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BOOK REVIEWS

Review of Stavros Ioannidis and Stathis Psillos's *Mechanisms in Science: Method or Metaphysics?*

Stavros Ioannidis and Stathis Psillos, *Mechanisms in Science: Method or Metaphysics?* Cambridge: Cambridge University Press (2022), 250 pp. $99.99 (hardback)

There is much to recommend and much that I think is true in Stavros Ioannidis and Stathis Psillos's *Mechanisms in Science: Method or Metaphysics?* It includes not only clear and concise philosophical argument and detailed yet digestible scientific case studies but some fascinating history of the mechanical philosophy. Especially interesting is the authors' comparison of Newton's disagreement with Leibniz over mechanical explanation with their own disagreement with New Mechanists. Mechanistic philosophers of science must certainly grapple with this book.

I have some reservations about the historical comparison, but here I focus on what I take to be the central philosophical theses of the book. These are (1) that much contemporary mechanistic philosophy of science contains metaphysical commitments that are unnecessary to understanding the concept of mechanism used in scientific practice and (2) that an account of that concept as a causal pathway—understood merely as a sequence of difference makers linked by relations of counterfactual dependence—captures its use without the unnecessary metaphysical commitments. Although I think both theses are mostly true, I take this opportunity to register some points of disagreement.

Which work in contemporary mechanistic philosophy of science is metaphysically profligate, and why? Two (among others) of the book's main antagonists here are Carl Craver and Stuart Glennan, to each of whom a critical chapter is devoted. Briefly, Craver's metaphysical extravagance is his concept of constitutive relevance, and Glennan's is his concept of activity. Constitutive relevance is the relation Craver, following Salmon (1984), takes to hold between an explanandum phenomenon and the explanatorily relevant parts of the mechanism responsible for it. When the phenomenon to be explained is the end product of a causal sequence, such as the output of an automotive production line or the eight ball's entering the corner pocket, explanatory relevance is causal (etiological) relevance. But it seems—and, importantly, it seems as a matter of ubiquitous scientific practice—that not all explananda are so related to their explanantia. Examples abound. There is a difference between an explanation of my extending my leg that cites the impact of the reflex hammer and one that cites the contracting muscle fibers. Some explananda are

(at least partly) composed of their explanantia, and most, including the authors, agree that there are no causal relations between levels of composition.[1] The notion of constitutive relevance is intended to explicate the kind of explanatory relevance at issue in these cases.

Why do the authors think that constitutive relevance is metaphysically extravagant? The argument seems to be that the concept of constitutive relevance is rendered otiose by the existence of *some* mechanisms that lack clear boundaries, the existence of *some* mechanisms that are not part of any "higher-level" acting entity (an S that ψs), and the existence of *some* mechanisms that seem to have "components" that are external to them (203). In other words, there are kinds of cases to which it is not obvious that the concept of constitutive relevance applies. For example, ions relevant to the firing of a neuron's action potential often reside outside the neuron, and the processes involved in erosion on a riverbank are not components of some acting entity. I will not deny (nor has Craver denied) the existence of such cases, and it is important for philosophers of science to account for the relations of (perhaps nonconstitutive) relevance operative in them. However, the existence of cases to which it is not obvious that the concept of constitutive relevance applies (or even the existence of cases to which it is obvious that the concept of constitutive relevance does *not* apply) does not entail the nonexistence of cases to which it obviously applies. At issue is a fundamental distinction between ways in which some explananda are related to their explanantia, and the authors must contradict scientific practice—which it is their stated aim not to do—by denying the distinction.

It is unclear why the authors insist on this denial, because it seems that they have the resources for a satisfactory and ontologically slim account of constitutive relevance: they accept the causal relation and the compositional relation. They (rightly) insist that scientific practice need not be committed to any particular metaphysics of these relations; for their purposes, and for practical scientific purposes, causation is difference making, and that's that. Craver, Glennan, and I (2021; building on work by Harinen 2018, whom the authors cite approvingly, and Prychitko 2021) have recently argued that causation and composition are all one needs for an account of constitutive relevance, an idea present in Craver (2007) and even in Salmon (1984) but not yet worked out fully adequately. (The authors seem to think that mechanists are committed to constitutive relevance being some mysterious third relation, as if explicating constitutive relevance in terms of causation and composition is equivalent to denying its existence.) I think the authors would find our updated account amenable: we explicate constitutive relevance in terms of causation and composition; we argue that the core of every mechanism is a causal process (the authors sometimes use the phrase "causal process" instead of "causal pathway" [e.g., 8, 106, 118]); and we do away with the "higher-level" entity S, instead focusing on sufficient epistemic conditions for entities to be constitutively relevant to some phenomenon that may or may not be embodied in a "higher-level" entity. Late in the book (205–8), the authors try to accommodate "componential" explanation in a way similar to ours, but I don't think they emphasize the importance of the

[1] The authors say that they accept interlevel causation, but they do not mean causation between levels of composition or part and whole; they simply mean that entities at different levels of scale and organization can causally interact, which no mechanist denies.

