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BOOK REVIEW

Finnur Dellsén: *Abductive Reasoning in Science* Cambridge: Cambridge University Press, 2024, 84 pages

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Finnur Dellsén's book, even though narrow, but very rich in content, was created as a part of the Cambridge's series: Cambridge Elements in Philosophy of Science. These Elements are constituted by various topics from the Philosophy and Methodology of Science.

Dellsén's Element consists of four chapters, across which he presents the readers with the main approaches to abductive reasoning in science. He does not leave some of the most influential and discussed objections and challenges aside. Furthermore, he makes the matter far more accessible by providing the reader with examples and helpful classifications.

The first chapter, *A Brief History of Abductive Reasoning*, is dedicated to track the origin of abductive reasoning not just to Charles S. Peirce, but even further, to the work of Francis Bacon and René Descartes. He shows that the abductive reasoning firstly emerged as a scientific practice rather than an explicit theory. Presenting the historical cases from such figures of modern science as Antoine Lavoisier and Charles Darwin, he supports this claim, since the structure of abductive reasoning can be observed as implicit within their most influential research. He continues this history cruise by presenting Peirce's schema of abduction, with the important note, that Peirce's use of the term "abduction" is distinct from how it is used and understood these days. For someone, who takes this Element to be an introduction to abductive inferences,

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this note is important, since the terms "abduction" and "inference to the best explanation" are often used synonymously and interchangeably in the relevant literature.

From Peirce, Dellsén moves to hypothetico-deductive (HD) model, which can be seen as another forerunner for the contemporary abductive reasoning. The difference between HD model and Peircean abduction lies in the main idea behind each account, that is, for abduction (Peircean) the goal is to formulate new theories, but for HD model (as presented by Hempel) it is hypothesis evaluation. Then the similarity, which is based on their structures, since "both require a kind of derivation of a manifest fact from a hypothetical guess" (p. 9), is even more curious because of above mentioned difference. The problem which arises with both accounts is that for a proposition, "surprising fact C" (in Peircean abduction) or "empirical consequences E" (in Hempel's HD model), there might be various incompatible propositions that make it a matter of fact (or theories from which E may be derived in HD model).

Last section of his historical tour is devoted to Gilbert Harman's IBE – Inference to the Best Explanation. Harman's main idea of such inference is that the truth of the hypothesis is inferred upon its capability to provide a better explanation of evidence, than any other would. This kind of reasoning is purely comparative. Dellsén then shows how Harman's IBE is an improvement when compared to HD model. Many abductive inferential accounts are these days labeled as IBE whether they are improvements of Harman's or not.

With this, Dellsén moves to the second chapter of the Element – *Contemporary Accounts of Abductive Reasoning.* He distinguishes between *inferential, probabilistic* and *hybrid* accounts.

Inferential accounts consist of inferring hypotheses based on their explanatory considerations. Dellsén states that in this sense, most accounts of abductive reasoning are inferential. It can be found for example in Harman's (1965), but also in Lipton's (1991). Lipton (1991) is explicit on what constitutes the *best* or *better* explanation – it is the one that would be the *loveliest*, i.e. it would provide the most understanding, if it were true. Some issues may arise with inferential accounts because their evaluative structure often differs. Since it is the explanatory virtues (such as simplicity, scope, unification etc.) that determine the explanatory goodness, one compares the degree of virtuousness of one hypothesis with the rest of those already formulated, but not with other potential ones.

Probabilistic accounts on the other hand situate the abductive reasoning into the Bayesian framework. The crucial part of Bayesianism for abductive reasoning is the Bayes' theorem which shows how is the posterior probability dependent on the prior probability, likelihood and expectedness of evidence, and the Rule of Conditionalization that tells a rational agent how to update their credences after obtaining some new evidence E.

One of the probabilistic accounts that Dellsén presents is from van Fraassen's critique of inferential accounts. The idea is that if abductive reasoning is to be implemented in Bayesian framework, one should award the best explaining hypothesis greater posterior probability (probability of hypothesis conditional on the evidence) than Bayesianism would. Dellsén calls this conditionalization with explanatory bonus an *Abductive Conditionalization*, since the explanation plays its role. However, van Fraassen himself claims that this is not plausible, because it is in conflict with the original Rule of Conditionalization.

Another possibility is to let explanatory consideration constrain Bayesianism, specifically by influencing the probability values that are at its core. This would then save Bayesian Conditionalization, but it would not justify the abductive reasoning, since there is no rational ground for such constraints to be required.

