Studies in History and Philosophy of Biological and Biomedical Sciences 62 (2017) 20–24

Contents lists available at ScienceDirect

Studies in History and Philosophy of Biological and Biomedical Sciences

journal homepage: www.elsevier.com/locate/shpsc

Modelling with words: Narrative and natural selection

Dominic K. Dimech

Department of Philosophy, University of Sydney, Quadrangle A14, Sydney, NSW 2006, Australia

ARTICLE INFO

Article history:
Received 30 June 2016
Received in revised form
8 February 2017
Available online 20 February 2017

Keywords:
Modelling
Verbal models
Narrative
Charles Darwin
Natural selection

ABSTRACT

I argue that verbal models should be included in a philosophical account of the scientific practice of modelling. Weisberg (2013) has directly opposed this thesis on the grounds that verbal structures, if they are used in science, only merely describe models. I look at examples from Darwin's On the Origin of Species (1859) of verbally constructed narratives that I claim model the general phenomenon of evolution by natural selection. In each of the cases I look at, a particular scenario is described that involves at least some fictitious elements but represents the salient causal components of natural selection. I pronounce the importance of prioritising observation of scientific practice for the philosophy of modelling and I suggest that there are other likely model types that are excluded from philosophical accounts.

1. Introduction

Contemporary philosophy of modelling emerged as a departure from debates over what constitutes a scientific theory, in which the term "model" referred to a formal semantic object (a "partial interpretation" in Braithwaite, 1962; Nagel, 1961. See also Lloyd, 1988; Suppes, 1962; Van Frassen, 1980). Philosophers of science now speak of the *practice* of scientific modelling, and Godfrey-Smith (2006) – representative of this practice-based tradition – defines models as, "idealized structures that we use to represent the world, via resemblance relations" (2006, pp. 725–726). Models are now understood as things that scientists spend their time building, analysing, and modifying in light of their results. Even though not all science involves models, a lot of scientific practice does encompass modelling, and they are particularly ubiquitous in the biological sciences (see Winther, 2006). The need for a departure from the old, formal sense of "model" was prompted by concerns that philosophical debates about theory did not make reference to, and were thus irrelevant to, real-world scientific practice (see Cartwright, Shomar, & Suárez, 1995; Morgan & Morrison, 1999; Odenbaugh, 2008).

Recent studies of models in science, however, still identify a pretty narrow range of things that can count as models. Michael Weisberg, in *Simulation and Similarity: Using Models to Understand the World* (2013), argues that purported model types, such as verbal, diagrammatic, and pictorial, are to be excluded from an account of modelling on the grounds that we can account for such things as model descriptions. Weisberg does not define "descriptions" precisely but gives a series of examples and indicates that they refer to models and make them present in contexts in which, for whatever reason, the model itself cannot be present (2013, pp. 31–39). Weisberg would want his distinction between models and model descriptions to reflect the practical reality of science, and this would happen if scientists only ever use verbal structures to refer to some more important thing that is doing the heavy work.

Here I argue that we ought to recognise verbal models in a philosophical account of modelling because verbal structures do indeed have the capacity for robust scientific work. Previous studies have explored the role that verbal structures can play in science (Huneman, 2007; Lennox, 1991; O'Hara, 1988; Richards, 1992; Winther, 2006, 2011), but this defence of the capacity of verbal structures against a reductive argument like Weisberg's is original. Here I analyse parts of Charles Darwin's *On the Origin of Species* (1859/1964) (henceforth, the *Origin*) and show that Darwin used models in the form of invented, idealized narratives to display how the process of natural selection works.

Getting the right typology in a philosophical account of models is important because it determines from the outset the examples that will be looked at when investigating other philosophical questions about models. A broad implication of the argument here is that the description/model distinction is a weak device for reducing the number of types of models we recognise. This, consequently, lends reason to suggest that other model types that are excluded, such as diagrammatic and pictorial, could be models. In fact Winther (2006, p. 447) has argued that developmental

E-mail address: dominic.dimech@sydney.edu.au.

http://dx.doi.org/10.1016/j.shpsc.2017.02.003
1369-8486/

biology, a subject area he explicitly points to as containing verbal models, also contains diagrammatic models (see also Sheredos, Burnston, Abrahamsen, & Bechtel, 2013). Godfrey-Smith (2006, p. 732) also claims that one prime example of a work of evolutionary modelling, Maynard Smith & Szathmáry's *The Major Transitions in Evolution* (1995) involves many models that are not mathematical. It is clear that some models in that book are given in diagrammatic form, such as a model of the Oklo reactor (1995, pp. 18–20), and the stochastic corrector model of gene replication (1995, pp. 55–58). In general, the philosophy of modelling still needs to capture the full diversity of practices that involve models.

