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On closing the gap between philosophical concepts and their usage in scientific practice: A lesson from the debate about natural selection as mechanism

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ABSTRACT

In addition to theorizing about the role and value of mechanisms in scientific explanation or the causal structure of the world, there is a fundamental task of getting straight what a 'mechanism' is in the first place. Broadly, this paper is about the *challenge of application*: the challenge of aligning one's philosophical account of a scientific concept with the manner in which that concept is actually used in scientific practice. This paper considers a case study of the challenge of application as it pertains to the concept of a mechanism: the debate about whether natural selection is a mechanism. By making clear what is and is not at stake in this debate, this paper considers various strategies for dealing with the challenge of application and makes a case for *definitional pluralism* about mechanism concepts.

1. Introduction

> *I honor Darwin's struggles as much as his successes, and I focus on his few weaknesses for entry points of revision—his acknowledged failure to solve the "problem of diversity," or his special pleading for progress in the absence of any explicit rationale from the operation of his central mechanism of natural selection.*
>
> - Stephen J. Gould, *The Structure of Evolutionary Theory* (2002, p. 47).

It is quite common for scientists to refer to natural selection as a mechanism. Given recent and prevalent philosophical attention to the nature of mechanisms and their role in scientific explanation, one is inclined to ask: is natural selection a mechanism in the technical sense? After all, both scientists and philosophers have already theorized and debated about the nature of natural selection for decades (Bouchard & Rosenberg, 2004; Horan, 1994; Matthen & Ariew, 2002; Millstein, 2006; Sober, 1984; Walsh, Lewens, & Ariew, 2002). It is perhaps unsurprising that some philosophers of biology are currently engaging in a debate about whether natural selection is a mechanism (Barros, 2008; Havstad, 2011; Illari & Williamson, 2010; Matthewson & Calcott, 2011; Nicholson, 2012; Skipper & Millstein, 2005).

Instead of offering a resolution or answer to the debate about natural selection as a mechanism, this paper works to highlight what philosophers can learn from it. It does this by assessing what is at stake in the debate about natural selection as a mechanism. In other words, it assesses which philosophical theses or positions—if any—might be problematized by the notion that natural selection is not a mechanism. First, Section 2 makes clear what is *not* at stake in the debate. There I consider three proposals from Levy (2013) for what "might" be at stake—theses regarding mechanistic explanation, methods of investigation, and causality—and argue that none of them are actually at issue.

Second, Section 3 makes a case for what *is* at stake in the debate and what we can learn from it. What is really at stake in the debate

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is something fundamental to any view about the relation between mechanisms and scientific explanation or causality: the concept of a mechanism itself. What we learn from this are three strategies for closing the gap between the manner in which scientists and philosophers think and talk about mechanisms, as well as perks and pitfalls for each. On one strategy, philosophers might offer a definitional account of mechanism that is broad and permissive, in order to capture the sundry uses of the term in scientific practice. On another strategy, philosophers might push highly restrictive conceptions of mechanism with a normative standard, which would render incorrect many uses of the term 'mechanism' in scientific practice. I recommend a third strategy that maintains a kind of *definitional pluralism* about mechanism concepts. On this strategy, distinct conceptions of mechanism are not in competition, but rather designed to capture the manner in which mechanism is used and understood differently in various disciplines or fields of scientific practice.

The three strategies described above consider specifically problems for philosophical conceptions of mechanism and their role in scientific practice. These strategies, however, may be of interest to a broader audience of philosophers of science. 'Mechanism' is just one instance of many in which scientists use a term of philosophical interest in a variety of different ways—'modularity' and 'function,' for example. For those general philosophers of science motivated by the manner in which scientists actually employ these key scientific concepts, the three strategies described in Section 3 may work as a useful guide.

2. Three proposals for what is at stake

Levy (2013) considers three kinds of "Mechanism theses"—views associated with the philosophy of mechanisms—as candidates for "what is, or might be, at stake" in the debate about natural selection as a mechanism (p. 109). On Levy's reasoning, a Mechanism thesis is 'at stake' if it might be refuted by the notion that natural selection is not a mechanism. In this section, I consider Levy's model of the philosophy of mechanisms and assess his arguments for why some of these Mechanism theses might be at stake. My analysis differs from Levy's, however, in two important ways. First, Levy's analysis is a noncommittal exploration of the issue. He does not assert what *is* or *is not* at stake, but rather what *might* or *could be* at stake. My analysis, in contrast, offers a full-fledged account of what is and is not at stake in the debate.

