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International Commentary on Evidence

Bayes Wars Redivivus — An Exchange

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Abstract

An electronic exchange among 10 evidence scholars that began with a discussion of the restyled Federal Rules and grew into a significant restatement of debates in evidentiary scholarship over the last 50 years, touching on relevance, probative value, inference, Bayesianism and the foundations of evidence, with an introduction by Michael Risinger.

KEYWORDS: Bayesianism, relevancy, probative value, inference

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INTRODUCTION

Attempts to domesticate both formal symbolic notation[1] and probability theory[2] to the description of legal proof have a long history. Until fairly recently, however, such attempts as were made can be regarded as significantly off the main intellectual track for the bulk of theorists and academic commentators, to say nothing of judges and practitioners. Things began to change significantly in 1968 with the publication of John Kaplan's watershed article invoking the economics model and management tool called decision theory as a possible model for legal evidence and inference.[3] This article was followed in fairly short order by Finkelstein and Fairley,[4] and by Laurence Tribe's cautionary rejoinder,[5] which set the pot bubbling for a generation of then-young evidence scholars. The implications (vel non) of Bayes' theorem and of the asserted differences between "objective" and "subjective" probabilities for the theory of evidence and inference in legal proceedings became the dominant theme of nearly two decades of legal scholarship from the late 1970s to the mid 1990s, much of the later work dealing with the tensions between the formal Bayesian accounts and the power of the emerging "story model" of human information processing, and with such vexed

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[1] Wigmore's "chart" method of inference mapping , originally outlined in 1913, is well known. See JOHN HENRY WIGMORE, THE PRINCIPLES OF JUDICIAL PROOF AS GIVEN BY LOGIC, PSYCHOLOGY AND GENERAL EXPERIENCE AND ILLUSTRATED IN JUDICIAL TRIALS, 744-58 (1913). By far the most ambitious program of symbolization is to be found in JEROME MICHAEL AND MORTIMER J. ADLER, THE NATURE OF JUDICIAL PROOF: AN INQUIRY INTO THE LOGICAL, LEGAL, AND EMPIRICAL ASPECTS OF THE LAW OF EVIDENCE (1931). However, this work was privately printed, and merely précised in the two-part law review article based on it, Jerome Michael and Mortimer J. Adler, *The Trial of an Issue of Fact*, (pts 1&2) 34 COLUM. L. REV. 1224, 1462 (1934) so that their system of symbolization was of limited circulation and even more limited impact. For the curious, the original full treatment is now available in the Hein-on-Line treatise database.
[2] The earliest explicit attempt to assimilate formal probability theory to evidence and proof in English appears to be Appendix I of Best's 1844 treatise on "presumptions," WILLIAM M. BEST, A TREATISE ON PRESUMPTIONS OF LAW AND FACT, WITH THE THEORY AND RULES OF PRESUMPTIVE OR CIRCUMSTANTIAL EVIDENCE IN CRIMINAL CASES, 353-58 (1844). It is an acknowledged borrowing of LaPlace's similar attempts in French a quarter century earlier. It is perhaps telling that this invocation of formal probability theory was to be found only in an appendix. However, that was more than any other evidence work in English for well over a century.
[3] John Kaplan, *Decision Theory and the Factfinding Process,* 20 STAN. L. REV. 1065 (1968).
[4] Michael O. Finkelstein & William B. Fairley, *A Bayesian Approach to Identification Evidence*, 83 HARV. L. REV. 489 (1970).
[5] Lawrence H. Tribe, *Trial by Mathematics: Precision and Ritual in the Legal Process*, 84 HARV. L. REV. 1329 (1971).

notions as "conditional relevance."[6] For more than a decade now, those fights have subsided,[7] not because of the emergence of a synthetic consensus, but because other perhaps more immediately pressing issues have seized the focus of the academy, such things as the nature and control of asserted expertise in the courtroom, and confrontation after *Crawford*. But the old fires still burn beneath the surface. Many of the original players are still on the scene, and newcomers are looking to be heard when the time is right. However, it may come as something of a surprise that last summer, on a listserv restricted to academics in evidence,[8] a seemingly innocuous thread concerning the anticipated effects of the "restyled" versions of the Federal Rules of Evidence morphed into a full-throated exchange concerning the very foundations of the concepts of evidence, inference and relevance itself, featuring some of the established voices from the height of the "Bayes Wars," and some significant new ones to boot. All in all, it was just too good to let it languish as a bygone thread on a restricted listserv, so we have, with the permission of all involved, lightly edited the exchanges, and present them here. The participants have been invited to supply whatever footnotes they wish for their remarks, but with the exception of the correction of a few infelicities of spelling and the like, they appear here in all their spontaneity as they crackled back and forth like summer lightning in late August and early September of 2009.

Michael Risinger

THE EXCHANGE:

ROGER PARK:

The restyled rules are available online at:
http://www.uscourts.gov/rules/proposed0809/EV Rules.pdf.

They are definitely a stylistic improvement over the existing rules. I wish the rules had been styled this way from the beginning. It's not clear that it's

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[6] The general outlines are well reported in Roger C. Park and Michael J. Saks, *Evidence Scholarship Reconsidered: Results of the Interdisciplinary Turn*, 47 B.C. L. REV. 949, 984-995 (2006).
[7] At least in the pages of most American law reviews. Contributions to the debates have been more likely to be seen in specialized journals such as LAW, PROBABILITY AND RISK, and in specialized volumes such as HENDRIK KAPTEIN, HENRY PRAKKEN AND BART VERHEIJ, EDS, LEGAL EVIDENCE AND PROOF: STATISTICS, STORIES, LOGIC (2009).
[8] Moderated by Professor Roger C. Park, evid-fac-l@chicagokent.kentlaw.edu.

worth the trouble now that the rules have been in use for decades, but I guess that decision has already been made. We aren't the first. It's already happened to the rules of civil procedure, criminal procedure, and appellate procedure.

The restylers didn't like the word "shall." The substitutes are "must," "may," and "should." Thus, in Rule 609(a)(2) the restyled rule states that the evidence "must" be admitted. In Rule 104(b), the requirement that the court "shall" admit the evidence (when the foundation fact has been established by evidence sufficient to support a finding) has been changed to a statement that the court "may" admit the evidence.

It's true that judges are free to exclude evidence that passes 104(b) but flunks 403, so in that sense the original phrase "shall admit" may have been an overstatement. So far as I know, this feature of the original didn't cause a problem, and the original version seems stronger than the restyled version in indicating that even if the judge does not believe the factual condition to be true, she is obliged to let in the evidence if a reasonable jury could believe it to be true. Does this change border on being a substantive change?

[Professor Park responded to a suggestion that the new language is consistent with existing law because even if evidence satisfies the requirements of Rule 104(b), it could still be excluded on other grounds, such as hearsay or undue prejudice, as follows]:

I still think that restyled rule 104(b) does not spell out the limited power of the judge. Because of the "may" language, it could be read to mean that the judge has discretion to reject the evidence when the judge does not believe that the factual condition has been established, even there is evidence sufficient to support a finding.

Here is the current restyled rule 104(b):

(b) Relevancy Depends on a Fact. When the relevancy of evidence depends on fulfilling a factual condition, the court may admit it on, or subject to, the introduction of evidence sufficient to support a finding that the condition is fulfilled.

Below is a suggested revision. I am not at all confident that it is bullet-proof, but perhaps it at least suggests a possible direction for a different approach.

(b) Relevancy Depends on a Fact. When the basis for objecting to an item of evidence is that it is irrelevant in the absence of proof that a factual condition linking it to the case has been fulfilled, then the court must admit the evidence on, or subject to, the introduction of evidence sufficient to support a finding that the condition is fulfilled.

If the Advisory Committee chose to take the further step of trying to cure the inconsistency between the way the word "relevancy" is used in Rule 104(b) and the way it is used in Rule 401, this further step could be taken:

> (b) Probative Value Depends Upon a Fact. When the basis for objecting to an item of evidence is that it has insufficient probative value in the absence of proof that a factual condition linking it to the case has been fulfilled, then the court must admit the evidence on, or subject to, the introduction of evidence sufficient to support a finding that the condition is fulfilled.

PETER TILLERS:

Roger,

Your suggested revision may imply that the trial court does not have the discretion to rule that the evidence of the factual condition must be presented to the trial court before the conditionally relevant evidence is admitted. Although there may be some disagreement about this, I think the conventional larnin' is that the trial may permit the foundational evidence to be presented later but that it need not do so.

ROGER PARK:

I agree, that's a possible defect. The same defect exists in the present (pre-restyled) rule providing that the evidence "shall" be admitted upon or subject to the introduction of evidence sufficient to support a verdict. The defect doesn't seem to have caused a problem, and if it did cause a problem, then changing the rule to fix the problem would exceed the mandate of the restylers (it would change the law in one of the circuits).

My version isn't crystal clear on the point, and I guess the fix would be to say that the judge *must* admit the evidence "on" the introduction of evidence sufficient to support a finding and *may* admit the evidence "subject to" the introduction of evidence sufficient to support a finding.

PETER TILLERS TO ROGER PARK:

Yes, that's quite true. Then one must figure out if the original version of the rule was infelicitously written or whether something else was afoot. Sometimes infelicitous language masks indecision. Sometimes not.

ROGER PARK TO PETER TILLERS:

Personally, I would prefer a longer, less formal, more discursive rule about linking evidence into a case by proving a foundation fact, perhaps even one including an example. However, the chance of such a change being adopted is so remote that I won't take the trouble of drafting it.

The current rule 104(b) means nothing to students by itself, and I doubt that my change cures that. The addition of the "linking it to the case" language is an attempt to make it a bit clearer by using the link metaphor, but it probably is not enough to do the job.

FREDERICK MOSS:

How about:

> 104(b). When the relevancy of evidence depends on fulfilling [? "proof of"] a factual condition, the court [, subject to the other Rules,] [shall] admit it on the introduction of evidence sufficient to support a finding that the condition is fulfilled. The court may admit it subject to the later introduction of evidence sufficient to support a finding that the condition is fulfilled.

