific results and scientific methods", i.e., science itself is supposed to do all the metaphysical work needed or feasible. In particular, no additional (philosophical) methods are used. Thus, an argument via scientific theory change would, strictly speaking, be inacceptable from their methodological standpoint: empirical data about the development of the physical sciences is not itself subject to explanation by physics, and therefore not apt to figure in metaphysical reasoning. Similarly, naturalized metaphysics has no resources to work out input from scientific rival theories. Inductive metaphysics is less restrictive. For inductive metaphysics arguments based on theory change are perfectly fine, or even encouraged, as inductive metaphysics allows for various kinds of empirical sources of knowledge.

There are several prima facie advantages of inductive metaphysics over naturalized metaphysics and a priori metaphysics in the face of McKenzie's challenge.

[11] A first attempt that also discusses the limitations of this has been put forward in Salimkhani (2020).

First, as inductive metaphysics is not based solely on the physical sciences, its progress is not fully dependent on the progress of the physical sciences. Second, inductive metaphysics can still profit from the progress of the physical sciences in various ways.

7 Some Potential Objections

In the following, we respond to a few potential objections. First of all, one may worry whether it is actually possible to exclude metaphysical theories. In our view, the corresponding problems in metaphysics are often exaggerated. We agree that the underdetermination problem – recall that there is one for science as well! – is more severe in metaphysics than in science (due to the higher level of generality), however, we maintain that there is no qualitative difference, rather it is a matter of degree (see also Chakravartty (2017)).[12] As in the sciences, underdetermination may be tamed by use of principles or continuity conditions (e.g., Haack (2007), Salimkhani (2020)). Importantly, metaphysical theories can be excluded, as the case of naive Humeanism shows. Overall, it seems hardly plausible to argue that metaphysical theory change is catastrophic, while accepting scientific theory change as unproblematic.

Here is another objection, call it the *triviality concern*: maintaining to relax McKenzie's requirement that subsequent theories stand in approximation relations themselves, as we proposed, is in danger of trivialising scientific and metaphysical progress. Especially given that we seem to take *any* kind of addition to or exclusion from theory space as a progressive result. Now, first of all, we take it that progress is a gradual concept. Just because we might accept rather trivial results as progress does not mean that we are unable to have some kind of metric that helps to, at least, distinguish very important cases of scientific or metaphysical progress from trivial cases. For example, exploring or excluding a large chunk of some rather weird and detached part of theory space may be significantly less informative than exploring or excluding a small region in what is agreed to be a highly relevant part of theory space. In other words, exploring or excluding many many implausible theories is less important than exploring or excluding a highly plausible candidate theory like general relativity. This hints at the fact that assessing what is more and less relevant progress depends on background assumptions or background information about what the serious candidate theories are. But we usually do have good (but fallible) reasons to expect that certain regions of theory space are more relevant than others – for example, empirical data and consistency conditions. Second, it will often be highly non-trivial to assess the relevance of some scientific or metaphysical result, in the first place: a rather minor ontological change by adding a new particle may turn out as groundbreaking progress much later, conversely, what has been viewed as a crucial insight may turn out moot.

As a fairly general account of what science and metaphysics are about and how both make progress, the theory space view may also generally be challenged

[12] We are sympathetic to the view that science and metaphysics are continuous.

by some version of the demarcation problem. What theories shall be counted in as scientific or metaphysical such that they can be part of the respective theory space? This debate is hardly settled once and for all, but, in our view, such a general problem should not be taken to speak against the proposal.

To conclude, we take it as unproblematic to have progress as generally easily achievable, because progress is indeed gradual and the fact that there are more crucial results is not affected by there also being trivial ones. In fact, sciences like zoology will arguably often "just" be about 'collecting stamps', they often "just" inform about what is on the list of what there is – but this is relevant.

8 Conclusion

We have seen that theory change is a potential challenge for conceptualising scientific and, hence, metaphysical progress. But we have argued that this challenge can be met. In short, our diagnosis of McKenzie's attack on naturalistically-inclined metaphysics is that it relies on an inappropriately narrow notion of scientific progress, namely the (direct) approximation account. Replacing this account by a more appropriate alternative, namely the theory space account, leads to a convincing refutation of McKenzie's argument. Metaphysics can and does make progress.

More specifically, we have defended the following three claims: (1) progress in science is better understood as exploring and excluding theory space, (2) this conception of scientific progress inspires a generalisation to a notion of metaphysical progress, and (3) our understanding of metaphysical progress prefers inductive metaphysics over naturalized metaphysics.

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