Toward a New Picture of the Causalist/Statisticalist Debate

UNED, 17.1.2020

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Outline

1. The State of Play
2. New Tools
   - 2.1 Unpacking Causal Structures
   - 2.2 Two Examples: Walsh *et al.* and Abrams
3. How to Move Forward?
   - 3.1 Connections to other fields?
   - 3.2 Connections to metaphysics of science?

The take-home: The core problem in this debate is *much* more general than usually thought, which should push us to new approaches!

The State of Play

The Trials of Life: Natural Selection and Random Drift*

Denis M. Walsh†‡
University of Edinburgh

Tim Lewens
University of Cambridge

André Ariew
University of Rhode Island

We distinguish dynamical and statistical interpretations of evolutionary theory. We argue that only the statistical interpretation preserves the presumed relation between natural selection and drift. On these grounds we claim that the dynamical conception of evolutionary theory as a theory of forces is mistaken. Selection and drift are not

THE JOURNAL OF PHILOSOPHY

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TWO WAYS OF THINKING ABOUT FITNESS AND NATURAL SELECTION*

The concept of fitness is, Philip Kitcher[1] says, "important both to informal presentations of evolutionary theory and to the mathematical formulations of [population genetics]" (*ibid.*, p. 50). He is absolutely right. The difficulty is to harmonize these very different

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argue
natural selection and drift. On these grounds we claim that the dynamical conception
of evolutionary theory as a theory of forces is mistaken. Selection and drift are not

Biology and Philosophy **17:** 33–53, 2002.

Are Random Drift and Natural Selection Conceptually Distinct?

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Abstract. The latter half of the twentieth century has been marked by debates in evolutionary biology over the relative significance of natural selection and random drift: the so-called "neutralist/selectionist" debates. Yet John Beatty has argued that it is difficult, if not

Brit. J. Phil. Sci. **55** (2004), 693–712, axh406

Fitness, Probability and the Principles of Natural Selection

Frédéric Bouchard and Alex Rosenberg

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Brit. J. Phil. Sci. **57** (2006), 627–653

Natural Selection as a Population-Level Causal Process

Roberta L. Millstein

ABSTRACT

Recent discussions in the philosophy of biology have brought into question some fundamental assumptions regarding evolutionary processes, natural selection in particular. Some authors argue that natural selection is nothing but a population-level, statistical consequence of lower-level events (Matthen and Ariew [2002]; Walsh et al.

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Selection and Causation*

Mohan Matthen and André Ariew†

We have argued elsewhere that natural selection is not a cause of evolution, and that a resolution-of-forces (or vector addition) model does not provide us with a proper understanding of how natural selection combines with other evolutionary influences. These propositions have come in for criticism recently, and here we clarify and defend them. We do so within the broad framework of our own 'hierarchical realization model' of how evolutionary influences combine.

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(A) Natural selection is not a cause of evolution. (We are not opposed to Darwin and the modern synthesis—quite the contrary. Rather, we argue that the relationship envisaged by these theories is not a causal

Drift and "Statistically Abstractive Explanation"*

Mohan Matthen†‡

A hitherto neglected form of explanation is explored, especially its role in population genetics. "Statistically abstractive explanation" (SA explanation) mandates the suppression of factors probabilistically relevant to an explanandum when these factors are extraneous to the theoretical project being pursued. When these factors are suppressed, the explanandum is rendered uncertain. But this uncertainty traces to the theoretically constrained character of SA explanation, not to any real indeterminacy. Random genetic drift is an artifact of such uncertainty, and it is therefore wrong to reify it as a cause of evolution or as a process in its own right.

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A New Foundation for the Propensity Interpretation of Fitness

Charles H. Pence and Grant Ramsey

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ABSTRACT

The propensity interpretation of fitness (PIF) is commonly taken to be subject to a set of simple counterexamples. We argue that three of the most important of these are

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Drift and "Statistically Abstractive

Biol Philos (2016) 31:459–482
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AREA REVIEW

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A critical review of the statisticalist debate

Jun Otsuka[1]

Received: 27 October 2015 / Accepted: 5 May 2016 / Published online: 24 May 2016

Abstract Over the past decade philosophers of biology have discussed whether evolutionary theory is a causal theory or a phenomenological study of evolution based solely on the statistical features of a population. This article reviews this controversy from three aspects, respectively concerning the assumptions, applica-

Philos Theor Pract Biol (2017) 9:1

Four Pillars of Statisticalism

Denis M. Walsh,* André Ariew,† Mohan Matthen‡

Over the past fifteen years there has been a considerable amount of debate concerning what theoretical population dynamic models tell us about the nature of natural selection and drift. On the causal interpretation, these models describe the causes of population change. On the statistical interpretation, the models of population dynamics models specify statistical parameters that explain, predict, and quantify changes in population structure, *without* identifying the causes of those changes. Selection and drift are part of a statistical descrip-

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What's At Stake?

1. Levels of causal interest or "action" (individual vs. population)
2. The nature of supervenience and multi-level causal processes
3. Definitions of natural selection and genetic drift (especially process- vs. outcome-based)
4. Definitions of fitness (especially individual- vs. trait-based)
5. The role of abstraction and observer-dependence

We can’t argue all of this at once!

But! We should be able to step back and look at the relationships between these questions.

