Book Review

Since antiquity, the principle that parsimonious theories are better than more complex ones, which received the label *Ockham's Razor* from Libert Froidmont in the 17th century, has played a pivotal role in countless scientific and philosophical arguments; and it is an anchor around which much of Elliot Sober's work of the past 25 years has revolved. In his *User's Manual*, Sober revisits the insights he has gained over the years, adjusts them where necessary and synthesizes them to a comprehensive account of parsimony arguments. His aim is to provide both a descriptively adequate analysis of their form and use as well as a normative framework for their evaluation. To this end, he, on the one hand, reconstructs a wide array of parsimony arguments from science and philosophy, revealing a remarkable plurality of different *razors*. On the other, Sober develops two probabilistic parsimony paradigms which, in his view, constitute the justificatory foundation of all successful parsimony arguments. This thoroughly argued monograph is the only currently available inquiry of its kind and, thus, fills an important gap in the literature on explanation, confirmation, model building, and scientific reasoning more generally.

Chapter 1 reviews classical parsimony arguments from authors such as Aristotle, Ockham, Copernicus, Descartes, Newton, Hume, Kant, and Morgan. In all the heterogeneity that this survey uncovers Sober identifies two main types of razors: the *razor of silence* and the *razor of denial*. While the first demands to remain silent about the truth of non-parsimonious theories, the second requires to reject them as false. Moreover, Sober scrutinizes the attempts of the pre-1900 writers to justify their razors. While some contend that parsimonious theories are preferable because nature is uniform or because God is immutable, others hold that the parsimony principle is a logical maxim or an epistemological primitive. Sober shows that all of these accounts are wanting. Justifying a razor with recourse to some metaphysical simplicity principle is non-illuminating, for it merely replaces one questionable principle by another, whereas analyzing it as a primitive does not even attempt to provide reasons for why simplicity should be a guide to truth and not just an aesthetic frill or psychological attractor.

In chapter 2, Sober sets out to resolve the deficiencies of the pre-1900 accounts by developing the two probabilistic parsimony paradigms. The discussion opens with an exceptionally accessible introduction to two of the leading philosophies of probability, Bayesianism and frequentism. In Bayesianism, there are two conceivable ways to justify a preference for simpler theories: either they are shown to have higher priors than their more complex rivals or higher likelihoods (or both) [85]. Sober discards the first option for there is no systematic connection between simplicity and higher priors. By contrast, he finds such a connection between sim-

plicity and higher likelihoods. More specifically, with recourse to Reichenbach's *principle of the common cause* Sober identifies seven background assumptions (e.g. that common causes screen-off their effects, that separate causes are mutually independent, that causes are probability-raisers, etc.) such that, if a system complies with these assumptions, models featuring a single common cause can be proven to have higher likelihoods than models with multiple separate causes. Based on the *law of likelihood* it follows that the more parsimonious (common-cause) models have higher posterior probabilities and, hence, are preferable on Bayesian grounds.

In frequentism, by contrast, "more parsimonious models, when fitted to the data, often confer lower probabilities on the data at hand; here parsimony and likelihood clash" [141]. Nonetheless, by drawing on the *Akaike Information Criterion* (AIC) Sober shows that when it comes to estimating the predictive accuracy of a model from a frequentist perspective, likelihood is only one relevant measure, another one being the number of adjustable parameters in the model. AIC penalizes models for complexity, to the effect that, whenever complex models do not fit the data significantly better, their parsimonious rivals have higher predictive accuracy and, hence, are preferable on frequentist grounds [131]. This paradigm also presupposes the fulfillment of empirical assumptions, for example, that repeated estimates of the value of an adjustable parameter form a bell-shaped distribution [133].

The main upshot of these paradigms is two-fold. First, the parsimony principle is neither primitive nor rooted in some metaphysical parsimony postulate; instead it follows (mathematically) from standard probabilistic frameworks of confirmation and model selection. Sober speaks of *reductionism about parsimony*: parsimony is not an end in itself; it is only epistemically relevant if it contributes to a more fundamental epistemic goal. Second, the principle of parsimony cannot be validated *a priori*, rather, its justification depends on the viability of empirical background assumptions. Hence, Ockham's razor is *context-sensitive*: it is only applicable in modeling contexts that satisfy the relevant background assumptions.

Chapters 3 and 4 then apply the two paradigms to two types of parsimony arguments in evolutionary biology and psychology, respectively. Chapter 3 argues that under certain assumptions about the evolutionary process (e.g. that it has the Markov property), cladistic parsimony—according to which phylogenetic trees inducing a minimal amount of character state changes are preferable—is justified within the Bayesian paradigm. In chapter 4, Sober discusses various studies investigating whether chimpanzees are mind-readers or mere behavior-readers. He first finds that neither of the parsimony paradigms are conducive to decide the matter based on the experiments reported in those studies, which have tested single behavioral responses of chimpanzees only. He then suggests a new type of experiment, which, by testing multiple behavioral responses, could generate evidence favoring the mind-reading hypothesis over its behavior-reading rival.

