

Naturalized Metaphysics without Scientific Realism

Amanda Bryant

University of Calgary

Abstract

Abstract: It is often assumed that a commitment to scientific realism naturally, if not necessarily, accompanies a commitment to naturalizing metaphysics. If one denies that our scientific theories are approximately true, it would be unclear why one should index metaphysics to them. My aim is to show that the project of naturalizing metaphysics does not require realist assumptions. I will identify two success conditions for the project of disentangling naturalized metaphysics from realism: 1) the *narrow* success condition, which requires the antirealist to explain why naturalized metaphysics is preferable to non-naturalized metaphysics, and 2) the *broad* success condition, which requires the antirealist to explain why naturalized metaphysics is preferable to metaphysical quietism. I believe that the antirealist can meet these conditions. Although I will not defend any definitive way of meeting them, I will explore argumentative avenues open to the antirealist. In particular, I will consider some conceptions of naturalized metaphysics, discuss their antirealist-compatible expected payoffs, and consider whether those payoffs enable the antirealist to meet the success conditions of the project. I will find that the antirealist has several argumentative avenues open to them.

Keywords: Naturalized metaphysics; Scientific realism; Epistemology of metaphysics; Epistemic value; Facticity.

1. Introduction

It is common to think that a commitment to scientific realism at least goes naturally with, if not necessarily accompanies, the project of naturalizing metaphysics. It is *prima facie* puzzling why one who does not believe that our scientific theories are approximately true would, at the same time, insist that metaphysics should be indexed

to them.¹ If one thought, further, that our scientific theories were false or likely false, one might reasonably believe that it would spell doom for a metaphysics based on or derived from science. What would be the value of a metaphysics anchored to false science? My aim in this paper is to show that the project of naturalizing metaphysics can come apart from the assumption of realism—and to explore how the naturalist programme can cohere with even a strong form of scientific antirealism.

I am not the first to notice or question the assumption that scientific realism is a precondition for naturalized metaphysics. Guay and Pradeau note that “a majority of proponents of scientific metaphysics adopt scientific realism... [and many] of them even suggest that scientific realism is a *necessary* component of every project in metaphysics of science” (2020: 1852). While realism is, they say, “a perfectly legitimate... position” (2020: 1853), they suggest that the metaphysics of science “should perhaps not attach itself too rapidly” to it (2020: 1852). That is because, *inter alia*, realism is “demanding and difficult to demonstrate” (2020: 1854), and its truth or falsity is “not already settled” (2020: 1855). In their view, presupposing realism “leads to excluding without good reasons some possible avenues for metaphysics of science” (2020: 1854). In much the same spirit, I wish to indicate the presence of some antirealist-compatible avenues for naturalized metaphysics. I do so because I consider antirealism (like realism) rationally permissible and because I think, with Guay and Pradeau, that it would be unwise to needlessly foreclose available options. In addition to identifying such options, this paper will begin to explore them in greater detail. In particular, I will examine which adjustments to the naturalist’s philosophical package are forced by the denial of realism.

One parameter that arguably needs adjusting is the doxastic attitude that the naturalist takes toward the theories of naturalized metaphysics. Belief in the truth of those theories is clearly not on the table for an antirealist naturalist. One well-explored alternative to belief is van Fraassen’s (1980) notion of *acceptance*. To accept a theory is to believe that the theory is empirically adequate and to commit to using its language and explanatory resources in further research.² I flag the issue of doxastic attitudes as one that the antirealist naturalist needs to consider, but it will not be my focus here.

My focus will instead be on various conceptions of naturalized metaphysics, as well as its aims, prospects, and value. I will explore how those parameters can be adjusted to form a cohesive package with antirealism. I will identify two conditions for successfully disentangling naturalized metaphysics from the assumption of realism, which I will call the narrow and broad success conditions. The narrow condition requires the antirealist to explain why naturalized metaphysics is preferable to non-naturalized metaphysics; the broad condition requires the antirealist to explain why naturalized metaphysics is preferable to metaphysical quietism. I will not assume the

¹ One who thinks that naturalizing metaphysics is not about contact with scientific theories but rather scientific practices does not appear to face the same *prima facie* puzzle (Waters 2014, 2017, 2018, 2019). An approach that attends to the complexity and plurality of scientific practices might sit more obviously well with certain localized antirealisms (ex. Ereshefsky 1998, 2018). This is an interesting and fruitful avenue of inquiry but not one that I will explore further here.

² For relevant applications of this notion, see Elgin 2017, Beebe 2018, and Rosen 2020.

burden of definitively meeting these conditions on behalf of the antirealist, but I will highlight a number of argumentative routes they might take.

Section 2 defines scientific realism and antirealism. Section 3 gives a general definition of naturalized metaphysics and discusses why it is often assumed to go hand-in-hand with realism. Section 4 outlines the narrow and broad success conditions for the project of disentangling naturalized metaphysics from the assumption of realism. Section 5 outlines the sorts of philosophical packages that are open to the antirealist. It considers specific conceptions of naturalized metaphysics, their envisaged payoffs, the compatibility of those payoffs with antirealism, and finally, whether the payoffs would enable the antirealist to meet the narrow and broad success conditions. I will identify a number of combinations that could, with further argument, do the trick. Section 6 concludes.

2. Scientific Realism

There are many substantively distinct formulations of *scientific realism*. Some are axiological, in that they concern the aims of science (van Fraassen 1980), while others concern its actual accomplishments (Boyd 1983, Devitt 1997, Psillos 1999). Some are ontological, in that they concern the mind-independent existence of the unobservables posited by science; some are semantic, in that they concern the truth or successful reference of scientific theories; and some are epistemological, in that they concern knowledge or justified belief with regard to scientific theories (see Chakravartty 2007). The general spirit of the view is captured by its slogan formulation, which states that *our best current science is approximately true*. This slogan is loaded; each of its constitutive notions—‘best’, ‘current’, ‘science’, ‘approximately true’—is vague and requires elucidation. Realists have devoted substantial effort to that task, with special attention to the meaning of ‘best’ (often cashed out in terms of maturity) and of ‘approximately true’.³

The slogan formulation is a *wholesale* formulation (Magnus and Callender 2004) in that it generalizes about science on the whole. For my purposes here, it will be important to construe realism broadly, so that it includes both wholesale varieties and more *selective* varieties—that is, varieties that attach realist commitment to systematically identifiable parts of science. It is important to do so because it has already been established that the naturalist can do without wholesale realism. The arguable progenitors of recent interest in naturalized metaphysics, Ladyman and Ross, are not themselves wholesale realists but rather selective ones. Thus, I will define scientific realism (or just ‘realism’) in the following disjunctive way.

Scientific realism: Either our best current science is approximately true or significant parts of it, which are identifiable in a non-*ad-hoc* way, are.

Scientific antirealism (or just ‘antirealism’) is likewise formulated in a variety of substantively distinct ways. I will define it as the negation of realism.

Scientific antirealism: It is the case neither that our best current science is approximately true nor that significant parts of it, which are identifiable in a non-*ad-hoc* way, are.

³ See for example Hunt 2011; Psillos 1999; Smith 1998; Weston 1987, 1992; and Worrall 1989.