This eliminates the problem with Roger's suggestion that seems to require the judge to "conditionally admit" evidence subject to being "connected up." It also notes what is probably obvious and unnecessary, that to be admitted the item of evidence must also not be excluded by other rules. This is a bit wordy, but clearer, I think.

FREDERICK MOSS:

The Moss suggestion cleaned up a bit:

> 104(b). When the relevancy of evidence depends on fulfilling [? "proof of"] a factual condition, the court [, subject to the other Rules,] [shall] admit it on the introduction of evidence sufficient to support a finding that the condition is fulfilled. The court may admit it subject to the later fulfillment of the condition.

MICHAEL RISINGER:

Dear Roger,

I don't think that there in fact is an inconsistency between 104(b) and 401—merely that both are looking at slightly different parts of the same elephant, and both are to an extent incoherent, but not necessarily inconsistent. I think 104(b) should be clarified by indicating that all relevancy is conditioned on fact, but that 104(b) only applies when the proponent's theory of relevance is dependent on an adjudicative fact not subject to either judicial or jury notice without admissible evidence. I do not think that would be inconsistent with the original intendment of the rule, but given the welter of judicial opinions, which I myself am not very conversant with (and really have little desire to be) maybe it would seem to the restylers to be inconsistent with at least some lines of (incoherent) judicial analysis.

PETER TILLERS:

Dear Michael,

If I understand your point (and I think I do), I agree with you. I think you already know the general position I take about conditional relevance: I think ALL evidence is, conceptually speaking, only conditionally relevant (and conditionally probative).

      This is not to say that Federal Rule of Evidence 104(b) satisfactorily solves the problem of how the law should handle conditionally relevant and conditionally probative evidence. The sources of the difficulty are familiar to you. One is, again, precisely that all evidence is conditionally relevant but Rule 104(b), as interpreted and applied, assumes that only a subset of evidence is conditionally relevant and probative. But, of course, it does not necessarily follow that Rule 104(b) should be applied to all offered evidence. (The administrative difficulties alone would be nightmarish.) Indeed, it is not even clear, again for reasons familiar to you, that Rule 104(b) as presently written should be applied to ANY offered evidence: the law's treatment & understanding of inference networks is a jumble—and perhaps for that reason alone it might be better to abolish R 104(b)—as long as people don't forget that such abolition of the legal rule won't make inference networks (the phenomenon of conditionally relevant and probative evidence) go away.

      Those are my two bits.

PETER TILLERS:

David Kaye long ago argued—I think he was the first to do so, but I'm not completely sure—that Federal Rule of Evidence 401 embodies (I would say "perfectly embodies") an idea that is an integral part of Bayesian analysis, the idea that the effect of an "event" such as evidence is always only to alter a prior probability (or prior odds), that the relevance of evidence cannot be determined by the probability of the fact in issue that ensues once the evidence is given or known but that relevance depends only on whether there is a difference between the prior probability and the posterior probability of some hypothesis or possibility (here a possible "fact"), and that (hence) if the likelihood ratio is not "1" the evidence in question is relevant. Of course, as we-all sophisticated folks know, the terms "prior" and "posterior" are just one way of viewing Bayes' Theorem—the temporal factor is inessential and what counts is whether there is a difference between the unconditional probability—the one that takes the form $P(H)$—and the conditional probability—the one that takes the form $P(H|E)$. (Of course, the super-super-sophisticated among us know or think that there is no such thing as an unconditional probability and that the appropriate comparison is between the probability $P(H|B)$ and $P(H|B \& E)$...where "E = evidence" and "B = background knowledge" or "everything else we know" or something of the sort.)

David Kaye can say all of the above more elegantly than I can.

It is sometimes said that the thirty years' war over mathematical analysis of evidence is over. If the war is over (is it? who won?), I think we should preserve the original form of Rule 401 as a memorial to the Bayesian side ("sides"?) in that bitter struggle. If objection were made that the original form of Rule 401 (the current version) is a partisan memorial and that the continued presence of such a partisan memorial would threaten to reignite bitter passions and quarrels, it should be noted that the drafters of Rule 401 had probably never heard the word "Bayes" or any of its variants. (Perhaps they just had a lot of common sense.)

By saying the above, I take no position, of course, on who was correct and who was incorrect about the power of Bayesianism for analysis of "juridical evidence." If nothing else, this is because there are too many variants of Bayesianism for any ordinary mortal to explain and justify any such assessment without writing an 800-page treatise. The task of writing such a tome is better left to the mathematicians, logicians, and philosophes, who might be able to explain themselves in 150 pages rather than 800.

DAVID KAYE:

Peter,

1. I was not the first to use Bayes' rule to illuminate Rule 401. Rick Lempert's article, *Modeling Relevance*,[9] is a model of clarity in presenting the idea. I wish I had written it, though. And the notion that relevance involves a shift in the probability of a hypothesis has deeper roots. It is present, for instance, in John Maynard Keynes's classic treatise on probability.[10]

2. I do not think that the change in wording will make much difference, if only because some important treatises present the idea of a change in probability from before to after clearly enough[11] and the earlier phrasing will remain part of the rule's history. But I could be wrong. The more concise phrasing could reinforce the tendency of writers not familiar with this literature to compare the wrong quantities when determining whether the probability shifts.[12]

PETER TILLERS:

Until recently I used to introduce my Evidence students to Bayesianism. After doing so, I would consider the possible limitations of Bayesianism. Among the things I would say was the following:

> Other Limitations of the Standard Version of Bayes' Theorem:
>
> There are two other possible difficulties with Bayesian analysis that are worth mentioning now. These difficulties are of a less technical and a more substantive or fundamental sort.

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[9] 75 MICH. L. REV. 1021 (1977).

[10] In presenting a logical-relation theory of probability, Keynes wrote that "[t]he simplest definition of Irrelevance is as follows: h_1 is irrelevant to x on evidence h, if the probability of x on hh_1 is the same as its probability on evidence h." J. M. KEYNES, A TREATISE ON PROBABILITY 55 (1921) (footnote omitted).

[11] *E.g.*, 1 MCCORMICK ON EVIDENCE § 185 (Kenneth S. Broun ed., 6th ed. 2006).

[12] An example of this error can be found in Deborah Davis & William C. Follette, *Rethinking the Probative Value of Evidence: Base Rates, Intuitive Profiling, and the "Postdiction" of Behavior*, 26 LAW & HUMAN BEHAV. 133 (2002). For some attempts to clarify the matter, see Richard D. Friedman & Roger C. Park, *Sometimes What Everybody Thinks They Know Is True*, 27 LAW & HUMAN BEHAV. 629 (2003); David H. Kaye & Jonathan J. Koehler, *The Misquantification of Probative Value,* 27 LAW & HUMAN BEHAV. 645 (2003); Gary L. Wells, *Murder, Extramarital Affairs, and the Issue of Probative Value*, 27 LAW & HUMAN BEHAV. 623 (2003). Davis and Follette defend their unusual interpretation of probative value in *Toward an Empirical Approach to Evidentiary Ruling*, 27 LAW & HUMAN BEHAV. 661 (2003).

First, Bayes' Theorem seems to be silent about the principles or generalizations that people seem to use to support conclusions they draw from evidence. For example, when jurors reason about the probative value of escape evidence, they probably say things like this:

> "I just don't think innocent people think of escaping from jail. They have faith in the criminal justice system and they are willing to take their chances."

or:

> "People who have committed crimes are very likely to escape from jail. They are immoral people and they have no compunctions about breaking the law."

The equation that Lempert gives us doesn't speak to the role of such judgments. And yet they seem to be very important for making judgments about the implications of evidence.

Second, when people try to figure out what happened, they very often tell stories. For example, Juror A might say:

> "You know, I think what happened is that DD had a fight with his wife, he left the house in a huff, went to the bar, and shot the first person he saw."

Juror B:

> "I don't think that's what happened at all. I think after DD argued with his wife he got morose and depressed and, unconsciously looking for a scapegoat, he began to stew about the insult by VV earlier that day. DD then decided to kill VV, went to the bar, and shot VV in cold blood."

The standard version of Bayes' Theorem does not require that such scenarios or stories be formulated when the force of evidence on factual hypotheses is evaluated. But it is possible that the formation of stories or scenarios is fundamental to reasoning about evidence. What to do?

Cf. Judea Pearl (causal hypotheses); cf. B. Robertson & A. Vignaux (all evidence is "trace evidence," matter left by some physical, hence, causal process; hence, causal hypotheses are integral to evaluation of evidence).

RONALD ALLEN:

I certainly would never object to maintaining anything as a memorial to something dear to someone else's heart, but I wonder how much either the old or the new language of FRE 401 bears on anything interestingly Bayesian. It is true that the likelihood approach to relevance is, as Rick Lempert said many years ago and has repeated many times, a useful, and I would say powerful, heuristic that can advance one's understanding of the inferential process, but it is difficult to see likelihood ratios as capturing the heart of the matter. Consider a simple case: a person accused of murder in a small town was seen driving to the small town at a time prior to the murder. The prosecution's theory is that he was driving there to commit the murder. The defense theory is an alibi: he was driving to the town because his mother lives there to visit her. The probability of this evidence if he is guilty equals that if he is innocent, and thus the likelihood ratio is 1, and under what is suggested as the "Bayesian" analysis, it is therefore irrelevant. Yet, every judge in every trial courtroom of the country would admit it, and I think everyone on this list would say it is relevant. And so we have a puzzle.

The puzzle is deeper, because again as everyone on this list knows, all evidence is contingent on the remainder of the evidence, and thus at the time any particular question of admission is asked one can't have any idea what the likelihood ratio might be. Evidence thought to be inculpatory might turn out to be exculpatory, and so on. Indeed, much evidence has just the interesting aspect of my example: under certain assumptions it is inculpatory and others it is exculpatory. Is all such evidence then irrelevant also? Hardly, so the puzzle deepens.

