Metaphysical Perspicuity

Chanwoo Lee

Abstract

Scientific theories often allow multiple formulations, e.g., classical mechanics allows Lagrangian and Hamiltonian formulations. While we count them as equally true, it has been suggested that one formulation can still be more metaphysically perspicuous than another. This paper provides a new account of metaphysical perspicuity, offering both descriptive and revisionary components: As a descriptive component, we examine how metaphysical perspicuity has been conceptualized in the literature. As a revisionary component, we challenge the conventional conception that associates metaphysical perspicuity with other neighboring notions. Thus, we argue that metaphysical perspicuity is a sui generis notion, worth adding to philosophers' toolbox.

1   Introduction

What makes our representation of the world successful? One obvious factor is *truth*; we value true representations above false representations.[1] Nevertheless, one may argue that the *manner* of representation matters as well. Consider, for example, an English sentence 'The average American adult man has 2.3 children', which may represent a statistical truth about the American demographics. Some argue that, aside from its truth value, the given sentence leaves more to be desired as a *perspicuous* representation of the fact.

> Taken at face value, this would appear to suggest that there is a certain American male who is average and who has 2.3 children, which is absurd. But of course, the original sentence, as it is standardly used, carries no such implication. It is merely an unperspicuous way of expressing the fact that the number of children with American fathers divided by the number of American adult males is equal to 2.3. (O'Leary-Hawthorne and Cortens 1995, 155)

No person can have 2.3 children, which makes the sentence 'The average American adult man has 2.3 children' unperspicuous; while it can be interpreted as true, it represents a statistical fact about the American demographics indirectly. A more perspicuous

---

1   A similar notion is *accuracy*, which comes in degrees. For the present purpose, accuracy can be treated in the same way we treat truth; an accurate representation can either be metaphysically perspicuous or unperspicuous.

representation has to directly represent the statistical fact the way it is, explicitly using statistical terms.

Note that the present usage of 'perspicuous' may not necessarily align with the more ordinary usage of the English adjective 'perspicuous', which may be interchangeable with expressions such as 'clear' or 'easy to understand'. For example, it is not difficult to understand the meaning of 'The average American adult man has 2.3 children'. Nonetheless, it might fail to be "a perspicuous characterisation of reality *just as it stands*." (O'Leary-Hawthorne and Cortens 1995, 146) Its lack of perspicuity has to do with the number of children you can have, which is an objective feature of the world. The present paper concerns this specific notion of perspicuity, which we may refer to as 'metaphysical perspicuity'.[2]

───────────────

2   I use the term 'metaphysical perspicuity' to follow the convention of the literature
    (O'Leary-Hawthorne and Cortens 1995; Møller-Nielsen 2017): The adjective
    'metaphysical' in 'metaphysical perspicuity' is intended to be interchangeable with
    'objective', 'ontic', 'worldly', etc., as opposed to 'psychological' or '(merely) epistemic'.
    That is, 'metaphysical' in 'metaphysical perspicuity' does *not* necessarily mean 'abstract'
    or 'extra-empirical', i.e., "metaphysical perspicuity is also, I think, a notion that is
    reasonably serviceable in physical (rather than "merely metaphysical") contexts."
    (Møller-Nielsen 2017, 1257)

Metaphysical perspicuity has been used in many areas of philosophy,[3] but the notion itself has received little scrutiny. This paper aims to provide an account of metaphysical perspicuity in the context of philosophy of science, both descriptive and revisionary. First, I provide a descriptive account of metaphysical perspicuity with reference to Jill North's (2021) recent work (Section 2). At the same time, I also aim to extend the account of metaphysical perspicuity in a revisionary way. I argue that metaphysical perspicuity is more versatile than conventionally construed, allowing us to incorporate non-fundamentality as well as context-dependency (Section 3). Thus, I aim to show that metaphysical perspicuity is a useful concept that can be used to capture important insights into metaphysics of science.

2   A Descriptive Account: North's Case

In her recent works on philosophy of physical sciences, North (2013; 2021) has argued that the notion of metaphysical perspicuity plays an active role in scientific theorizing.[4] Physical theories often allow multiple different formulations which yield the same empirical success:

---

3   See, e.g., the recent discussion of the idea of a metaphysically distinguished language (e.g., Dorr 2005; Sider 2009; 2011), cf. Finocchiaro's (2022) discussion of 'fidelity'.

