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Acceptance, values, and probability

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ABSTRACT

This essay makes a case for regarding personal probabilities used in Bayesian analyses of confirmation as objects of acceptance and rejection. That in turn entails that personal probabilities are subject to the argument from inductive risk, which aims to show non-epistemic values can legitimately influence scientific decisions about which hypotheses to accept. In a Bayesian context, the argument from inductive risk suggests that value judgments can influence decisions about which probability models to accept for likelihoods and priors. As a consequence, if the argument from inductive risk is sound, then non-epistemic values can affect not only the level of evidence deemed necessary to accept a hypothesis but also degrees of confirmation themselves.

1. Introduction

In this essay, I examine the relevance of the argument from inductive risk to personal probabilities used in Bayesian analyses of confirmation. The argument from inductive risk asserts that scientists' decisions about what evidence is sufficient for accepting hypotheses can have ethically significant consequences and therefore that ethical values can be relevant to such decisions (Braithewaite, 1953; Churchman, 1948; Cranor, 1993; Douglas, 2000, 2009; Elliott, 2011, 2013; Elliott & McKaughan, 2014; Hempel, 1965; Jeffrey, 1956; Levi, 1960, 1962, 1967; Nagel, 1961; Rudner, 1953; Shrader-Frechette, 1991; Steel, 2010; Steel & Whyte, 2012). One classic line of objection to the argument from inductive risk, due to Jeffrey (1956), insists that accepting and rejecting hypotheses is not the business of scientists. Instead, Jeffrey proposed that scientists should assign probabilities to hypotheses in light of the available evidence and pass these probabilities along to policy makers. Rudner (1953) retorted that this maneuver does not evade the argument from inductive risk because scientists would still have to accept claims about probabilities. Some advocates of the argument from inductive risk regard Rudner's reply as decisive. For instance, Douglas (2009, 53–54) reaffirms Rudner's response, and characterizes Jeffrey as having no answer to Rudner on this matter. But Jeffrey did have an answer. Jeffrey asserted that probabilities in a Bayesian approach are not the sort of thing one chooses to accept or reject; *they are degrees of belief scientists have and which they should report to policy makers* (1956, 246; see Steele, 2012, 896–897). Thus, Jeffrey claimed that personal probabilities fall outside the purview of the argument from inductive risk, contra Rudner.

The dispute between Rudner and Jeffrey, therefore, turns on a disagreement about which cognitive attitude probabilities assigned to hypotheses should be taken to represent in scientific reasoning, degrees of belief or acceptance. To discuss this dispute without prejudging the result, it is helpful to introduce a neutral term for referring to the type of probability in question. I will use "personal probability" to refer to probabilities interpreted as representing a cognitive state of a person, such as a scientist, or perhaps an aggregate cognitive state of some group, such as a panel of experts.[1] This definition is neutral in that it makes no assumption about the sort of cognitive state in question, other than that it is potentially involved in reasoning. Nor is it assumed that differing interpretations of personal probabilities are mutually exclusive.

[1] Personal probabilities can be distinguished from *objective chances*, that is, probabilities used to represent stochastic processes (i.e., any process that generates random outcomes such as casino gambling, automobile accidents, incidences of disease, measurement errors, and so forth).

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Personal probabilities could be interpreted as degrees of belief in some contexts and in terms of acceptance in others, and might even represent some combination of the two in a single case. Nor do I assume that degrees of belief and acceptance are the only two options. Perhaps personal probabilities could represent some other cognitive attitude altogether. With this terminological clarification in hand, let us return to the disagreement between Jeffrey and Rudner.

Like most Bayesians, Jeffrey assumed that personal probabilities represent degrees of belief, while Rudner implicitly understood them as representing a type of acceptance. Like Rudner, Cohen (1992, 108–116) argues for interpreting personal probabilities in terms of acceptance, rather than as degrees of belief. Following Cohen (1992), I understand accepting a statement S in a given context to be a decision to make S available as a premise for reasoning in that context. While acceptance is a decision that one may voluntarily decide to undertake or not, belief is often regarded as not being directly subject to deliberation. As Pascal observed long ago, one cannot simply decide to believe in God, although one may choose to engage in activities, such as attending religious services, expected to increase one's chance of forming that belief. Personal probabilities interpreted as degrees of belief, then, would be regarded as largely involuntary and not subject to deliberate choice. On the other hand, if Rudner and Cohen are correct, then personal probabilities can be accepted or rejected as a result of conscious deliberation. Consequently, their position entails that personal probabilities are no refuge from the argument from inductive risk.