Some of the puzzlement is reduced if the trial process is looked at in explanatory rather than probabilistic terms, because then driving to the town is part of each party's explanation, and thus plainly relevant. Pardo and I have written about this a bit and so I won't belabor the point here.

More generally, the likelihood ratio aspect of Bayesianism is not unique, nor even attributable to it. It is simply an example of contrastive and counter-factual reasoning, which has been with us since recorded history, I think (and I suspect even longer). To this extent, as Peter suggests, Bayesian approaches and natural reasoning processes may overlap, and so I would be completely enthusiastic about keeping the old language of FRE 401 as a memorial to common sense (although I'd prefer "tribute," since "memorial" has certain implications about its present status).

None of this, by the way, should be taken as inconsistent with what I said above about Bayesian approaches being powerful heuristics, and in some (but quite small) set of cases powerfully useful.

ROGER PARK:

I'm not sure I understand Ron's point.

Suppose that the driving-to-town evidence is the prosecution's first piece of evidence.

The state of the evidence before this proffer is that we don't know where the defendant was at the time of the murder. After the proffer, we have good reason to believe he was in the town where the murder took place. That increases the probability that he committed the murder.

The fact that defendant then testifies to another explanation for being in town doesn't change that. Compared to no evidence about him being in town, the prosecution's driving-to-town evidence considered together with the defense counter-evidence elicited by it makes it more likely that he committed the murder.

DAVID KAYE:

I think Ron's point is that the value of a likelihood ratio depends on other evidence in the case, beliefs about the world, and assessments of competing explanations. The particular example may not be the best for making this point, but the general observation is correct. Probabilities do not spring into existence in isolation. Any numbers are just the tip of an iceberg of thought. In this sense, the ratio is not "the heart of the matter." How one arrives at it is crucial.

The nice thing about the ratio, however, is that when it is arrived at in a satisfactory and reasonable way, it can clarify the degree of support that an item of evidence gives to one hypothesis over another. Thus, I think the set of cases in which likelihood theory is at least somewhat helpful is quite large. But the ratio is embedded in a much deeper and richer reasoning process, and I suspect that one's characterization of its value depends on what features of good reasoning one chooses to emphasize.

I also think that the current wording of Rule 401—the emphasis on before and after—is to the good but that it is more directly supportive of a Bayesian perspective than a likelihood-ratio theory of probative value. This remark may be cryptic, but, due to the crush of business at the start of the semester, I won't try to elaborate.

RONALD J. ALLEN:

Just to clarify things, and then I'll be silent, I think the awkwardness comes in trying to think of this in a likelihood, or degree of support, way. Also, to be clear, I am by no means saying that neither approach can ever work. Rather, I am

giving an example of where there is, as I said, awkwardness. Now, to Roger's point—sure, one can hypothesize a case where things work through just fine, but suppose the defendant's opening statement was that he was there visiting his mother. Now again the evidence is irrelevant. One might say, but there is no evidence that he was there. Okay, so now the state wants to ask this question, the defendant objects on relevancy grounds and asks to make an offer of proof. He establishes to the court's satisfaction that he will offer proof that he visited his mother. On that showing, the state's offer is irrelevant under what I will call just to simplify things the "Bayesian" perspective. Now, this result is perfectly ridiculous for lots of reasons, but the point is not—both sides will present the same evidence meaning the probability of it being presented (or however you want to formulate the question) conditional upon guilt or innocence is 1.0 and thus their ratio is 1.0, which means it is irrelevant.

We can quibble with the example, but we can easily repair the example, even though I think it makes the point more than adequately. Roger's disagreement rests upon the assumption that presence is a contested fact, but in my hypothetical, and often in real cases, facts like this aren't contested, or their implications are argued to cut in opposing directions. None of this is a problem for an explanatory account of proof, but it does cause problems for a Bayesian account. That's not to say Bayesian accounts don't have other virtues and explanatory accounts other problems. Both are true, but I was responding to only this one issue.

DAVID KAYE:

Let's see. The two hypotheses are H_p (D was in town and had the opportunity to kill the deceased), and H_d (D was in town to visit his mother and was with her at the time of the murder). The evidence is E (D was seen driving into town before the murder). E does not support H_p over H_d (the likelihood ratio LR is 1). The witness's testimony should be excluded as irrelevant—if the defendant represents that his theory of the case is H_d when the state proffers the evidence and if the state has no other reason for presenting E than refuting H_d.

On the other hand, if D does not respond to the proffered evidence by conceding that he was in town at the pertinent time, and the issue is whether H_p is true as opposed to H_d' (D was out of town), then the LR is large (if the witness is not mistaken, of course). Hence, E is relevant under the likelihood approach—it supports H_p over H_d'.

Thus, I don't see the awkwardness in the LR formulation as long as one is careful in specifying the hypotheses at issue—what the evidence is being used to prove (and disprove). The LR forces one to do this because the probabilities in it are conditional on competing hypotheses.

Admittedly, I am leaving out the reasons to introduce evidence of uncontested facts listed in *Old Chief v. United States*.[13]   To forestall a labored analysis that would address these, I am happy to stop and leave it to the readers to decide which ways to think about relevance and probative value are the most helpful, instructive, awkward, or complicated.

RONALD J. ALLEN:

Let's see further. Under David's theory, evidence is relevant until one hears from the defendant, but then it might not be. Unless, of course, the defendant presents such a strong response that the evidence becomes helpful to him, in which case it is relevant again. Unless the state responds, in which case it may not be relevant any more. And of course, if the evidence is a critical part of both parties' case, it's not relevant at all! How could one not love such a misshapen child and think it anything but awkward? Beats me. Now, to be sure, "awkward" to some extent to me means how well our theories explain our observations—like trials, but it should be noted that David isn't explaining them—or more accurately put, his explanation is false. Pace David, the evidence is relevant regardless what D says. If the defendant agrees that he was there, the evidence is relevant even though it is a critical component of both cases (and the likelihood ratio is 1.0); if he disagrees it is relevant because it distinguishes the stories. In both cases it has explanatory value. And again, regardless what David thinks or his theory predicts, not a judge in the land would disagree. Nor would anyone (perhaps excluding David) on this list, I suspect (please correct me if I'm wrong). Of course, we could all be deserving of disdainful rejection, I guess. See, e.g., The Sane Society.

The theory is deeply wrong in another sense. My point was that it is difficult to determine relevancy until one has heard all the evidence and that the question then is its explanatory value, not anything much having to do with likelihoods or their cousins. One way to understand David's response is to agree to wait and see what the evidence is, what does the defendant claim, for example. But, after one has heard all the evidence, there are no likelihoods to form, but only, in Bayesian terms, priors, which are not informed by Bayesianism. So, this move doesn't work, either, leaving no defense except to recognize a misshapen child for what it is.

If anybody is interested in any of this, and I infer from the quite limited range of participants that the answer is probably no, I'd be happy to communicate off line.

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[13] 519 U.S. 172 (1997).

SAMUEL GROSS:

I hesitate to get involved in this debate—especially with all the piles I see before my just-back-from-vacation eyes—but I'll insert one oar and keep quiet and regret it.

I am a fan of Lempert's work on Bayesian interpretation of probative value, but I think its value is something different than what it's often said to be. It is most useful not as a description of how judges or jurors should evaluate evidence but of how lawyers should argue the probative value of evidence—which is (in my view) probably the most important thing we should be trying to teach.

We can't know how an item of evidence affects the likelihood of (say) a criminal defendant's guilt. As more than one writer on this list has pointed out, that depends on knowing many other facts about the case, some of which are never known in any case in which there's a genuine dispute. A brick is not a wall (all bow)—a great truth in this context—but what is the wall? The most common description is that the wall is a story that describes the known and unknown facts of the case, a story of what happened. If so, there are at least two implications to consider.

1. In all but the rarest cases, many if not most of the bricks will be inferred rather than observed (and if said to be observed, they may be contested). No news here.

2. A brick—let's say an uncontested fact—may be a part of two or three or several walls.

Item: D is stopped in his car three minutes after an aborted bank robbery, 1/2 a mile and speeding away from the site. Prosecution says it's relevant to guilt: it shows he was escaping. Defendant says it is relevant to innocence: no escaping bank robber would speed and attract attention. I used to be a criminal defense lawyer, so I think the defendant's argument is quite a bit more specious than the prosecutor's; you may agree. But I think almost any judge would let it in for either side, without going through this academic exercise, because it's relevant in the context of the argument that side is making, and that's enough pass the low threshold set by 401.

More important item: Defendant in a murder case is the dead victim's son. Is that relevant to show he's guilty? Is it relevant to show he's innocent? The answer in any such trial will be Yes, to both questions. But why (as a Bayesian matter)? I don't have a clue, although we can all come up with lots of scenarios—he loved his father and would never harm him, he hated his father's guts, he lived with his father and therefore was nearby when someone else killed the old man, his father drove him crazy, and so forth. As far as "relevance" goes,

it doesn't matter: the stark reality of the trial will be that whatever wall an advocate may try to sell to the jury, it better include this fact as a brick.

My point—as I said at the start—is simply that the probative value of evidence depends on its place in the argument that is being made. It is commonplace in trials that some uncontested fact is held up plausibly as convincing "evidence" for diametrically opposing positions.

In that context, I try to use Bayesian logic to help my students figure out how to make strong arguments. Ultimately these arguments are mostly in the form of "this uncontested fact would [almost] never have occurred unless the contested fact I'm arguing about is as I say it was," and, in opposition "actually [given what we know—or infer] that uncontested fact would have happened as it did regardless of the other events we're arguing about." In my own experience, some students are helped by restating these basic arguments in the formal terms of likelihood ratios. In particular, it reminds them to think through the fundamental question: how likely would this fact be if reality were the opposite of what the proponent claims? For others, it's a waste of time—I hope not an actual impediment—so I keep it short, put it in writing, and emphasize verbal equivalents.