4   Also see, e.g., Møller-Nielsen (2017), Martens and Read (2021), Jacobs (2022) for the recent use of metaphysical perspicuity in philosophy of physics, especially on symmetry-related models.

classical mechanics allows Lagrangian and Hamiltonian formulations, non-relativistic

quantum mechanics allows the Schrödinger and the Heisenberg picture, etc. In each case,

both formulations of the physical theory count as true; neither should be construed as only

expressing a partial or approximate truth.[5] However, according to North, one formulation of a

physical theory can be more metaphysically perspicuous than another; the more perspicuous

formulation has more reasons to be preferred:

> we should, other things being equal, prefer a formulation that most directly
>
> corresponds to the nature of the physical world, for this brings with it a level of
>
> "metaphysical perspicuousness" that is preferable. […] the more perspicuous
>
> formulation, the one that is preferable for that reason, more directly gets at the
>
> true nature of physical reality. (North 2021, 7)

North claims that a formulation is metaphysically perspicuous if it "directly corresponds to

the nature of the physical world".[6] This characterization needs more unpacking though. First,

5   See footnote 12 for more discussion on approximation and idealization in sciences.

6   North's use of 'metaphysical perspicuousness' slightly differs from the present use of

'metaphysical perspicuity' in the following way: while we take 'direct correspondence to

the nature of the world' and 'metaphysical perspicuity' to be synonymous, North takes

'metaphysical perspicuousness' to be what follows from the direct correspondence (cf.

Wallace and Timpson 2010). Nonetheless, for the purpose of this paper, this disagreement

what does she mean by '*direct*' as opposed to 'indirect' correspondence? She offers the following as an intuitive explanation:

> There is a difference between a theory's being such that all the physical facts *can be recovered* from it, and being such that those facts are reasonably *directly represented* by it. In a slogan, there is a difference between what a theory *can* say, or what it can be made to say given suitable definitions, and what it *does* say. (North 2021, 213)

You may have two different theories from which you can *recover* the same set of physical facts, but it does not follow that the facts are *directly represented* by both. Whereas a theory *indirectly* corresponds to what it *can* say, a theory *directly* corresponds to what it *does* say. Consider the earlier example 'The average American adult man has 2.3 children.' The statement can be interpreted as true, but it does not directly 'say' the corresponding statistical fact; it has to be 'recovered' from the statement. As such, a statement, formulation, or theory is metaphysically perspicuous only if it directly represents the intended fact or domain (see Section 3.2 for more discussion about the 'intended domain').

---

does not make a substantial difference; North seems to suggest that, necessarily, a perspicuous representation is in direct correspondence with the world and vice versa.

Metaphysical perspicuity is also associated with *objectivity* in the sense that it has to be independent of a particular subject or perspective.[7] For example, North (2021, sec. 2.1) considers how a two-dimensional Euclidean space can be represented in a multitude of coordinate systems with different degrees of objectivity. A "particularly nice kind" among them are the Cartesian coordinate systems, which, unlike many others, capture the invariance of the distance between two points. Given how invariance is associated with objectivity in geometric theorizing, North infers that the Cartesian systems are better at capturing "the intrinsic, objective nature of this space". Hence, insofar as they intend to represent the Euclidean space, the Cartesian systems are taken to be more metaphysically perspicuous than many others. Thus, metaphysical perspicuity can be characterized as the quality of the representations such that they 'directly' correspond to the 'objective' features of the world. A statement, formulation, or theory that is metaphysically perspicuous represents 'reality just as it stands.'

