Review

In this book Strevens presents a set of rules for defeasibly inferring physical probabilities from causal structure. He makes three main claims about these rules: i) the rules are innate to all human beings, though perhaps not open to introspection, ii) they have played important roles in scientific discoveries and iii) the rules are reliable in practise.

The presentation of arguments is, in general, clear and accessible to an audience far beyond those who think about probabilities for a living, as long as the glossary is frequently consulted. It quickly becomes clear that Strevens deeply cares about the issues and about presenting his ideas to a wide audience. To this end, the explanations of complicated physical problems are given on an informal level. While the wider audience is thus well-catered for, the expert reader may feel frustrated by the lack of formal definitions of the main notions. For example, Strevens does not offer any account of what exactly he means by "physical probabilities".

The rules to infer physical probabilities are, among others, the microdynamic rule, the equilibrium rule and the uniformity rule. Taken together these rules allow what Strevens terms *equidynamics*. Ingredients of these rules are, among other things, random walks and evolution functions of physical systems. Colin Howson, in his review (2013, Notre Dame, Philosophical Reviews), points out that it is implausible that non-experts are using such complicated rules. Strevens replies in this blog that the complex ingredients are only used for the vindication of the rules, but emphatically not for their application. In my opinion, Strevens presentation in his book is ambiguous in this respect; one needs to read with great care and a good dose of good-will to differentiate when Strevens refers to thinking in ordinary humans and when he aims at vindicating his rules.

While the presentation of arguments – setting the above mentioned ambiguities aside – is of a high standard, their content seems open to objections.

In Chapter 8.3 Strevens claims that to explain our innate ability to infer physical probabilities it is necessary to consider a systems of inference rules which are at least as complex as his equidynamic rules. I would like to offer a simpler alternative. When faced with an experiment with n possible outcomes which are epistemically symmetric, then defeasibly infer physical probabilities in the Laplaceian manner by dividing favourable by possible outcomes. To convince oneself that the intuitive condition is met it suffices to check that the initial conditions are reasonably flatly distributed and that there is no obvious bias.

To substantiate claim ii) Strevens considers Maxwell's derivation of the distribution of gas molecules in an ideal gas and Darwin's "On the Origin of Species". Addressing Darwin's theory, Strevens makes the assumption that, on average, a swifter wolf catches more deer than a slow wolf. He then goes on to claim (p. 133) "You might wonder whether there is not some nonprobabilistic way to infer a connection between the speed of wolves and their success in the chase... Nothing I have said precludes this possibility... I have no idea, however, in what way such reasoning might proceed." Based on this claim Strevens goes on to (p. 133) "develop a psychological model of the way in which, in the absence of statistics, normal humans reason probabilistically about fitness."

Even granting Strevens that he here refers to an intuitive application of his rules

(which may not be open to introspection), his argument can never work. Firstly, just because Strevens cannot conceive of another way does by no means have implications for what actually happens in our brains. Secondly, there seem to be at least two perfectly good ways to do such inferences. Counter-factual reasoning of the form: "had the wolf been faster, it might have caught the deer" seems to nicely fit the bill. Evidence-based reasoning in the form of observational studies (faster predators catch more prey) may also well explain many of Darwin's ideas which Strevens attributes to be the result equidynamic thinking.

Strevens's main argument for the reliability of his rules relies on initial conditions being sufficiently smoothly distributed in the world. The evidence he presents for the smoothness consists of two studies of goal-directed human muscular activity ("neuro-motor" noise increases with the force of the movement) and the observation that noise smoothes "out initial conditions" (p. 192). If the noise is too weak to sufficiently smooth out initial conditions, then Strevens points out that the noise arose from some prior process which itself is subject to noise (p. 193). While this is so, considering causally prior processes does not introduce any further noise. An accurate description of the main process under consideration takes causally prior noise into account. Hence, Strevens's move fails to achieve the smoothing out. Furthermore, his discussion completely ignores systematic biases.

At the end of Chapter 11 Strevens finally shows his true convictions (p. 180): "Behind every great deterministic theory in the biological or social sciences is, I suggest, a stochastic - an equidymanic - rationale." Taking his conviction at face value it becomes clear why Strevens feels so passionately about equidynamics, equidynamics is behind every great deterministic theory in the biological or social sciences.

His main empirical basis for this grand suggestion consists of observational studies of infants which report that infants watching balls drawn from transparent urns are surprised when the observed frequencies in a sample (drawn by a blind-folded experimenter) differ significantly from the proportions in the urn. Throughout his book Strevens refers to these studies claiming that they convincingly demonstrate that we all have an innate ability to reason equidynamically and that we intuitively apply these abilities in all sorts of situations. A critical reader would hope for more evidence than this.

In the penultimate chapter (p. 207) Strevens adds a strong qualification to his previous arguments "I conjecture that the rules of equidynamics are universal – that is, that they are used by all mentally competent adult humans (and perhaps even very young children). My evidence for this is limited." I think the reader, while reading the main body of the text, would find it helpful to know that Strevens qualifies the arguments in the main body of the text in this way.

On the next page (p. 208) Strevens states that "some aspects of the rules formulated here are frankly speculative; regard them as a first step on the path to the equidynamic truth." Again, informing the reader of the speculative nature of the equidynamic rules at the outset seems preferably to me.

Let me make one final critical point. The further Strevens takes his readers into the realm of equidynamic reasoning the scanter the references to authors other than himself become and the more he refers to his own work. The reader might thus have the impression that this book is not part of a wider discussion, although the problems

Strevens addresses are of high interest to a great number of reasoners and cognitive scientists.

Having made these critical points I have to say that I enjoyed reading Tychomancy which provided plenty new food for thought. I particularly enjoyed the informal explanations of the how the final state of a thrown die sensitively depends on initial and boundary conditions. The way Strevens explains the workings of simple gambling devices on an informal level while grounding his explanations in the best currently available physical descriptions of these devices (systems of partial differential equations) is commendable. I also appreciated that Strevens uses the wheel of fortune as his first example of a simple gambling device rather than a coin or a die which we all have read our fair share about.

I want to end this review with two quotes from the last chapter. The first quote is a good examples of Strevens's witty style, the second quote, the last sentence of the book, shows how passionately Strevens feels about equidynamics. "Our ancestors did not escape the saber-tooths by trashing them at roulette." (p. 217) "Some of the oldest forms have perhaps taken scientific innovation furthest: spatialization, causality, probability – probability and equidynamics." (p. 226)

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