The second manner in which my analysis differs from Levy's regards the source of the debate about natural selection as a mechanism: Skipper and Millstein (2005). It will become evident that while Levy and others attribute to Skipper and Millstein a strong claim that "natural selection is not a mechanism," in what follows I defend a weaker reading of their arguments. A closer look at Skipper and Millstein's concerns for natural selection as a mechanism reveals a different sort of philosophical claim—an epistemological worry—regarding the challenges of accurately characterizing natural selection as a mechanism.

2.1. Mechanistic explanation and natural selection

Could a mechanistic account of explanation be at stake in light of the debate about natural selection as a mechanism? Levy (2013) tethers the new philosophy of mechanisms to a set of theses regarding the explanatory relevance of mechanisms or mechanistic information to scientific explanation (i.e., EM):

> **Explanatory Mechanism** (EM) is a thesis about explanatory relevance: it states that to explain a phenomenon, one must cite mechanistic information, i.e. specify underlying parts and their organization. EM contrasts with other general accounts of explanation, such as the Deductive-Nomological model. (p. 100).

Proponents of mechanistic explanation in biological science are perhaps the most familiar new mechanists. While the accounts vary in detail and discipline, all can be understood as defending a similar philosophical thesis that successful explanations make explicit appeal to mechanisms or the features/properties of mechanisms, such as parts/entities, activities/interactions,[1] and organization (Bechtel, 2008; Craver, 2007; Darden, 2006; Machamer, Darden, & Craver, 2000).

It is not *prima facie* obvious that a mechanistic account of explanation is at stake with respect to the question of whether natural selection is a mechanism. Levy (2013, p. 112) provides the following argument for why—"potentially at least"—the case of natural selection may cause trouble for the key tenets of mechanistic explanation. First, in some cases (including natural selection), the mechanistic details (e.g., parts and organization) are not explanatorily relevant.[2] In those cases, the best explanatory approaches are probabilistic and populational. Moreover, we might read Skipper and Millstein (2005) as making a related point that natural selection is not composed of parts, nor does it have stable organization. Therefore, if Skipper and Millstein (2005) and Strevens (2008) are right, then natural selection is a case in which parts and organization are not explanatorily relevant and, consequently, it is a case that problematizes the key tenets of mechanistic explanation.

This argument, though, raises two difficult questions. First, Levy assumes a rather strong commitment on behalf of proponents of mechanistic explanation: namely, that a mechanistic approach ought to apply equally well to *all* phenomena of explanatory interest to scientists. But is it a burden of the mechanistic view of explanation that all natural phenomena ought to be explained mechanistically? The foundational projects for mechanistic explanation—Bechtel and Richardson (1993/2010), Machamer et al. (2000), Darden (2006), Craver (2007) and Bechtel (2008)—do not endorse any strong monism about explanation across the sciences. Rather, these contributions highlight the value of mechanistic thinking to specific disciplines; namely, molecular biology and cognitive neuroscience. It does not follow that an account of mechanistic explanation is at stake in the event that natural selection is a phenomenon that is best explained with non-mechanistic methods, such as population statistics. It could simply be that while synapses and protein synthesis are best explained mechanistically, natural selection is not. This would not demand a rejection or reformulation of the new mechanistic account of explanation.

Levy's argument, however, motivates a second important question regarding his interpretation of Skipper and Millstein (2005). He interprets them as providing the argument that natural selection is not a mechanism, because they raise "problems such as whether natural selection has parts, whether it is regular in the requisite ways etc …" (Levy, 2013, p. 112). It is not uncommon that philosophers of biology read Skipper and Millstein as providing this particularly strong metaphysical claim regarding the nature of natural selection. In posing the question of whether natural selection is a mechanism, Havstad (2011) explains, "Skipper and Millstein (2005) argue that it is not" (p. 512). But do they? While this reading is tempting, Skipper and Millstein do not endorse such

[1] While Machamer et al. (2000) construe the causality in mechanisms in terms of 'activities,' Glennan (2002a, 2002b) in terms of 'interactions'. Tabery (2004) shows how these distinct approaches are not in conflict, but rather, how they compliment one another.

[2] Levy cites Strevens (2008) as providing the groundwork for this premise.