- Ontology vs. behavior
- Composition

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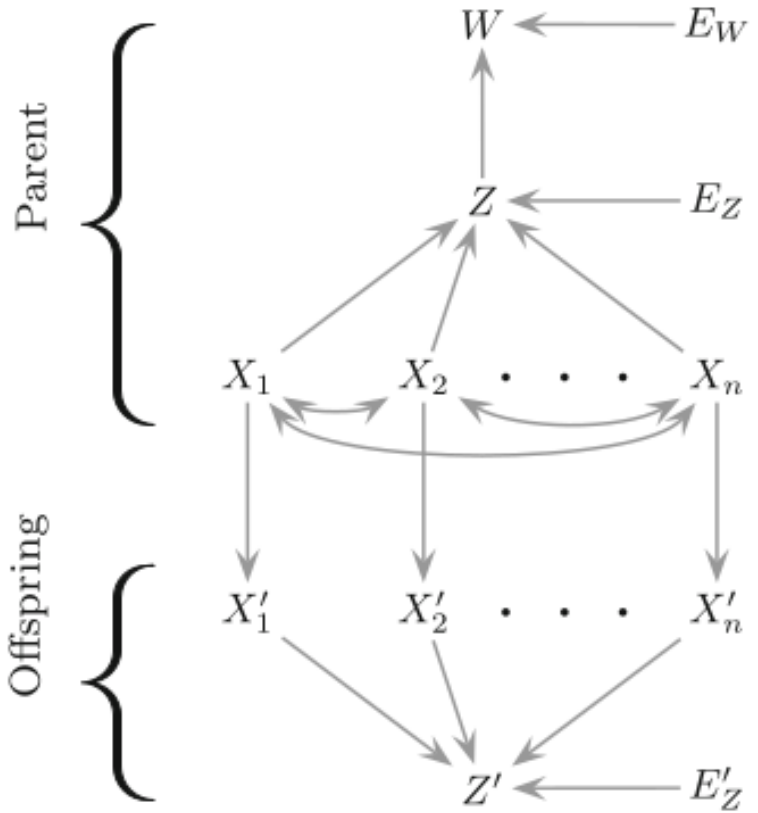

$$W = \beta Z + E_W,$$

$$Z = \sum_i \alpha_i X_i + E_Z,$$

$$X'_i = X_i \quad \text{for } 1 \leq i \leq n,$$

$$Z' = \sum_j X'_j + E_{Z'}.$$

Fig. 1 A causal model underlying the breeder's equation. For the sake of simplicity the model here does not consider sexual reproduction or mutation. *Double-edged arrows* in the *graph* represent statistical dependence, or *linkage disequilibrium*, among parental genes. The structural equations on the *right* quantitatively specify each causal relationship in the *graph*

Focus on re-deriving the equations of classical population genetics comes at the cost of generality

Focus on re-deriving the equations of classical population genetics comes at the cost of generality