What makes metaphysical perspicuity especially relevant in the context of philosophy of science is that it is taken to facilitate *explanation.* That is, other things equal, the more metaphysically perspicuous a representation is, the more explanatory it is. "Direct

_____

7   The present characterization of 'objectivity' is more specific than how North (2021) uses the term 'objectivity'; the sense of 'objectivity' in the present paper is closer to what North calls 'structure' (see North 2021, sec. 2.3).

formulations are […] more explanatory: we understand more readily what it is about the world that makes the formulation as good and useful as it is." (North 2021, 8) Insofar as a 'direct' representation of the subject matter can contribute to a clearer understanding, the use of a metaphysically perspicuous representation can lead to more explanatory power.[8]

This also aligns well with the received view that closely associates the notion of reality with the notion of explanation, e.g., the 'explanatory criterion' of reality that "something is real if its positing plays an indispensable role in the explanation of well-founded phenomena." (Psillos 2005, 398–99) Insofar as the notion of 'reality' here can be understood as being more-or-less interchangeable with 'objective features' of the world (cf. Rosen 1994), we can reasonably expect a metaphysically perspicuous representation to have explanatory value; a metaphysically perspicuous directly represents what is 'real', which is likely to be explanatorily relevant.

For these reasons, North suggests that metaphysical perspicuity should be recognized as a theoretical virtue in scientific theorizing. That is, a metaphysically perspicuous formulation/theory should, other things being equal, be preferred to unperspicuous rivals. Other things equal, scientists have a reason to, and often do, choose a theory or formulation

_____

8   This characterization remains neutral about many contested debates on the nature of explanation, e.g., whether representations themselves are explanatory or not (Bueno and Colyvan 2011; Craver 2014; Nguyen and Frigg 2021).

that 'directly' corresponds to the 'objective' features of the world. North (2021, chap. 3) provides a systematic account of the inferential patterns in physics that revolves around metaphysical perspicuity.

This paper does not take a stand on the methodological aspect of North's account, e.g., how to determine the metaphysical perspicuity of a scientific representation without presupposing what the objective features of the world are like. Instead, we focused on what it means for a representation to be metaphysically perspicuous; we can learn from North how the notion of metaphysical perspicuity is conventionally conceived of.

Hence, the account of metaphysical perspicuity presented by far is *descriptive*; I aimed to provide an explicit account of the use of metaphysical perspicuity in the existing literature. In the next section, I provide a *revisionary* account of metaphysical perspicuity to complement the descriptive account here; while it remains consistent with what was presented in this section, the revisionary account challenges some conventional views about metaphysical perspicuity implicitly assumed in the literature.

3   A Revisionary Account: Beyond the Conventional Conception

In the previous section, we considered how North characterized metaphysical perspicuity in terms of 'the true nature of physical reality'. For some readers, this description may resemble some neighboring philosophical concepts, e.g., fundamentality. Indeed, the notion of

metaphysical perspicuity has conventionally been associated with such neighboring concepts in the literature.

In this section, I offer a revisionary account of metaphysical perspicuity that challenges the conventional conception. I argue that the scope of metaphysical perspicuity is not as restrictive as conventionally construed. First, I suggest that metaphysical perspicuity is orthogonal with fundamentality; a metaphysically perspicuous representation need not be exclusive to the fundamental realm (Section 3.1). Furthermore, I suggest that metaphysical perspicuity need not be limited to context-independent features, which is motivated by the recent works on the context-dependency of scientific explanation (Section 3.2).

This revisionary account has two general upshots: First, it implies that the notion of metaphysical perspicuity is more widely applicable than conventionally construed, which makes it more versatile. Second, it shows that metaphysical perspicuity does not collapse into neighboring notions such as fundamentality, indicating that it deserves more philosophical attention.

3.1   Non-Fundamental?

Metaphysicians often distinguish between the fundamental from the non-fundamental layer of the world.[9] For instance, physicalists who distinguish the fundamental from the non-fundamental layers will argue that physical facts underlie other facts about the world (cf. Stoljar 2022). The world is, fundamentally speaking, taken to be nothing but subatomic particles and their interactions; macro-level phenomena involving molecules, mid-sized objects, life forms, social entities, etc. are then taken to be non-fundamental. Such non-fundamental layers may be 'real', but in some sense, depend on the fundamental layer.

The use of metaphysical perspicuity in the extant literature has conventionally been restricted to the fundamental layer of the world (cf. Sider 2011). That is, metaphysical perspicuity is taken to go hand in hand with fundamentality; a representation is metaphysically perspicuous only when it corresponds to the fundamental feature of the world. For example, given physicalism, only the representations in microphysical terms will count as metaphysically perspicuous. If such a characterization of metaphysical perspicuity is correct, the notion of metaphysical perspicuity will not offer much content beyond what the notion of fundamentality can do.