On this characterization, the antirealist believes in the substantial falsity of our best current science. Some might find the strength of this formulation unpalatable. There are certainly humbler forms of antirealism. For instance, one might adopt the view that we cannot know or be justified in believing our best current science and that the best policy is to suspend judgment. In adopting such a view, the antirealist would play the role of the skeptic. By no means do I wish to assert that the strong form of antirealism is the most attractive or defensible one. I have defined antirealism in this strong way because doing so presents the greatest challenge to my present aims and so makes for a more significant outcome if I am successful. The challenge is to show how someone who believes that science is substantially false could at the same time believe that naturalizing metaphysics is desirable or even requisite, perhaps even for epistemic reasons.⁴ I am optimistic that the challenge can be met, which is, I think, important and interesting. If I am right, then it should be comparatively easy to square more modest forms of antirealism with the naturalist programme in metaphysics.

3. Naturalized Metaphysics and the Assumption of Realism

Just as there is a heterogeneous family of scientific realisms and antirealisms, the view *that metaphysics ought to be naturalized* has been cashed out in a number of distinct ways. As a terminological note, I will reserve the term ‘naturalist’ for one who adopts that view, which is a local form of methodological naturalism, not to be confused with numerous other non-equivalent senses of the term.⁵ Moreover, while others may wish to preserve distinctions among the following terms, I will consider ‘naturalized metaphysics’ (and, equivalently, ‘naturalistic metaphysics’) to be co-extensive with ‘scientific metaphysics’, ‘metaphysics of science’, ‘science-guided metaphysics’ and ‘scientific ontology’. While these terms have been characterized in different ways, they typically mean something like the following:

Naturalized metaphysics: Metaphysics that engages with science in some substantive way.

The naturalist’s immediate challenge is to define ‘metaphysics’ and ‘science’ in a way that makes the view contentful (Chakravartty 2017, Williamson 2013). For my purposes here, I will take the respective academic institutions and their activities as rough proxies for what is intended by the terms. There are differing conceptions of the appropriate *modes* of engagement, higher and lower bars for what counts as an adequate

⁴ Compare what McKenzie calls *the progress problem*: “the science upon which contemporary [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” (2021: 436). See McKenzie 2020 for greater detail.

⁵ The view that metaphysics should be naturalized is *local* in that it pertains to metaphysics only; it is *methodological* in that it is a methodological prescription; it is a form of *naturalism* in that it prescribes engagement with science. For more discussion of local and non-local methodological naturalisms and how they differ from other forms of naturalism, see Bryant 2020b. See also Papineau 2014.

degree of engagement, and different views about the precise *object* of engagement—that is, which sciences ought to be privileged and why. However, the common denominator is that metaphysics should not float entirely free of science; it should not be what I have called “free range” metaphysics (Bryant 2020a).

One natural rationale for thinking that metaphysics should not float entirely free of science is the belief that the domain of metaphysical fact does not float entirely free of the domain of scientific fact. On such a view, *contra* Kant, it is not that there are two discrete levels of reality, the empirical and the properly metaphysical, only the former of which is revealed by science. The domain of metaphysical states of affairs is not distinct from nature and in principle epistemically inaccessible via the methods of science. Rather, science and metaphysics have, at least to some extent, a shared target of inquiry. Since the domains of metaphysical and scientific interest overlap to some extent, science is to a proportional extent a source of evidence relevant to metaphysical matters.⁶

Moreover, the thought continues, science is a *good* source of evidence concerning such matters. This is where realism finds its natural entry point. In explaining what makes science an especially *good* source of pertinent evidence, it is tempting for the naturalist to appeal to realism directly or indirectly. She might invoke realism relatively directly by claiming that science gives us a *true* picture of reality, generates *knowledge* of it, or reveals *facts* about it—these factive notions being signals of realist commitment. Alternatively, she might invoke realism indirectly by gesturing toward properties of science that frequently motivate realism, such as its unparalleled success (e.g. Ladyman and Ross 2007: 7). In sum, since the naturalist motivates her project by appeal to the goodness of scientific evidence, and since realism offers a straightforward basis for considering scientific evidence good, it is natural to assume that realism accompanies the project of naturalization.⁷

Indeed, many philosophers draw the connection explicitly. For instance, according to Hawley, whether one is optimistic or pessimistic about the prospects for making metaphysical progress on the back of scientific progress is, in large part, “parasitic upon debates and decisions about scientific realism” (2006: 468). She explains: “it should come as no surprise that anyone who is sceptical about the ability of science to give us knowledge of quarks and quasars will be sceptical about whether science

⁶ A reviewer worries that the just-so story I am telling on behalf of the naturalist fails if science and metaphysics operate at such different levels of description that they are incommensurable. We know they are not incommensurable, since science demonstrably speaks to metaphysics by informing and standing in evidential relations to it (existing naturalized metaphysics supplies the proof). If they are partially incommensurable, then one of the limits on naturalized metaphysics will be the limits of commensurability. It’s up for debate where those limits fall, but this has the air of a feature rather than a bug.

⁷ While I have suggested that realism naturally enters the scene in a justificatory capacity, for the role it plays in giving the naturalist reason to positively assess or privilege scientific evidence, others have imagined the relationship between realism and naturalism somewhat differently. For instance, Devitt does not see realism as playing a justificatory role with respect to naturalization but as an inevitable outgrowth of an antecedent commitment to naturalism. In his view, “when we approach our metaphysics empirically, Realism is irresistible” (1999: 96).

can give us knowledge of universals and possible worlds” (2006: 454). Conversely, optimism about science may translate into optimism about naturalized metaphysics:

[D]ifferent naturalisers will take different approaches. But one attractive option is to see the naturalising metaphysician... as a kind of scientific realist, who uses inference to the best explanation to move from the empirical successes of a scientific theory to the accuracy of the metaphysical picture embedded in the theory. (Hawley 2018: 189)

Ladyman and Ross draw a connection between the truth-conduciveness of science and that of naturalized metaphysics: “[t]he naturalistic metaphysician... is optimistic about the possibility of bringing metaphysical hypotheses into closer conformity with objective reality to the extent that these hypotheses non-trivially unify bodies of *established scientific knowledge*” (my emphasis 2013: 109). The reference to scientific knowledge—and, indirectly, the suggestion that a metaphysics that engages with that knowledge has a better shot at ‘conforming to objective reality’—indicates realist commitment. Schrenk also comments on the connection between naturalized metaphysics and realist commitment: “Philosophers who engage with the metaphysics of science tend to sympathize in one way or another with science itself... they see science... as the single most important, most reliable path to truth” (2017: 296). In that way, he says, “Scientific Realism is at least an ally to metaphysics of science” (2017: 298). The phrase is apt; scientific realism is often taken to be at least an ally to naturalized metaphysics if not a presupposition of it (as in Esfeld 2009).

4. Success Conditions for Naturalized Metaphysics Without Realism

We have seen that scientific realism figures into one obvious rationale for naturalized metaphysics, so it should come as no surprise that a naturalist who avows antirealism would need some alternative account of its rationale. If one thinks that our best current science is substantially false, then why bother with a metaphysics that is anchored to it? There are two preliminary explanatory challenges for the antirealist naturalist, which I will refer to as, respectively, *narrow* and *broad* success conditions. These will be success conditions for the project of disentangling naturalized metaphysics from the assumption of realism.