Population-genetics focus removes any way to talk about individual organisms

New Tools

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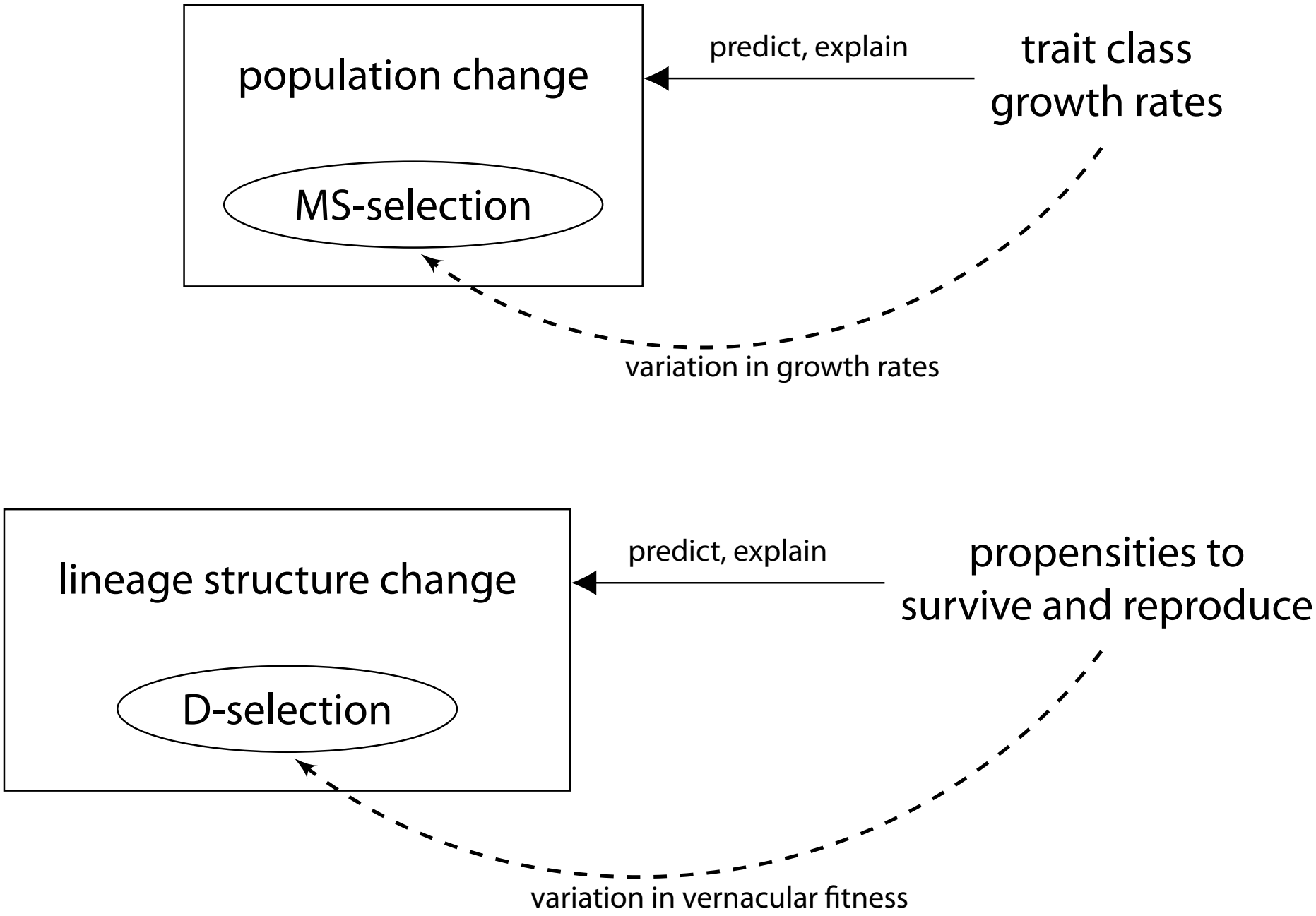
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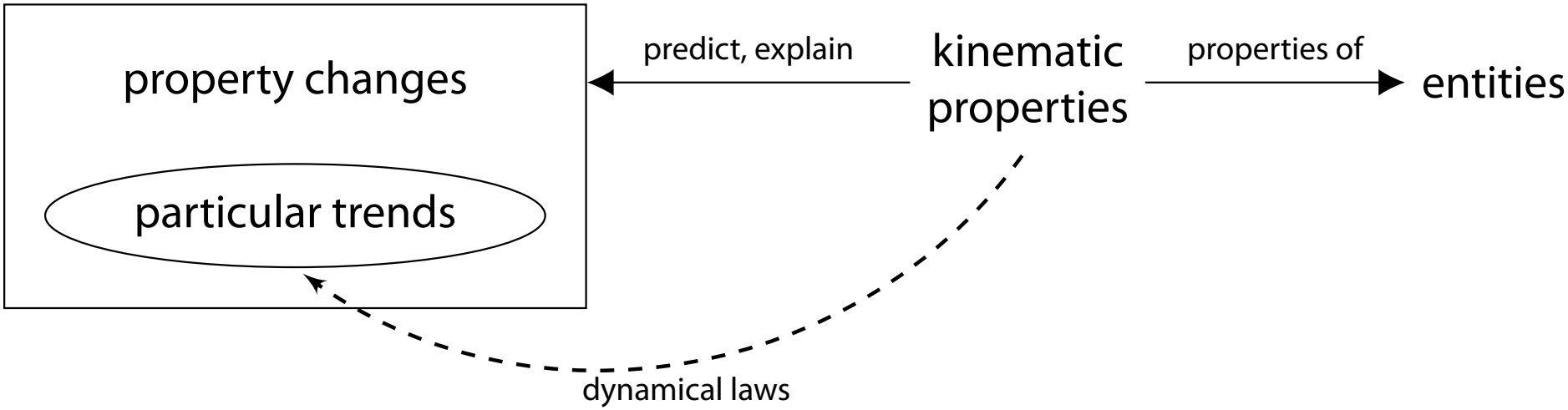