In the case of philosophy of science too, the focus has been on the fundamental layer. For instance, when North argues that a metaphysically perspicuous theory can let us know

9 See, e.g., Fine (2001), Schaffer (2009), Sider (2011) for some well-known accounts of the distinction between the fundamental and the non-fundamental.

the true nature of the world, she tentatively restricts her scope to theories about the fundamental layer.[10]

> Notice that when making these inferences, we assume that the laws in question are fundamental laws. Assuming that Aristotle's physics is the fundamental theory, we infer that the world has a preferred-location structure. Assuming that Newton's physics is the fundamental theory, we are led to ascribe a different structure to the world. (Perhaps there is some similar principle at work for nonfundamental laws, but I won't consider this here.) (North 2021, 57)

Metaphysical perspicuity has thus been associated with fundamentality, but is this association necessary? Is metaphysical perspicuity indeed exclusive to the fundamental domain? I reject this association; metaphysical perspicuity and fundamentality are orthogonal. I argue that, in principle, metaphysical perspicuity does not discriminate between the fundamental and the non-fundamental layer; insofar as they are objective features of the world, each layer can be represented in a metaphysically perspicuous manner on its own. For example, even if

_____

10 Also, North sometimes seems to suggest that metaphysical perspicuity and fundamentality go hand in hand: "The better—*more direct, perspicuous, explanatory, fundamental*—characterization of the plane's structure is given by a geometric object, a metric tensor, which does not mention coordinate labels and more directly captures the nature of the plane, itself a geometric object." (North 2021, 164–65, emphasis added)

physicalism is true, a non-fundamental domain such as that of social science need not rely on a physical theory to be perspicuously represented.

My argument can be put more explicitly with reference to the well-received view that special sciences can be autonomous even when the world is fundamentally governed by physics (e.g., Fodor 1974). A theory of special sciences, e.g., economics, can be scientifically successful despite being non-fundamental. In contrast, it is unclear whether a fundamental theory such as that of particle physics can well account for an economic phenomenon; even if it does, the account using particle physics is more likely to invoke physical features which are irrelevant in economics.

In the given case, metaphysical perspicuity can (and perhaps should) be ascribed to a theory of economics, not particle physics. My argument is twofold: First, we can attempt a 'conceptual analysis' of the notion of metaphysical perspicuity based on its characterization in Section 2. Recall that our earlier characterization only requires 'directness' and 'objectivity' as the desiderata of metaphysical perspicuity; neither desideratum seems incompatible with the non-fundamental domain. For example, the socioeconomic structure may not be fundamental, but we may still admit that it is an objective feature of the world; a theory of economics can describe 'the true nature' of the world. Moreover, when it comes to an economic phenomenon, a physical theory is likely to offer a very roundabout account of the phenomenon at best, if at all; it is likely that a more direct account of the economic

phenomenon can be found in economics itself. Thus, the conceptual analysis of metaphysical perspicuity suggests that a theory of economics, which is meant to be about the non-fundamental domain, can still be perspicuous.

Second, we can consider the 'conceptual engineering' approach; instead of merely analyzing the notion of metaphysical perspicuity, we can consider "how we *ought* to use [it] to suit specific aims" (Isaac, Koch, and Nefdt 2022, 2). I argue that the conceptual engineering approach also leads to the same conclusion that there is a reason to accommodate the non-fundamental domain. Recall how metaphysical perspicuity was meant to facilitate explanation; we expect a perspicuous theory to be more explanatory than a less perspicuous counterpart. In the given example, the theory of economics is supposedly more suited to explain the economic phenomenon compared to that of particle physics. Given this supposition, we can ask whether the theory of economics ought to be deemed more perspicuous than the theory of particle physics. If not, a problem will emerge; it will conflict with the presumption that the theory of economics offers more explanation than the theory of particle physics does. If we insist that the theory of particle physics is more perspicuous given its fundamentality, the notion of metaphysical perspicuity no longer seems to fulfill its 'specific aim' that it is meant to facilitate explanation. Hence, the exclusion of the non-fundamental domain will defeat the "specific aims" of introducing metaphysical perspicuity in the first place.

