Abstract

Many scientific disciplines rely on the construction and use of models: biomedical sciences are no exception. This PhD thesis addresses several aspects of the practice of scientific modeling. First, I discuss the nature of modeling as such, proposing a novel, complementary account of scientific modeling which I term the *experimentation-driven modeling account* and which drives the construction of mechanistic models in many fields of biological and biomedical research, such as cancer immunology. Second, I scrutinize an objection to the mechanistic account of explanation according to which the account fails to accommodate the common practice of idealizing difference-making factors. I argue that this objection ultimately fails because it is riddled with a number of conceptual inconsistencies. Third, I analyze the roles of similarity judgments in some fields of cancer research which employ a variety of mouse models to learn about the disease mechanisms, arguing that by appreciating the epistemic complexities it is possible to shed new light on more general philosophical debates regarding scientific representation. Fourth, mechanisms can also be studied using more theoretical apparatus in the form of simulations. I investigate an example of an agent-based model used to model the outbreak of SARS-CoV-2 and I present reasons for concluding that although these models rely on simplified assumptions, the best of these models can nevertheless be construed as models of actual mechanisms, delivering both mechanistic and difference-making evidence, and serving as tools for evaluating the effects of possible interventions. Finally, I discuss immunology more generally and present a conceptual model of how to think about the immune system. In light of the COVID-19 pandemic and such others as may arise in the future, an adequate understanding of the immune system is required, and philosophy can be of assistance in that regard.

Keywords

abstraction; agent-based models; biomedicine; cancer; COVID-19; idealization; immunology; mechanistic explanation; molecular biology; mouse models; philosophy of science; SARS-CoV-2; scientific models; scientific representation