But I'm drifting away from the main point. 401 says that relevant evidence must make some proposition that matters more or less likely. But no judge can know if it does, and if so which way it does; that depends on the other "facts" of the case—and on the tribunal's evaluation of them. It follows that in practice "relevance" must be an aspect of argument, not of observation or calculation. I doubt if many judges and lawyers consciously think this way, much less talk in these silly terms, but I submit that this is the unstated logic of the game they play.

DAVID KAYE:

Sam poses another interesting question. He writes:

> More important item: Defendant in a murder case is the dead victim's son. Is that relevant to show he's guilty? Is it relevant to show he's innocent? The answer in any such trial will be Yes, to both questions. But why (as a Bayesian matter)? I don't have a clue, although we can all come up with lots of scenarios—he loved his father and would never harm him, he hated his father's guts, he lived with his father and therefore was nearby when someone else killed the old man, his father drove him crazy, and so forth. As far as "relevance" goes, it doesn't matter: the stark reality of the trial

will be that whatever wall an advocate may try to sell to the jury, it better include this fact as a brick.

A Bayesian could use Bayes' nets to handle this. That is, the Bayesian judge (or advocate) could generate a list of scenarios (walls?) with prior probabilities worth considering. In some, the defendant's identity as the son will suggest guilt. (It will be a node in a Bayes' net linked to a material proposition that alters the probability of the latter proposition as computed without this node.) In others, it will suggest innocence. In still others, it may have no impact on the posterior probability of the scenario or the material propositions embedded in it. The judge should treat the relationship as relevant under Rule 401 if there are one or more scenarios such that (1) a juror reasonably could worry about the scenario, and (2) a juror reasonably could believe that the defendant's relationship as the son shifts the probability for the scenario or for any material propositions within it.

This explanation is still a little rough, and it may not be exactly what I said in response to Ron's example. I am still thinking it through. The point I made earlier was that judgments of relevance (under a likelihood theory, a Bayesian perspective, or anything else) must depend on where we are at in the trial and what positions the parties are known or expected to take.

Returning to Sam's question, it should be added that some facts are just presented for the sake of a rich and realistic narrative. They can be part of a Bayes' net, but their relevance need not flow from their ability to shift a probability. We let a witness state his or her name, for example. My citation to *Old Chief v. United States*[14] was meant to recognize this distinct category of relevant evidence.

I think this is as far I can go on this thread.

RONALD ALLEN:

Let's see again. Sam Gross raises two issues. First, that he hasn't got a clue about which of the virtually infinite possible scenarios matter, what their prior probabilities are, and not mentioned but equally distressing what the various pertinent conditional probabilities might be, and second that the same piece of evidence will be possibly pertinent to lots of different stories with opposing implications (the original issue we began discussing). David's response is that the Bayesian judge can provide the very scenarios and the prior and conditional probabilities that Sam says he hasn't got a clue about. As David has said in other contexts, that's a pretty neat trick. In any event, one can always make things up

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[14] 519 U.S. 172 (1997)

that one doesn't know and go about one's business as though one did; there is nothing peculiarly Bayesian about that (and—another story—maybe it unfortunately too often does characterize trials). In any event, on the assumption that you don't know all these things that Sam doesn't, David's answer isn't terribly helpful, unless one believes in omniscient Bayesian judges (and jurors, I guess) who do not suffer from the informational vulnerabilities that we mere mortals do. David doesn't address the second point, which as I say is where we began, and that is that the same piece of evidence can support both guilt and innocence, making the pertinent likelihood ratio 1.0. In fact, many if not most trials have massively overlapping evidence. The actual differences between the evidentiary proffers of the opposing sides often come to only a few points, yet judges consistently let all this overlapping evidence in for just the reason Sam identifies. Thus, if the likelihood ratio approach to relevance were true in some sense, that means the trial judges throughout the country have been admitting massive amounts of irrelevant evidence. Now, maybe that is true, but maybe it suggests a problem with the theory. FYI, explanatory accounts of juridical evidence don't seem to me at any rate to have quite the same problem here (although as I said originally and will repeat, they have others). Again, and like David, I will now retire from the scene.

MICHAEL RISINGER:

Dear All,

Like Sam, I have hesitated to join this seemingly intractable debate. I agree with Sam that knowledge of the theorem of the Reverend Bayes, perhaps translated from formal to ordinary language, is very useful in teaching argumentation. I also think it is useful in disciplining inference. But I don't think it either maps on to the human inferential process very well, or that we should expect it to. This failure to be captured by Bayes' Theorem is not necessarily a criticism of the accuracy of the human inferential process tout court. Formal systems are true within the bounds of their defining assumptions. Bayes' Theorem, like all formal systems, is incomplete, and in the case of Bayes' Theorem, that incompleteness extends to important aspects of the process by which one piece of information bears on another—base rates of occurrence in the world being one, and how to define the reference set to which the base rate inquiry applies being another. The reference set problem (or "reference class" problem as it tends to be known in the literature both in and outside of the law) has been usefully written about by Ron Allen and Michael Pardo, and their piece (Ronald J. Allen and Michael S. Pardo, The Problem of Mathematical Models of Evidence, 36 J. LEGAL STUDIES 107 (2007)) is a good introduction to it. Jim Franklin, the Australian mathematician

and philosopher who wrote THE SCIENCE OF CONJECTURE (about probability concepts and reasoning before Pascal) is currently undertaking a major project examining the reference class problem and how to approach it—that is, rules, principles, or at least heuristics, for justification in defining reference classes and electing one possible reference class over another. I've written a little about itmyself, and intend to do more in the future. The reference class problem may prove more intractable than even the debate about Bayesianism, but some progress can be made, I think, concerning more and less justified ways of approaching it. With no such explicit corralling of the reference class problem, Bayes' Theorem is fairly sterile even without considering the well-known problem of "prior probabilities." In addition, our whole approach to relevance, as reflected in Rule 401, which I call the "god-view approach," is fundamentally wrong. In my opinion (as the Magliozzi brothers are accustomed to add on the end of any such cosmic pronouncement). It fails to take into account the knowledge state of the processor (factfinder) as well as the characteristics of the putative evidence, and the two considerations are in fact inseparable. And now for the shameless self-promotion (as the Magliozzi brothers would further say): I have written a little article that bears on all this entitled *Inquiry, Relevance, Rules of Exclusion and Evidentiary Reform.* It will be in the Brooklyn Law Review's festschrift volume in honor of Margaret Berger. [15]

DAVID KAYE:

Ron and others,

I think the example nicely establishes that the answer depends on the question you ask. You get a different LR if you ask a different question (compare a set of different hypotheses). That relevance is relative affects all plausible theories of how to determine whether a fact is relevant. If a judge is asking, intuitively, "In light of everything known at the moment of decision on an objection, would a reasonable juror find this item of evidence *E* helpful?" the judge needs to consider what stories the juror could reasonably consider. *E* will be relevant to deciding between some pairs of these alternative constructions of the events but not to other comparisons. This may be awkward, but it affects all plausible theories of relevance. At least, I think it does.

       Incidentally, like Sam, I present the likelihood ratio briefly in a general Evidence class, as one way to think about one aspect of circumstantial evidence— a way that some students will find congenial and others will find perplexing. As

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[15] D. Michael Risinger, *Inquiry, Relevance, Rules of Exclusion and Evidentiary Reform,* 75 BROOK. L. REV. 1355 (2010).

Peter, Michael R., and Ron have pointed out, there is much more to inductive reasoning than this. And as you and Michael Pardo (and L. Jonathan Cohen, among others) have argued, the formalism begs deeper epistemological questions.

BRUCE HAY:

What I don't think has been sufficiently emphasized in this very interesting discussion is the difference between the judge's and jury's tasks. As I understand things, a judge doesn't have to, and indeed should not, decide whether (she thinks) a piece of evidence makes a fact more or less likely; rather, she has to decide whether a reasonable trier of fact might consider it to have that effect. Ron's conundrum—the piece of evidence that seems (to the judge) to point equally to guilt and innocence—doesn't raise any admissibility problem, unless all reasonable jurors would have to see the evidence the way the judge does; in the examples we've discussed, reasonable minds could disagree about the evidence's valence, especially after hearing the stories the lawyers will try to spin around it, as Sam points out. That is why ambivalent evidence is routinely admitted. This doesn't contradict the Bayesian approach to relevance; it just complicates it by forcing judges to be second-order Bayesians, i.e., asking themselves whether a Bayesian juror might reasonably assign the evidence a likelihood ratio other than 1.

MICHAEL PARDO:

Dear Bruce, David, Ron, and others:

Assuming this discussion is not yet exhausted, I have a quick follow-up to Bruce's message, which I hope will clarify what I think the central dispute is in the exchange between David and Ron.

Even when we move (thanks to Bruce's clarification) to the second-order question of what any reasonable fact-finder could conclude, the same problem arises for the Likelihood Ratio theory. Again, I think we could construct numerous examples in which two features hold (which I take to be Ron's initial point): (1) evidence is relevant, and (2) no reasonable fact-finder could decide that the evidence supports one side's theory over the other side's theory. For example, suppose the evidence at issue is that a fight occurred and the only dispute is over who started it. If you think this example doesn't work, any that meets the above two conditions will do. If such examples exist, then this is a potential problem for the LR theory—it means that either the LR theory is false or that our conclusions (intuitions, considered judgments, or whatever) about what evidence is relevant and when have to change.

Now, I understand one of David's responses to this point to be that this is a problem for any theory of relevance or probative value. But, the explanatory theory that Ron and I have argued for does not suffer from this problem (although, as Ron notes, it may suffer from other problems). In the fight example above, for example, the evidence is relevant because it is part of each side's explanation, even if it cannot be used to rationally distinguish between them. Please note that this is not meant to suggest that the LR theory cannot explain other cases or be useful as a teaching tool, as other have suggested.

If you've read this far—thank you.

PETER TILLERS:

Dear Michael & All,

I am no mathematician. I am not even a logician. But I feel safe in saying that it is important to be precise about mathematics and formal logic.

> "If such examples exist, then this is a potential problem for the LR
> theory—it means that either the LR theory is false…"

Do you mean to say that such examples establish the mathematical invalidity of the ratio known as the likelihood ratio?