14

Thus, I argue that metaphysical perspicuity and fundamentality are orthogonal; metaphysical perspicuity can be ascribed to a non-fundamental domain as well. Thus, contrary to what the conventional conception suggests, metaphysical perspicuity does not collapse into fundamentality.

Caveat: we presupposed that *there can be a non-fundamental yet objective layer of the world*. Some may challenge this presupposition; only the fundamental layer of the world is objective and the non-fundamental layers inevitably involve some subjective elements.[11] Granted, I suggest that an extensional overlap between metaphysical perspicuity and fundamentality does not compromise our position; what matters is that they are still conceptually distinguishable.

3.2   Context-dependent?

In Section 3.1, I argued that an ascription of metaphysical perspicuity need not be restricted to a certain level of description; a theory of economics can be more metaphysically

_____

11 Sider's (2011) account can possibly be interpreted this way, e.g., he claims "no proposition about cities—that is, no proposition involving the notion of being a city—is real" (Sider 2011, 144) given that 'city' is a non-fundamental notion (cf. Barnes 2014; Sider 2017). For a contrary account of 'emergent ontology', see, e.g., the approach based on 'real patterns' (Dennett 1991; Wallace 2010).

perspicuous than a theory of particle physics when the intended domain is economic phenomena. Notice that metaphysical perspicuity is determined relative to the *intended* domain here. If, for example, the intended domain were the physical substrate of people's economic actions (however hodgepodge it may be from a physical perspective), then this could be more perspicuously represented in terms of particle physics. This suggests that the intended domain can be a key factor in determining metaphysical perspicuity. I argue that this feature of metaphysical perspicuity makes the notion more flexible than conventionally construed. Importantly, I argue that metaphysical perspicuity can, in principle, be *context-dependent* in the sense that the context can determine the intended domain.

To motivate this conception, let us consider some recent literature on the context-dependency of scientific explanation: Bokulich (2018) emphasizes how, in practice, scientific explanation relies on a particular, contextualized representation of the phenomenon to be explained:

> scientists do not study phenomena in their full complexity; rather, they study a simplified representation of the phenomenon contextualized within a particular field, research program, or explanatory project. (Bokulich 2018, 801)

As an example, she illustrates how water, a seemingly simple kind of chemical entity, is represented in a multitude of ways even within a single scientific field, each of which reflects a different set of properties of water: Water can be represented either as a continuum, as a

collection of classical atoms, or even quantum-mechanically. Moreover, even within the

classical picture, water molecules allow a plurality of representations, each of which has its

strength and weakness depending on the context. Thus, each representation "carve[s] up the

space of possible causal explanatory factors differently" (Bokulich 2018, 797), leading to

different explanations based on each context.[12] That is, each representation seems to directly

correspond to some 'causal explanatory factors' in their given context.

Note that context-dependency in the present sense does not imply *agent-dependency*.

A water scientist may focus on a specific representation based on her interest in the fluid

_____

12 Some might argue that this process necessarily involves approximation or idealization,

which leads to a false representation. While I remain neutral about this proposal here, I

think this proposal can, if correct, provide interesting support for the case of a *false and*

metaphysically perspicuous representation; just like truths, false representations can be

perspicuous as well. It may be argued, for example, that an idealization can help directly

represent a causal mechanism hidden behind some explanatorily irrelevant details; the

idealized representation, which is false but still accurate enough or 'close to truth' (Oddie

and Cevolani 2022), can be metaphysically perspicuous in virtue of directly representing

the objective causal mechanism despite ignoring some details. Hence, approximate and

idealization can possibly provide a plausible case for the view that the true/false and

perspicuous/unperspicuous distinctions are crosscutting.

nature of water, but it does not necessarily make what corresponds to the representation, i.e., the fluidity of water, any less *objective*. The role of the context is limited to determining which feature, among many equally objective 'causal explanatory factors', to focus on, which does not compromise objectivity.