The first is well-encapsulated by a passage from Chakravartty. He remarks that the naturalist:

...must assume that some parts of scientific theories are likely to be retained over time across theory change, and furthermore, that we are in a position to identify at least some of these parts. Without some such identification... the scientific ground of naturalized metaphysics would inevitably shift significantly in time... [and] one would have no good reason to suspect that metaphysics done in conjunction with it at any given time is preferable to metaphysics that is alien to it. (2013: 39)

This line of reasoning shows that realism plays an important explanatory role for the naturalist: it justifies her preference for her own metaphysical approach. The antirealist naturalist needs to explain the preferability of her approach in some other way. Here we have our first success condition.

Narrow success condition: The antirealist naturalist must give some reason why naturalized metaphysics remains preferable to non-naturalized metaphysics notwithstanding the falsity of science.

Virtually all naturalists in my sense of the term are strongly committed to the superiority of naturalized metaphysics to non-naturalized metaphysics. To maintain that commitment, they will need to meet this narrow success condition.

Regarding the formulation of the condition, I acknowledge that without explicit precisification, ‘preferable’ isn’t particularly contentful. The formulation immediately raises the question, ‘preferable *how?*’. This indicates that to determine whether the condition is satisfied, we need a criterion of preferability. The same will be true of the second success condition. I have intentionally left this open because I wish to canvas, in an exploratory spirit, some of the many and varied reasons an antirealist might have for preferring naturalized metaphysics, as well as the sorts of epistemic and non-epistemic criteria of preferability they might apply. I leave it to the reader to judge which of these reasons and criteria are compelling—but the heterogeneous results are, I think, deeply interesting.

Still, one might worry that this open approach renders my ultimate conclusion—that there are plenty of argumentative avenues open to the antirealist naturalist—unsurprising. That there are plenty of avenues open to the antirealist naturalist is a consequence of the permissive way I define success.⁸ One might hope to see, for instance, a specifically epistemic restriction on the kind of preferability that must be shown—that naturalized metaphysics has distinctively epistemic payoffs even when paired with the assumption of strong antirealism. I invite readers who share this concern to interpret the success conditions epistemically. The approach discussed in section 5.1 won’t obviously meet the conditions so interpreted, but more promising options will be discussed in 5.2 and 5.3. Readers who are content to take a more exploratory approach can, with me, leave the success conditions open to a wider range of interpretations.

The second success condition emerges when one considers the anti-metaphysical spirit of many antirealisms, including van Fraassen’s constructive empiricism.⁹ Van Fraassen’s constructive empiricism famously commits not to the truth of scientific theories but instead to their empirical adequacy. He comments that “the assertion of empirical adequacy is a great deal weaker than the assertion of truth, and the restraint to acceptance *delivers us from metaphysics*” (my emphasis 1980: 69). The constructive empiricist has, as part of their philosophical temperament, a generalized aversion to metaphysics. For many constructive empiricists, an anti-metaphysical temperament

⁸ I thank a reviewer for bringing this criticism to my attention.

⁹ In this paragraph, I use ‘antirealism’ in a broad sense, not in my narrow sense. I take van Fraassen’s constructive empiricism to be one of the humbler and more skeptical kinds of antirealism discussed above.

is part of what disposes them to constructive empiricism in the first place. While there is nothing essentially anti-metaphysical about antirealism in principle, it does often have an anti-metaphysical spirit. One might wonder whether those antirealists who seek to avoid metaphysics are comparatively wise, given the epistemically risky nature of metaphysics. Perhaps the antirealist is better off not bothering with metaphysics, naturalized or not. This thought leads us to the second success condition of the project.

Broad success condition: The antirealist naturalist must give some reason why pursuing naturalized metaphysics is preferable to avoiding metaphysics entirely notwithstanding the falsity of science.

They should, in other words, say something about the value of naturalized metaphysics that would make it worth the epistemic risk it entails.

One might be tempted to dispense immediately with the broad success condition by invoking the familiar claim that *metaphysics is unavoidable*. More than one philosopher has remarked upon the apparent indispensability of metaphysics to human thought (see Kant's *Prolegomena* 4:367 and Peirce *CP*, 1.129). They argue that metaphysics inevitably emerges in our thinking whether we like it or not, and without recognized standards or criticism it takes its own haphazard shape. One who is compelled by remarks such as these might reason that, since we are bound to do metaphysics implicitly anyway, we might as well come out in the open and do it *explicitly* and *in the best possible way*, which the naturalist believes is in concert with science.

Yet the skeptic might respond that, while we cannot entirely avoid metaphysical concepts and assumptions, that does not mean we should jump headfirst into the organized pursuit of metaphysics. While we cannot avoid metaphysical concepts and terms, for instance, we can, as a regulative ideal, do our best to minimize how much metaphysical theorizing we actively do. Thus, the skeptic may argue, the broad success condition should be understood as a demand to know why we should attempt naturalized metaphysics rather than declining to pursue organized metaphysics and instead adopting metaphysical quietism *so far as possible*. What, in other words, does the naturalist think makes organized metaphysics worth saving?

The realist naturalist should, of course, have an answer to that same question. However, their optimism about the capacity of science to generate knowledge, some of which concerns metaphysical matters, gives them a straightforward path to an answer: we should save organized metaphysics because we can pin our hopes for metaphysical knowledge on the back of our trust in scientific knowledge. The path for the antirealist is not so straightforward. If one has reason to reject our best science, then one has reason to reject the naturalized metaphysics drawn from it.¹⁰ But if naturalized metaphysics is not plausibly approximately true, then why bother with it at all?

¹⁰ I do not mean to suggest that the truth of antirealism would logically entail the falsity of naturalized metaphysics. It would not. It is just that the naturalist thinks that the relevant epistemic relations and properties track: if science is justified, then naturalized metaphysics is also justified (albeit to a lesser degree); conversely, if science is rationally disbelieved, then so too is naturalized metaphysics. Of course naturalized metaphysics could turn out to be true notwithstanding the falsity of the science it was based on, but this would be wildly coincidental, and nobody would be justified in expecting it.

Some suggest that a satisfying answer is not forthcoming. For instance, Ladyman and Ross approvingly cite van Fraassen’s belief that, in their words, “a metaphysics that is not at least broadly true... is worthless... [and] should be abandoned” (2013: 109).¹¹ One of my aims here is to challenge that sort of view. In the remainder of the paper, I will explore some candidate values in virtue of which naturalized metaphysics would be worth pursuing even if it were false. I will identify a number of payoffs relative to which an antirealist could meet the narrow and broad success conditions I have outlined. My aim is not to defend or privilege any particular one but rather to explore options. I will conclude that there are plenty of ways in which antirealism can sit comfortably with the naturalist programme.

