Natural Selection and the Metaphysics of Causation

New Perspectives on Causation in the Life Sciences, 27/6/2022

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The Philosophy of Biology

The Causal Structure of Natural Selection

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The Causal Structure of Natu

Outline

1. A causal structure for natural selection
2. The problem of multi-level probabilistic causal systems
3. Appeals to elsewhere
   - 3.1 Universality in statistical physics
   - 3.2 Causal exclusion in philosophy of mind

The take-home: Selection serves as a peculiar and interesting case for the metaphysics of causation – let's understand it better!

A Causal Structure for Natural Selection

Individuals live and die, give birth, mate, eat, and so on.

Fitter individual organisms are more likely to succeed than the less fit.

Populations are likely to change over time in the direction of increased fitness.

Where, or what, exactly, is natural selection?

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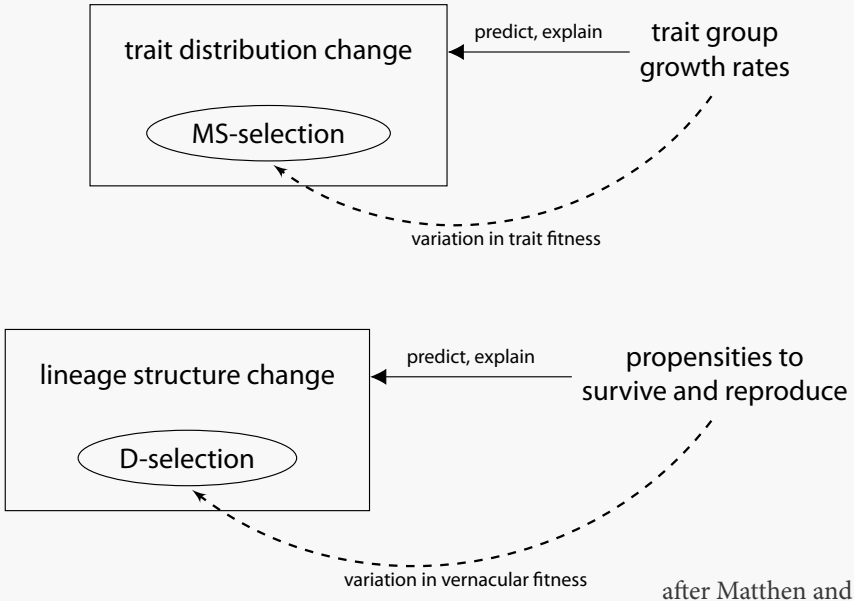
More precisely, is there an account of those three (classes of) facts on which natural selection is *causing* something, or is natural selection merely a *label* or a *summary* of those facts?

There is a healthy (viz. massive) debate concerning this question.

How can we generalize it so that we can fruitfully put it in contact with other literatures – in the metaphysics of science, the study of causation, the philosophy of physics, the philosophy of psychology, etc., etc.?



after Matthen and Ariew (2002)

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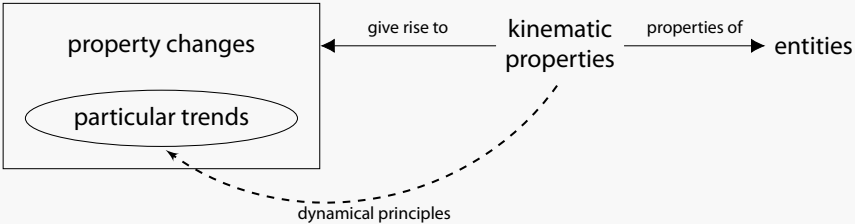
Perhaps! But: there's two important things missing from their picture.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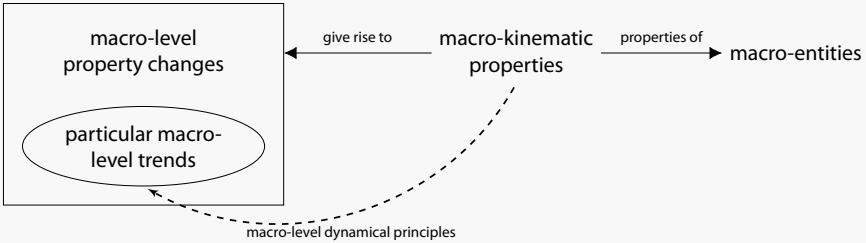
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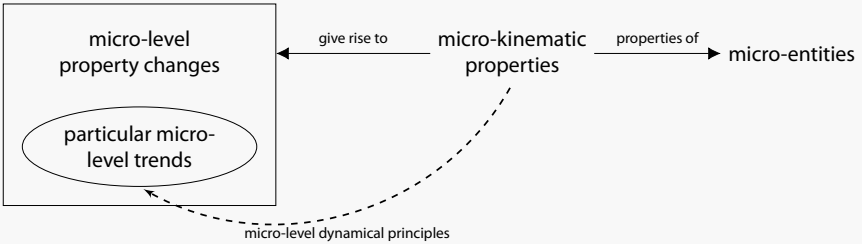
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What does that let us do?