I argue that this context-dependency of scientific representations can be naturally accommodated under the present account of metaphysical perspicuity; metaphysical perspicuity can be context-dependent in a relevant sense. To understand this, recall the observation at the beginning of this section that metaphysical perspicuity is determined relative to the *intended* domain. The context-dependency of metaphysical perspicuity can be seen as a mere extension of this observation; metaphysical perspicuity is context-dependent only in the sense that the context can decide which set of objective features counts as the intended domain.

Going back to Bokulich's example, the context can decide which 'causal explanatory factors' constitute the intended domain. Given that such factors are objective and directly representable, their representation can be metaphysically perspicuous in the given context. Hence, context-dependency is fully consistent with the characterization of metaphysical perspicuity presented in Section 2.

Why accommodate context-dependency though? What is its upshot? My answer is, as in Section 3.1, doing otherwise may defeat the purpose of introducing metaphysical

18

perspicuity in the first place given its 'specific aim' of facilitating explanation. Bokulich's account is arguably backed up by the actual practice of scientific explanation; if our account of metaphysical perspicuity cannot accommodate the context-dependency diagnosed by Bokulich, then it may end up failing to account for the actual scientific practice. Thus, being able to accommodate context-dependency is virtuous for the present account of metaphysical perspicuity.

At the same time, we need not be *committed* to the context-dependency of metaphysical perspicuity itself nor that of explanation. If, for independent reasons, the seemingly context-dependent nature of explanation can be challenged *contra* Bokulich, there would be little reason to believe that metaphysical perspicuity is context-dependent either. The notion of metaphysical perspicuity itself remains neutral in this debate; all I aimed to show was that metaphysical perspicuity is flexible enough to accommodate such possible cases if needed.

Thus, I argue that metaphysical perspicuity can have applications going beyond the type of cases conventionally construed: We can attribute metaphysical perspicuity to a representation in a non-fundamental domain, and moreover, it can be taken as context-dependent as well. Thus, neither does the notion of metaphysical perspicuity collapse into the notion of fundamentality nor does it fail to account for actual scientific practice.

4   Concluding Remarks

In this paper, I provided an account of metaphysical perspicuity, which distinguishes between a perspicuous and a non-perspicuous representation. My account was both descriptive and revisionary; on the one hand, I accounted for the extant uses of the notion of metaphysical perspicuity as in North's work, and on the other hand, I showed that its scope can be extended beyond what is conventionally construed. Thus, I suggest that (i) metaphysical perspicuity is a *sui generis* notion distinct from other neighboring notions and (ii) it can be a useful addition to philosophers' toolbox, which is potentially applicable to many areas of philosophy including metaphysics of science.

References

Barnes, Elizabeth. 2014. "Going Beyond the Fundamental: Feminism in Contemporary Metaphysics." *Proceedings of the Aristotelian Society* 114 (December): 335–51. https://doi.org/10.1111/j.1467-9264.2014.00376.x.

Bokulich, Alisa. 2018. "Representing and Explaining: The Eikonic Conception of Scientific Explanation." *Philosophy of Science* 85 (5): 793–805. https://doi.org/10.1086/699693.

Bueno, Otávio, and Mark Colyvan. 2011. "An Inferential Conception of the Application of Mathematics." *Noûs* 45 (2): 345–74. https://doi.org/10.1111/j.1468-0068.2010.00772.x.

Craver, Carl F. 2014. "The Ontic Account of Scientific Explanation." In *Explanation in the Special Sciences: The Case of Biology and History*, edited by Marie I. Kaiser, Oliver R. Scholz, Daniel Plenge, and Andreas Hüttemann, 27–52. Synthese Library. Dordrecht: Springer Netherlands. https://doi.org/10.1007/978-94-007-7563-3_2.

Dennett, Daniel C. 1991. "Real Patterns." *Journal of Philosophy* 88 (1): 27–51.

Dorr, Cian. 2005. "What We Disagree About When We Disagree About Ontology." In *Fictionalism in Metaphysics*, edited by Mark Eli Kalderon, 234–86. Oxford University Press.

Fine, Kit. 2001. "The Question of Realism." *Philosophers' Imprint* 1 (1): 1–30.