I do not believe the antirealist naturalist who explores these sorts of alternate values should be viewed as cornered and desperate—or as pursuing what should be regarded as “a last resort”, as McKenzie puts it (2020: 24). There is rich and fertile philosophical terrain to be trodden here concerning non-factive epistemic aims and values, how they relate to and trade off against one another, what happens when we privilege some over others, and their potential to shift ongoing philosophical dialectics. So I take the antirealist naturalist to be at an exciting juncture in theoretical space.

5. Naturalized Metaphysics: Conceptions and Expected Payoffs

In what follows, I will consider whether naturalized metaphysics can have antirealist-compatible ‘payoffs’ (that is, whether it can promote truth-independent values) that give the antirealist naturalist the resources to meet the narrow and broad success conditions. Since there are many specific conceptions of naturalized metaphysics, I will proceed by surveying a small sample of them, examining the explicit rationale and expected payoffs of each, and considering whether each assumes realism. Where realism is assumed, I will consider whether that same metaphysical project could be pursued for other reasons, with antirealist-compatible payoffs in view. In each case, I will consider whether the antirealist-compatible payoffs could enable the antirealist naturalist to meet the narrow and broad success conditions I have outlined.

5.1 Quinean Ontology

I begin with Quine, whose conception of naturalized metaphysics is familiar. On Quine’s conception, naturalized metaphysics involves deductively deriving ontological commitments from regimented science. Regimenting a scientific theory involves clarifying and simplifying it by translating it into logical notation.

Quine is a realist, and he takes naturalistic philosophy to begin with realist assumptions. Quine views the scientific method as the “way to truth” and the “last arbiter of truth” (1960/2013: 21). Moreover, according to Quine, “[t]he naturalistic philosopher begins his reasoning within the inherited [i.e. scientific] world theory as a going concern. He tentatively believes all of it, but believes also that some unidentified

¹¹ Note that this is a departure from their claim, to be discussed below, that naturalized metaphysics is *probably false* yet still desirable insofar as it is the “best metaphysics we can have at [time] t” (2007: 2).

portions are wrong” (1981: 72). This is consistent with the realist’s commitment to approximate truth.

What does Quine take to be the expected payoff of his form of ontology, and does it hinge on the assumption of realism? The ontologist’s regimentation of science is rationally considered truth-conducive, according to Quine. He remarks that “simplicity, in a theory that squares with observation sentences so far as its contacts with them go, is the best evidence of truth we can ask; no better can be claimed for the doctrines of molecules and electrons” (1960/2013: 230). Further, he claims that “[t]he quest of a simplest, clearest overall pattern of canonical notation is not to be distinguished from a quest of ultimate categories, a limning of the most general traits of reality” (1960/2013: 147). In other words, the Quinean ontologist aims to derive a true ontology. The expected payoff here is a true metaphysics—or, at least, one whose truth is best evidenced.

While realist commitment factually underlies Quine’s naturalistic approach to metaphysics, we can ask whether realism is essential to it. If one did not expect science to supply us with a true ontology, why else might one pursue Quinean ontology? I suggest that one place to look for an answer is applied ontology. Applied ontology attempts to discern the ontological commitments of concrete domains in science, industry, and government and how they can be systemized into classification systems that enable consistent representation of information.¹² Quine’s conceptions of ontology and ontological commitment are foundational to applied ontology (Smith 2003, 2014). Indeed, in many of its applications, applied ontology does something generally resembling the Quinean project: it uses the tools of logic to limn the ontological commitments of the sciences. Granted, such projects go well beyond Quine’s vision of ontology in terms of the rich suite of sophisticated methods they implement (Arp et al. 2015). Nevertheless, they can be understood as an extension of the Quinean tradition.

Applied ontology also responds to some pressing practical needs, including, among others, those generated by big data. Scientists are to an increasing extent dealing with vast quantities of rich data. However, their datasets are often “characterful” in the sense that they have diverse contents and structures and are full of gaps, inconsistencies and uncertainties (Cooper and Green 2016). This makes the data immensely difficult to work with and draw conclusions from. In such contexts, applied ontology serves the purpose of cleaning up problematic datasets, by making the data more consistent, complete, and ultimately more useful. This is a pragmatic payoff. Moreover, it is antirealist-compatible, because it does not require the truth of science.

The final question to consider in relation to Quinean approaches is whether the suggested truth-independent payoff would give the antirealist naturalist the resources to meet the narrow and broad success conditions. That is, would the pragmatic benefit of making large scientific datasets more useful make the sort of Quinean applied ontology that I have described: 1) preferable to non-naturalized metaphysics and 2) preferable to no organized pursuit of metaphysics? The answer in both cases is, arguably, yes.

¹² See Lean 2021 for a discussion of the metaphysical import of such ontologies—especially in relation to naturalized metaphysics.

The first thing to consider is whether non-naturalized metaphysics could have the same payoff as Quinean applied ontology—that is, whether non-naturalized metaphysics could serve to clean up characterful scientific data. Suppose for the sake of argument that it could. It would have to serve that purpose either by design or by accident. But non-naturalized metaphysics has nothing directly to do with large scientific datasets. As a matter of definition, such metaphysics does not engage with science directly. So any metaphysics that set out with the explicit aim of cleaning up large scientific datasets wouldn't count as 'non-naturalized' in the first place. For it would be constrained by the content of the science to which it was designed to apply. Therefore, if the conceptual resources of a truly non-naturalized metaphysical system somehow helped to clean up some scientific dataset, it would have to be entirely incidental. By working directly with such datasets with the express aim of mitigating their characterful quality, Quine-style applied ontology would achieve the relevant payoff more consistently and predictably. And while the potential for non-naturalized metaphysics to produce such a payoff is merely hypothetical, the capacity of Quinean applied ontology to do so is demonstrable. So, relative to the payoff of cleaning up characterful scientific data, Quinean ontology is preferable to non-naturalized metaphysics.

Moreover, I doubt it would be terribly controversial to suggest that making scientific datasets more useful is something worth doing. One who recognizes the value therein would conclude that doing Quinean ontology is preferable to doing no metaphysics. The upshot is that I have found just what the antirealist naturalist needs: an approach to naturalized metaphysics that plausibly has an antirealist-compatible payoff, relative to which the narrow and broad success conditions can be met.

One might point out that, in this first case, the success conditions have only been met by retreating to the domain of pragmatic value. That may be so, but there is nothing illicit about it. We are seeking antirealist-compatible reasons to pursue naturalized metaphysics; those reasons need not be epistemic. However, I do think the antirealist naturalist can hope for more than what might be characterized as *merely* pragmatic value. While it is harder to show that naturalized metaphysics can have properly epistemic value where antirealism is held fixed, we will see that there are some interesting possibilities in that regard.

5.2 Science-Unifying Metaphysics

Ladyman and Ross defend an alternate conception of naturalized metaphysics in their rallying cry for the naturalization of metaphysics (2007, 2013). On their picture, naturalized metaphysics is an exercise in unifying scientific theses while privileging fundamental physics. This involves showing how two or more scientific theses explain more together than they do individually. Call this sort of naturalized metaphysics *science-unifying metaphysics*.

