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Philosophy, Ontology, and Scientific Explanation

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Explanation is one of the goals of science. One of the goals of the philosophy of science is to account for the logic of scientific explanation. But advances in informatics technologies are changing science in important ways. In my doctoral research I am developing a philosophical account of scientific explanation with a focus on the role of informatics in science. I consider how scientist are using, and could best be using, informatics technologies to express, test, and communicate their scientific explanations.

Biomedical ontologies are an excellent example of the productive intersection of science, informatics, and philosophy. Using ontologies, scientists are able to coordinate on systems of terminology, encode their data for better reuse and sharing, and search and analyze that data more effectively [2,16]. My goal is an account of scientific explanation that builds on these successes.

Philosophers of science have developed a number of accounts of explanation, from deductive-nomological [8,7] to unification [6,9] and pragmatic explanation [17], and from causal-mechanical [15,5] to mechanistic [11,3], interventionist [18], and model-based explanation [4]. These diverse accounts have many insights, but none of them is a good fit for all of the many sorts of scientific explanation. None of these accounts were designed with informatics systems in mind, although deductive-nomological and unification accounts have been adopted in artificial intelligence research on explanation [10, p.68].

I begin by distinguishing the sorts of things that are explained and do the explaining in scientific articles: entities, data, kinds, models, and theoretical considerations. By "entities" I mean concrete particular things; data are records of measurements and classifications of entities; kinds are similar to the universals that ontologies describe; and by "models" I mean (roughly) abstract systems for drawing inferences, such as equations, algorithms, and perhaps some narratives. I support these distinctions with textual evidence from scientific journals.

One important type of explanation is model-kind explanation, where aspects of a model explain aspects of a kind. The kind could be a biochemical pathway, such as glycolysis, while the model is a network of molecule kinds and reaction kinds, including glucose, ATP, and phosphorylation [12]. Ontologist use decidable fragments of first order logic to reason over kinds and their relations. Scientific modelling usually requires more powerful logics and mathematics. I am exploring the use of typed programming languages for expressing such models.

This theoretical work on scientific explanation is supplemented by my applied research into the use of ontologies for reporting in radiology [1,14,13]. My hope is that a better understanding of scientific explanation and the role of informatics in science will lead to better explanations, and to better informatics systems for building, testing, and sharing explanations.

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