Finocchiaro, Peter. 2022. "Seek the Joints! Avoid the Gruesome! Fidelity as an Epistemic Value." *Episteme*, February, 1–17. https://doi.org/10.1017/epi.2021.52.

Fodor, Jerry. 1974. "Special Sciences (or: The Disunity of Science as a Working Hypothesis)." *Synthese* 28 (2): 97–115. https://doi.org/10.1007/BF00485230.

Isaac, Manuel Gustavo, Steffen Koch, and Ryan Nefdt. 2022. "Conceptual Engineering: A Road Map to Practice." *Philosophy Compass* 17 (10): e12879. https://doi.org/10.1111/phc3.12879.

Jacobs, Caspar. 2022. "Invariance, Intrinsicality and Perspicuity." *Synthese* 200 (2): 135. https://doi.org/10.1007/s11229-022-03682-2.

Martens, Niels C. M., and James Read. 2021. "Sophistry about Symmetries?" *Synthese* 199 (1): 315–44. https://doi.org/10.1007/s11229-020-02658-4.

Møller-Nielsen, Thomas. 2017. "Invariance, Interpretation, and Motivation." *Philosophy of Science* 84 (5): 1253–64. https://doi.org/10.1086/694087.

Nguyen, James, and Roman Frigg. 2021. "Mathematics Is Not the Only Language in the Book of Nature." *Synthese* 198 (24): 5941–62. https://doi.org/10.1007/s11229-017-1526-5.

North, Jill. 2013. "The Structure of a Quantum World." In *The Wave Function: Essays on the Metaphysics of Quantum Mechanics*, edited by Alyssa Ney and David Albert, 184–202. Oxford University Press.

———. 2021. *Physics, Structure, and Reality*. Oxford: Oxford University Press.

Oddie, Graham, and Gustavo Cevolani. 2022. "Truthlikeness." In *The Stanford Encyclopedia of Philosophy*, edited by Edward N. Zalta and Uri Nodelman, Winter 2022. Metaphysics Research Lab, Stanford University. https://plato.stanford.edu/archives/win2022/entriesruthlikeness/.

O'Leary-Hawthorne, John, and Andrew Cortens. 1995. "Towards Ontological Nihilism." *Philosophical Studies* 79 (2): 143–65.

Psillos, Stathis. 2005. "Scientific Realism and Metaphysics." *Ratio* 18 (4): 385–404. https://doi.org/10.1111/j.1467-9329.2005.00301.x.

Rosen, Gideon. 1994. "Objectivity and Modern Idealism: What Is the Question?" In *Philosophy in Mind*, edited by John O'Leary-Hawthorne and Michaelis Michael, 277–319. Kluwer Academic Publishers.

Schaffer, Jonathan. 2009. "On What Grounds What." In *Metametaphysics: New Essays on the Foundations of Ontology*, edited by David Manley, David John Chalmers, and Ryan Wasserman, 347–83. Oxford University Press.

Sider, Theodore. 2009. "Ontological Realism." In *Metametaphysics: New Essays on the Foundations of Ontology*, edited by David John Chalmers, David Manley, and Ryan Wasserman. Oxford University Press.

———. 2011. *Writing the Book of the World*. Oxford University Press.

———. 2017. "Substantivity in Feminist Metaphysics." *Philosophical Studies* 174 (10): 2467–78. https://doi.org/10.1007/s11098-016-0739-7.

Stoljar, Daniel. 2022. "Physicalism." In *The Stanford Encyclopedia of Philosophy*, edited by Edward N. Zalta, Summer 2022. Metaphysics Research Lab, Stanford University. https://plato.stanford.edu/archives/sum2022/entries/physicalism/.

Wallace, David. 2010. "Decoherence and Ontology, Or: How I Learned to Stop Worrying and Love Fapp." In *Many Worlds? Everett, Quantum Theory, and Reality*, edited by Simon Saunders, Jonathan Barrett, Adrian Kent, and David Wallace. Oxford University Press.

Wallace, David, and Christopher G. Timpson. 2010. "Quantum Mechanics on Spacetime I: Spacetime State Realism." *The British Journal for the Philosophy of Science* 61 (4): 697–727.