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PHD THESIS SUMMARY: Understanding with Models

PHILIPPE VERREAULT-JULIEN
Doctorate in philosophy, January 2019
EIPE, Erasmus University Rotterdam

Theoretical modelling raises many epistemological challenges. Models appear to explain phenomena, yet it is not obvious that they satisfy requirements that typical theories of scientific explanation deem essential, for instance faithfully representing causal factors of interest (Reiss 2012). My doctoral thesis aims at answering the following central and general question: What, if anything, can we learn from theoretical models? The overarching project is to show that models, especially in economics but also in other disciplines, may provide epistemic benefits in the form of understanding even when they do not actually explain or when they do not provide causal knowledge.

Chapter 2 analyses what I call the inferentialist-behavioural account of understanding (InfBUn) (Ylikoski 2009; Ylikoski and Aydinonat 2014; Kuorikoski and Ylikoski 2015). According to InfBUn, what constitutes understanding is having knowledge of relations of counterfactual dependence and having the ability to draw what-if inferences. Drawing on literature in epistemology and philosophy of science, in this chapter I argue that InfBUn is inadequate. First, I show that the behavioural concept of understanding cannot properly distinguish illusory from genuine cases of understanding. This is because it places excessive emphasis on actual inferential performance as a criterion for understanding rather than the ability proper. Second, I contend that it is not necessary to have a behavioural concept of understanding in order to retain compatibility with the view of models as extended cognition. I then propose that InfBUn should be better viewed as an *evaluative* account of understanding and not as a *substantive* one.

The third chapter examines what I call the factive inferentialist account of representation (FInfR) (Kuorikoski and Ylikoski 2015; Kuorikoski and Lehtinen 2009). FInfR has two key features. First, it holds that models represent in virtue of the correct what-if inferences they afford. Second, FInfR claims that, contrary to the traditional

inferentialist account of representation (Suárez 2004), it is compatible with the factivity of explanation, i.e. the requirement that explanations have a true explanans. I argue that FInfR does not, in fact, allow to demarcate merely phenomenological models from explanatory ones. This is because the notion of *correct* what-if inferences is either too ambiguous or too liberal. I then expound a programmatic dilemma FInfR faces. The first option is to double down on deflationism, *viz.* dismissing any substantive criteria about successful representation. The second one is instead to substantiate under what conditions what-if inferences are explanatory. I argue that the first horn is undesirable because it implies abandoning FInfR's main motivation, namely its commitment to the factivity of explanation and to realism.

Chapter 4 (part of it is published in Verreault-Julien 2019b) first argues against two sets of views one can commonly find in the literature about the relationship between understanding and explanation:

1. Causal knowledge is necessary for understanding.
2. Only explanations can provide that knowledge.

Following a terminology I borrow from Pritchard (2014), I call the conjunction of these views, or tenets, the *narrow* knowledge account of understanding (narrow KAU). This chapter has three aims. The first is to show that narrow KAU faces descriptive and normative issues because it cannot account for scientific practices that do not actually explain (e.g., theoretical modelling) and for those that do not explain causally (e.g., mathematical explanations). The second aim is to debunk the tenets of narrow KAU. The third aim is to propose an alternative to narrow KAU, one that I coin *broad* KAU. Broad KAU, contrary to its narrow sibling, makes the following two propositions:

1. Causal knowledge is not necessary for understanding.
2. Having an (actual) explanation is not necessary for understanding.

I propose an account of broad KAU that builds on Reutlinger's (2016) counterfactual theory of explanation. I show that, by amending the veridicality condition of his theory in favour of what I call the *possibility* condition, we are left with an account of understanding. While the veridicality condition requires the actual truth of the explanans and the explanandum, the possibility condition only demands their possible truth. This allows to separate explanation from understanding.

Explanation requires to have true information about actuality whereas understanding only requires true information about possibility. This account, I contend, can accommodate both mathematical and how-possibly explanations.

In chapter 5 (separately published in Verreault-Julien 2019a), I propose and develop a new account of how-possibly explanations (HPEs). HPEs are usually contrasted to how-actually explanations (HAEs). Instead of taking the degree of empirical support as the demarcation criterion between HPEs and HAEs (e.g. Bokulich 2014), I suggest that the fundamental feature of HPEs is that they provide knowledge of possibility. While HAEs are characterized as propositions of the form '*p* because *q*', HPEs include a possibility operator and thus have the form '◇(*p* because *q*)'.[1] Crucially, HPEs have a truth value, they can be true or false. Evaluating their truth value requires at least a minimal amount of relevant background knowledge. Finally, I argue that models should not be viewed *stricto sensu as* HPEs. Rather, models provide reasons to believe propositions of the form '◇(*p* because *q*)'.

Chapter 6 (also published in Verreault-Julien 2017) uses many insights from the previous chapters and applies them to a specific case in economics, namely the Arrow and Debreu (1954) model of general equilibrium. The model is considered to be a landmark achievement of economic theory, yet it is also often criticized (Blaug 2002). The main claims of this chapter are that the general equilibrium model provides a *mathematical* HPE and that this HPE affords understanding not only of the model, but also of the world. I show that proving the existence of a general equilibrium was motivated by the fact that it could inform economists, albeit minimally, about its actual existence. This is because mathematical claims can serve an evidential role with respect to causal claims. For if the equilibrium would be mathematically impossible, then this would be evidence that it is causally impossible.

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[1] This reads 'It is possible that (*p* because *q*)'.

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Philippe Verreault-Julien obtained his PhD in January 2019 from Erasmus University Rotterdam under the supervision of Julian Reiss (Durham University) and Jack Vromen (Erasmus University Rotterdam). His research mainly focuses on the epistemology of theoretical modelling. Starting fall 2019, he will be a postdoctoral researcher at the Centre for Philosophy of Natural and Social Science, London School of Economics and Political Science. He acknowledges the financial support of the Fonds de recherche du Québec – Société et culture (FRQSC) for his PhD research.

Contact e-mail: <verreaultjulien@esphil.eur.nl>
Website: <https://pvjulien.net>