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# EVOLUTION AND THE MACHINERY OF CHANCE

Marshall Abrams

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Reviewed by  
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[\*Evolution and the Machinery of Chance: Philosophy, Probability, and Scientific Practice in Biology\*](#)<sup>□</sup>

Marshall Abrams

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For almost twenty years, Marshall Abrams has been, through a long series of papers, one of the primary contributors to a flourishing debate on explanation, causation, chance, and probability in natural selection. He

has argued that a causal understanding of evolutionary explanations can be grounded in facts about populations and individual organisms, despite the statistical character of such explanations (which has pushed some to argue for a contrary, eliminativist position about the causal efficacy of evolutionary factors like natural selection and genetic drift). In this he is not alone; others (including myself) have offered similar accounts. But what makes his stance both unique and compelling is that he has long claimed that it is the interpretation of probability that allows us to construct such an approach. In parallel work (offering his own take on a perspective developed differently by authors like Ismael [2011] or Strevens [2011]), he has laid out what he calls the 'far-flung frequency mechanistic' interpretation of probability (or 'mechanistic probability' for short), which—in addition to being applicable to classic cases like casino games—can also, he argues, ground the probabilities of evolutionary change that the theory of natural selection offers us.

This book is his latest contribution to the construction of this long argument, one which brings together, cleans up, and rigorizes a number of the elements of his view. One of the main reproaches that one might have offered to Abrams prior to its appearance was that this view was rather scattered, spread across a number of journal articles, some of which are explorations of potential positions in the hypothetical, which Abrams does not actually hold. This has made reconstructing the true 'Abramsian' approach to evolution a somewhat challenging task (as I learned a few years ago, when my effort to do so was met with a kind email explaining that I had missed the mark). No longer—we now have here the complete story, in a well-written, clean volume of some 225 pages, loaded with biological examples and references to competing positions in the philosophical literature.

There is much on offer in this relatively dense book, and the later portions build on the earlier in a genuinely systematic way; it will thus be hard for me to do justice to the entirety of the work in a short review. Instead, after a brief summary, I'll mention a few of the book's most positive aspects, and offer a few (hopefully constructive) worries.

We begin with Abrams's proposal for a new target of analysis in evolutionary theorizing: what he calls the 'population–environment system'. As readers of Abrams will know, he has long argued that the environment plays a vital and often under-theorized role in our view of natural selection's action. He proposes here that, in a sense familiar from authors on probability like Hacking or Popper, the proper unit of analysis is a population within an environment, a combination that—because it harbours complexity of the right sort, at the right scale (*sensu* Wimsatt's emphasis on scale and organization)—is stable enough to ground probabilities in repeated trials. One house sparrow in one particular place and time, he argues, might be too sensitive to initial conditions; two inches to the right, and she becomes the hawk's afternoon snack. But population–environment systems are more stable, and their complexity is 'lumpy' enough to support probabilistic inferences. A meticulous examination of the impact of making this claim follows, both for philosophical and biological practice.

In the second half of the book, we see a number of advantages of and potential problems for the view of evolution that results. Abrams carefully argues that evolutionary explanations can still be genuinely causal, not mere epiphenomena of organisms acting in their environments, in part because the pragmatic choices that biologists make do not render populations any less real as objects of study. He closes with an analysis of various concepts of fitness and a return to some technical features of the interpretation of probability that lies at the heart of the picture.

On to the positives, which are too numerous to adequately describe here. First and foremost, despite the fact that the material is dense and the concepts sometimes technical, the book is pedagogical in the best of ways. Figures are plentiful and helpful, biological examples are worked out thoroughly and remain accessible to those who haven't read the original literature, and a number of analogies recur throughout the work, making some of the more difficult points easier to grasp. (I would be remiss if I didn't note, with admiration, that the commitment to

clear analogies even means that Abrams did research on the operation of pinball machines, so that a long-running pinball analogy would be technically accurate.)

More substantively, what we might call the volume's 'philosophical orientation' is noteworthy. To say the very least, it is popular (perhaps too popular, I might hazard) to be a pluralist in the contemporary philosophy of biology. At first glance, something like pluralism seems to run through Abrams's book. Organisms might be members of more than one population, depending on the research interests of the biologists that are in the process of studying them. Organisms have a plethora of traits, any of which might enter into a selective explanation. Environments, too, can be divided up into any number of different collections of sub-environments. But I think it is wrong to read this commitment as a kind of pluralism (or at least as any very simple kind of pluralism). I would instead call Abrams's approach something like 'anti-foundationalism'. Given the incredible variety within the biological world and biological practice, it is practically impossible to argue that only one type of biological explanation is legitimate, or to be a hard-nosed, exclusionary 'monist' about biological explanations. A number of authors in this debate (again, I count myself among them; see, for example, Pence and Ramsey [2015]) have attempted to argue instead that a subset of these explanations are genuinely fundamental. The rest don't thereby lose any legitimacy; we are not here to rule out whole swathes of biological practice. But they are nonetheless derived, grounded by the facts that are taken to be at the root of any selective story.