Finally, in chapter 5 Sober assumes what he calls *methodological naturalism$_p$*: "philosophical theories should be evaluated by the same criteria that ought to be used in evaluating theories in natural science" [245]. In that light, he investigates

whether six classical parsimony arguments from philosophy—thematically ranging from atheism, mind-body identity and epiphenomenalism to moral realism, Platonism, and solipsism—meet the quality benchmarks imposed by his parsimony paradigms. It turns out that only the arguments for atheism and mind-body identity pass the test.

Most of Sober's argument reconstructions are very illuminating and he succeeds in developing a compelling framework for the evaluation of parsimony arguments. In addition, Sober's monograph stands out for its conceptual clarity and transparency with respect to background assumptions, which typically remain implicit in discussions of Ockham's razor. Conversely, however, those passages of the book that do not meet those high standards are all the more noticeable. For instance, Sober works with a misleading notion of closeness to the truth. For him, a proposition p being close to the truth does not mean that p is approximately true (i.e. p has a fuzzy truth value close to 1), rather it means that p states something close to some target proposition q that is true [146]. This then creates the 'paradox' that a false proposition can be closer to the truth than a true one. For instance, if the temperature in a room is $20°C$, the proposition "The temperature is $0°$ or $10°$ or $20°$ or ..." is true but, according to Sober, farther away from the truth than the false proposition "The temperature is $20.1°$" [144-147]. This is a mere artifact of Sober's misleading terminology. A disjunction with one true and many false disjuncts may be less *informative* than a false statement with only one disjunct, but the former is as close to the truth as it gets. Truth is no guide to informativeness, but it surely is a guide to truth.

Another passage that does not meet the usual quality standards of the book is Sober's suggestion of a new type of experiment to test the mind-reading hypothesis for chimpanzees [217-243]. Experiments on this hypothesis typically focus on one behavioral response R_1 and test whether a stimulus S raises the probability of the chimpanzee exhibiting behavior R_1. Yet, a probabilistic dependence between S and R_1 can be equally accounted for by a causal model featuring an intervening mental ('mind-reading') variable M on the path from S to R_1, and by a pure behavior-reading model that directly links S to R_1. As an alternative experimental set-up, Sober suggests to investigate two responses R_1 and R_2. If, in the resulting data, S screens-off R_1 from R_2, the behavior-reading model is selected, but if S fails to screen-off, Sober claims it follows that there is an intervening variable between S and R_1/R_2 [222], which constitutes "evidence for mind-reading" [241]. However, there are many models without intervening variables that could equally account for S's failure to screen-off, for instance, one with a direct causal dependence between R_1 and R_2 or one with a latent common cause that is not located between S and R_1/R_2 but on the same level as S. Sober does not discuss any of these options. Possibly, they can be excluded for the chimpanzee case based on empirical background assumptions, but Sober does not mention any such assumptions. As it stands, his proposal on how to distinguish between behavior- and mind-reading models is inconclusive.

Finally, Sober's rejection of the master argument for epiphenomenalism [260-

264] makes me wonder whether it is adequate to impose his normative framework on *all* parsimony arguments. There is a long-standing tradition in the literature on causation to define a cause as a *non-redundant* difference-maker of its effect, meaning that a parsimony constraint is built into the very notion of causation. An example of such a theory is the manipulationist account, to which Sober himself is sympathetic [265]. It defines X to be a cause of Y iff it is *possible* to intervene on X such that Y changes, when all other (off-path) causes of Y are held fixed. Sober correctly shows that it is *impossible* to intervene on a mental variable M_1 while holding fixed its supervenience base P_1 when testing whether M_1 is a cause of a downstream effect P_2 of P_1 [262], *viz.* that M_1 is redundant to account for P_2. This, subject to the manipulationist theory, entails that M_1 does not cause P_2. Yet, although the inefficacy of M_1 logically follows from a theory Sober himself finds attractive, he claims that the parsimony argument for epiphenomenalism is unsuccessful because it does not comply with his paradigms. In my view, a more convincing conclusion to draw would be that, in philosophy, there exist valid and meaningful parsimony arguments that are not concerned with selecting among different theories based on empirical data but rather with clarifying the conceptual consequences of metaphysical theories.

Notwithstanding the few less compelling passages, *Ockham's Razors* is a highly recommendable and thought-provoking inquiry of a pervasive type of argument that, to my knowledge, has not been so thoroughly analyzed to date.

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