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Kirk W. Junker

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REVIEW ESSAY

EXPANDING THE NOTION OF "SCIENTIFIC"


Reviewed by KIRK W. JUNKER

Duquesne University School of Law, Pittsburgh, Pennsylvania, USA

In reading Barbara Koslowski’s Theory and Evidence: The Development of Scientific Reasoning, one may be convinced that the ancient debate between classical rationalists and empiricists is alive. And like most people who carefully investigate the ability of either rationalism or empiricism truly to account for all of our ability to know, Koslowski arrives at the position of saying that knowledge (in this case scientific knowledge) is a product of both: “neither theory nor data alone is sufficient to achieve scientific success; each must be evaluated in the context of, and constrained by, the other” (252). The problem, according to Koslowski, for those who insist upon empiricism as being the only type of understanding which counts as science, is that we then exclude much of the productive thought in children and adults from the realm of science. This sense of exclusive empiricism champions itself as being theory-independent. The theory-independent notion of science uses covariation as its exclusive criterion for scientific reasoning (275). “In short, the empiricist aim of rationally reconstructing scientific inquiry in terms of theory-independent principles went along with an (all but exclusive) emphasis on the role of Humean indices. And this, in turn, brought with

Address correspondence to Kirk W. Junker, Duquesne University School of Law, 600 Forbes Ave., Pittsburgh, PA 15282, USA. E-mail: junker@duq.edu
it a corresponding emphasis on hypothesis testing rather than hypothesis discovery and revision" (11). Consequently, according to Koslowski, if we are willing to expand our notion of scientific reasoning to go beyond testing for covariation, then we will find that many more children and adults can be seen to reason in a manner which would be called "scientific."

In the expanded notion of scientific reasoning, which she carefully lays out in Part I of the book, emphasis upon causal mechanisms and alternative theory construction also qualify as "scientific reasoning." In constructing her argument, Koslowski refers to two bodies of knowledge not often associated with each other—the philosophy of science on the one hand, and educational and child cognitive psychology on the other. Later on, I will make my own associations with a third—law. The philosophy of science that Koslowski generally presents is that of the "received view," of analytic philosophy represented by such philosophers as Kitcher, Popper, Putnam (even Putnam on Popper), Quine, and van Fraassen. It is this philosophy which in large measure provides us with a notion of scientific reasoning limited to testing for covariance. Within this analytical framework, Koslowski provides solid and thorough reasoning in support of her claims—but she does remain largely within this analytical framework in doing so. This is not a book claiming to debunk analytical thinking, but rather to expand the carrying capacity of analytical thinking. That is Koslowski's strength—to argue persuasively within the analytic tradition. "In this book my concern is not with whether, from an epistemological perspective, scientific thinking can ultimately be rationally reconstrued so as to be theory-independent. Rather, the concern is with the strategies that underlie actual scientific practice, and in this regard, the philosophical debate is relevant for the following reason: in terms of actual scientific practice, empiricists and realists alike point out that in causal reasoning and scientific inquiry, strategies are not applied in a theory-independent (that is, knowledge-base-independent) way" (9). This may make the philosophical debate important, but I do not think it will make it relevant, if by "relevant" she means relevant to the scientists. I must say that in my experience, in terms of actual scientific practice, scientists themselves are often uninterested in their underlying strategies, particularly the philosophical aspects of those strategies. Unlike sociology and history, maintains the former chair of the (British) Committee on the Public Understanding of Science, Lewis Wolpert, philosophy has nothing to say to science. Whether it can is one
thing; whether it does is another. But here too, my own postgraduate science students bear out this epithet—none of them have ever heard of induction or deduction (in their philosophical sense) as ways of describing scientific practices, but that does not make the philosophy of science useless. Most persons concerned with the public understanding of science conclude that what “the public” needs to know about science is not more scientific facts, but rather something of scientific method and practices. That bit of irony would suggest a role for the philosophy of science—to explain the practices and methods of science to the interested public, regardless of whether scientists themselves are interested in navel-gazing.

Koslowski goes on to trace the ramifications and application of the received view of philosophy of science to educational and child psychology where she finds it operating as an exclusionary force that denies the label of “scientific” to reasoning based upon causal mechanisms or theory construction. It is this application that fits the book neatly into the series in which one finds it—“Learning Development and Conceptual Change.” More broadly, however, Koslowski’s arguments and evidence provide the basis for seriously reconsidering what it is to be “scientific.”