Realism operates in the background in the form of *structural realism*. According to structural realism, the structural, i.e. mathematical, content of our best scientific theories is carried over in limiting cases across theory change, and it is *that* content that realist commitment should track. According to Ladyman and Ross' eliminative ontic structural realism, the structural content describes the underlying structure of reality—which is composed of relations all the way down—approximately correctly.

Ladyman and Ross claim that, in wedding itself to successful scientific theories that make novel predictions and give “correct descriptions of the structure of the world” (2007: 92), science-unifying metaphysics is the only sort of metaphysics that qualifies as a “legitimate part of our collective attempt to model the structure of objective reality” (2007: 1). The science-unifying metaphysician can be “optimistic about bringing metaphysical hypotheses into closer conformity with objective reality” and thereby “contributing to objective knowledge” (2013: 109). So, like Quine, Ladyman and Ross think that the expected payoff of naturalized metaphysics is *true* metaphysics, or at least, metaphysics whose convergence on truth we can be optimistic about—and this expected payoff hinges on their realism.

If we replace the structural realist’s optimism with antirealist pessimism, what—if any—value could there be in unifying scientific theses that one believes to be false? Given that unification is understood to increase explanatory scope (i.e. how much is explained) one might argue that there is epistemic value in relatively great explanatory scope, *even if the explanation on offer is in fact false*. On traditional conceptions of explanation—namely, factive ones—what I’ve just suggested is incoherent. However, the recent “non-factive turn” in epistemology (Turri 2018) develops non-factive conceptions of key epistemological notions. On such conceptions, being true is not a necessary condition of belonging to the relevant epistemological categories. In the case of explanation, one can have an explanation without it being the case that both explanandum and explanans are true (see for instance Bertrand 2022). This conception allows for the possibility of false explanations. The envisaged antirealist thinks that, insofar as science is substantially false, so too are the majority of its explanations. Yet the conceptual resources of the non-factive turn allow us to consider them explanations nonetheless. My suggestion here is that there could be something about explanation that is both independent of truth and epistemically valuable, in virtue of which explaining more is desirable.

For instance, the antirealist naturalist might appeal to Lipton’s (2004) notion of the ‘loveliness’ of an explanation, i.e. the extent to which an explanation renders an explanandum intelligible. It seems conceptually possible that a false explanation could make an explanandum intelligible, just as, for instance, models and other idealizations can be heuristically valuable. A related approach would be to invoke a conception of non-factive understanding.¹³ For instance, *understanding* can be thought of as the grasping of “a comprehensive set of interrelated propositions about [a] subject matter and how they relate to each other” (Sjölin Wirling 2021: 644). This does not require the truth of the propositions grasped, and it is an apparently epistemic value. Thus, the antirealist naturalist could argue that false explanations could be valuable in virtue of promoting non-factive understanding. Greater explanatory scope would then be valuable insofar as it would entail greater understanding.

In a similar spirit, Cartwright argues that *ceteris paribus* laws are “not even approximately true” (1983: 57), and yet they are explanatory. That is because they “organize, briefly and efficiently, the unwieldy, and perhaps unlearnable, mass of highly detailed knowledge that we have of the phenomena” (1983: 87). This organizing

¹³ See Doyle et al. 2019, Elgin 2017, McSweeney 2023, Potochnik 2020, and Sjölin Wirling 2021.

power, she says, “has nothing to do with truth” (1983: 87). Organizing power seems at first glance pragmatically valuable, but Cartwright’s reference to *learnability* suggests that it may also be considered epistemically valuable. The antirealist naturalist might extend this sort of view beyond the context of *ceteris paribus* laws to that of science-unifying metaphysics. They might argue that the false explanations of science-unifying metaphysics are valuable in virtue of their organizing power, and that greater explanatory scope is valuable because it entails greater organizing power.

There are many blanks to fill in, of course. How precisely do we further cash out intelligibility, understanding, and organizing power—and are they the same or different? Why are they valuable? What makes them *epistemic* values? Filling in these blanks clearly requires additional philosophical work. For my part, I wish only to flag this style of argument as a live possibility for the antirealist naturalist.

Regarding the narrow success condition, relative to the payoff of increased explanatory scope, science-unifying metaphysics arguably has an advantage over non-naturalized metaphysics. That is because science sets out to explain a wealth of data gathered through the observational and experimental practices that figure so prominently in scientific practice. In tying itself to the project of scientific explanation, science-unifying metaphysics ties itself to the explanatory aspirations of science and shares its vast explanatory scope. Non-naturalized metaphysics, by comparison, is not always clearly an explanatory enterprise, and when it is, its data are comparatively impoverished. They tend to be, primarily, everyday empirical appearances, common sense intuitions, the deliverances of thought experiments and other *a priori* modes of reasoning. So if greater explanatory scope is a boon, science-unifying metaphysics appears to be more valuable than non-naturalized metaphysics relative to it.

Yet one might wonder, even if naturalized metaphysics is preferable to non-naturalized metaphysics relative to explanatory scope, is it preferable from a broader lens that considers the aims and potential accomplishments of each? In particular, is it preferable to pursue naturalized metaphysics that aims to unify false science and thereby gain intelligibility, non-factive understanding, or organizing power—or to pursue non-naturalized metaphysics that aims at truth? The answer partly depends on how one weighs the relevant epistemic values and, granted, it’s hard to top the value of truth. However, the answer also depends on how likely each inquiry is to reliably achieve its respective aims. I have argued elsewhere that because the constraints on the content of non-naturalized metaphysics are excessively permissive, non-naturalized metaphysics is unlikely to achieve truth or justification—and believing that it can or does reliably achieve those aims is a form of bad faith (Bryant 2020a). To establish the preferability of naturalized metaphysics relative to the lens of aims and accomplishments, the antirealist naturalist would need to show that naturalized metaphysics is comparatively more likely to achieve its aims reliably. While this remains to be shown, the bar for success is not particularly high.

Now turning to the broad success condition. Holding fixed antirealism, would possessing relatively great explanatory scope make science-unifying metaphysics preferable to no organized attempt at metaphysics? Here, the answer is conditional. It depends on whether a persuasive case can be made for the value of false explanations. I have not attempted to make that case here but have gestured toward some possible

avenues for further argumentation. The upshot is this: when naturalized metaphysics entails unifying scientific theses in the manner that Ladyman and Ross suggest, so long as one is willing to countenance non-factive accounts of explanation and of the value of explanatory unification, naturalized metaphysics has an antirealist-compatible, seemingly epistemic payoff relative to which the narrow and broad success conditions can be met.

5.3 Scientifically Informed Metaphysics

Perhaps the most common conception of naturalized metaphysics is one in which the metaphysician simply attends to science as she goes about her metaphysical theorizing. Chakravartty advances one such conception when he characterizes naturalized metaphysics as an exercise in making metaphysical claims and inferences that are “informed by, or sensitive to” the empirical aspects of science (2017: 76). He explains that for metaphysics to be ‘sensitive to’ or ‘informed by’ the empirical aspects of science is for those aspects to be a *basis* for and a *constraint* on metaphysical theorizing.¹⁴ This, in turn, means that “the ground of empirical inquiry is the inspiration or motivation for certain metaphysical inferences... [and] the ground of empirical inquiry is being taken seriously as setting limits on the viable conclusions of those inferences” (2017: 84). While Chakravartty calls this project *scientific ontology*, to avoid any potential confusion with the Quinean project, I will call it *scientifically informed metaphysics*.