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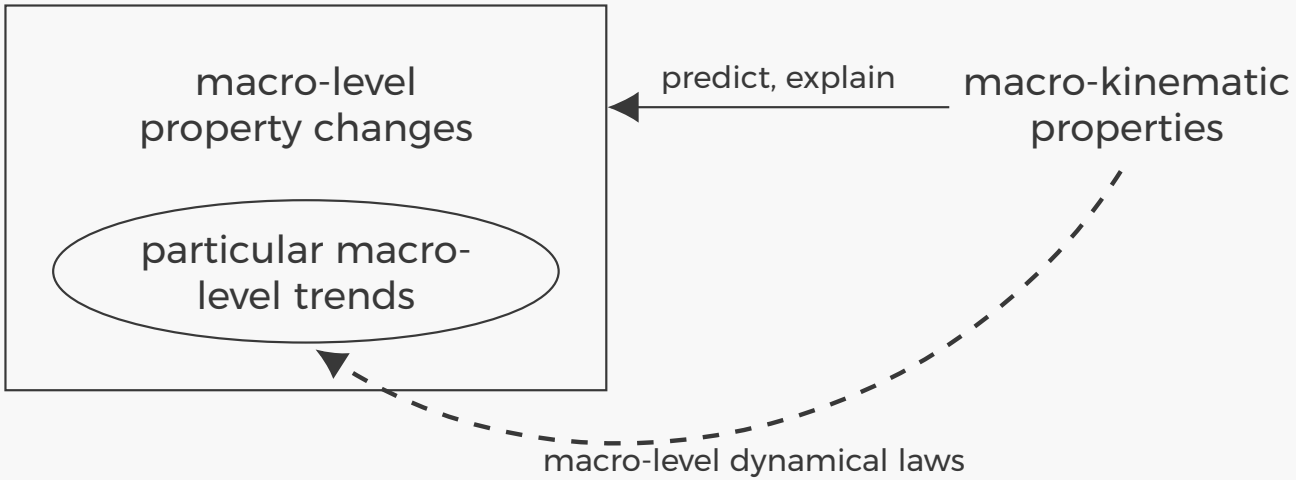
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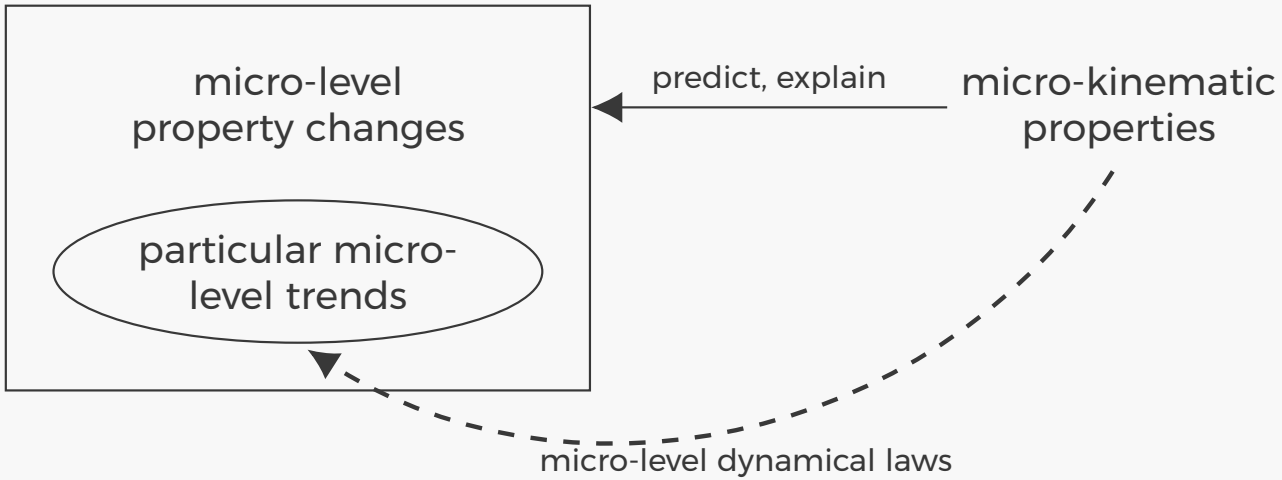
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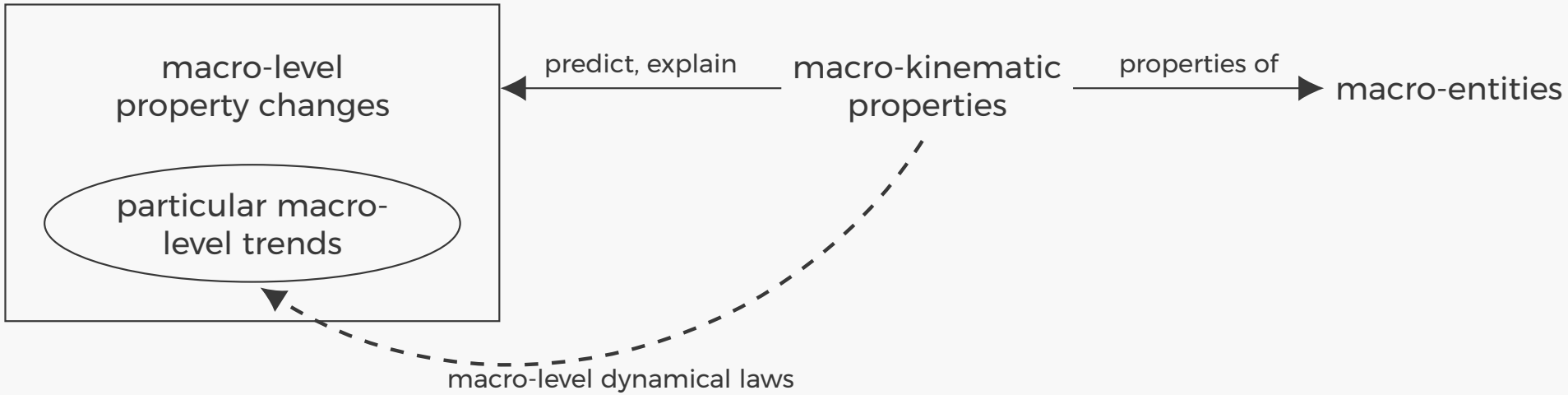