1. It lets us see the role of the **underlying entities** in these explanations
2. It lets us look at **inter-level relations** – and we already know, at the very least, that composition is involved!

Multi-Level Probabilistic Causal Systems

What kinds of questions could we ask?

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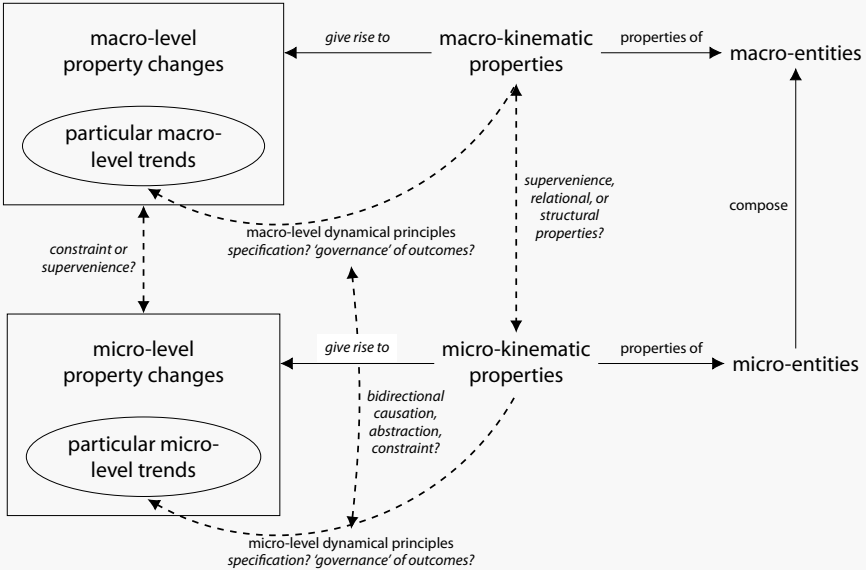
...too many.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Appeals to Elsewhere

Universality in Statistical Physics

Some philosophers of physics talk about these kinds of questions in the context of the **universality** of statistical mechanics: statistical ensembles have properties that can be understood (and whose behavior can be guaranteed) at the ensemble level.

Universality in Statistical Physics

But there are difficult arguments (still subject to some degree of debate) surrounding just how to **ground universality** in statistical-physics contexts. None of them seem to straightforwardly apply to organisms and populations.

How could we understand a putative evolutionary analogy to universality?

Causal Exclusion

Kim's causal exclusion argument: if future mental states are determined by current brain-causes, then mental events cannot be genuinely causal on pain of a kind of problematic causal overdetermination.

Causal Exclusion

The thing I most wish I had said in the book that I didn't:
But causal over*determination* seems to only really make sense when we're talking about *determination* of the effects by two sets of causes.

Fitness properties do not *determine* future population change. So this whole argument seems to be at best a stretched analogy.

Causal Exclusion

Obviously there will be some sense of **exclusion** here: the levels are connected by a composition relationship! So this will result in something like a kind of consistency requirement.

How should we understand the requirement of inter-level consistency in a probabilistic-causal context?

More generally…

An evolving population seems to be a kind of system that has **really interesting** causal properties. And I suspect that:

1. Its lessons will generalize (to, say, social science, political science, economics, elsewhere in physics…)
2. But evolution is particularly replete with careful modeling, formal reasoning, models, case studies, and worked-out consequences of adopting various positions in this space.

More generally…

So let's get to work trying to better understand what's happening here!

Questions?

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