Last group of abductive accounts Dellsén calls hybrid, since they are a combination of inferential and probabilistic features of abductive reasoning. The *dualistic* hybrid account can be understood as a simultaneous and independent occurrence of two distinct forms of reasoning that can both be influenced by explanatory considerations in a single agent. The *heuristic* account on the other hand takes one type of reasoning to be more normatively fundamental, and mostly it is the probabilistic reasoning. For such heuristic to be plausible, the abductive inference (specifically a standard form of IBE) ought to approximate normatively correct probabilistic reasoning, which could be expected, since explanatory considerations have an impact on both accounts. Hence, heuristic accounts "must arguably assume that rational probability assignments favor hypotheses that provide better explanations, as per probabilistic accounts" (p. 29).

Such overview of various abductive accounts with their advantages and disadvantages makes it much easier for one to compare and evaluate these accounts. And if this Element would be used as an introduction to the issue of abductive reasoning, probabilistic and hybrid accounts show right away that

there are some other approaches to scientific reasoning, with which combining the abductive approach can have a great impact.

In the third chapter, Dellsén aims to eliminate any doubts about whether or why explanatory hypotheses should be preferred. Since abductive reasoning is based on inferring a higher probability to a hypothesis that best explains some evidence, the most important part is to make clear what does it mean to be a best explaining hypothesis – we have a question about what constitutes explanatory goodness (or power, as it is often referred to). Dellsén presents two conceptions of explanatory goodness: *virtue-theoretic* and *subjunctive* conception.

Virtue-theoretic conception is based on a list of theoretical features called explanatory virtues that a hypothesis instantiates. But what counts as such virtue? In the literature these days we can find lots of lists that (from author to author) vary in quantity, classification and explication of these virtues, but it is possible to identify some of them that are most cited (i.e. Dellsén refers to scope, parsimony, unification, plausibility and analogy). One of the most discussed problems with virtue-theoretic conception is the non-measurability of the virtues. Though, some philosophers came with probabilistic measures of explanatory power or goodness, which represents the degree of a virtue in quantitative terms, there still cannot be found any consensus on how to understand or explicate the explanatory goodness. Subjunctive conception, with Elliot's (2021) terminology, covers Lipton's (2004) idea of "loveliness" which is determined by how much understanding is provided by a hypothesis, supposing it is true. Dellsén then points out one detail – that Lipton is noncommittal about what counts as an explanatory virtue and quite thrifty on the question of what constitutes the *loveliness* of hypothesis. This shows that the subjunctive conception needs an elaboration.

The next chapter focuses on how the explanatory goodness relates to truth. If a better explanation of a hypothesis means that it is more virtuous, and if those virtues are epistemic, then a better explanation should also mean that the hypothesis is more likely to be true. Dellsén calls this view *realism about explanatory goodness*. He also discusses the opposite view – *antirealism about explanatory goodness* – the idea that the better explaining hypotheses are not more likely to be true than those which are not as good in explaining. Dellsén then ends this classification with a note that it is in fact reasonable to take some

of the explanatory virtues as truth-conducive and others as not. Furthermore, he demonstrates the difference in regard of explanatory goodness between realists and antirealists on two particular virtues (*scope* and *parsimony*). To conclude this section, Dellsén points out another, more plausible view of the explanatory goodness, which he calls *contextualism* – theory's truth-conduciveness is context-dependent, i.e. it depends on other factors that are beyond the theory or hypothesis itself.

The last chapter titled *Is Abductive Reasoning Irrational?* is focused on the main objections and challenges that abductive reasoning faces, most of which are based on questioning its rationality.

Perhaps the most influential and discussed objections to a form of abductive reasoning, come from Bas van Fraassen (1989, 142–143). The *bad lot objection* to IBE basically points out, that we cannot ever be sure that the best hypothesis is among those considered, hence we might find ourselves choosing the best out of a bad lot. Even though, many authors have tried to show that van Fraassen is mistaken, or that his objection has no merit, Dellsén showed some of the historical examples where scientists in fact found themselves choosing a hypothesis from a bad lot. He then shows possible responses to this objection, which he divides to *reactionary* and *revisionary* responses. Every one of them is then accompanied by a rejoinder which could disrupt the original response.

Such influential response might be found in Lipton (1993), who identifies two stages of IBE – the formulation of rival explanatory hypotheses and comparative evaluation of those hypotheses. According to Lipton, if someone is reliably capable of the latter, they will also be reliably capable of the former – that is because a reliable comparative evaluation needs to be based on a large set of true background theories, that themselves would have been generated by IBE in an earlier time.