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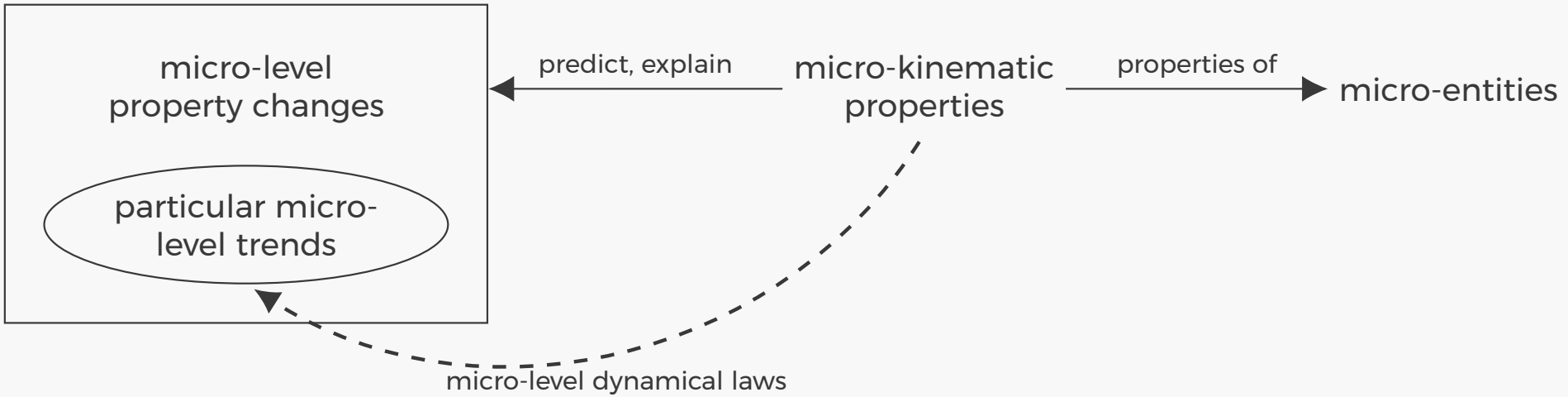
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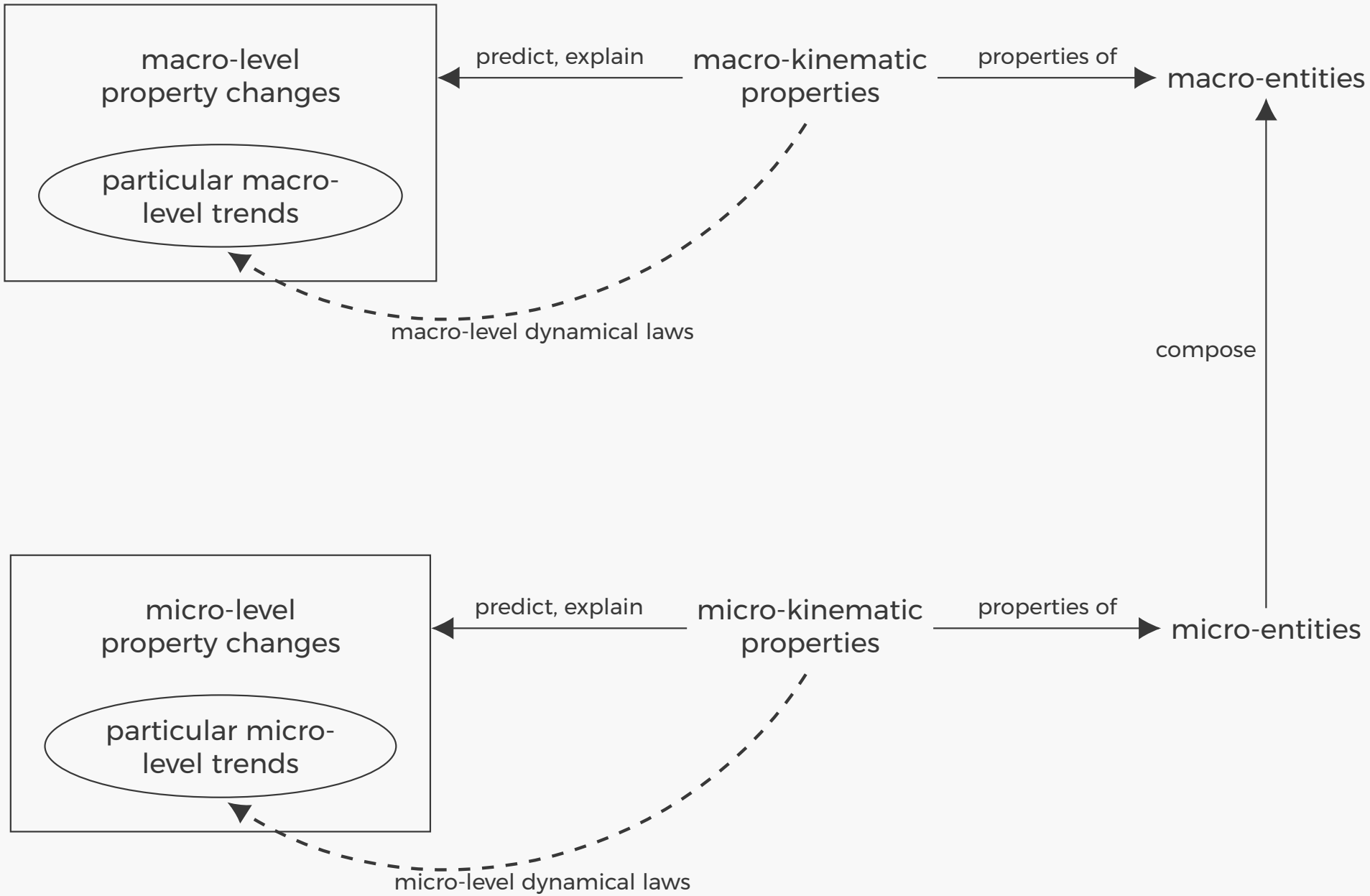
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