For example, she provides alternative ways of understanding the practice of people’s clinging to beliefs for which there is disconfirming evidence. Typically this practice is dismissed as confirmation bias. However, Koslowski points out three alternatives to treating it as confirmation bias: perhaps the disconfirming evidence yielded a conclusion that was based on measures that were either confounded or ambiguous. Second is the problem of the multiple interpretations of what in fact would constitute “confirmation bias.” Third, and most important, given Koslowski’s own driving hypothesis, would seem to be that many studies of “confirmation bias” are based upon misleading descriptions of scientific inquiry that ignore theory and (causal) mechanism (51). She goes on to say that it could be that the experimenter may simply be unable to generate an alternative theory to account for the disconfirming evidence, so they stay with the original theory (53).

True to her assertion that science necessarily must include both theory and empirical evidence, in Part II of the book, Koslowski takes nine aspects of scientific reasoning and demonstrates through her own set of sixteen experiments how the received view of scientific reasoning is too limiting and limited. These nine features are: when non-Humean indices
replace or override covariation; beliefs about covariation and causal mechanisms—implausible as well as plausible; assessing internal and external validity; evaluating explanations in light of alternative accounts; rendering implausible causes plausible; deciding whether anomalies refine a theory or call it into question; disconfirming mechanism and covariation components of a theory; confirmation, disconfirmation, and differing views of scientific inquiry; and spontaneous generation of appropriate tests, causal mechanisms, and alternative hypotheses.

Because Koslowski keeps her arguments and evidence operating within the analytic tradition of philosophy and its application to cognitive psychology, as I hinted earlier, one must make several theoretical assumptions in order to tie her work to law. First one would need to decide whether her evidence has persuaded us that her main argument is valid—that both children and adults are better scientists than they are normally credited with being, if we are willing to expand our definition of scientific reasoning and include emphasis on theory construction and causal mechanisms in our definition of scientific inquiry instead of limiting the definition to testing for covariation.

Indeed I do find her argument persuasive. If we then turn to law, perhaps the most obvious ramification of her work is to look for the places where children and adults are asked to reason scientifically, if not actually conduct scientific inquiry. The common place in which this occurs is in the common law tradition where men and women sit as jurors to determine issues of facts. While they may not themselves directly conduct scientific inquiry, they are often called upon to judge the scientific inquiry of expert witnesses. As Rao (1999) and others have noted, frequently critics of the legal system in general, and jurors’ abilities in particular, want to point to the juror’s inability to reason scientifically and to understand scientific evidence as being a reason to curtail if not abolish the ancient role of the juror—ancient if we include the dikastes of Athens, for example; medieval if we only want to look at English common law. In either case, dikastes or English, the jury long precedes scientific inquiry based upon testing for covariation. But as I have argued elsewhere (Junker 1999), given the relatively few contemporary cases in common law tried before a jury (a number decreasing all the time) arguments about “law” or the “legal system” based upon the role and abilities of juries is misplaced and unrepresentative of legal practice. So where else might one find lessons in law to be learned from Koslowski’s expansive definition of scientific inquiry?
The next obvious step would be with judges. Like jurors, judges are often not trained in science, and certainly cannot be practicing science at a bench while sitting on the bench. In these cases which proceed without a jury (including the civil law systems descended from the Roman), which are far and away the majority of cases, it is the judge who must both determine issues of fact and interpret the law. In these cases, the judge must determine the credibility of witnesses, including experts, determine what evidence is admissible to establish facts, and ultimately determine what facts have been established, before he or she can proceed to interpreting the law.

The next place would be to look to witnesses who provide evidence through testimony in court. Witnesses may relay to the court their personal observations so as to construct facts, and witnesses may also be qualified as “experts”; a status which permits them to go beyond relaying personally observed fact, to opining about things not personally observed. In the United States, the admissibility of an expert’s testimony about science had long been subject to what was known as the “Frye test,” named for the plaintiff in the 1923 lawsuit which announced the test. The Frye test paid homage to science’s notion of knowledge production through peer review. It held that only scientific evidence based upon principles and methods generally accepted by the relevant scientific community would be accepted as legal evidence. Prompted by changes in official rules of evidence, the Frye test was changed by the celebrated 1993 U.S. case of Daubert v. Merrell Dow Pharmaceuticals, 113 Supreme Court 2768. In the Daubert case, the United States Supreme Court held that a trial judge has a gatekeeping function regarding expert witnesses in science to insure that a theory or technique can and has been tested; to determine whether the theory or technique has been subjected to peer review and publication; whether, in respect to a particular technique, there is a high “known or potential rate of error” and whether there are “standards controlling the technique’s operation”; and whether the theory or technique enjoys “general acceptance” within the “relevant scientific community.”