Revisionary responses to the bad lot objection hold that such objection should be a reason to reformulate or replace IBE with some other account of abductive reasoning, as it may help to avoid it. Such responses can be found in Kuipers (2000) or Dellsén (2018) – they are based on the development of an abductive account which does not guarantee an absolute conclusion about the hypothesis. Rather they use a comparative conclusion saying that it is closer to the truth (Kuipers, ibid) or more likely to be true (Dellsén, ibid), than its

competitors. Then, for the cases in which IBE can effectively establish the absolute conclusion, e.g. Musgrave (1988) and Lipton (2004) suggested a modification of IBE, as to include a requirement for the inferred hypothesis not only to be better than others available, but also to be *good enough*, sufficiently explanatory to be inferred at all.

In this light Dellsén (2021) developed a different account for the justification of inferring a good enough hypothesis, which is based on a process of *explanatory consolidation*. It includes accommodation of two different types of information which would make the considered hypothesis more plausible as better explanation of the evidence at hand than any other possible hypothesis.

The second van Fraassen's objection is known as *The Dynamic Dutch Book Argument.* Van Fraassen uses this argument as a motivation for moving from inferential accounts (such the Harman's and Lipton's) to a sort of probabilistic one, which he then ends up also rejecting. His objection is pointed on the earlier mentioned *Abductive Conditionalization,* specifically saying that it conflicts with Bayesian Conditionalization, since it requires assigning bonus points to a hypothesis, which according to Bayesian Conditionalization it does not deserve. And since any updating of probabilities that conflicts with Bayesian Conditionalization guarantees one to lose in a bet from a Dutch bookie, and an agent knows that this is the risk of following any other rule (Abductive Conditionalization in this case), van Fraassen claims, that such agent is *diachronically incoherent*, therefore irrational. Dellsén then presents Igor Douven's version of Abductive Conditionalization in which not only bonus points are added to the best explanatory hypothesis, but also penalty (zero points) to all the competitors. Even if this move does not completely avoid the vulnerability of a Dutch bookie, it is not irrational to use this form of conditionalization, since in some cases it might be even more beneficial than the Bayesian account.

Lastly in this section Dellsén presents some of the most recent challenges to abductive reasoning – *The Screening-Off Challenge, The Problem of Multiple Rivals* and *Incoherence Across Explanatory Levels.*

The screening-off challenge is focused on the abductive reasoning within the Bayesian framework, especially on the role of the explanatory considerations. Sober and Roche (2013) argue that the fact, that if a hypothesis were to explain some evidence, it should raise the probability of such hypothesis more than

would evidence itself, can be seen as *evidentially irrelevant,* according to their *screening-off criterion.*[1]

The problem of multiple rivals depicts that the result of abductive reasoning is the one hypothesis that does best in explaining concerned evidence regardless of the fact, that among considered hypotheses there may be several plausible explanations, that are nearly as good as the best one. Dellsén's (2017) suggestion is that within the inferential and hybrid accounts this problem can be faced after a generalization of IBE to *abductively robust inference (ARI).* What ARI gives us is the possibility of inferring a claim that is entailed by several hypotheses (set of best explanations for that claim), from which at least one would be true.

Last of the recent challenges is the Incoherence across explanatory levels, which aims at the fact that a phenomenon can be explained at multiple levels. So, if we were to infer various hypotheses from the same evidence, those hypotheses do not necessarily all have to be mutually competing. Rivals would be only those which are at the same level. Climenhaga (2017) suggests that some of abductive accounts would then be incoherent, since this would allow to make inferences that are incompatible with each other. Dellsén then suggests that there is a privileged level of explanation for IBE to operate on, this level would be that "at which the set of hypotheses provide more informative explanations" (p. 62).

To conclude this abductive journey, there is not much I can add to. Dellsén's work on this element is perfectly balanced – he goes into details of some particular cases or accounts where it is the case that a fine detail makes a difference. On the other hand, he does not do so in passages where so many details would do nothing more than confuse the reader. That is the main reason why this Element is a great starter point for any beginner in the field of abductive reasoning. Furthermore, his classifications serve not only to better understand individual accounts of abductive reasoning or approaches to explanatory goodness, but also to easily navigate through the text, especially in cases where he refers to previous passages. We could say that Dellsén, in just a few pages, managed to introduce the basics of abductive reasoning in science, supporting many of them with examples, but also pointed out important objections that many authors have to the use of IBE in science, as well as potential answers

[1]Explanatory considerations are evidentially irrelevant if $Pr(H|E\&X) = Pr(H|E)$, where X is the fact that H explains E. In such case one could say that E screens off H from X.

and open questions related to them. This Element therefore stands as a successful and concise guide to abductive thinking, accessible to everyone.

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