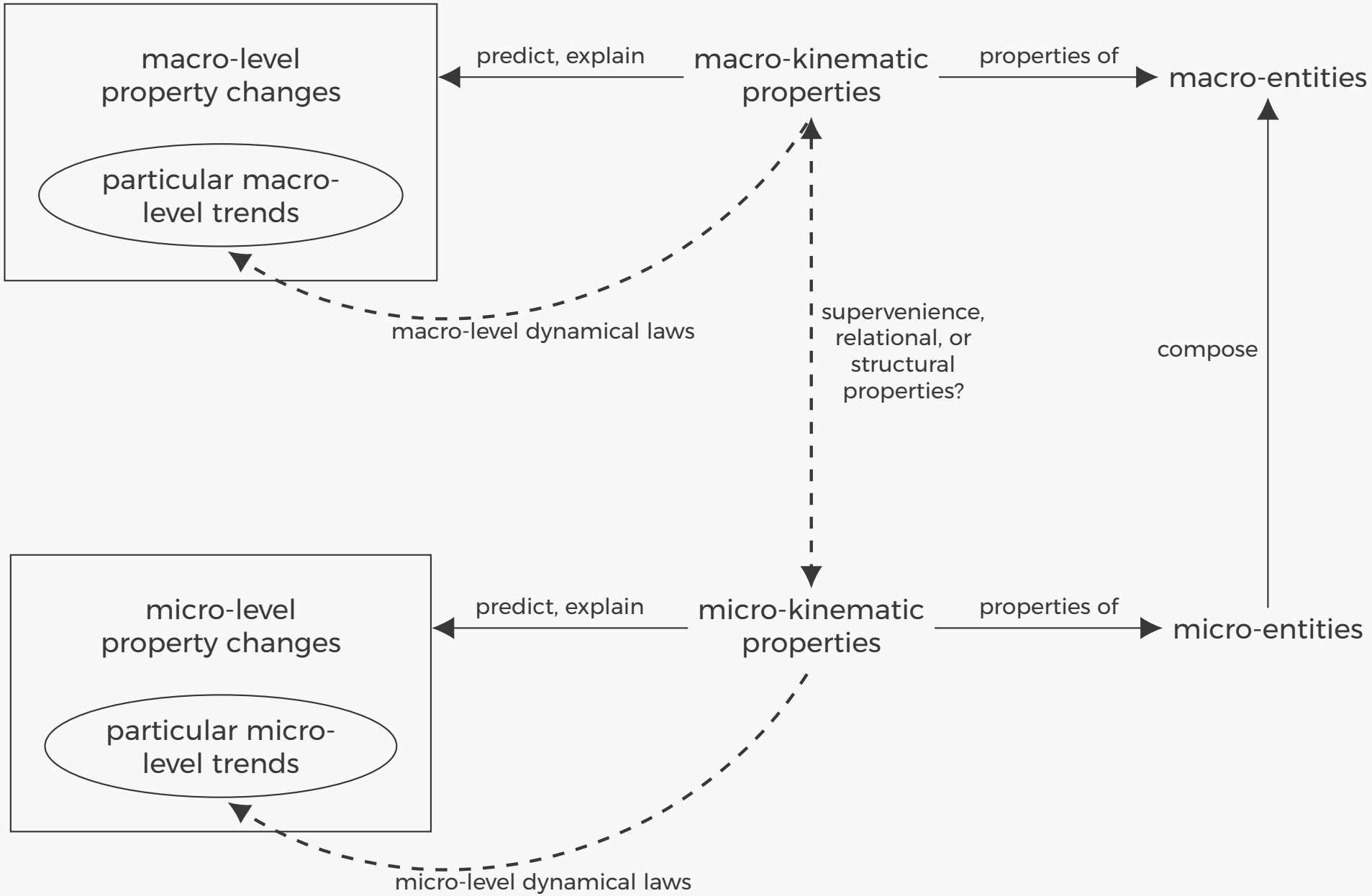
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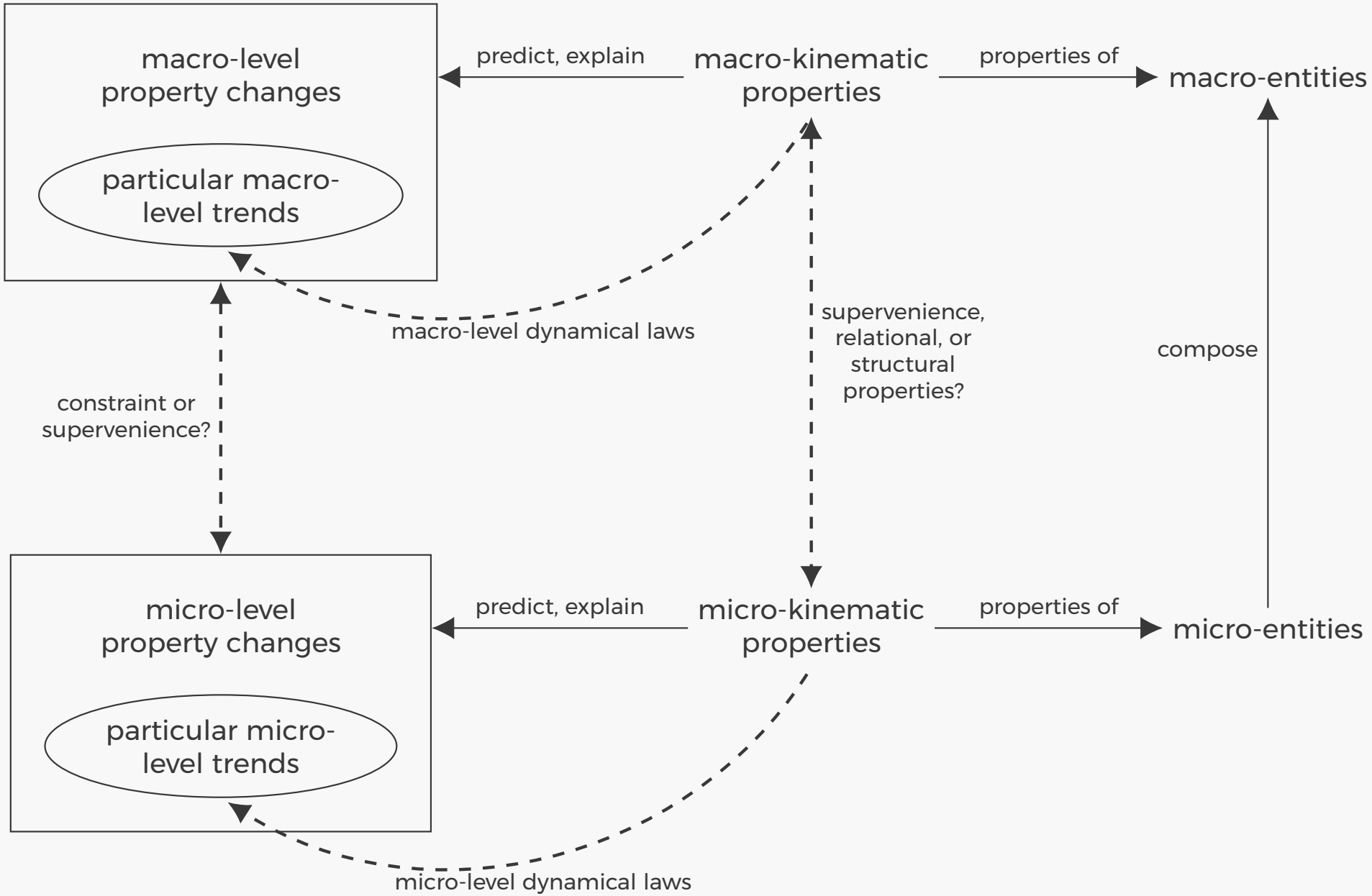
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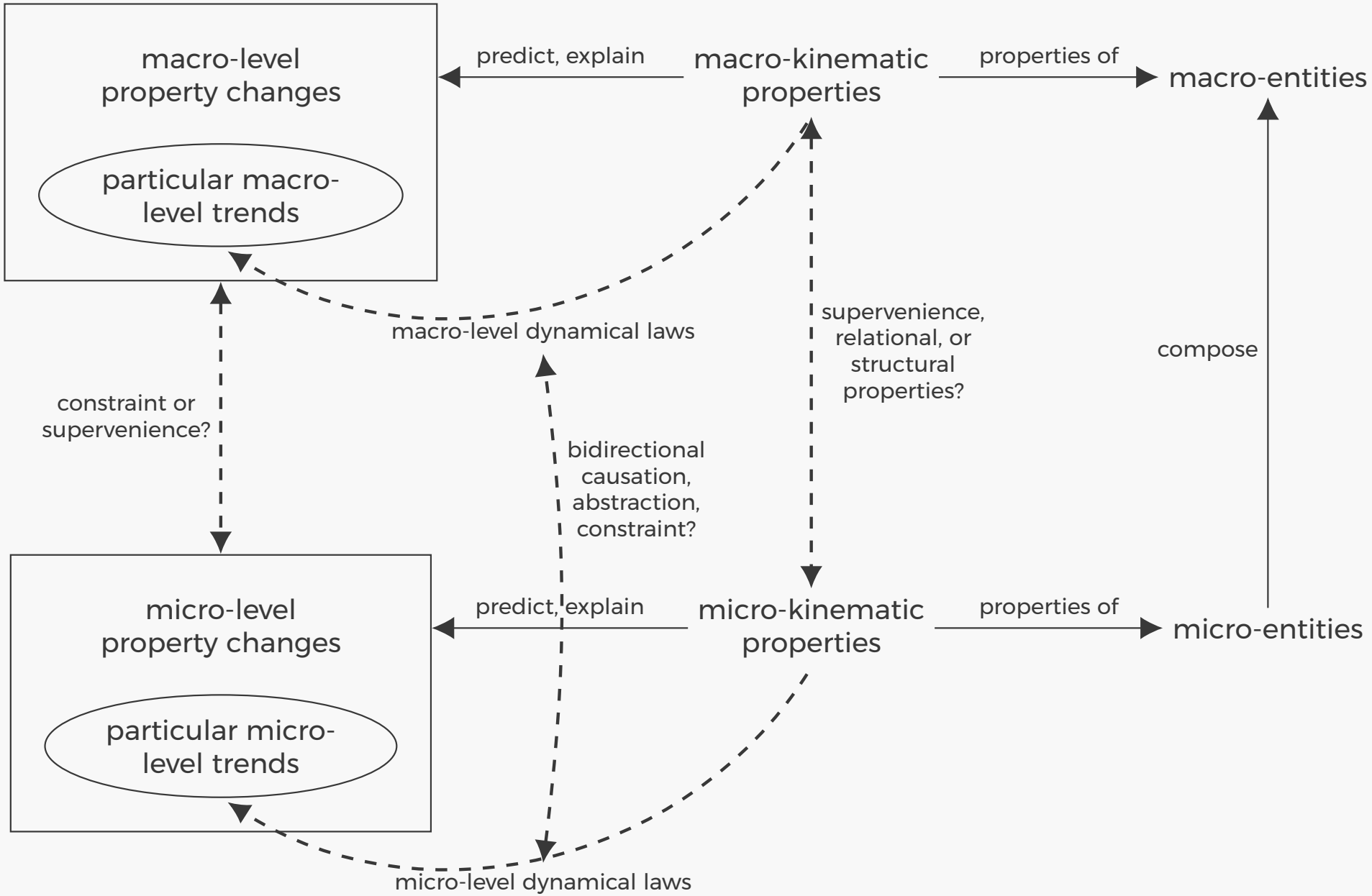