According to Chakravartty, the propositions of scientifically informed metaphysics characteristically carry lower epistemic risk than propositions with less empirical exposure, like those of non-naturalized metaphysics. This is one reason to prefer scientifically informed metaphysics to its rivals. Epistemic risk, Chakravartty says, is “a feature of propositions... that determines how confidently one is able to judge whether they are true or false; that is, whether and to what extent they are conducive to knowledge” (2017: 84). These are inversely correlated, such that the more confidently one can judge truth value, the lower the epistemic risk. Moreover, scientifically informed metaphysics does seek knowledge, Chakravartty says, and in any knowledge-seeking endeavour, “the less epistemic risk the better” (2017: 85). The expected payoff of scientifically informed metaphysics, then, is relatively low epistemic risk.

The mentions of truth, falsity, and knowledge might tempt one to conclude that realism is operating in the background here. But it need not be. Even if one thinks that knowledge is the aim of scientifically informed metaphysics, one might not think that the truth condition of knowledge is ever actually met. Moreover, notice that on Chakravartty’s characterization, the inverse correlate of epistemic risk is not *confidence that p is true* but rather *confidence in one’s judgment of the truth value of p*. We had better restrict that to *rational* confidence to rule out cases of unearned or unwarranted confidence. So if the antirealist is rationally confident that science is false, then they will be rationally confident that scientifically informed metaphysics is false—and thus sci-

¹⁴ I have argued elsewhere that the constraining role of science with regard to naturalized metaphysics is epistemically significant and can explain the preferability of naturalized to non-naturalized metaphysics (Bryant 2021).

entifically informed metaphysics will carry relatively low epistemic risk notwithstanding its perceived falsity. This has the surprising consequence that having comparatively low epistemic risk is an antirealist-compatible payoff of scientifically informed metaphysics—or, more precisely, of its constitutive propositions.

Could the payoff of relatively low epistemic risk enable the satisfaction of the narrow and broad success conditions? First let us consider whether scientifically informed metaphysics is clearly preferable to non-naturalized metaphysics relative to considerations of epistemic risk. If we accept Chakravartty's conception of scientifically informed metaphysics and its relation to non-naturalized metaphysics, then it is clearly preferable in that regard. We saw that Chakravartty thinks the propositions of scientifically informed metaphysics lend themselves to more confident judgments of truth or falsity in virtue of their empirical exposure. Since such metaphysics is informed by the empirical aspects of science, that puts us in a relatively good position to judge whether its propositions are true or false.¹⁵

But how does all of this square with antirealism? The answer partly depends on what we think are the epistemically relevant features of *p*'s having low epistemic risk—the features that explain why it is epistemically valuable. One might think that what is significant is that when *p* has low epistemic risk, we are in a relatively good *evidential* position relative to *p*. We are able to pronounce confidently on its truth value because we have lots of evidence pertaining to it. From that perspective, adding antirealism to the picture only helps matters. That is because, to the wealth of scientific evidence relevant to scientifically informed metaphysics, the antirealist adds additional evidence, such as evidence from the history of science. So one can argue that, relative to epistemic risk, scientifically informed metaphysics is preferable to non-naturalized metaphysics because it has more evidence that speaks to the truth or falsity of its claims.

All that remains is to consider whether, relative to epistemic risk, the antirealist has some reason to prefer scientifically informed metaphysics to no organized pursuit of metaphysics. Well, which is less epistemically risky: scientifically informed metaphysics or no metaphysics? At first glance, no organized pursuit of metaphysics carries *no* epistemic risk. Nothing ventured, nothing gained *or* lost. But on more careful consideration, we cannot compare the levels of epistemic risk assumed, respectively, by the scientifically informed metaphysician and the metaphysical quietist. That is because *p*'s epistemic risk corresponds, inversely, to one's degree of confidence in one's assessment of *p*'s truth value. The metaphysical quietist countenances no metaphysical propositions, and so makes no pronouncements upon truth or falsity in which to be confident or not. So the quietist gives us nothing to evaluate or compare in terms of epistemic risk. As a workaround, perhaps we could assess degrees of confidence not in metaphysical systems but in overall philosophical systems. But that will not work, because the antirealist believes aspects of her philosophical system (such as her epistemological principles) and merely accepts others (such as the propositions of

¹⁵ That is not to say, however, that the naturalist is in an ideal position to make such judgments. Given underdetermination at various levels—of scientific interpretation by scientific theory, of scientific theory by empirical data, and by metaphysics by science—she is not in an ideal position. The claim is just that she is in a better position than her rivals.

scientifically informed metaphysics). At any rate, the upshot is that epistemic risk does not enable the antirealist naturalist to meet the broad success condition—at least not on Chakravartty’s conception of epistemic risk. In sum, relative to the payoff of reduced epistemic risk, scientifically informed metaphysics arguably can meet the narrow success condition but can’t meet the broad one.

*

I wish to discuss one final epistemic payoff of naturalized metaphysics, which is hinted at by the language of certain naturalists. For instance, Chakravartty says that the empirical aspects of science are a good ground for scientifically informed metaphysics because “empirical inquiry is our *best bet* for knowledge” (my emphasis, 2017: 85). In similar spirit, Maudlin writes that the metaphysician should interpret and elucidate physical theories because they “provide us with the *best handle we have* on what there is” (my emphasis, 2007: 1). Years prior to their remark on the worthlessness of false metaphysics (see §4 above), Ladyman and Ross commented:

Since [scientific] knowledge can be incorporated into unified pictures, we can... have some justified metaphysics. Based as it is on incomplete science, this metaphysics probably is not true. However, if it is at least motivated by our most careful science at time t , then it is *the best metaphysics we can have at t* . (my emphasis, 2007: 2)

The common thread here is that science is our best form of inquiry about the world, and thus if we want to do metaphysics, then naturalized metaphysics will be the best form of metaphysics. These philosophers are working with different conceptions of naturalized metaphysics, and it is open to debate which conception is truly best and in which ways. For simplicity, I will continue to index the discussion to scientifically informed metaphysics, and I will suppose that it is the best metaphysics we can have at t .

None of this talk of bestness presupposes realism. Science can be epistemically best relative to the available alternatives without being true. Likewise, naturalized metaphysics can be best without being true. The way in which it is best—relative to knowledge, justification, understanding, explanation and prediction, or other epistemic goals—is open to precisification.¹⁶ The point is that being best does not require successfully achieving whatever we take to be our epistemic aim—or that the epistemic aim be defined in terms of truth. Thus, being epistemically best is an antirealist-compatible expected payoff of scientifically informed metaphysics. With appropriate elucidation and argumentation, this could be a promising option for the antirealist naturalist.