No, you don't mean that.

You mean to say that a particular "interpretation"—or in the jargon of non-mathematicians, "application," or "use"—of the likelihood ratio is "false."

It is true that one can use Bayes' Theorem—one can "interpret" it—in a way that contravenes common sense. It is also true that the use of Bayes' Theorem in a particular real-world context (e.g., trial by jury) may not be enlightening. Sometimes, in short, doing a "Bayesian number" on some problem of evidence is a waste of time from almost any point of view. But suggestions that particular interpretations of Bayes' Theorem are "false" are overly strong. Such suggestions imply, though they do not expressly say, that a determined Bayesian just could not recast a Bayesian analysis of this or that putative counter-example (but a counter-example of what precisely?) in a way that makes a Bayesian "interpretation" consistent with the putative counter-example. This is a strong claim that requires very strong evidence.

BTW: There are quite respectable people who combine Bayesian analysis with "explanations." Indeed, David Schum has written two books that are practically all about that. See, e.g., his EVIDENTIAL FOUNDATIONS OF PROBABILISTIC REASONING (1994). (This book is a classic.) In a recent article I refer to Schum-style inference networks as "NAGs," networks cum

generalizations (or "nomological propositions"). See P. Tillers, *Are There Universal Principles or Forms of Evidential Inference?* in J. JACKSON, M. LANGER & P. TILLERS, EDS., CRIME, PROCEDURE, AND EVIDENCE IN A COMPARATIVE AND INTERNATIONAL CONTEXT (Hart, 2008) & http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1079235.

Bayesian analysis is compatible, not only with much vice, but also with great (epistemological & inferential) virtue.

N.B. Bayesianism is (among other things) a kind of logic. As Michael Risinger mentioned, this kind of logic can be applied (sometimes but not always profitably) without the use of any numbers. (Quantitative verbal expressions are not quite the same thing as numbers.)

* * *

I thought that David Kaye already made the key point: Bayesian analysis is the tip of an iceberg of thought. Arguments that there is, actually, an iceberg below the iceberg's tip—and I most certainly do believe that there are many different non-Bayesian strategies for analyzing evidence (I have been riding this particular hobby horse for precisely 23 years!)—are, pardon the expression, old hat—and are, by now, trivial and uninteresting.

* * *

The above comments may sound a bit stentorian. I hope you folks will forgive me for that. I am in a rush to make the discussion of the uses and limits of Bayesian logic a bit more precise. Of course, I was in rush to do that 20+ years ago. See P. Tillers & E. Green, EVIDENCE AND INFERENCE IN THE LAW OF EVIDENCE: THE USES AND LIMITS OF BAYESIANISM (1988), an offshoot of Symposium on Evidence and Inference in the Law of Evidence: The Uses and Limits of Bayesianism, 66 B.U. L. Rev. Nos. 3-4 (1986). It appears that I have failed.

Now I will do my very best to retire from this over-heated fray. (We are plainly in the midst of a Forty Years' War, not just a Thirty Years' War. Indeed, some historically-minded observers contend that the war has been going on since the 18th century. Some observers—e.g., Jim Franklin—even think that precursors of this War can be found in antiquity. See, e.g., Aristotle on the limits of his own invention, the syllogism.

MICHAEL S. PARDO:

Dear Peter,

I did not mean to suggest that the examples show the mathematical invalidity of anything. I meant that the LR theory of relevance is false as a description or explanation of when juridical evidence is relevant. My point is a general one that,

at least as I understand it, would apply to any theory or account of relevance (not just the LR theory). If (1) any theory implies answers as to when an item of evidence is relevant/irrelevant; and (2) there is a mismatch between those answers and our considered judgments about what judges and jurors will/ought to conclude about whether the evidence is relevant; then (3) that theory is false as a description or explanation of relevance. (Of course, it might also turn out that the theory provides better conclusions and so we should abandon the underlying judgments.)

        In short, I was trying to clarify a methodological point in the debate, not making any substantive claims about the formal validity of likelihood ratios, Bayes' Theorem, or any other analysis. I also did not mean to imply that there is something incompatible between probabilistic analysis or reasoning of any kind and explanation-based accounts of legal proof; there's not.

PETER TILLERS:

Michael, ok, mea culpa

PETER TILLERS:

Dear Friends & Colleagues,

Although I do not agree with everything Michael Pardo says (I don't agree with anyone about everything), I think Michael Pardo is one of the most thoughtful commentators on Evidence. And, incidentally (or not so incidentally), he pays attention to neuroscience. This is good: people who worry about the workings of inference should worry (or think) about the workings of the brain.
P.S. Watch out: the Evidence community will yet turn into a love-fest.

DAVID KAYE:

Thanks, Mike, for trying to focus the discussion. I have some further clarifications:
        1. Ron said or implied that a Bayesian theory does not work because it requires "omniscient Bayesian judges (and jurors, I guess) who do not suffer from the informational vulnerabilities that we mere mortals do," and he complained that I did not address this point. I did not claim that real judges are like Dworkin's Hercules or other idealizations. I noted that the judge has to do the best he or she can in considering the scenarios that reasonably come to mind at each stage of the trial, given the information and intelligence at the judge's disposal and the arguments of counsel. The judge will have plenty of clues as to

which narratives are reasonable to consider. The parties' opening statements, general knowledge of the world, and a party's explanations of why the proffered evidence is relevant all will help. In the same manner, a judge "inferring to the best explanation" will do his or her best in making rulings at each point in time. As I suggested, the problem of limited information and cognitive capacity is something any theory has to deal with if it is supposed to model the behavior of real judges, jurors, or advocates. A Dworkinian Hercules is not a realistic construct, but rather is a normative ideal or a heuristic device. A judge need not be clever enough to imagine every conceivable narrative to conclude, as Sam did, that in every account of events that will matter as the trial unfolds, some facts probably are important. Or a judge may discover, as the trial develops, that what initially appeared to be relevant (or didn't) is relevant (or isn't). Probabilities are conditioned on prior information, and as that information changes so do the probabilities that fit into likelihood ratios. This is not an embarrassment. It is the human condition, which lacks precognition and omniscience. There is nothing theoretically disturbing with a judge thinking, "If I had known then what I know now, I would (or would not) have admitted that evidence."

2. Mike emphasizes another point (closer to the starting point of the discussion)—that "the LR theory is false" because evidence can be relevant if "it is part of each side's explanation, even if it cannot be used to rationally distinguish between them." This criticism assumes that "LR theory" means that the only criterion for relevance is a likelihood ratio. It is clear from Lempert's original article and both editions of his casebook that this is not the LR theory he propounded. To tie together the threads of the explanations that Roger, Sam, Bruce, Peter, and I (and anyone else I may have unintentionally overlooked) have offered in this exchange of ideas, let me, once again, distinguish between two types of evidence—(a) circumstantial evidence and (b) evidence that fills out a narrative. (Of course, some evidence can fall into both categories.)

a. Lempert introduced the likelihood ratio to explain the relevance of circumstantial facts. How is it that a blood stain or a prior conviction is relevant? His answer was that it changed the odds of a material fact by an amount given by the likelihood ratio. Some circumstantial facts can have this effect within conflicting narratives. One side says that the fact makes the conclusion it wants to draw stronger (the son loved the father, so he would not kill him). The other side says it makes the opposite conclusion stronger (the son wanted to get the father's estate sooner, so he killed him). In both narratives being the son as opposed to an unrelated individual matters and affects the probability of a material conclusion. It matters in conjunction with other facts (which could be modeled in a Bayes net if desired). So being the son is relevant on a Bayesian account, because the judge cannot say that both these narratives have equal probability, and must let the jurors consider these and any other competing

narratives that come to their minds. That takes care of circumstantially relevant evidence that seemingly "cannot be used to rationally distinguish" two narratives.

b. The other category of relevant evidence on a Bayesian (or other) account is evidence that is relevant for some reason other than the fact that a reasonable juror could think it has a likelihood ratio that differs from unity. This evidence is of two types. (i) Some of it is derivatively relevant. Charts, photographs, some real evidence, etc., are relevant if they help the jury understand other relevant evidence. (ii) Other relevant evidence is for narrative integrity, to give color and depth to the narratives. Proper names of witnesses fall into this category. No Bayesian ever contended that evidence in category (b) cannot be relevant. [16] After all, it helps a Bayesian (or other) factfinder in evaluating the probabilities of each side's reconstruction of the events.

ROGER PARK:

Gee, I never thought the restyled evidence rules would take us this deep.

The way I understand the messages, even those who say that the likelihood ratio doesn't capture the heart of the matter or that sometimes evidence with a likelihood ratio of 1.0 ought to be admissible don't go so far as to say that thinking in terms of likelihood ratios is always useless.

It seems to me that when interpreting Rule 401's provision that "evidence having any tendency to make the existence of any fact that is of consequence to the determination of the action more probable or less probable than it would be without the evidence," it *must* be OK to think about whether the evidence being offered renders a fact more probable. If that's true, then it seems to me that it's also OK to think about whether we'd be more likely to find the evidence if the fact were true than if it were not.

With regard to ambiprobative evidence (e.g., the victim was the defendant's father), it seems to me that Bruce Hay's solution (below) works. In other instances an item of evidence tags along just because it helps us understand

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[16] I put it this way in *McCormick*:

> [L]eeway is allowed even on direct examination for proof of facts that merely fill in the background of the narrative and give it interest, color, and lifelikeness. Maps, diagrams, charts, and videotapes can be material as aids to the understanding of other material evidence. Moreover, the parties may question the credibility of the witnesses and, within limits, produce evidence assailing and supporting their credibility. [¶] The second aspect of relevance is probative value, the tendency of evidence to establish the proposition that it is offered to prove.

1 McCormick, *supra* note 11, § 185. The likelihood ratio merely captures the probative value of circumstantial evidence. *Id*.

other evidence. An example is a chart showing the floor plan of a bank. Even if it's hard to explain why it has a likelihood ratio different from 1.0 if you consider it in isolation, it's certainly entitled to be admitted if it helps us understand other evidence that does move the needle. The same can be said of evidence such as names. Having a way to identify the various actors helps us understand other evidence.