Abrams has little use for this kind of 'foundationalist' view. One gets the clear impression throughout the book that, for him, biological practice is biological practice. A proper philosophy of biology reconstructs that practice—all of it—and explains its success. We are not necessarily 'pluralist' as a result, if by 'pluralist' one means that we ought to let inconsistent practices flourish on an equal footing. Rather, these are the phenomena that philosophers of biology are charged with saving, and if we do our jobs carefully we should be able to save them all. This methodology is even laid out explicitly: possible worries about poor research practices aside, we owe it to ourselves to explain the probable (approximate) truth of the assumptions behind any models that are successfully used by biologists (p. 69).

This leads, unsurprisingly, to a deep and profound concern for careful engagement with biological models throughout the work. We have laboratory experiments on *Drosophila* in chapter 2, surveys of the use of 'fitness' across different models in chapter 4, studies of human evolution and sub-populations in chapter 5, plant evolution in chapter 6, and so forth. In each case, the primary literature is discussed at length, potential problems or implications are considered, and, finally, conclusions are drawn about the sort of philosophical interpretation that makes sense of what the biologists are up to. The book is a great example of doing such work not simply to cherry-pick examples of practices that would be useful to pre-existing philosophical needs or as a kind of basic 'science reporting', but to genuinely force the philosophical view to advance in order to take on the challenge that a difficult case from biological practice can offer.

Finally, I want to close with a handful of worries that I had while reading, to give an idea of the interesting and provocative questions that the book raised, at least for me. First, a metaphysical question: what is a trait? Obviously, concerns about 'trait identification' have a long pedigree, and have recently seen more biological and philosophical examination in the context of studies of evo-devo. But I think this problem hits Abrams particularly hard. From the first page of the introduction, 'trait' is used in its pre-theoretic sense, and often interchanged with the idea that organisms distinguished by their traits form types. But traits are also the bearers of some important properties. We learn later, for instance, that 'the selection gradient [...] is a causal property of heritable traits that reflects probabilistic influences of the trait on changes in its future distribution in the population' (pp. 164–65). To be certain that traits can play this kind of metaphysical role, it strikes me that we need a more fully fleshed out theory of what traits are and how they can bear such complex properties.

As a second critique, a few important moves in Abrams's arguments are unfortunately left for future work—though we do get an idea of what that work will be, so interested readers can keep an eye out for it. To take just one example, he argues extensively that the lives and deaths of individual organisms are just too fortuitous, too variable, too complex to be able to support the kinds of probabilistic inferences that his picture of evolutionary theory relies upon. But then he notes, in responding to a worry about whether population–environment chances can genuinely be thought of as 'long-run', that 'long-run chance trials can be applicable even when the "repeated" trials are quite different' (p. 192). While the text goes on to imply a technical argument for this conclusion in an upcoming manuscript (which I have no reason to doubt, given the quality of the other technical work on offer here), *prima facie* this cuts against Abrams's repeated insistence that too much uniqueness in the probability base is highly destructive to the possibility of evolutionary theorizing. I'm looking forward to learning why this case is different.

One final concern that I'd like to raise is, if you will, the 'dark side' of Abrams's careful reconstruction of biological practice. If the 'foundationalists' in this debate are perhaps too willing to reinterpret or abandon the details of biological practice in order to preserve the coherence of their foundations, the 'anti-foundationalist' view runs the opposite risk of confusing the model for the modelled. Supporters of a foundationalist picture do so in part because they think that a correct understanding of the foundations—of the underlying basis in the world for modelling practices—can give us, in turn, a reasonable-enough approach to the use of biological models without needing to account for every instance of that modelling practice directly. Anti-foundationalists, as I've already argued, regard the models and their assumptions to be the phenomena that philosophy of biology needs to interpret. There is at least a difference of opinion here; there might further be a difference in views about scientific modelling, or even a meta-philosophical difference about the proper role of philosophy of biology. In any case, this book has strongly encouraged me to reflect on the issue further.

I hope that these objections can serve as examples of the interesting and profound discussions that I am certain that Abrams's book will inspire (and is already inspiring). The debate over evolution's causal foundations had, I think it is fair to say, faltered somewhat in recent years, as positions crystallized and little genuinely innovative material arrived on the scene to force serious rethinking. The publication of Abrams's book comes precisely at a moment when this debate is taking on new life, and I hope that the arguments to come can live up to the high standard that it sets.

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