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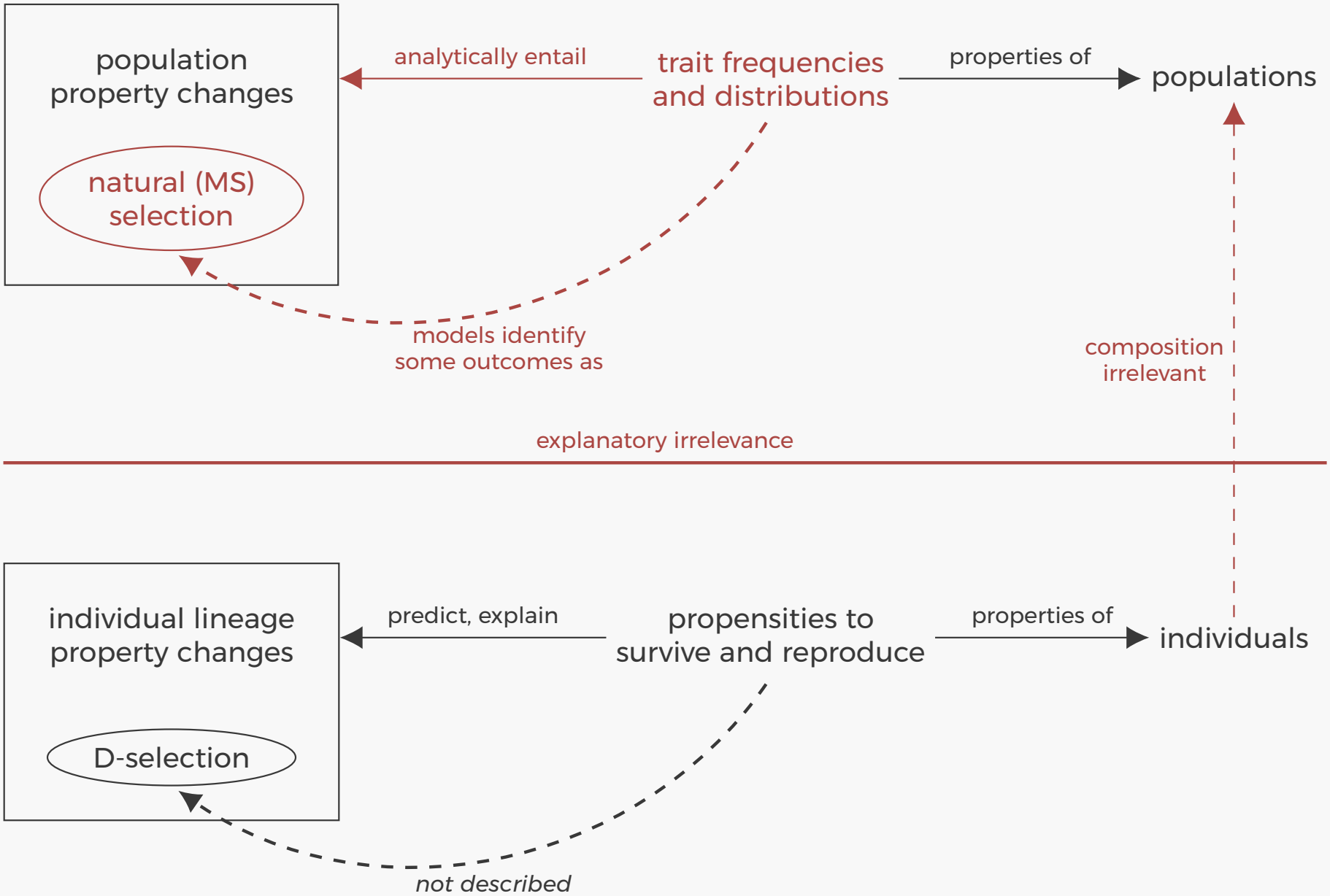
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Erkenn (2015) 80:519–549
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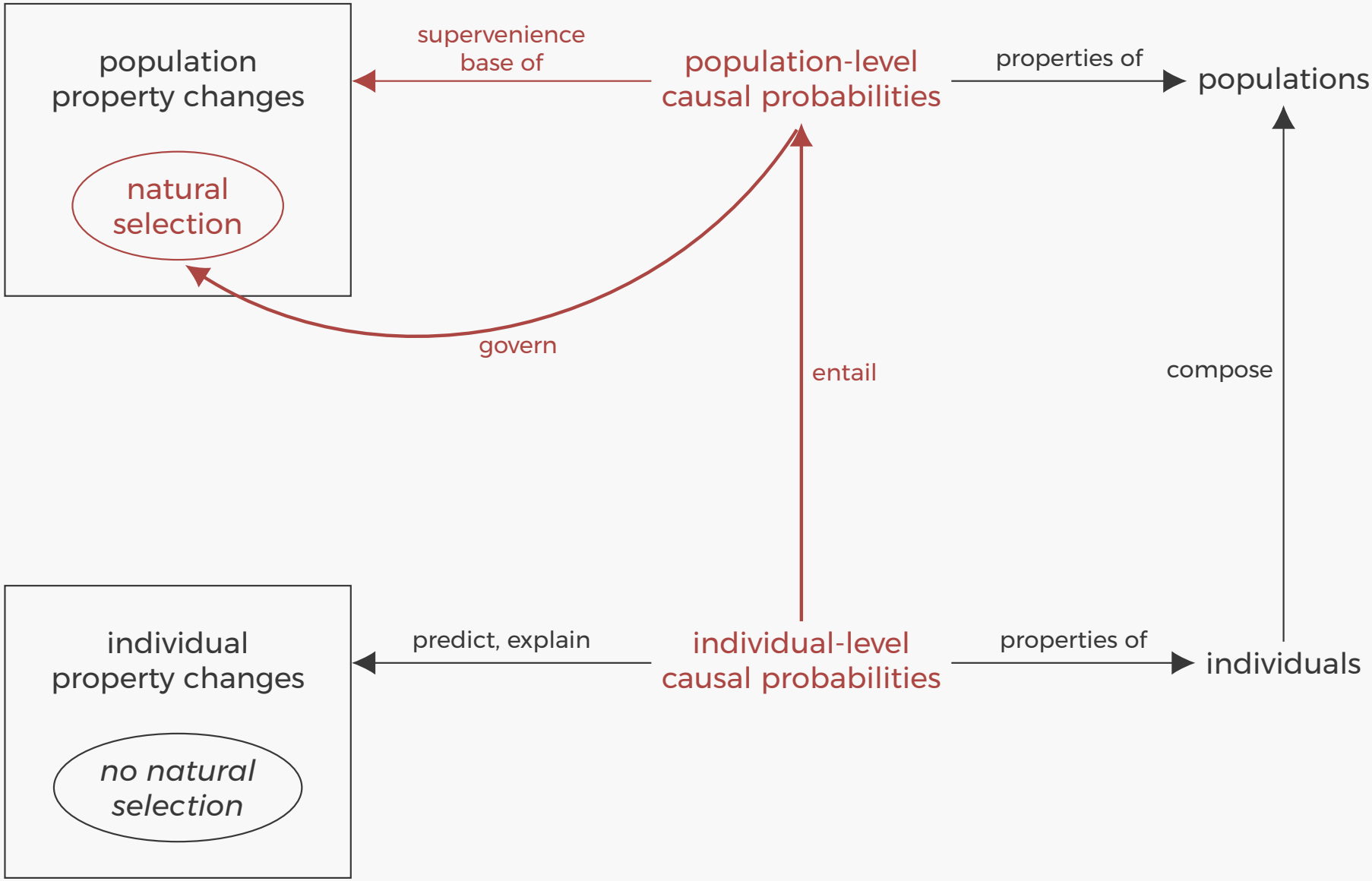
ORIGINAL ARTICLE