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compositional relation enough. If they did, I think we would be in agreement. They write that "identifying the components of a causal pathway that links an initial cause to some effect can then be usefully distinguished from etiological causal explanation that identifies antecedent causes, although in both cases what we are identifying are causal relationships between variables or components of a pathway" (206). Thus componential explanation involves identifying causal mediators in a pathway. Indeed, but where is the *explanandum* in such explanations? It is *composed*, in many cases and at least in part, of the causal pathway.

The authors would still object to our updated account of constitutive relevance on the grounds that it relies on a concept of mechanism as "a collection of entities whose activities and interactions are organized such that they are responsible for some phenomenon" (Craver, Glennan, and Povich 2021, 8810). Call this characterization of a mechanism, following recent tradition, *minimal mechanism*. Here we get to the authors' complaints with Glennan. According to them, to characterize adequately the concept of mechanism, it is sufficient to characterize it as a causal pathway, where this latter concept, contra Glennan, does not need further characterization in terms of a dualism of entities and activities.[2] Instead, they characterize a causal pathway merely as a sequence of difference makers linked by relations of counterfactual dependence. However, it is possible to read minimal mechanism in an ontologically neutral way that does not commit one to any particular metaphysics of entities and activities. The authors mention this possibility and note only that it is "very hard to read in such a neutral way" because it is "too metaphysically loaded" (94) and "invite[s] various metaphysical questions" (103). It is easy for me to read in a neutral way—"entities" is just an umbrella term for the referents of the scientist's nouns, "activities" is just an umbrella term for the referents of her verbs, and we'll leave the metaphysics aside. On this neutral reading, the generality or abstractness of the terms "entity" and "activity" is not an indication of their standing for metaphysical categories but simply a reflection of the fact that we need terms that are topic-neutral enough to apply across scientific fields, a desideratum the authors themselves place on any account of mechanism (111). On such a reading, I think minimal mechanism is just as metaphysically austere as the authors' account of mechanism as a causal difference-making pathway, which also invites various metaphysical questions, for example, about the nature of the relata of the difference-making relation.[3] Sometimes the authors use the term "entities" to describe the relata (112), sometimes

[2] Another problem the authors have with minimal mechanism is that they strangely seem to think that its proponents think that practicing scientists ought to describe mechanisms using the terms "entity" and "activity." They write, for example, that "the description of the pathway, according to [the authors' account], has to be given in terms of the specific scientific field (or fields) and not in terms, for example, of entities and activities" (93), and they challenge their opponents to answer "*What is added to scientific practice by insisting that a description of a mechanism has to be couched in some preferred philosophical categories, for example, entities and activities, powers and whatnot*?" (104, emphasis original). No mechanist I know has ever suggested such a constraint on scientific practice.

[3] Another metaphysical question their account invites: what grounds the relations of counterfactual dependence that hold between the relata? The authors admit that they commit themselves to laws to answer this question, but they insist that they can remain neutral on the metaphysics of laws (162n7). It is unclear at what point declarations of neutrality cease to be meaningful—if I claim that powers ground relations of counterfactual dependence and that I remain neutral on the metaphysics of powers, is this really metaphysical neutrality?

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"particulars" (90)—sounds metaphysical! Perhaps the authors will object that they don't mean anything metaphysically substantial by those terms; I would say the same for my neutral reading of minimal mechanism.

Despite these objections, I mostly agree with the authors' central theses and recommend the book to all philosophers of science interested in mechanism. I agree that scientific practice is consistent with many different metaphysical theories, among which we can remain neutral in our account of mechanism. And I view our updated account of mechanism and constitutive relevance as, if not a sibling of the authors' account, much closer than previous accounts (Craver, Glennan, and Povich 2021). I think we are converging, and this book will push the field forward, hopefully toward further convergence.

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Review of Boyd et al.'s *Philosophy of Astrophysics: Stars, Simulations, and the Struggle to Determine What is Out There*

Philosophy of Astrophysics: Stars, Simulations, and the Struggle to Determine What is Out There, edited by Nora Mills Boyd, Siska De Baerdemaeker, Kevin Heng, and Vera Matarese, Cham: Springer, 2023.

This open access volume is a must read for all those who want to enter the discussion of relevant philosophical questions in scientific practice by considering one of the most exciting and expanding fields of the natural sciences, i.e., astrophysics.

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