Given Kosowskis’s desire to expand what would count as scientific reasoning, her work will not likely come as good news to those who would champion the narrowing of what counts as science within the courtroom, as announced in the Daubert decision. Kosowski would seemingly be opening up possibilities for methods, theories and techniques used to provide scientific evidence at trial. Just as Marcia Angell (1996) and others
thought that they had begun to persuade lawyers to make legal evidence conform to scientific evidence (for instance, by limiting testimony on health issues to epidemiological studies) as one may interpret from the Daubert decision (the criteria for which have now recently been applied to all expert testimony, not just scientific; see Kumho Tire Company V. Carmichael, 1199 U.S. Supreme Court 2198), Koslowski wants to expand what would count as scientific. (These contexts are of course Anglo-American, but so are Koslowski’s experimental subjects and theorists. Whether that matters is for another day and place.)

This last point regarding the expansion of the Daubert criteria to all expert testimony leads to what is perhaps the most cutting point made by the application of Koslowski’s arguments to law. Insofar as the discipline of law sees itself as proceeding by reason, and reason is conflated with scientific reason, any critique of scientific inquiry can be a resounding critique of the practices of law in its attempts to establish and determine facts—with or without the testimony or presence of generally recognized “scientific” inquiry. This sort of reflexive move would result in allowing not only more people’s thought to count as scientific, but would also expand the notion of acceptable legal reasoning insofar as legal reasoning wants to be scientific.

In some ways it is only in this sense of application to other fields like law that discussing what is and what is not “scientific” reasoning makes any sense. In my experience representing scientists in the courtroom and in teaching scientists in the classroom, I have found that they rarely find it useful or necessary to sit back and theorize about what constitutes science or scientific reasoning, or what Koslowski would call the underlying strategies. These practitioners might be tempted to say “scientific” means what scientists do, and what scientists do is what scientific is. If we were to accept this characterization, and then look at what scientists do in a historical or social context, we would be unlikely to come up with “hypothesis testing” as a descriptive term. This brings me to the final application I wish to make of Koslowski’s scholarship to law. If scientists need not create norms of practice to live up to, in order to be scientific, but rather are scientific in what they do, why do other people want to have their practices called “scientific”? In other words, what is at stake in the desire to have one’s thought classified as “scientific”? Ever remaining true to the tradition within which she works, Koslowski only offers that we can hope for “better theory” (282). Better theory would work as follows:
Method and theory (or reasoning strategies and knowledge about the world) each enhance the other, as well, in terms of progress over time. Consider again the situation on which, on the basis of covariation, we tentatively propose, as a working hypothesis, a hitherto undiscovered underlying mechanism. If the working hypothesis turns out to be accurate and the posited mechanism does in fact exist, that mechanism can in turn suggest that we look for additional covariations that might otherwise have gone unnoticed. And these additional covariations (and non-covariations) will help us further refine our working hypothesis by adding to our understanding of how the mechanism operates, which will enable us to make still additional, more refined predictions of the circumstances under which various covariations will obtain. The result, over time, will be an increasingly accurate and complete theory and a set of increasingly accurate and complete reasoning strategies. That is, the knowledge acquired by the mutual enhancement of method and theory will be cumulative (13).

But law is not science, and evidence for law need not be evidence for science. To illustrate this, one might take note of the fact that in its evidentiary practices, law makes explicit what science tacitly assumes. For example, in many jurisdictions of law, questioners are not permitted to ask witnesses for a legal conclusion; yet in social science, it is at most recommended that a researcher not do so with a subject, and in natural science, conclusions only count if the evidence to support them has been sought as well—preferably first. Also, the burden of proof is stated in law, and only comes up in science in such indirect ways as the “precautionary principle.” Moreover, the rules of evidence in law are made explicit, arbitrary though they may seem, rather than acting as an invisible force—as though the evidence itself will manifest its evidentiary nature.

And finally, regarding law, it is worth pausing for a moment to consider the notion of experiment. Unlike clinical “trials” and other uses of the word “trial” in science, in trials at law, experiment is largely absent, and lawyers, witnesses, juries, and judges must concern themselves with actual events in uncontrolled situations. When a scientific expert does testify, he or she can of course draw upon experimental evidence to lend credibility to the offered opinion in the case at hand, but the persuasive nexus between the experiment and the real
(and uncontrolled) event is open to the scrutiny of the fact finder in the case—judge or jury.

Even if we improve upon our scientific theory, as Koslowski hopes, can we assume that science will become a more prevalent criterion in decision making among adults and children? I think not. Eurobarometer surveys on such issues as biotechnology, for instance, indicate that more people would still use the criterion of morality than of risk in opting for or against biotechnology on offer, even when they well understand the scientific nature of risk calculation. So even if we count what Koslowski would have people believe, the later (larger) question remains unanswered and the answer remains unaltered—"will scientific understanding change belief or action?" Koslowski's response in the case of disconfirming evidence may give us the answer here: "This is not to say that worldviews are never changed. Clearly they sometimes are, but usually over a period of time longer than the typical experiment" (49).

REFERENCES