Probability and Manipulation: Evolution and Simulation in Applied Population Genetics

Marshall Abrams[1]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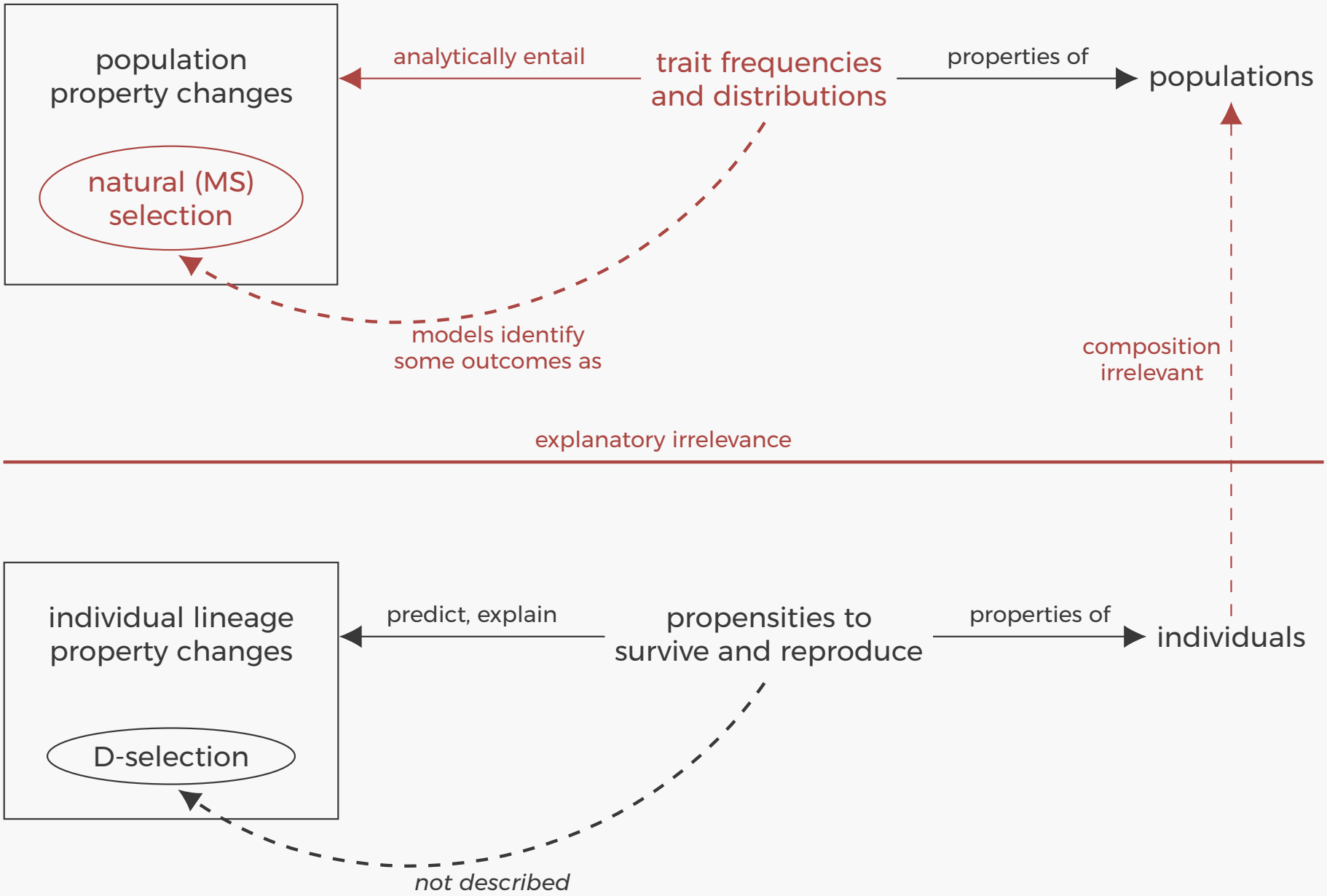
More broadly: This problem is **not specific to evolutionary biology.** It's been with us since (at least) **the earliest statistical theorizing.**

How to Move Forward?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For the statisticalists, the top-left of the diagram is "isolated" from the rest of the causal structure.

This property is present in some macro-explanations in statistical physics, and is called **universality.**

Questions about the relationship between macro- and micro-level kinematic properties are **endemic throughout philosophy of science.**

We need to be in dialogue with metaphysicians of science!

Questions?

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