RONALD ALLEN:

Dear All,

David Kaye is correct that for Bayes' theorem to be more than of minor significance for understanding juridical proof we would have to surmount cognitive and informational limits that are in fact insurmountable, but that was not my point in my previous email. My point picked up on Sam Gross who hypothesized that the information needed to run Bayesian analysis usually doesn't exist. David's answer to that was Bayesian judges who, for that to be a coherent answer, need the information that Sam Gross hypothesized doesn't typically exist. In short, David's answer didn't address the point Prof. Gross was making, it seemed to me. However, from the need to surmount insurmountable cognitive and informational limits, we can know from conceptual analysis that (dare I say it?) Bayesianism is false as a theory designed to predict outcomes about or to explain or discover the nature of juridical proof and the reasoning process at trial—false as an empirical matter. "False" here means, as was perfectly clear in Mike Pardo's email it seems to me, not very helpful as an explanation of the data, for predicting outcomes, or discovering knowledge about the matter in question. Nor does it serve the other intellectual virtue of justification. To be sure, even false theories can be useful in some ways, and their operations sometimes intersect truth. Two good examples are the theory that the earth is flat and Newtonian physics. Both are internally consistent and quite useful, but both are false (some argue that Newtonian physics is a special case rather than false but that takes us into different epistemological waters). Compare them to the phlogiston theory of combustion, which again is internally consistent but not very useful, although some of its predictions overlap oxygen theory (and actually historically phlogiston theory apparently played an important contributory role in advancing knowledge).

In David's most recent email, he again doesn't address the questions that I at least thought were being posed. These have to do with what I referred to earlier in the thread as the massive overlap of proof at most trials. His response is to give an example where the inferences drawn may distinguish the cases of the parties, but the problem is with the "massive" amount of evidence which is not like

that. The simple example is Pardo's fight or a car crash, but these simple examples capture an essential feature of what needs to be explained if in fact it is true that evidence massively overlaps. The claim is that a substantial amount of and maybe most evidence that is admitted in courts in the US is of the overlap kind which cannot be explained by a likelihood ratio approach, because the same evidence and the same inferences are critical parts of both stories (there was a fight, or there was a car crash). If that claim is true, then the likelihood approach is (dare I say it again?) a false empirical theory because it explains very little. It is simply unresponsive to that point to hypothesize that there may be evidence that is not of the overlap variety.

Maybe like Newtonian physics, the use of Bayes' Theorem is as a special case limited to those proffers that may distinguish the cases. Fine with me, but it bears mentioning again that there is nothing particularly Bayesian in either comparative or counterfactual reasoning. They are tools employed in Bayesian reasoning but in other forms of reasoning as well. Nonetheless, if using either tool makes one a Bayesian, then we are indeed all Bayesians, although like most evidence at trial this doesn't distinguish being a Bayesian from much else.

What does distinguish Bayesian reasoning in an interesting way (for our purposes, but there are others, such as the disputes about the merits of hypothesis testing and so on) is the formal manipulation of conditional probabilities operating on mathematical probabilities or the maintenance of the consistency of a fully specified set of beliefs under certain conditions. That takes us back to Sam Gross's point that the normal condition of the legal system is the absence of both. The normal reason why a judge will conclude "some facts are probably important" is that they are critical to one of the parties' explanations and not because they distinguish that explanation from any other or because even a rough and ready application of Bayes' Theorem generates an updated prior. That determination is quite straight forward, and again consistent with what one observes at trials. At least that is my and I believe Mike's claim. And if facts do distinguish one case from another, I agree one can give the reasoning process an informal Bayesian cast, as one can give it other casts as well. That leaves the Bayesian explanation consistent with other explanations for a small slice of what is being examined and inconsistent with a larger portion of it.

ROGER PARK:

Bruce said: "As I understand things, a judge doesn't have to, and indeed should not, decide whether (she thinks) a piece of evidence makes a fact more or less likely; rather, she has to decide whether a reasonable trier of fact might consider it to have that effect."

Mike responded:

Even when we move (thanks to Bruce's clarification) to the second-order question of what any reasonable fact-finder could conclude, the same problem arises for the Likelihood Ratio theory. Again, I think we could construct numerous examples in which two features hold (which I take to be Ron's initial point): (1) evidence is relevant, and (2) no reasonable fact-finder could decide that the evidence supports one side's theory over the other side's theory. For example, suppose the evidence at issue is that a fight occurred and the only dispute is over who started it. If you think this example doesn't work, any that meets the above two conditions will do. If such examples exist, then this is a potential problem for the LR theory—it means that either the LR theory is false or that our conclusions (intuitions, considered judgments, or whatever) about what evidence is relevant and when have to change.

It seems to me that it's actually very hard to construct hypos in which a reasonable jury could only find equipoise. One can hypothesize that the crucial issue is whether the coin came up heads or tails, and the coin fell into the drainpipe while being flipped. Or that there are two equidistant holes in the fence through which the cow could have traveled, and only one of them would make the railroad liable. But these cases are oddities. (Moreover, they are cases in which a directed verdict should be granted on grounds that the evidence is insufficient to support a finding.) Though we usually don't think of them as cases where the evidence should be excluded on relevancy grounds, such cases are so unusual (and the sufficiency ruling is such a suitable alternative to exclusion of evidence) that we haven't really had much reason to give thought to it. My take on it would be that the better approach for the judge would be to admit the evidence and then rule on sufficiency at the end of the case, because something might turn up that does render the evidence relevant. Maybe there will be circumstantial evidence about, say, the position of the cow on the railroad track or marks on the fence at one of the holes that does give the jury a basis for choosing between theories when all the evidence is in.

It seems to me that in Mike's fight hypo, there will be something different about the contesting eyewitnesses that would allow a legitimate argument that the jury could reasonably believe one over the other.

Admittedly, some credibility contests are basically ineffable. But I'd hate to give judges the role of sorting those out from others. In most cases of credibility contests, it seems to me that the approach of saying that the issue is

whether the jury could reasonably find that the evidence makes a fact of consequence more likely is a coherent way of viewing the admissibility issue.

So, it still seems to me that asking whether the evidence could be viewed by the jury as making a fact more likely is a workable way of thinking about relevance, especially if we add that other evidence that helps understand relevant evidence (such as the floor plan of the bank) is also admissible.

DAVID KAYE:

Dear readers (offline responses indicate that there are still a few out there),

I suspect that the extent of the disagreement between Ron and me in this thread is less than meets the eye, but I'll add a few words of defense against Ron's charge that my reconciliation of Sam's observations with a Bayesian account of relevance overlooks something crucial. Ron writes that "Sam Gross ... hypothesized that the information needed to run Bayesian analysis usually doesn't exist," and that I "didn't address the point Prof. Gross was making.…"

> Sam wrote the following:
>
> > More important item: Defendant in a murder case is the dead victim's son. Is that relevant to show he's guilty? Is it relevant to show he's innocent? The answer in any such trial will be Yes, to both questions. But why (as a Bayesian matter)? I don't have a clue, although we can all come up with lots of scenarios—he loved his father and would never harm him, he hated his father's guts, he lived with his father and therefore was nearby when someone else killed the old man, his father drove him crazy, and so forth. As far as "relevance" goes, it doesn't matter: the stark reality of the trial will be that whatever wall an advocate may try to sell to the jury, it better include this fact as a brick."

I responded that Sam actually gave the information a Bayesian approach requires. If all the scenarios or narratives (the walls) that connect a mass of facts (the bricks) contain the fact in question (the same brick), then a Bayesian judge (a metaphor, not a description of reality), as I put it, "should treat the relationship as relevant under Rule 401 [because] there are one or more scenarios such that (1) a juror reasonably could worry about the scenario, and (2) a juror reasonably could believe that the defendant's relationship as the son shifts the probability for the scenario or for any material propositions within it." I added that other facts that are part of the narratives that the parties propose or that jurors might construct

could produce likelihood ratios of 1 but still would be relevant to give depth, meaning, form, and structure to Sam's walls—a condition that is entirely consistent with the Bayesian use of likelihood ratios to explain the relevance of circumstantial evidence.

> To which Ron replies:

> In David's most recent email, he again doesn't address…the massive overlap of proof at most trials….The claim is that a substantial amount of and maybe most evidence that is admitted in courts in the US is of the overlap kind that cannot be explained by a likelihood ratio approach because the same evidence and the same inferences are critical parts of both stories (there was a fight, or there was a car crash).

The response was implicit if not explicit in my previous explanations. The walls can be massive—they can be full of bricks that both parties use (or that anyone else who is engaged in a rational reconstruction of the events will use). There can be one undisputed fact or one thousand. The Bayesian analysis (at least the one that I proposed) is the same. The judge admits suitable proof of all the important facts—the ones needed or useful in developing a series of rich, comprehensible, and convincing alternative narratives. (To a Bayesian, some are useful because they change important likelihood ratios, while others are useful for other reasons.) Such overlapping facts—massive or minuscule in quantity—are not a bad or incomprehensible thing to the Bayesian judge or juror any more (or less) than they are for the inference-to-the-best-explanation judge or juror. Both engage in deciding which of the metaphorical walls is (probably) real, and both need a web of information for that purpose.
　　If this theory is false like Newtonian physics (useful in getting the Space Shuttle into the right orbit) or even a flat-earth theory (useful for local navigation), then so be it. Likelihood ratios help me think more clearly about the probative value of certain kinds of evidence. That's good enough for me.[17]

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[17] As examples of such reasoning, consider Richard Lempert, *Some Caveats Concerning DNA as Criminal Identification Evidence: With Thanks to the Reverend Bayes,* 13 CARDOZO L. REV. 303-341 (1991); Thomas D. Lyon & Jonathan Koehler, *The Relevance Ratio: Evaluating the Probative Value of Expert Testimony in Child Sexual Abuse Cases,* 82 CORNELL L. REV. 43 (1996); NATIONAL RESEARCH COUNCIL, COMMITTEE ON DNA TECHNOLOGY IN FORENSIC SCIENCE: AN UPDATE, THE EVALUATION OF FORENSIC DNA EVIDENCE (1996).

