# Discussion of "Statistical Inference: The Big Picture" by R. E. Kass

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In this piece, Rob Kass brings to bear his insights from a long career in both theoretical and applied statistics to reflect on the disconnect between what we teach and what we do. Not content to focus just on didactic and professional matters, the focus of his 2009 article (Brown and Kass, 2009), in this commentary he proposes a remake of the foundations of inference. He proposes to replace two fundamental "isms"—frequentism and Bayesianism—with a new "ism"—"pragmatism;" an approach that he puts forward as more ecumenical and practical, enshrining in foundations what good statisticians already do.

There is a lot to commend in this piece, particularly the emphasis on the subjunctive nature of all model-based inference, and I am sure the other commentators will do justice to its strengths. But in spite of its clarity and initial promise, I found Kass's proposal ultimately unsatisfying. It seems less a new foundational philosophy than a call for a truce, one of many over the years. It is telling that all of the examples show practical equivalence between Bayesian and frequentist estimates, so the biggest stakes here seem to be what people think, not what they do. The difficulty with "big tent" foundations is that in circumstances where different philosophies within the tent dictate different actions, there is no guidance as to what route to take.

It is interesting to contrast this with the philosophic version of "pragmatism," originally put forth by the polymath C. S. Peirce in the late 1800s [also credited with proposing the log-likelihood ratio as a measure of evidence (Hacking, 1965)], whose intellectual heirs included William James, Thomas Dewey, W. V. O. Quine and Richard Rorty. Pragmatism embraced three maxims, the most important of which was that the meaning of ideas was defined by their practical, observable effects. Ideas that made no material difference in the real world had no meaning.

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Kass alludes to a possible difference in real-world consequences just once, in his mention of the analysis of high-dimensional data sets. But he states his pragmatist philosophy is agnostic on how to approach these, and that the choice should be "according to their performance under theoretical conditions thought to capture relevant real-world variation in a particular applied setting." It would have been extraordinarily useful to see such an example, and if indeed there could be a model-based resolution of what are often quite difficult conundrums.

In the domain with which I am most familiar, clinical trials, the traditional frequentist-Bayesian inferential dilemma arises most commonly in the interpretation of "early stopped" trials, that is to say, should the inference depend upon the stopping rule, and if so, how? This becomes particularly acute when the stopping is due to an unplanned analysis. This particular situation arose recently in the high-profile case of the diabetes drug Avandia. In 2007, a meta-analysis was published that raised concern about the cardiovascular risks of Avandia (Nissen and Wolski, 2007), leading to calls that the FDA should remove the drug from the market. The RECORD trial was being conducted in Europe to examine the efficacy and safety of Avandia, and its industry sponsor requested an unplanned analysis in response to the new data. This analysis (arguably) indicated no excess cardiac risk, and this interim result was then published, at the behest of the sponsor (Home et al., 2007; Nissen, 2010). Many doubted that an interim result that had demonstrated excess risk would have been published and discounted the result. How should this be sorted out? What are the dimensions of "real-world variation" here that we should include in the model, and on what grounds do we determine how to measure the evidence and how to act? This was a real decision, with real, big-time consequences. What guidance would "statistical pragmatism" give us in skirmishes like that?

Kass says he has been guided by "past and present sages," but leaves the job of naming them to Barnett (1999). Kass is right that many have preceded him on this path, and it would have been quite illuminating

to compare this proposal more directly to those of his predecessors. Among the several I would have liked to have seen contrasted would be George Box, whose descriptions of the theoretical nature and pragmatic utility of models, which he adjoined to his attempts to resolve the Bayesian-frequentist "deadlock," are remarkably similar to this essay in spirit, if not in substance. Box's paper on Fisher's ecumenicism, "Science and Statistics" (Box, 1976), included graphics not so different than those found here, albeit with a more prominent role for experimental "filter" through which we see the world. He thought it important that our "wrong" models be subject to continual revision in accord with changes in scientific understanding, one of Kass's central points.

Interestingly, in a response to a 1990 essay by Glen Shafer in this journal on the "Unity and Diversity of Probability," which had similar aims to this one (Shafer, 1990), Box (1990) stated "There is another substantive issue I would like to raise. This concerns the fatal fascination of the word 'unity.' Unity in many things is desirable, but we should not be trying to impose 'oneness' on a situation where 'twoness' is of the essence." One wonders if he would make the same comment here. He went on to characterize statistical inference as reducible to model fitting and model criticism, claiming that Bayesians are better at fitting, frequentists better at criticism, and that we need to be good at both.

It is interesting to look to the field of bioethics to see how it deals with a variety of foundational theories seemingly at odds with each other, but which capture important features of desirable ethical conduct. Two dominant theories are utilitarian (or consequentialist), which focus on outcomes (somewhat akin to frequentist approaches) and deontologic, which focus on the intrinsic morality of how people treat each other, which has some parallels to Bayesian logic (Beauchamp and Childress, 2001). These underlying ethical philosophies provided, as all philosophies must, competing definitions for foundational concepts, which in ethics include moral goods and moral duties.

However, in looking for ethical principles that should guide clinical research, ethicists borrowed from multiple traditions, enshrining that guidance in the Belmont report, which did not try to resolve foundational differences (National Commission, 1979).

The three principles it espoused were (1) Respect for persons (autonomy), a primarily deontologic construct; (2) Beneficence (and non-maleficence), mainly utilitarian, and (3) Justice (fair distribution of harms and benefits), derived from yet other moral philosophies. These

principles are sometimes in tension, reflecting their different foundational pedigrees, keeping ethicists in business. But the Belmont principles have still proven to be enormously influential and useful, capturing the key features of each theory, translating them into the applied domain, and providing a framework for regulation and for ethical debate.

So perhaps Kass's proposal might be best framed not as a statistical philosophy, but as the beginning of a code governing statistical conduct and teaching. It could embrace such things as a desire for Bayesianly coherent procedures that have good frequentist properties, and perhaps provide guidance on the kinds of difficult questions that Kass has posed in his previous writings (Kass, 2006). Such a code need not resolve foundational differences, as statistical pragmatism does not, but it can distill the desiderata of those philosophies down to a kernel of principles applicable to all applied problems, implicitly endorsing goals of competing philosophies that most would support. I can see all the pieces of such a code here, but it would take some further work to abstract them.

In summary, I welcome this as an insightful piece with admirable goals, most of which I and, I suspect, other statisticians share. But whether those goals are best met by replacing our foundational theories, or by distilling and collectively endorsing the aspects of those theories that are most useful, is an open question. I believe that there are difficult inferential and decision problems that defy any foundational attempt at resolution, and that their origins are found outside statistics, in the incompleteness of our substantive knowledge. This creates the gap Kass highlights between our theoretical models and reality, a gap that certainly deserves to be front and center in any conversations about statistical procedures or results. But we still must draw conclusions and take action. I did not find an improved guide to such actions in this piece, but I did appreciate its renewed call to not let foundational dogma determine which direction we take. If this piece can serve as a step toward doing for statistics what the Belmont Report did for research ethics, it will have served a very important role.

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