In this article, I argue that decisions about which probability models to accept play a substantial role in applications of Bayesian methods, and thereby provide an opening for the argument from inductive risk, just as Rudner claimed. While Bayesians often follow Jeffrey in taking it for granted that personal probabilities should be interpreted as degrees of belief that are not subject to voluntary choice, Bayesians also speak of accepting some statements as evidence or background knowledge or of accepting a probability model. In Section 4, I describe Bayesian positions on this topic. In Section 5, I provide a textbook example of a Bayesian application from risk analysis to illustrate how decisions about probability models can be related to the argument from inductive risk.

In Section 6, I defend the claim that choices of probability models in scientific applications of Bayesian methods are often genuine decisions, and not mere reports of the degrees of beliefs of some person, such as a scientist. I give two reasons for this claim. First, the degrees of belief of actual people are normally vague and incomplete, and numerical expressions of degrees of beliefs are likely to be influenced by adventitious contextual factors. As a result, there often are no determinate degrees of belief to report or estimate, and personal probabilities heavily influenced by acceptance decisions may be the only quantitative personal probabilities there are. Secondly, I point out that degrees of belief are often driven by prejudice and simple heuristics that are prone to err in systematic ways, making it epistemically foolhardy to uncritically rely exclusively on one's degrees of belief. Thus, it is often wise to substitute carefully reasoned accepted personal probabilities for degrees of belief in computations of expected utility, or other probabilistic reasoning. As a result, constructing a Bayesian probability model often involves normative decisions about what would be reasonable to accept in the context, and not merely a report of actual degrees of belief.

The position defended here entails that decisions often must be made about which probability models to accept for likelihoods and priors in applications of Bayes' theorem. Since these decisions can have consequences for what sorts of errors are more or less likely, degrees of confirmation should not be viewed as prior to or independent of value judgments relating to costs of errors if the argument from inductive risk is correct. The result, therefore, is to drive the argument from inductive risk deeper into the heart of scientific reasoning. It is not merely that non-epistemic values may influence what level of exogenously given probability is deemed sufficient to accept a claim. If the argument from inductive risk is sound, values can also have a legitimate role in shaping assessments of those probabilities themselves.

2. Jeffrey versus Rudner on acceptance and belief

The most famous version of the argument from inductive risk is due to Richard Rudner (1953) and can be summed up as follows.

1. One important aim of scientific inference is to decide whether to accept or reject hypotheses.
2. Decisions about whether to accept or reject a hypothesis can have implications for practical action, and when this happens, acceptance decisions should depend in part on non-epistemic value judgments about the costs of error.
3. Therefore, non-epistemic values can legitimately influence scientific inference.

This argument was originally inspired by Neyman–Pearson statistical theory, which allowed practical and ethical considerations to influence how rates of Type I errors (i.e., rejecting the hypothesis when it is true) and Type II errors (i.e., accepting the hypothesis when it is false) are set in a statistical test of a hypothesis (Churchman, 1948; Rudner, 1953, 3). In its classic form, Neyman–Pearson theory included a behaviorist interpretation of acceptance. One of the approach's co-founders, Jerzy Neyman, held that instead of rules of inductive inference, one should more properly speak of rules of inductive behavior (Neyman, 1950). A rule of inductive behavior uses statistical data to select among a group of predefined actions, where "accepting a hypothesis" simply means performing a specific action that is appropriate if the hypothesis is true. For instance, if the test aims to decide whether a batch of milk is uncontaminated by harmful bacteria, accepting the hypothesis might be identified with shipping the milk off to grocery stores while rejecting the hypothesis might mean disposing of it. However, contemporary philosophical defenders of Neyman–Pearson statistics reject Neyman's "inductive behavior" interpretation of statistical tests (Mayo, 1996). One classic objection to the argument from inductive risk, then, rejects premise 2 on the grounds that the notion of acceptance in science should be construed in a purely epistemic manner (Dorato, 2004; Lacey, 1999; Levi, 1967; McMullin, 1982; Mitchell, 2004). Steel (2013) critiques theories of acceptance designed to evade premise 2 of the argument from inductive risk and argues that Cohen's theory supports the argument without lapsing into behaviorism. The point of departure of this essay, however, is a second classic, though less popular, objection voiced by Jeffrey (1956).

While most critics of the argument from inductive risk grant premise 1 and challenge premise 2, Jeffrey's objection does the opposite. According to Jeffrey, scientists should not be in the business of accepting and rejecting hypotheses. Jeffrey suggests that instead of accepting or rejecting hypotheses, scientists should assign probabilities to hypotheses and then pass them along to decision makers.

> To accept or reject hypotheses once and for all is to introduce an unnecessary conflict between the interests of the physician and the veterinarian. The conflict can be resolved if the scientist either *contents himself with providing them both with a single probability for the hypothesis* …, or if the scientist takes on the