PETER TILLERS:

My topic: Bovine Ruminations

Roger wrote: "…One can hypothesize that…there are two equidistant holes in the fence through which the cow could have traveled, and only one of them would make the railroad liable."

Let's picture this bovine problem this way:
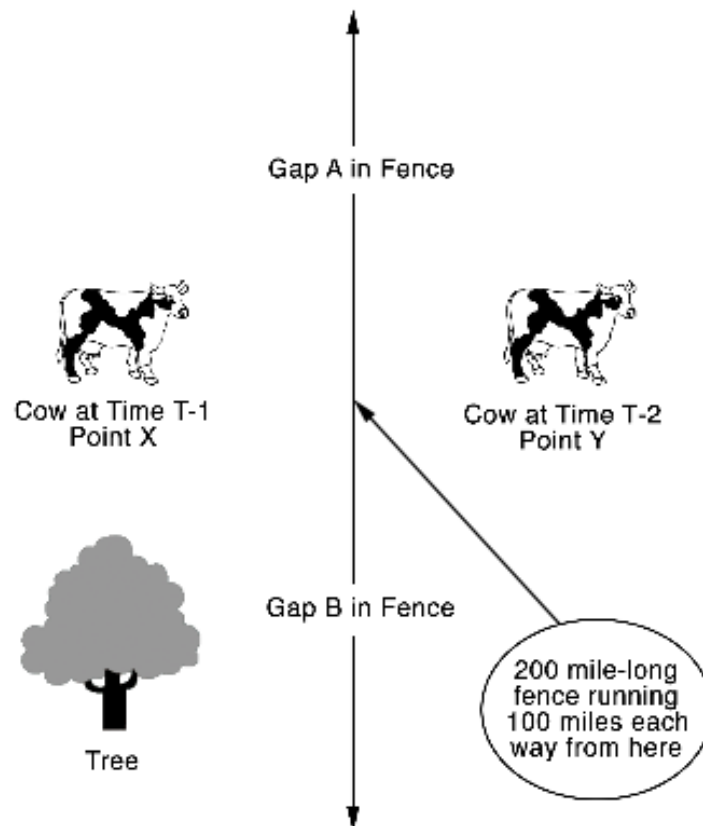
Stipulation: The issue: Did the cow go through Gap A or did the cow not go through Gap A?

Now, we might take Cow at Point X at T-1 and Cow at Point Y at T-2 as our evidence E [E = Cow at Point X at Time 1 & at Point Y at Time 2] that the cow went through Gap A—Ha—or that the cow did not do so, not-Ha.

One way to tackle this problem is to view it as a competition between two scenarios: Scenario 1: the Cow went from Point X at T-1 to Gap A to Point Y at T-2. Scenario 2: the cow went from X through B to Y.

Collateral query: Is evidence that leads to equipoise hard to find or rare? Suppose that the evidence is that in the interval between T-1 and T-2 the apparent brightness of Sirius [a nearby star] increased and decreased by one magnitude. Result: equipoise?

We might formulate the factual issue this way:

$$P(Ha|E)?$$

Now we might ask (if we are good Bayesians), what's the probability of E (cow at X at T-1 & cow at Y at T-2) assuming Ha (the cow passed through Gap A), and what's the probability of E assuming, or given, not-Ha (the cow did not pass through Gate A, which might be, in someone's mind, the probability that the cow passed through Gap B). Or:

What are the comparative values of P(E) in the following two situations:

<pre>
      P(E)   P(E)
     _____   and   _____
        ↑   ↑
        | |
        | |
       Ha   not-Ha
</pre>

To figure out the above probabilities, we might make some guesses.

For example, you—the trial judge—might guess that cows—and you think this is a cow like any other—like to take the shortest route between two points (but that cows can't or won't jump over fences).

But you, the trial judge, might also say to yourself, "But maybe cows also tend to walk away from trees to some degree."

One question is whether the trial judge's personal beliefs about these potential bovine behavior-influencing factors should determine the comparative values of P(E|Ha) and P(E|not-Ha) for purposes of admissibility.

In the mode of thinking given above, the trial judge apparently wants to combine the two principles to construct a model of bovine self-locomotion in the situation involved here. But suppose that the trial judge instead says to herself, "You know, I think one principle or another governs bovine walking, and I've got

to choose the principle that's more likely at work here," does this fundamentally change the way the judge thinks about and derives the conditional probabilities of E given Ha and, alternatively, given not-Ha? Or suppose the judge says to herself: "You know, my task is to weigh the relative probabilities of two scenarios, Scenario 1 given E and Scenario 2 given E (and I don't see any other possible scenarios here that have any perceptible chance of having happened)."

In any of the above mental-world situations is there anything that militates against the judge's or the jurors' interest in or the importance of the bottom line, the value, in their minds, of P(E|Ha) compared to the value of P(E|not-Ha)?

Collateral point: In any of the above situations, is it possible that numbers (probability values) might be attached to some or all of the ancillary principles in play?

In the situation (above) in which the trial judge sees two causal factors at play, can and perhaps should the trial judge say, "Well, that's my opinion. But a reasonable jury might have a different opinion about the vector that those two variables produce, and I'll let the jury decide how those two variables combine to determine how cows probably behave in this situation. In any case, however, no matter what bottom line conclusion the jury or I might reach about the combination of the two [or more] causal variables, I think that both I and the jury should hear the evidence and then ponder how the shortest-distance-between-two-points-principle and the tree-aversion-principle [and any other such principles] combine"?

* * *

I was going to add other questions & refinements. But I have grown weary (physically). So I'll stop. I can only pray that you can see roughly where I'm heading with all of this.

RONALD ALLEN:

Peter has given (yet another) example where there are two competing stories, and maybe (but I doubt it) where the evidence distinguishes them. What distinguishes them if anything does is people's background knowledge (which personally and idiosyncratically I view as "evidence," but that's another matter). No one is claiming such cases do not exist; indeed it is remarkable that we have to keep saying this. So, let me say it again: Such cases exist. The claim is that other cases exist where the evidence is critical to both parties' explanation but does not distinguish them. It is simply a logical error to think that claiming the first set exists has much to do with the second set.

As to Peter's hypothetical, I don't think it shows what he thinks it does. If that is all the evidence there is, and unless one can in fact on the basis of background knowledge infer with great than a .5 probability what the cow would

have done, trial courts will routinely direct a verdict in such cases against the party with the burden of proof. If there is background knowledge about cow behavior so that one can knowledgeably draw an inference about the cow, then Peter's hypothetical is not what he thinks it is for it is then not a case of equipoise. If there is not such knowledge, the only way to avoid a directed verdict would be expert witness testimony about cows or particularized evidence about this particular cow.

Peter Tillers:

To complete my ruminations about partial quantification of the peregrinations of a possibly-ruminating cow:

The problem, you will recall, is this:
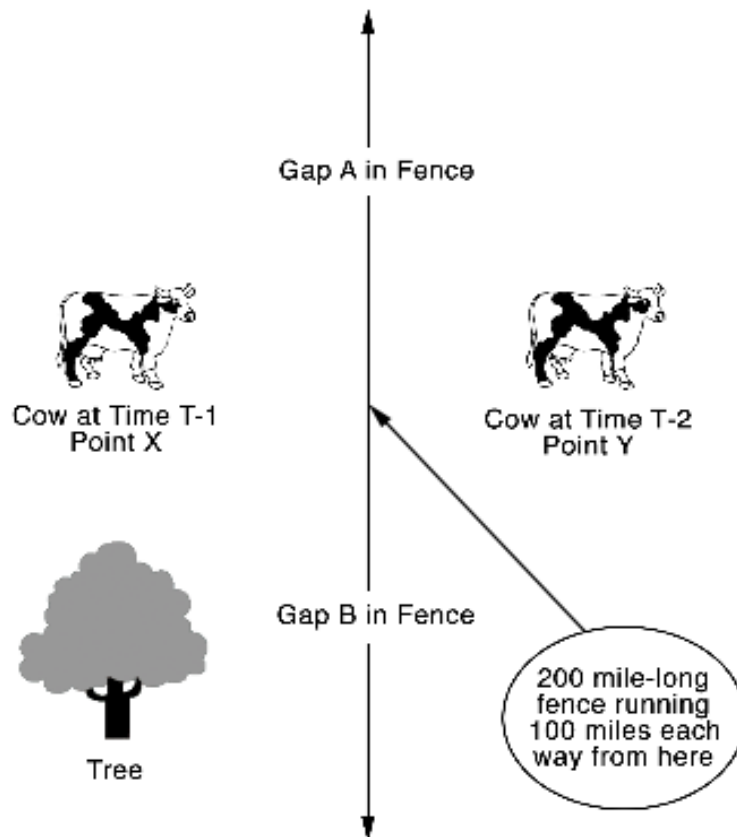
Stipulated issue: Did the cow go through Gap A or did the cow not go through Gap A?

In the original version of my hypothetical the cow may have had certain tendencies. One tendency might have been to seek to avoid trees to some extent. Another tendency may be to seek the shortest route between Point X and Point Y.

But now assume that cows—including this one—also perhaps have a tendency—a disposition or character trait, if you like—to amble toward the right rather than toward the left (all things being equal, of course).

You see the pickle we're in: there is a possibility that the tree-aversion tendency and the walk-to-the-right (do cows "walk"?) tendency have equal and opposite causal force. So perhaps the two tendencies produce a wash. Or perhaps they don't produce a wash because perhaps they don't have equal force, because both tendencies can't be at work at the same time, or because…of something else. Whatever the trial judge thinks, perhaps the judge should let the jury (if there is one) decide what's what. (Judicial meta-analysis is what is at work here, yes?)

I know you'll be happy to hear that this is my last word about cows.