¹⁶ Presumably, the naturalist would say that naturalized metaphysics is ‘best’ *in the same sense* that science is best. For instance, they might say that science is our best shot at understanding the underlying nature of reality and that naturalized metaphysics is our best shot at understanding the same, say, at a greater level of abstraction. I assume that the operative senses of bestness would dovetail, because naturalists tend to think that the good-making features of science are inherited, to some extent, by naturalized metaphysics, and that is what typically explains the comparative desirability of naturalized metaphysics. But I won’t foreclose *a priori* the possibility that the naturalist might find some way of arguing that science is best in one way and naturalized metaphysics in another. I thank Ylwa Sjölin Wirling for raising this issue.

Regarding the narrow and broad success conditions, the details would need to be filled in, but there is no in principle impediment to their satisfaction. If the claim that scientifically informed metaphysics is the best metaphysics we can have at t can be adequately spelled out and supported, then it would immediately follow that scientifically informed metaphysics is preferable to non-naturalized metaphysics. There could be a number of ways of doing this. One way might be to invoke Bayesianism and argue that the non-naturalistic metaphysician has limited evidence to conditionalize on and must therefore rely to an unacceptable extent on subjective priors. Bayesians sometimes argue that “prior opinion will tend to ‘wash out’ as believers acquire more and more information” (Joyce 2011: 445). With less data, subjective priors can exercise more influence. So scientifically informed metaphysics is arguably epistemically preferable relative to an epistemic policy that favours greater objectivity, understood in terms of the diminished role of subjective priors. The antirealist would then need to say why objectivity is epistemically valuable, independently of considerations of truth. This would be one way for the antirealist to flesh out the claim that naturalized metaphysics is the best metaphysics at t .

Regarding the preferability of scientifically informed metaphysics to no organized attempt at metaphysics, the idea that scientifically informed metaphysics is *the best metaphysics we can have at t* does not establish that it is worth doing. Neither does it rule it out. Rather, an independent case would need to be made for the value of metaphysics—and there are any number of argumentative directions that the proponent of scientifically informed metaphysics could go.

6. Conclusion

My aim was to show that the project of naturalizing metaphysics need not be accompanied by an underlying commitment to scientific realism. On the contrary, the naturalistic programme in metaphysics is compatible with even a strong form of antirealism that commits to the outright falsity of science. I identified two success conditions, narrow and broad, for the project of disentangling naturalized metaphysics from the assumption of realism. The antirealist must explain why, despite the falsity of science, naturalized metaphysics is preferable to non-naturalized metaphysics and to metaphysical quietism. I set out to show that it is possible for the antirealist to meet these conditions. I surveyed a number of conceptions of naturalized metaphysics and its potential payoffs in order to find avenues of argumentation that are open to the antirealist. The results were as follows:

- (1) Quinean ontology can have the antirealist-compatible payoff of making large scientific datasets more useful. This pragmatic payoff arguably satisfies the narrow and broad success conditions, because Quinean ontology will achieve this aim more consistently and predictably than non-naturalized metaphysics and because making scientific datasets more useful is pretty clearly worthwhile.
- (2) Science-unifying metaphysics can have the antirealist-compatible payoff of increasing the explanatory scope of science, so long as one is willing to countenance a non-factive account of explanation. In terms of explanatory scope, sci-

- ence-unifying metaphysics is preferable to non-naturalized metaphysics because it shares the explanatory scope of science; it is preferable to metaphysical quietism if a case can be made for the value of non-factive explanations.
- (3) Scientifically informed metaphysics can have the antirealist-compatible payoff of diminished epistemic risk, understood as the ability to pronounce confidently on the truth values of its propositions. The antirealist can argue that scientifically informed metaphysics is preferable to non-naturalized metaphysics from the perspective of epistemic risk because there is more evidence pertaining to its propositions. This payoff did not enable the antirealist to meet the broad success condition due to the inapplicability of the metric of epistemic risk to metaphysical quietism.
 - (4) Scientifically informed metaphysics can also have the antirealist-compatible payoff of being the best metaphysics available at t . Trivially, this would make it preferable to non-naturalized metaphysics; the challenge would be to substantiate the claim. I suggested that the antirealist might argue that scientifically informed metaphysics considers more data and therefore diminishes the influence of subjective priors in conditionalization. To meet the broad success condition and show that the best metaphysics we can have is preferable to metaphysical quietism, an independent case would need to be made for the value of doing metaphysics.

In all but one case (where metaphysical quietism was not risk evaluable), there were argumentative paths to satisfying the narrow and broad success conditions. Some are likely more attractive than others, but I leave those judgments to others. The details clearly need to be worked out in greater detail. My intent here was just to explore some of the antirealist's potential avenues of argumentation. It is telling just how many of them were revealed by such a small survey, holding fixed such a strong antirealist thesis. The avenues I have highlighted are hardly the only ones available: there are more modest varieties of antirealism, other conceptions of naturalized metaphysics, other antirealist-compatible payoffs, other conceptions of those payoffs, and other combinations thereof. Neither should one think that the success conditions must be met by privileging just one payoff or value; most kinds of inquiry will have more than one. The prospects of successfully wedding naturalized metaphysics to antirealism are, therefore, exceptionally promising.

References

- Arp, R., Smith, B. and Spear, A. 2015, *Building Ontologies with Basic Formal Ontology*, Cambridge, MA: MIT Press.
- Beebe, H. 2018, "The Presidential Address: Philosophical Scepticism and the Aims of Philosophy", *Proceedings of the Aristotelian Society*, 118, 1, 1–24.
- Bertrand, M. 2022, "We Need Non-factive Metaphysical Explanation", *Erkenntnis*, 87, 991–1011.
- Boyd, R. 1983, "On the Current Status of the Issue of Scientific Realism", *Erkenntnis*, 19, 1/3, 45–90.