In the next section I run through the core ideas behind contemporary philosophy of modelling. This sets the scene for the rest of the paper and provides a frame of reference for me to argue that verbal structures should indeed count as models. In Section 3, I proceed to go over Darwin's central claim in the *Origin* and then present his examples of verbal models. In Section 4, I address some objections about whether verbal models really represent a distinct category, and I conclude in Section 5 by summarising my argument and restating the general lesson that can be gleaned from it about how we decide what should or should not count as a model.

2. Models in science

Weisberg (2007) defines modelling by contrasting it with *abstract direct representation* (ADR). Modelling is a way of doing science in which an independent structure is used as a proxy to study some target phenomenon that is beyond direct investigation for some practical reason. ADR does not involve such intermediate structures but does involve making general claims and being selective about which features to represent and which to ignore. Unique to modelling is a methodological step of comparison, of determining in what respects the studied object is similar to the target (Weisberg, 2007, p. 223). Modelling, like ADR, involves idealization, and for Weisberg this involves, "a departure from complete, veridical representation […] In other words, a model is idealized with respect to its target when it fails to represent some important aspects of the target" (2013, p. 98). Godfrey-Smith (2009a, p. 48) more narrowly defines idealization as *fictionalizing*, that is, as representing things falsely, as opposed to just leaving truths out. Each of the examples I will look at from Darwin involve at least some fictionalizing and are therefore idealized according to even Godfrey-Smith's narrower sense. Darwin does bring in empirical facts in some of his examples, but in all the cases I pick out, Darwin is not attempting to describe what is really the case.

The upshot of modelling is that it makes possible the study of phenomena that would otherwise be too complex or beyond grasp for some other reason. A particular application of modelling is especially relevant here – that of using models to study general phenomena. Evolutionary scientists are not just interested in how this or that species evolved, but how the process of natural selection in general comes about. Scientists can theorize about general phenomena via ADR, but representing such phenomena in distinct structures is the work of modelling. In what follows, we will see that Darwin's invented scenarios of natural selection are not supposed to be about any particular cases but they capture what is common to all cases by representing only what is salient (see also Weisberg, 2013, pp. 114–121).

Weisberg is sympathetic to the point that in the past theorists were too narrowly focused on mathematical models and cites Winther (2006) as a source of agreement on this (Weisberg, 2013, p. 15). Unlike Winther, however, Weisberg does not recognise verbal models, instead countenancing only physical, mathematical, and computational models (2013, p. 7). Weisberg relies on the distinction between models and model descriptions for his rejection of verbal models, as he insists that the types of objects used as descriptions varies more widely than the types of things that are actually models (2013, p. 17). A mathematical model, like the Lotka-Volterra predator-prey model, can be described using formulas, using graphs, or diagrams, and these all may vary in levels of detail (see Weisberg, 2013, pp. 31–39). By way of example, Weisberg shows how Shepard and Metzler's (1971) purported verbal model of mental image rotation can be seen as a mere description of a computational model. If elaborated on, Weisberg tells us, the words in that model would be replaced with, "a lot of mechanistic detail of the sort that visual input *V* triggers mental mechanism *M*, which is processed by *P*, and gives output *O*" (2013, p. 18). This way of proceeding, however, involves a significant lacuna. It might be the case that we can think of the putative verbal model as a description of a hidden computational model, but Weisberg needs a reason why we ought to reject the existence of verbal models altogether and not just believe that verbal models can sometimes be transformed into computational ones.

3. Narratives in the *Origin*

3.1. Principles of natural selection

In order to make lucid what is being modelled in Darwin's scenarios, I will first provide a brief summary of the basic ideas behind Darwin's fundamental thesis in the *Origin*. Contemporary summaries of the theory of evolution by natural selection identify three principles that capture what is necessary to it. Godfrey-Smith (2009b, p. 18) cites Levins and Lewontin (1985) for the standard summary. Note that the following is mere abstraction, since there is not yet a further, proxy structure that these principles are represented in:

> 1. Individuals within a species vary in physiology, morphology, and behavior: the principle of variation.
>
> 2. Offspring resemble their parents on the average more than they resemble unrelated individuals: the principle of heredity.
>
> 3. Different variants leave different numbers of offspring: the principle of differential fitness.
>
> (Levins & Lewontin, 1985, p. 76).

Of course, Darwin did not understand his own theory in these terms, but we can identify the relevant corresponding parts in the text of *Origin*. In the following quotation, I have put a number just before each principle is referred to, even though the resulting numbering is out of order:

> Can it, then, be thought improbable, seeing that variations useful to man have undoubtedly occurred, that [1] other variations useful in some way to each being in the great and complex battle of life, should sometimes occur in the course of thousands of generations? If such do occur, can we doubt (remembering that many more individuals are born than can possibly survive) that [3] individuals having any advantage, however slight, over others, would have the best chance of surviving and of procreating [2] their kind? On the other hand, we may feel sure that any variation in the least degree injurious would be rigidly destroyed. This preservation of favourable variations and the rejection of injurious variations, I call Natural Selection.
>
> (Darwin, 1859/1964, pp. 80–81).