PAUL KIRGIS:

But why should we talk about past events in terms of probabilities? Assume we want to know whether one card that has already been flipped over is a red queen. The suit and number of that card is not a probable event—the card flipped exists; it consists of one particular number and one particular suit. Once the card has been flipped, chance is no longer involved. It is what it is. The fact that a human being doesn't know the number and suit until it is turned over doesn't somehow make that brute historical fact (assuming there is such a thing) an uncertain event.

Clearly it makes sense to talk about our *degree of certainty* as to whether a past event happened, and maybe when we talk about "probabilities" of past events we mean nothing more than "confidence index."

Maybe we just use the notion of probabilities heuristically. Much of the literature employing probabilities suggests that understanding. But if that's the case, why are we bound by the math of probabilities? In other words, why measure "confidence index" on a scale of zero to one? Doing so might be required only if it makes sense to think of confidence (or certainty) as some kind of discrete, finite condition, so that there really would be such as thing as being "100% certain." I know we occasionally say such things, but do we mean them literally? I find it hard to accept that I have a tank labeled "CERTAINTY" in my head that could conceivably be exactly empty or exactly filled exactly to capacity.

If there isn't any reason to measure the "probability" of past events on a zero to one scale, then why get worked up about conundrums like the conjunction paradox?

I wonder whether this problem doesn't lie at the heart of Ron & Michael's critique. What we are really doing at trial is a type of Peircean abduction. We're

hypothesizing about past events and their causes. We're not actually doing any probabilistic reasoning, even if probabilistic reasoning bears some superficial similarity to what we are doing. So it shouldn't be a surprise that probabilistic reasoning loses it explanatory power when things get complex.

I know Peter is very familiar with Peirce's logic (as is David Schum), because I heard it from them years ago. So Peter (and others) may have a powerful response to this. But it is the reason why I don't deal in Bayesian theory in my Evidence class.

DAVID KAYE:

Dear Paul,

Fundamental or foundational is an apt term here. You are opening a can of worms that writhed in this list and in many publications![18] The interpretations of standard probability theory that lend themselves to retrospective theories of legal factfinding are of two sorts—logical and subjective (or personal).[19] As you imply, frequentist theory has limited applicability, but we can have degrees of beliefs (justified or merely subjective) in statements about events that already have occurred just as we can in statements about events that have yet to occur. The connection between partial beliefs and probabilities, and between probability and inductive reasoning, is the subject of rich literature.[20] Naturally, there are competing philosophical theories. Finally, Jonathan Cohen and Ron Allen have written provocatively on puzzles involving the difficulties of reconciling the sometimes arbitrary elements of causes of action and multiplication of

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[18] If you want to pursue the past-future distinction, see, for example, Vaughn C. Ball, *The Moment of Truth: Probability Theory and Standards of Proof,* 14 VAND. L. REV. 807 (1961), reprinted in ESSAYS ON PROCEDURE AND EVIDENCE 84, 101 (1961); Laurence Tribe, *Trial by Mathematics: Precision and Ritual in the Legal Process,* 84 HARV. L. REV. 1329 (1971).

[19] *See, e.g.*, D.H. Kaye, Introduction: *What is Bayesianism*? in PROBABILITY AND INFERENCE IN THE LAW OF EVIDENCE: THE LIMITS AND USES OF BAYESIANISM 1 (Peter Tillers & Eric D. Green eds., 1988), reprinted as *What is Bayesianism? A Guide for the Perplexed,* 28 JURIMETRICS J. 161 (1988).

[20] For a nice exposition of this connection, see BRIAN SKYRMS, CHOICE AND CHANCE: AN INTRODUCTION TO INDUCTIVE LOGIC (4th ed. 2000); *see also* WESLEY SALMON, THE FOUNDATIONS OF SCIENTIFIC INFERENCE (3d ed. 1986).

probabilities (and more).[21] There have been responses from statisticians[22] as well as law professors.[23]

PETER TILLERS:

Assuming that your ontology is correct -- events in the past either happened or they didn't—your argument is tantamount to an argument for a "subjective interpretation" of probability—i.e., as you suggest, an interpretation that takes the view that probabilities are fundamentally about "belief states" or "credal states" and not about (except indirectly) events in the world.

Another way to put your thesis: For events in the past, probabilities are necessarily only subjective—they express our degree of certainty or uncertainty— rather than stochastic or aleatory.

The subjective probabilists—or some of them (e.g., de Finetti, Ramsey)— went further and said that all probabilities are subjective (or "personal") and that it never makes any sense to talk about probabilities in nature. (Students of quantum theory might or might not take issue with this more extreme thesis.)

There has been a serious debate about how to grade subjective uncertainty. You are not alone in thinking that probability theory is not necessarily the only way to measure or grade subjective uncertainty or even a good way (although I think that almost all theorists who have advocated other ways of measuring uncertainty have said that a Bayesian strategy can be a good way, that Bayesian logic sometimes works (in some sense)).

Some of the people who are interested in the conjunction paradox are interested in it because they think it amounts to a reductio ad absurdum either of probability theory or of a particular "interpretation" (application) of probability theory.

I have stolen much of what little I know about probability theory from David Schum. One of his central points about the probability calculus is that its usefulness depends on the structuring of a problem: a problem must be formulated in a way that makes it tractable to probability computations. (For

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[21] *E.g.*, L. JONATHAN COHEN, THE PROBABLE AND THE PROVABLE (1977); Ronald J. Allen & Sarah A. Jehl, *Burdens of Proof in Civil Cases: Algorithms vs. Explanations*, 2003 MICH. ST. DCL L. REV. 893

[22] A.P. Dawid, *The Difficulty About Conjunction*, 36 THE STATISTICIAN 91 (1987).

[23] D.H. Kaye, *Do We Need a Calculus of Weight to Understand Proof Beyond a Reasonable Doubt?*, 66 B.U. L. REV. 657 (1986) (describing the connection between legal elements and narratives of events); Saul Levmore, *Conjunction and Aggregation*, 99 MICH. L. REV. 723 (2001); Dale A. Nance, *Naturalized Epistemology and the Critique of Evidence Theory*, 87 VA. L. REV. 1551 (2001); *cf.* Kevin M. Clermont, *Standards of Proof Revisited*, 43 VT. L. REV. 469 (2009) (questioning the "relative plausibility" theory as a solution to the conjunction problem).

example, if probability theory is to have any work to do one must suppose that there are alternative (factual) hypotheses that are to some degree exclusive or complementary—that, to some degree, an increase in the probability of one hypothesis decreases—to some degree—the probability of other hypotheses that constitute its negation.   (I add qualifiers such as "to some degree" to accommodate hypotheses that are, to some extent, "fuzzy."))   In general, I think David is correct about that.

Note that David assumes that hypothesis formation—the development of hypotheses—is a process that cannot be described in terms of probability theory. This view gets into deep philosophical, epistemological, and inferential waters. Withal, I generally agree with David about this. This is one of the reasons why I have bought into Peirce's logic (if logic it is).

In fairness, I do want to acknowledge that there have been Bayesians who disagree with Schum about hypothesis formation and who think that Bayesian logic can account for hypothesis formation and that we ought to think about hypothesis formation in Bayesian terms.

To complicate matters further, consider one more point: There are people who (i) buy into Peircean logic and who (like David and me) agree that evidentiary details function as "signs" or "hints"; but (ii) think that the workings of such evidentiary hints can be described mathematically (there is a book called the "Mathematical Theory of Hints" and I believe the authors of that book use Shaferian logic & math).

I have taught a course on fact investigation for quite a few years now. I have my students "marshal" evidence in all sorts of ways. But I rarely ask them to construct inference networks or to do a "Bayesian number" on an inference network (or even on just a simple, one-stage inference). This is because during investigation my experience is that factual possibilities & issues are so fuzzy, ill-developed, etc., that I genuinely cannot imagine how to do a useful Bayesian analysis of those problems; the investigations my students conduct are usually largely exploratory; the students are trying to figure what the (factual, legal, chronological, etc.) issues are. (There are exceptions, however; sometimes issues emerge that seem readily & usefully tractable to Bayesian analysis.)

PETER TILLERS:

Paul,

An addendum: even if we believe past events either happened or they did not, there is reason to think about the uncertainty of past events—about stochastic (real-world) chances (real-world random processes). Suppose we know or believe Baby Joe was born in July of this year. Given what we think we know about

conception, gestation, et cetera, and the probabilistic nature of processes such as gestation, our knowledge of those chances gives us a basis for making some guesses about the time of conception. The language of the standard probability calculus gives us a coherent way of calculating and expressing our judgments about the chances of conception at various times.

MICHAEL RISINGER:

Dear Paul et al.

I am moved to put my oar in again after this posting by Paul and the various commentaries that have followed it. It is an opportunity to air a few foundational issues and be instructed by my betters for my sins.

Paul's position seems to me to make much too much out of the difference between past events and future events, both in terms of probability theory and general epistemology. From the point of view of a bettor trying to guess the result of a coin flip in a separate room (heads, tails, or standing edgewise) based solely on probability information (and I take this to be all information at root base), it makes no difference whether the coin was flipped before the bet, or flipped after the bet. And the prediction/post-diction distinction does not map on to epistemic warrant very well either. There are plenty of predictions that are better warranted than most post-dictions. There may be certain types of evidence potentially available for post-dictions that are not available for predictions (claims of direct human observation, for instance) but they are often unavailable, and even when available they are fallible and therefore merely probabilistic. Time's arrow may run both ways in relativity equations. It is unresolved whether that captures a fundamental reality, or needs a supplemental qualification. Our instinct is that there is something fundamental about the difference between past and future, but from a general probability theory perspective, that instinct is almost certainly misplaced. And I don't think a distinction between objective and subjective probability (or what is usually meant by the distinction when invoked) based on post-diction vs. prediction is tenable (although I am not clear on this because I find the very distinction unclear). Rather the distinction, if it means anything at all, has to do with the formality of specifications and the hardness of the given base-rates generating the probability (in hypothetical systems) or the nature of the data generating the probability estimate (in the real world).