- Bryant, A. 2021, “Epistemic Infrastructure for a Scientific Metaphysic”, *Grazer Philosophische Studien*, 98, 27–49.
- Bryant, A. 2020a, “Keep the Chickens Cooped: The Epistemic Inadequacy of Free Range Metaphysics”, *Synthese*, 197, 1867–1887.
- Bryant, A. 2020b, “Naturalisms”, *THINK*, 19, 56, 35–50.
- Cartwright, N. 1983, *How the Laws of Physics Lie*, Oxford: Oxford University Press.
- Chakravartty, A. 2017, *Scientific Ontology: Integrating Naturalized Metaphysics and Voluntarist Epistemology*, New York: Oxford University Press.
- Chakravartty, A. 2013, “On the Prospects of Naturalized Metaphysics”, in Ross, D., Ladyman, J. and Kincaid, H. (eds.), *Scientific Metaphysics*, Oxford: Oxford University Press, 27–50.
- Chakravartty, A. 2007, *A Metaphysics for Scientific Realism: Knowing the Unobservable*, Cambridge: Cambridge University Press.
- Cooper, A. and Green, C. 2016, “Embracing the Complexities of ‘Big Data’ in Archaeology: the Case of the English Landscape and Identities Project on JSTOR”, *Journal of Archaeological Method and Theory*, 23, 1, 271–304.
- Devitt, M. 1999, “A Naturalistic Defense of Realism”, in Hales, S. (ed.), *Metaphysics: Contemporary Readings*, Belmont: Wadsworth Publishing, 90–104.
- Devitt, M. 1997, *Realism and Truth*, 2nd Edition, Princeton: Princeton University Press.
- Doyle, Y., Egan, S., Graham, N. and Khalifa, K. 2019, “Non-factive Understanding: A Statement and Defense”, *Journal for General Philosophy of Science*, 50, 3, 345–365.
- Elgin, C. 2017, *True Enough*, Cambridge, MA: MIT Press.
- Ereshefsky, M. 2018, “Natural Kinds, Mind Independence, and Defeasibility”, *Philosophy of Science*, 85, 5, 845–856.
- Ereshefsky, M. 1998, “Species Pluralism and Anti-Realism”, *Philosophy of Science*, 65, 1, 103–120.
- Esfeld, M. 2009, “Hypothetical Metaphysics of Nature”, in Heidelberger, M. and Schieffmann, G. (eds.), *The Significance of the Hypothetical in the Natural Sciences*, Berlin: De Gruyter, 341–364.
- Guay, A. and Pradeu, T. 2020, “Right Out of the Box: How to Situate Metaphysics of Science in Relation to Other Metaphysical Approaches”, *Synthese*, 197, 5, 1847–1866.
- Hawley, K. 2018, “Social Science as a Guide to Social Metaphysics?”, *Journal for General Philosophy of Science*, 49, 187–198.
- Hawley, K. 2006, “Science as a Guide to Metaphysics?”, *Synthese*, 149, 3, 451–470.
- Hunt, S.D. 2011, “Theory Status, Inductive Realism, and Approximate Truth: No Miracles, No Charades”, *International Studies in the Philosophy of Science*, 25, 2, 159–178.
- Joyce, J.M. 2011, “The Development of Subjective Bayesianism”, in Gabbay, D.M., Hartmann, S., and Woods, J. (eds.), *Handbook of the History of Logic*, Amsterdam: North-Holland, 415–475.
- Kant, I. 1783/1977, *Prolegomena to Any Future Metaphysics That Will Be Able to Come Forward as Science*, 2nd Edition, Translated by J. Ellington, Indianapolis: Hackett.

- Ladyman, J. and Ross, D. 2013, “The World in the Data”, in Ross, D., Ladyman, J. and Kincaid, H. (eds.), *Scientific Metaphysics*, Oxford: Oxford University Press, 108–150.
- Ladyman, J., Ross, D., Spurrett, D. and Collier, J. 2007, *Every Thing Must Go: Metaphysics Naturalized*, Oxford: Oxford University Press.
- Lean, O. 2021, “Are Bio-Ontologies Metaphysical Theories?”, *Synthese*, 199, 11587–11608.
- Lipton, P. 2004, *Inference to the Best Explanation*, 2nd Edition, London: Routledge.
- Magnus, P.D. and Callender, C. 2004, “Realist Ennui and the Base Rate Fallacy”, *Philosophy of Science*, 71, 320–38.
- McKenzie, K. 2021, “Science-Guided Metaphysics”, in Bliss, R. and Miller, J.T.M. (eds.), *The Routledge Handbook of Metametaphysics*, Abingdon: Routledge, 435–446.
- McKenzie, K. 2020, “A Curse on Both Houses: Naturalistic versus A Priori Metaphysics and the Problem of Progress”, *Res Philosophica*, Saint Louis University, 97, 1, 1–29.
- McSweeney, M. 2023, “Metaphysics as Essentially Imaginative and Aiming at Understanding”, *American Philosophical Quarterly*, 60, 1, 83–97.
- Papineau, D. 2014, “The Poverty of Conceptual Analysis”, in Haug, M. (ed.), *Philosophical Methodology: The Armchair or the Laboratory*, Abingdon: Routledge, 166–194.
- Peirce, C.S. (1958), *Collected Papers of Charles Sanders Peirce*, Vol. 8, Edited by Burks, A.W., Cambridge, MA: Harvard University Press.
- Potochnik, A., De Regt, H., Elgin, C. and Khalifa, K. 2020, “Idealization and Many Aims”, *Philosophy of Science*, University of Chicago Press, 87, 5, 933–943.
- Psillos, S. 1999, *Scientific Realism: How Science Tracks Truth*, London: Routledge.
- Quine, W.V.O. 1981, *Theories and Things*, Cambridge, MA: Harvard University Press.
- Quine, W.V.O. 1960/2013, *Word and Object*, New Edition, Cambridge, MA: MIT Press.
- Rosen, G. 2020, “Metaphysics as a Fiction”, in Armour-Garb, B. and Kroon, F. (eds.), *Fictionalism in Philosophy*, Oxford: Oxford University Press, 28–47.
- Schrenk, M. 2017, *Metaphysics of Science: A Systematic and Historical Introduction*, New York: Routledge.
- Sjölin Wirling, Y. 2021, “Non-uniformism and the Epistemology of Philosophically Interesting Modal Claims”, *Grazer Philosophische Studien*, 98, 629–656.
- Smith, B. 2014, “The Relevance of Philosophical Ontology to Information and Computer Science”, in Hagengruber, R. and Riss, U. (eds.), *Philosophy, Computing and Information Science*, London: Pickering and Chatto, 75–83.
- Smith, B. 2003, “Ontology”, in Floridi, L. (ed.), *Blackwell Guide to Philosophy of Computing and Information*, Oxford: Blackwell, 155–166.
- Smith, P. 1998, “Approximate Truth and Dynamical Theories”, *British Journal for the Philosophy of Science*, University of Chicago Press, 49, 2, 253–277.
- Turri, J. 2018, “The Non-Factive Turn in Epistemology: Some Hypotheses”, in Mitova, V. (ed.), *The Factive Turn in Epistemology*. Cambridge: Cambridge University Press, 219–228.
- Van Fraassen, B. 1980, *The Scientific Image*, Oxford: Oxford University Press.

- Waters, C.K. 2019, "Presidential Address, PSA 2016: An Epistemology of Scientific Practice", *Philosophy of Science*, Cambridge University Press, 86, 4, 585–611.
- Waters, C.K. 2018, "Ask Not 'What Is an Individual?'" in Bueno, O., Chen, R.L. and Fagan, M.B. (eds.), *Individuation across Experimental and Theoretical Sciences*, New York: Oxford University Press, 91–113.
- Waters, C.K. 2017, "No General Structure", in Slater, M. and Yudell, Z. (eds.), *Metaphysics and the Philosophy of Science: New Essays*, Oxford: Oxford University Press, 81–108.
- Waters, C.K. 2014, "Shifting Attention From Theory to Practice in Philosophy of Biology", in Galavotti, M.C. et al. (eds.), *New Directions in the Philosophy of Science*, Berlin: Springer International Publishing, 121–39.
- Weston, T. 1992, "Approximate Truth and Scientific Realism", *Philosophy of Science*, Cambridge University Press, 59, 1, 53–74.
- Weston, T. 1987, "Approximate Truth", *Journal of Philosophical Logic*, 16, 2, 203–227.
- Williamson, T. 2013, "What is Naturalism?", in Haug, M. (ed.), *Philosophical Methodology: The Armchair or the Laboratory*, New York: Routledge, 29–31.
- Worrall, J. 1989, "Structural Realism: The Best of Both Worlds?", *Dialectica*, 43, 1–2, 99–124.