Idealized Models, Explanatory Roles, and Realism

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Abstract

Among philosophers of science, it is widely accepted that in order to provide an explanation a model must accurately represent the explanatorily relevant features of its target system(s). However, biologists frequently construct models that either omit, via abstraction, or inaccurately represent, via idealization, most of the features of real-world systems. A prominent example is the use of optimality models to investigate biological phenomena (Orzack and Sober 1994; Potochnik 2007; Rice 2012). This highlights a more general question of philosophical interest: how are highly idealized and abstract models nonetheless able to play explanatory roles in biological (and scientific) theorizing? In addition, the pervasiveness of idealized and abstract models appears to raise a serious challenge to scientific realism (Cartwright 1983; Odenbaugh 2011). In this paper, I distinguish three explanatory roles optimality models play within biological theorizing: hypothetical modeling, pattern modeling, and population-specific modeling. Distinguishing these explanatory roles is important for understanding the variety of ways highly idealized and abstract optimality models contribute to our understanding of biological phenomena. In addition, I argue that these explanatory roles capture a common progression within model-based theorizing that is key to characterizing some of the dynamical aspects of model-based science. Furthermore, I contend that models can be explanatory-by providing understanding that is essential to answering a why question-without providing a veridical representation of (the features of) any real-world target system. Finally, my analysis of these explanatory roles reveals several important insights for the debate over scientific realism.

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